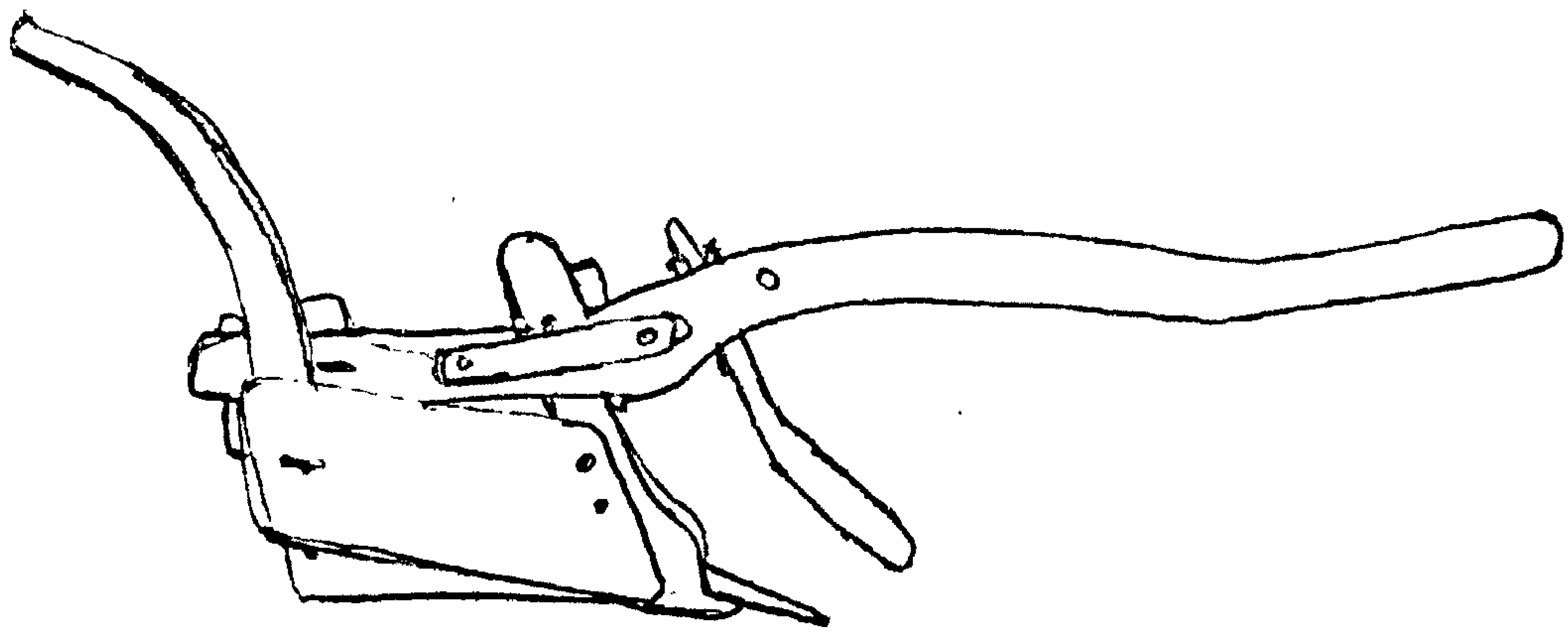
Spears or ploughshares : multiple indicators of activity related stress and social status in four Early Medieval populations from the North East of England

Sarah E. Groves

Spears or Ploughshares:

Multiple Indicators of Activity Related Stress and Social Status in Four Early Medieval Populations from the North East of England



A Thesis Submitted for the Degree of

Doctor of Philosophy

By

Sarah E. Groves

Durham University

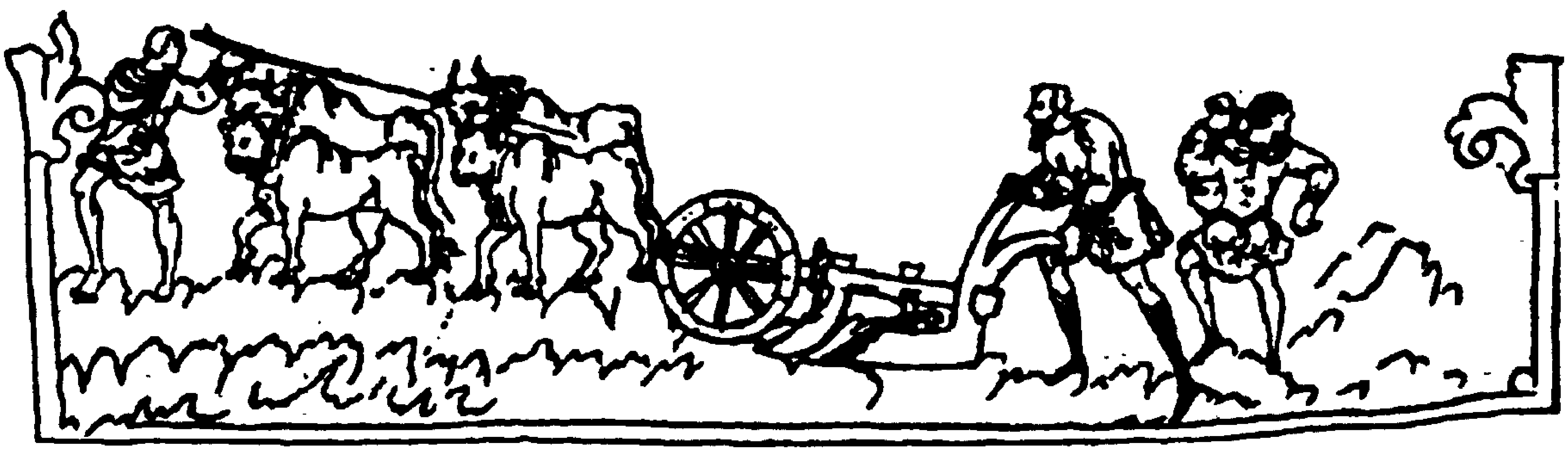
Department of Archaeology

April 2006

Two Volumes: Volume Two

Table of Contents: Volume Two

Chapter Five: Discussion and Conclusions



5: Discussion

In this Chapter, the results from the analysis of the four skeletal samples are discussed, and the similarities and differences between the sites are explored. Firstly, the demographics of the samples are discussed and similarities and differences in the age and sex profiles of the samples are explored. Secondly the burial practices and status groups identified in the four sites are compared, and possible explanations for the similarities and differences are proposed. Thirdly, the patterns seen in the occurrence of the conditions used as markers of activity related stress (MSM) are examined to identify trends in involvement within and between sites. The relationships between all four of the MSM are explored, and interpretations of the patterns identified will be given.

5.1: Age and Sex

As had been discussed in Section 1.4, age can be a factor in the development of many of the conditions utilised as MSM. Of the four samples examined in this study, the proportion of Older individuals (those over 41 years) was highest at the Bowl Hole, Bamburgh, and lowest at Norton Mill Lane. At Norton Bishopsmill, while the percentage of Older individuals was not as high as at Bamburgh, the percentage of Middle aged individuals was the highest of all four sites. As the proportions of Middle aged and Older individuals (individuals over 31 years) were highest at the two sites which were in use at a slightly later date (75% of individuals at Bamburgh and 62.5% of individuals at Norton Bishopsmill), the possibility is raised that there was some factor which changed over time, leading to a longer life expectancy at these sites. This variation between the sites may represent a degree of social change that may also have had an impact upon the activities carried out by individuals at these sites. The nature of the sites themselves may also have had an impact on the life expectancy of the individuals living there.

Bamburgh was the seat of the kings of Northumbria (Stenton, 1971), and consequently could be considered to be a high status site, although as discussed in section 3.1.4, the exact relationship between the individuals buried in the Bowl Hole cemetery and those who lived in the fortress is not known. The archaeological evidence for the fortress suggests that the population in the area had access to a varied diet, and a secure water supply to the fortress is provided by a well in the Keep, which appears to be Early Medieval in date, the presence of which in AD 744 is mentioned by Simeon of Durham, writing in the 12th century AD (Young, 2003, pp 5). Access to a good diet and clean drinking water is very important for the maintenance of good health, and perhaps the apparently high life expectancy of the individual from Bamburgh was aided by these factors.

However, it is possible that the individuals buried at Bamburgh do not represent a "normal" community, and the low percentage of individuals who died in young adulthood may be due to factors other than apparent good health. The individuals buried at Bamburgh in the Bowl Hole cemetery may have been retainers to the royal court, rather than being individuals of higher status, who are most likely to have been buried in the fortress itself, or in the cemetery associated with the church of St Aidan in the modern village. The isotopic analysis of the dental enamel from some of the individuals buried in the Bowl Hole also suggests that these individuals did not represent a normal settled community. If many of these individuals had moved to Bamburgh from other settlements it is reasonable to propose that the high proportion of older individuals could be due to the younger individuals being buried elsewhere. Perhaps the younger individuals were more likely to be involved in battle, and hence more likely to die and be buried away from the fortress, or returned to their original home for burial. If this were the case, we would expect to see few young males in this cemetery, but this is not the case, and there was actually one more male than the females in the Young and Young Middle age groups. Alternatively, the Bowl Hole cemetery may have been reserved for retired retainers and their families, hence the higher proportion of older individuals, or considering the evidence from the isotopic analysis, this cemetery may have been reserved for "outsiders" and their families.

There is no settlement associated with the cemeteries at Norton Mill Lane and Norton Bishopsmill, but the proximity of these two sites suggests that the same settlement may have used these two cemeteries, shifting the focus of the burials over time. If the Norton Bishopsmill sample represents a continuation of the Mill Lane sample, a genetic explanation for the difference in the proportions of individuals who died in young adulthood may not be applicable. As with Bamburgh, the ratio of males to females in the younger age groups was almost 1:1, so there does not seem to be a sex bias amongst the individuals who died young, reducing the likelihood that the low proportion of young individuals was due to them being young men involved in warfare, and buried elsewhere. It appears that the most likely explanation for the high percentage of older individuals at Bamburgh and Norton Bishopsmill was simply that people were living longer at these sites than at the two sites with earlier date ranges. The question that is now raised is why the percentage of individuals who died young was so much higher at Norton Mill Lane and Castledyke? One cause of death in young women in pre-modern societies is complications associated with childbirth (Molleson and Cox, 1993, Wells, 1975) and one case of death in childbirth has been identified at Castledyke South (Boylston *et al.*, 1996). If the higher proportion of younger adults from these earlier sites were predominantly female, obstetric fatalities could be a cause. At Castledyke the number of Young females was similar to the number of Young males, but while there were 10 Young/Middle aged females, there were only six Young/Middle aged males. At Norton Mill Lane, twice as many males were in the Young age group than females, but this pattern was reversed for the Young Middle aged adults, with seven females and four males.

The relatively high proportions of Young Middle aged females (26-30 years of age) in both of these skeletal samples may be due to an increased risk of death amongst women of childbearing age, but may also be due to other factors including the difficulty of accurately assigning an age at death to adult skeletons, or a factor increasing the likelihood of Young Middle aged males being buried elsewhere, such as involvement in warfare.

5.2: Burial Practice

Considerable variation in the burial practices was seen between the four sites, some of which is likely to be due to the different date ranges at the sites, although there was variation between the practices seen at the sites that were more similar in date.

5.2.1: Norton Mill Lane and Castledyke South

At Norton Mill Lane and Castledyke South, despite the apparent similarities in the burial assemblages at the earlier sites, the proportions of individuals in each artefact group showed differences between the two sites, perhaps suggesting differences in the construction of status at these sites. At Castledyke, burial without grave goods, or with only a single object (Group 1) was the most frequent practice, and the least frequent burial practice was burial with weapons (Group 3). However, at Norton Mill Lane, Group 4 (individuals with the most elaborate and varied grave goods, and potentially the highest social status (Alcock, 1981)) was the largest group, whereas the group without grave goods was the smallest. If the individuals without grave goods were those with the lowest social status (Evison, 1987), these results suggest that there was a difference in the social structure between these two sites, that burial practices had different meanings, or that at Norton Mill Lane, the lowest status individuals were buried elsewhere.

Following an assessment of the relative burial wealth of 27 Early Medieval sites from the south of England, Arnold found that there was a difference in the wealth of coastal and inland sites, with coastal sites having greater burial wealth and apparently more levels of social stratification than inland sites, probably as a result of increased levels of trade (Arnold, 1980). This has been suggested as an explanation for the differences seen between Norton Mill Lane and Castledyke, but as both of these sites were near to the coast and Castledyke was also very close to the Humber estuary, they probably had very good trade links. Therefore it is unlikely that the high proportion of individuals buried without grave goods, and lower proportion of individuals buried with "richer" burial assemblages at Castledyke was due to reduced access to trade items. The differences in the proportions of individuals in each of the artefact groups at these two sites could be due to incomplete preservation or excavation at the two sites, or differences in burial location. The apparently small percentage of potentially lower status individuals at Norton Mill Lane could be due to these individuals being primarily buried in a part of the cemetery which was not excavated, or the majority of lower status individuals, perhaps slaves, may not have been permitted burial in the same cemetery as the higher status free individuals. However, the time span during which Castledyke was in use was considerably longer than Mill Lane; from the late 5th to the 7th centuries AD at Castledyke, compared with the 6th to the 7th centuries at Mill Lane, and therefore the high proportion of burials without artefacts at Castledyke may in fact represent a change in burial practice during the lifetime of the cemetery. Further radiocarbon dating of the skeletal material from Castledyke could help to answer this question.

If the different artefact groups identified at these sites are representative of different social classes, and if that status was defined by kinship and heredity, rather than acquired through individual actions, the sex ratio in groups defined by apparently un-gendered burial assemblages should be equal. While the sex ratios in the "gendered" burial assemblages, i.e. "male" weapon burials and "female" dress items, followed the pattern observed in other studies (Lucy, 2002, Stoodley, 1999), there was also variation in the sex balance in some of the apparently "gender-less" burial artefact groups. At Castledyke South the proportion of males and females in Group 1 (those without grave goods) was almost equal, but at Norton Mill Lane only a single female fell into this group. If the Group 1 individuals were the lowest status individuals, and possibly slaves or servants, it is surprising that the proportions of the sexes in this group are not equal at Norton Mill Lane. Perhaps male slaves were considered more useful at this site than females, or perhaps the "missing" females from this group are actually in one of the other artefact groups. Another possibility is that females were considered more socially "valuable" than males at Norton Mill Lane, and this value may have been expressed through burial with more grave goods, while male status may have been expressed more through other means than treatment in burial.

There were also differences in the proportions of males and females in Group 2 (individuals with a knife, buckle, brooch or simple dress items) at these sites. At Castledyke the percentage of males and females in Group 2 was very similar, with only one more male present than the number of females. However, at Mill Lane there were almost twice as many males in this group than females. This imbalance may be indicative of problems of preservation at the site, resulting in more males than females being included in this study, but it may also indicate variations in the nature of social identity between the two sites. While Group 2 was defined by the presence of the same artefacts at Castledyke and Mill Lane, it appears that the meaning of these artefacts as indicators of social identity may have been different. At Castledyke males and females were equally likely to be buried with a knife, brooch or pin, but at Mill Lane, these artefacts were more commonly associated with males, suggesting that at this site female identity was expressed in other ways. Females were most frequently seen in Group 4 (individuals with brooches, knives, personal items, pins, bead strings, girdlehangers and any other dress objects), and it may be that at Mill Lane, burial with several jewellery items or dress fittings was the primary means of identifying female status. However, while the percentage of males in Group 4 was very small at Castledyke, at Mill Lane a third of the Group 4 individuals were male. While sex may have been the primary factor for burial with dress fittings at Castledyke, this was clearly not the case at Mill Lane, where another factor must also have been important.

At both sites all of the individuals buried with weapons were male, a fact which is to be expected (Härke, 1989). Although there were eight of these burials at each site, the proportion of the total sample that weapon burials constituted was different at Norton Mill Lane and Castledyke; at Norton the proportion of weapon burials was twice that seen at Castledyke. Although females were most frequent in Group 4 at both sites, the percentage of males in this group was much lower at Castledyke than at Norton Mill Lane, and as a proportion of the total sample, the number of Group 4 individuals was smaller at Castledyke than at Norton Mill Lane. Tainter (1977) has shown that in the Middle and Late Woodlands periods from the American Midwest, as the status of a group increased the number of individuals holding that status decreased. This appears to have also been the case at Castledyke South and Norton Mill Lane. If Groups 3 and 4 represented the highest status individuals at these two sites (the individuals with the most complex and "wealthy" grave goods), these results suggest that there were more high status individuals at Norton

Mill Lane than at Castledyke, and possibly that Norton was a higher status population, or a cemetery that was reserved for higher status individuals. However, considering the difference in the length of use of the two sites, it is possible that the higher proportion of apparently high status burials at Mill Lane is due to the shorter period of use. At Castledyke, the apparently high status burials may have been "diluted" by changes in burial practice during the lifetime of the cemetery, which led to a shift away from burial with grave goods, and hence a greater proportion of individuals being buried without artefacts. The change in burial practices seen in the "Conversion Period", beginning at c 600AD (Geake, 1997) may therefore have had more of an impact upon burial practice at Castledyke than at Mill Lane.

Age does not seem to have been a factor for burial with any group of grave goods at either Mill Lane or Castledyke, with individuals from all age bands being present in all of the artefact groups, with the exception of Group 1 at Mill Lane, where the small size of the sample is most likely to be responsible for the differences seen. The apparent lack of correlation between age and burial practices amongst the adult individuals at these sites suggests that status was not acquired and developed over the individual's lifetime, and hence may have had a substantial inherited component (*cf.* Peebles and Kus, 1977). Although the differences in sex distribution between the artefact groups may be an artefact of differential preservation of skeletal material at these two sites, or a result of incomplete excavation of the site, it is also possible that this difference in the proportions of males and females in the artefact groups is due to differences in the social structures, or attribution of status in death between the sites. Considering the impact which the difference in date range of these cemeteries may have upon the meaning of burial practices at these two sites, it may only be reasonable to compare "like with like" when examining patterns of skeletal change, in this case Groups 3 and 4, the weapon burials and the more "female" gendered burials. These burial artefact groups are most likely to represent similar social meanings at both Castledyke and Mill Lane. If the social meaning of these burial practices was the same or similar, it is more likely that the lifestyles and physical activities of these individuals were also similar, and therefore there should be similarities in the manifestations of MSM in these groups at both sites.

5.2.2: Bamburgh and Norton Bishopsmill

Bamburgh and Norton Bishopsmill have radiocarbon dates that overlap and, although the burial practices at these two sites were rather different, there are some similarities; at both sites the greatest percentage of both males and females were buried without grave goods (Group A), and the percentage of individuals buried with an animal bone and/or tooth (Group B) were quite similar, but the other two artefact groups cannot really be directly compared between these two sites, as the types of artefacts were quite different (Bamburgh Group C – multiple animal bones, Group D – multiple iron objects, Bishopsmill Group C – pottery, worked stone or flint, Group D – iron objects or coffin fittings). There were more burials with grave goods at Bamburgh than at Norton Bishopsmill, and more burials had multiple objects, suggesting that there was more potential for burial variability at Bamburgh, perhaps due to a stronger Christian influence at Norton Bishopsmill, or a shift in the meaning of the burial rite. It could be argued that the burial practices seen at Bamburgh represent a transition between those seen at Norton Mill Lane and Castledyke South and those seen at Norton Bishopsmill. While there were no burials with weapons at Bamburgh, there was one burial practice that was exclusively male, that of deliberately placing animal bones over the body (Group C), and the proportion of males and females buried with iron objects (Group D) was similar to the proportions seen in Group 4 at Norton Mill Lane. However, the high proportions of individuals buried without grave goods (Group A) was similar at Bamburgh and Bishopsmill.

Of the two most similar artefact groups from these sites, Groups A and B, at both Bamburgh and Norton Bishopsmill the percentage of males buried without grave goods (Group A) was higher than the percentage of females, although at Bamburgh the variation was less marked, while in Group B (individuals with single animal bones, teeth or shells) this pattern was reversed. It is particularly interesting to note that the percentage of males buried without gave goods at Norton Bishopsmill is very similar to the percentage of males without grave goods at the earlier site of Norton Mill Lane, perhaps indicating some continuity of the proportion of the population who were considered the lowest status. The percentage of females without grave goods at Bamburgh is very similar to that seen at Castledyke South, but it is difficult to draw any conclusions from this similarity, as the sites are both temporally and spatially distant.

In contrast with Castledyke and Mill Lane, at Bamburgh and Bishopsmill there appears to have been a link between burial practice and age; the highest proportions of Middle aged and Older adults were seen in the groups with the most artefacts, Groups C and D (burials with multiple animal bones, pottery, flint or iron objects), while the majority of Young and Young/Middle aged individuals were buried with few or no artefacts. Inclusion in Group D at Bamburgh appears to have been particularly dependent upon age; there were no individuals under the age of 31 years at death in this group, and the majority of Group D individuals were over 40 years old. At Bishopsmill the pattern was a little less clear cut, with two individuals under the age of 31 being present in Group D. This suggests that to some extent at these two sites status, as indicated by burial with a larger number of artefacts, or burial with coffin fittings, may have been acquired with age.

The questions surrounding the meaning of burial practices in these later sites will probably remain unanswered, particularly as burial practices from the 7th century AD onwards have received far less attention from researchers exploring the meaning of burial rites than the cemeteries of the 5th to early 7th centuries AD (Hadley, 2002). Despite the dearth of information, it may still be possible to infer meaning from the burial practices at these later sites, particularly when considered in the context of the transition to Christianity. Geake (2002) has argued that the Conversion Period marks a change in the way in which male and female status was expressed, with high status female burials becoming more archeologically visible, through burial in barrows or with more elaborate grave goods and high status male burials apparently disappearing. Geake (*ibid*) tentatively suggests that this may be due to males being buried in churchyards as an expression of their status, and their alliance with both spiritual and secular power.

Bamburgh is historically closely linked with the spread of Christianity into Britain, because of the associations with the sainted king, Oswald and the nearby monastic sites on Lindisfarne (Young, 2003), but the burial practices at this site are not immediately recognisable as being "Christian". The Bowl Hole cemetery at Bamburgh does not appear to fit into any of the three categories of Conversion Period cemeteries suggested by Geake (2002); while some burials at Bamburgh were associated with grave goods, they cannot really be described as "well-furnished", yet there are too may individuals with grave goods to fit into the "churchyard type" (Geake, 2002), although Bishopsmill may fall into this category. The final type proposed by Geake also does not really fit Bamburgh; a churchyard type with a few well furnished burials. Perhaps Bamburgh is simply an oddity, due to its location and the somewhat unusual nature of the people buried there. The apparently unusual burial practices at Bamburgh might in part be explained by the possibility that the Bowl Hole cemetery was specifically for non-local individuals. As mentioned above, the isotopic evidence shows that many of the individuals tested to date did not grow up in Bamburgh, but may have come from elsewhere in the Kingdom of Northumbria, or further afield (Paul Budd, *pers comm*). As there are few radiocarbon dates from this site, it is not known if the "non-local" burials are earlier or later than the "locals", but it is possible that the "locals" are second (or third) generation "non-locals" who still maintained the cultural practices of their ancestors. It is also possible that these people did consider themselves to be Christian, but also continued to include objects in the burials of their dead, which reflected their social identities, without considering this to be incompatible with their Christian beliefs.

The majority of the burials At Bamburgh were not in the stereotypical supine extended position expected at Christian sites, and as was seen predominantly at Bishopsmill. Also, some individuals were buried clothed, with personal items and animal bones and teeth. Although the practice of burying people in their clothes is not incompatible with these people being Christians ((Geake, 2002, Hadley, 2002) and see Chapter 2), the practice of including cuts of meat, animal teeth and in some cases sheep/goat mandibles suggests that there was some concept of an afterlife requiring food, or some other ritual reason for the inclusion of this animal material. The practice of feasting at the side of the grave is one of the few that the Early Medieval church felt necessary to legislate against (Taylor, 2001), suggesting that this practice was seen as a problem, and was incompatible with the rule of the Church. The fact that all the individuals buried with deliberately placed animal bones at Bamburgh were males may be significant, and may indicate another means of identifying some of the missing males in Conversion period burial grounds.

As mentioned above, Norton Bishopsmill falls rather more easily into the "Churchyard Type" (Geake, 2002), the cemetery is distinct from the potentially related site at Mill Lane, and there are few grave goods other than occasional animal bones or items of personal jewellery. Interestingly, in contrast with Bamburgh, of the few individuals from Bishopsmill who were buried with animal bones, only one was an adult male. The group that stands out as being potentially the highest in status is those who appear to have been buried in coffins. The percentage of females who were buried with iron objects or coffin fittings (Group D) was higher than the percentage of males in this group. The presence of iron objects and coffin or box fittings in these burials suggests that these individuals were buried in coffins or re-used domestic wooden boxes (Thompson, 2004 pp 125). It is tempting to begin to draw parallels between these wooden boxes and the household coffers or strongboxes to which women in the Early Medieval period are thought to have held the keys; keys that may be represented by the latchlifters and girdlehangers seen in earlier period burials (see Chapter 2, section 2.1.1). Perhaps the wealthier women in the Norton Bishopsmill cemetery were buried within the box itself, rather than with a symbol relating to its use. Even if this was the case, it is likely that the coffin or box also had a different meaning, possibly associated with the desire to keep the body from contact with the soil, and hence decomposition (Thompson, 2002), and was probably only available to those individuals who could afford the time and expense of making a coffin or sacrificing a chest to be used for burial. It may be relevant to note that while the females with coffin fittings from Norton Bishopsmill were from the whole range of age groups, all of the males with coffin fittings were from the Older age group. Perhaps for males the status associated with coffined burial was acquired through age, while for females, status was more influenced by sex, and perhaps by the status of their husband or family.

The association of more complex grave goods, and particularly iron objects with older individuals at Bamburgh and Norton Bishopsmill is a dramatic shift from the lack of association between burial practice and age at Castledyke and Norton Mill Lane. If status was inherited at these chronologically earlier sites, as is suggested by the association of apparently high status artefacts with young individuals, who cannot have acquired this status through life, the association of more complex artefacts with older individuals at the chronologically later sites may indicate a change in the way in which status was acquired. Perhaps the shift in burial practice at Norton Bishopsmill represents a move towards status being acquired during life or with advancing age, rather than being inherited.

However, this is not the only possible explanation for this change in burial practice between the earlier and later sites. The association between older individuals and more complex grave goods at Bamburgh and Bishopsmill may be the result of these older individuals continuing to observe earlier traditions of burial, while younger individuals did not, and instead followed newer practices – possibly influenced by Christianity. Many methods of identifying status in Early Medieval society make the assumption that grave goods and burial practice symbolise status in a static manner and that the society did not change the manner in which status was displayed (James, 1989). Clearly this was not the case in Early Medieval England; burial practices changed dramatically over time, with changes in both the style of burial (e.g. the shift from cremation to inhumation) and in the types of grave goods deposited with individuals (Geake, 2003). In some cases these changes took place during the lifetime of the cemetery, as is clearly apparent in the case of mixed cremation and inhumation cemeteries such as Spong Hill, Norfolk and Great Chesterford, Essex (Hills *et al*, 1984; Evison, 1994). However, where the shifts in burial practice are more subtle it may be more difficult to identify them as chronological changes rather than differences in social status. These changes may been generational; younger individuals may have expressed their social status using means other than burial practice, perhaps through involvement in the Church during life or the distribution of possessions via a will after death (Thompson, 2004). Older individuals may have been reluctant to change to follow new trends, or felt less need to follow the latest trend in social expression.

In addition to the variations seen in burial practices between the sites, there were also striking variations in the patterns of skeletal changes within and between the samples. The following sections will discuss the results of the analysis of skeletal changes associated with physical activity, relate these results to the age, sex and artefact groups within the four samples, and examine the similarities and differences between the four sites. It was originally hoped that it would be possible to produce a combination of the results of MSM for each skeleton, to examine interactions between all four changes on an individual basis. However, due to problems of preservation there were very few individuals present from each site that were sufficiently well preserved to examine all four types of changes from the same individuals, and hence the samples that could be compared in this manner were too small to obtain meaningful results.

5.3: Prevalence of Skeletal Changes

5.3.1: Osteoarthritis

At all four sites the frequency of osteoarthritis and possible osteoarthritis increased significantly with age, a relationship that is to be expected from the clinical data (Moskowitz and Holderbaum, 2001) and from the findings at other archaeological sites (Jurmain 1999 pp 54). Although the relationship between age and osteoarthritis is clear, it is possible that where cases are seen in younger individuals the aetiology is more likely to involve physical stress. There was no significant difference in the prevalence of OA between the sexes in any of the samples examined; these results conflict with the findings of modern clinical studies, which have shown that females are more likely to develop osteoarthritis in multiple joints than males (Birrell, 2004, Maillefert *et al.*, 2003). This conflict may be due to the difficulties of accurately identifying osteoarthritis in skeletal material, or the result of different patterns of disease in archaeological samples, but may also be due to differences in levels of physical activity and access to healthcare in modern and archaeological populations.

The percentage of individuals that were affected by joint disease at each site varied considerably, and this variation may have been due to differences in the demographics of the four different samples. At Castledyke, 31.4% of the individuals had OA in one or more joints, at Bamburgh, 25% of the individuals were affected, at Norton Bishopsmill 23% had OA and at Norton Mill Lane only 18% of the individuals had OA. The frequency of osteoarthritis was the highest at Castledyke South, and although this site did have a high percentage of older individuals, the proportion of Older individuals was highest at Bamburgh, so it is possible that the high percentage of individuals with osteoarthritis at Castledyke was not simply the consequence of an older population. However, at Norton Mill Lane, the frequency of osteoarthritis was the lowest, and the proportion of Older individuals from this sample was also the lowest, so it is possible that the lower frequency of OA at this site was due to the lower proportion of older individuals in the sample.

The prevalence rates of osteoarthritis in modern populations are varied, in the study reported by Lawrence et al, 20% of the adults examined had radiographic evidence of OA in one or more joints (Lawrence *et al.*, 1966), a percentage which is quite similar to those seen in the present study. A more recent survey of the prevalence of joint pain in Britain found that 29% of adults reported joint pain or arthritis (ARC, 2002), a figure that is considerably higher than the 15-16% reported from the US (HANES II study, reported in Jurmain 1999, pp 47). As these figures are based on self-reported cases of joint disease, they may not be representative of true frequencies. As discussed in Chapter 1.4, osteoarthritis may be visible in dry bone or radiographs, but present few symptoms and conversely joint pain can also be present without the presence of osteoarthritic changes of the kind recorded in the present study. Therefore the prevalence of OA seen in radiographic studies is probably the most comparable with the prevalence seen in archaeological studies.

While the prevalence of OA at three of the four sites was higher than the prevalence reported by Lawrence et al (1966), this is not particularly surprising. Modern western societies are, on the whole, much less active than populations in the past (Pitsavos *et al.*, 2005 (in press)), and also have much better access to healthcare, so it is not surprising that the prevalence of OA was higher in the past. The majority of Early Medieval populations are likely to have been involved in physically demanding economic activities such as farming (Fowler, 2002), and hence placed more stress upon their joints, and when they received injuries the lack of adequate treatment could increase the risk of developing secondary OA (Grauer and Roberts, 1996). If levels of mechanical stress influence the prevalence of OA, the results of the present study may indicate that the levels of mechanical stress were highest at Castledyke and Bamburgh and lowest at Norton Bishopsmill and Norton Mill Lane. The aetiology of osteoarthritis is influenced by genetics (Chitnavis *et al.*, 1997), so the similar and relatively low prevalences of OA in the two Norton sites may be due to genetic continuities between the two samples, or other environmental similarities.

i) Side

There were differences in the pattern of joints affected in the right and left sides of the limbs. In all four skeletal samples the percentage of functional joints affected was higher from the right side of the upper limb than the left, but in the lower limb this pattern was reversed and the asymmetry of involvement was less marked. The higher frequency of right side joints affected may be due to the inherent asymmetry of the human body. The majority of individuals are right handed (and hence left legged), and thus the joints of the right upper limb are potentially exposed to more mechanical stress and trauma than the left side; several studies have found associations between OA in the upper limb and asymmetrical patterns of activity (Steele, 2000). The differences in the patterns of joint disease between the sides of the upper and lower limbs is most likely to be explained by the role of the lower limb in locomotion and weight bearing, functions from which the upper limb is freed by bipedalism, and hence can be more asymmetrical in both form and function (Ruff, 2000b). Bipedalism requires the lower limb to be more symmetrical than the upper limb, and as the mechanical stresses to which the lower limb is exposed (e.g. walking and running) are generally symmetrical it is not surprising that the patterns of OA and possible OA are more varied that those seen in the upper limb. There are few studies of archaeological material that have examined patterns of asymmetry of joint disease in both the upper and lower limbs, but the studies that do exist have shown a great deal of variation in patterns of asymmetry of joint involvement in both the upper and lower limbs, within and between populations (Bridges, 1991a, Crubezy *et al.*, 2002, Jurmain, 1999, Larsen, 1997).

5.3.2: Prevalence of Enthesopathies

Enthesopathies and possible enthesopathies were very common at all four sites; almost all the individuals examined had at least one enthesis with some changes. As with osteoarthritis, in all four skeletal samples there was a general increase in the prevalence of enthesopathies with increasing age, although this association was strongest at Bamburgh and Castledyke, and less well defined at Mill Lane and Bishopsmill. Clinically, the prevalence of enthesopathies has been shown to increase with age (Niepel and Sit' Aj, 1979, Shaibani *et al.*, 1993), and in an archaeological context, Weiss has shown that age is the best predictor of the severity of enthesopathies in both the upper and lower limbs (Weiss, 2003, Weiss, 2004).

On average, males were a little more frequently affected than females at Castledyke, Bamburgh and Bishopsmill, but at Mill Lane, females were more frequently affected than males in the upper limb, although not significantly so. This higher frequency of involvement of males is a pattern that has been observed in most other studies (al-Oumaoui *et al.*, 2004, Dutour, 1986, Eshed *et al.*, 2004, Hawkey and Merbs, 1995, Robb, 1998), although Peterson (2000) found that at some sites, females were more severely affected than males, and associated this pattern with females undertaking higher levels of activity than males. Most research to date has associated sexual dimorphism of enthesopathies with sex differences in activity patterns, but this may not be the most reliable interpretation. Individuals with larger limbs have more "severe" enthesopathies, when recorded using the system devised by Hawkey and Merbs (1995), than those with smaller limbs, and as males are usually more robust than females, this may explain some of the differences that are seen in the frequency and appearance of enthesopathies between the sexes (Weiss, 2003, Weiss, 2004). Although there may be some association between enthesopathies and division of labour according to sex, it is most likely that the majority of differences in prevalence of enthesopathies between males and females are "normal", and are due to the greater size and muscle mass of males. Robb (1998) has argued that if sexual dimorphism of enthesopathies is due to the greater body mass of males, this dimorphism should affect both sides equally or affect the lower limbs more, as they carry the weight of the body. Therefore where sexually dimorphic asymmetries of enthesopathies are seen, they may be due to differences in mechanical stress rather than just sex differences (Robb, 1998).

The percentage of individuals with possible enthesopathies and enthesopathies was quite varied between the four sites, and followed a pattern that was similar to that seen in the frequency of OA and possible OA. In the upper limb, the percentage of individuals with over five entheses with enthesopathies was highest in the Bamburgh sample (58%), followed by Castledyke (33%), Norton Mill Lane (19%) and Norton Bishopsmill had the lowest percentage of individuals with enthesopathies (6%). The frequencies of individuals with enthesopathies in the lower limb followed the same pattern, except that the percentage of individuals affected was slightly lower at Norton Mill Lane than at Norton Bishopsmill. At all four sites, enthesopathies were less frequent in the lower limb than in the upper limb. These results conflict with the findings of clinical studies, as clinically recognised enthesopathies are more common in the lower than the upper limbs (Benjamin and McGonagle, 2001). However, Benjamin and McGonagle (*ibid*) also stated that enthesopathies were most frequent in the plantar fascia and the Achilles tendon, and as these regions were not examined in the present study, due to problems of poor preservation in skeletal material, it is possible that the frequency of enthesopathies in the lower limb is artificially low as a result. Even if this is the case, the differences between the samples in the percentages of individuals with enthesopathies in the lower limb reflect those seen for the upper limb. Where a high percentage of individuals with entheses in the upper limb was observed, as at Bamburgh, the percentage of individuals with enthesopathies in the upper limb was also high. Similarities in the pattern and severity of enthesopathies in the upper and lower limbs has suggested to reflect a degree of whole body activity (Churchill and Morris, 1998), but this pattern could be explained by the concept of "bone formers", the theory that some individuals are more pre-disposed to bone formation at the entheses (Rogers *et al.*, 1997). Consequently an individual with enthesopathies in the upper limb who is a "bone former" is more likely to also have enthesopathies in the lower limb. Nevertheless, the difference in the percentage of individuals affected in the upper limb and the individuals with enthesopathies in the lower limb was not the same at each site, and these differences may reflect differential loading of the upper and lower limbs between the sites.

Comparing the prevalence of enthesopathies from the present study with the results from other archaeological samples is not simple. Although several of the most recent studies (Eshed *et al.*, 2004, Weiss, 2003, Weiss, 2004) have used the system developed by Hawkey and Merbs (1995), this is by no means the only method used to record enthesopathies in skeletal material, and may not always be the most appropriate to the material being examined (al-Oumaoui *et al.*, 2004). Researchers often choose to record different entheses, to examine the whole body or both the upper and lower limbs for general studies (al-Oumaoui *et al.*, 2004, Steen and Lane, 1998), or to focus on specific bones or entheses to try to identify specific activities (Munson Chapman, 1997, Peterson, 1998, Peterson, 2000), and it may be difficult to compare the results of these studies. Rogers and Waldron (1989) reported that 39% of the individuals from the 10^{th} – 15^{th} century AD cemetery at Wells Cathedral, UK, had "bony proliferation at at least one enthesis" (*ibid* pp 170), but as there are no illustrations of the changes recorded, it is not possible to compare what Rogers and Waldron recorded as enthesopathy with the present study. Of the skeletal material examined by Dutour (1986), 22% had one or more enthesopathies, but again the definition of enthesopathies was vague and the sample examined was small. No other studies of enthesopathies in archaeological material presented their results in terms of the percentage of individuals affected, instead results are generally given in terms of entheses affected (al-Oumaoui *et al.*, 2004, Crubezy *et al.*, 2002, Steen and Lane, 1998), or as scores of severity at each enthesis (Peterson, 1998, Peterson, 2000) or as summed scored over several entheses (Weiss, 2003, Weiss, 2004).

Comparisons with clinical studies are also problematic. Enthesopathies of the upper limb accounted for 31% of work-related illnesses reported in the US between the 1^{st} October 1993 and 30^{th} September 1994 (Feuerstein *et al.*, 1998), and although this percentage is similar to the percentage of individuals with upper limb enthesopathies at Castledyke, and at Wells Cathedral (Rogers and Waldron, 1989), it is not realistic to draw comparisons between these two samples and the results of the US study. The US study, by its nature recorded symptomatic cases of enthesopathy (Feuerstein *et al.*, 1998), and as there is no way of knowing which (if any) of the enthesopathies recorded in archaeological material were symptomatic, it is not possible to directly compare these prevalences. It may be the case that it is only reasonable to compare the results from the four skeletal samples examined in the present study with each other, as this is the only way to exclude variations resulting from differences in recording methods.

i) Side

As with osteoarthritis, in the upper limb the percentage of enthesopathies was, on the whole, higher on the right side than on the left, but in the lower limb there was more variation, with enthesopathies tending to be more frequent on the right side and possible enthesopathies being more frequent on the left. These results suggest that, in the upper limb, the percentage of entheses with enthesopathies was most influenced by handedness

(Wilczak, 1998), and greater involvement of the right side of the upper limb has been noted in other archaeological samples (al-Oumaoui *et al.*, 2004, Eshed *et al.*, 2004, Hawkey and Merbs, 1995, Peterson, 1998).

There are few studies of laterality of enthesopathies in the lower limb but where side differences have been examined in the lower limb, much lower levels of asymmetry have been identified than are seen in the upper limbs (al-Oumaoui *et al.*, 2004), a finding which corresponds with the needs of the lower limbs to be more symmetrical for the purposes of locomotion (Ruff, 2000b). This does not, however, explain the levels of asymmetries seen in the percentages of entheses affected by possible enthesopathies in the lower limbs in the present study. As Weiss has demonstrated (2004), larger limbs have more severe enthesopathies, and in this study, on average the left femurs were larger than the right (see below). This would suggest that the percentage of femoral entheses with enthesopathies should be higher on the left side, but this was not the case, although the percentage of possible enthesopathies was higher on the left side at Castledyke and Norton Mill Lane, and similar at Norton Bishopsmill. These findings indicate that while less prolific changes to the entheses may have been associated with limb (and hence body) size, the more prolific changes may have a different aetiology. This suggests that, in studies where the aim is to identify differences related to physical activity, a rigorous definition of enthesopathies should be employed, and it may be appropriate to attempt to score these lesions for "severity" of the change. Although the right-dominance of involvement in the lower limb was somewhat unexpected, the similarity in asymmetry between the four sites suggests that this may be due to a factor that is influential at all four sites, and may be a "normal" pattern.

5.3.3: Prevalence of Schmorl's Nodes

Schmorl's nodes were also common at all four sites, with the highest proportion of individuals being affected at Castledyke (86%) and the lowest at Norton Bishopsmill (67%). Although these prevalences are much higher than those reported by Schmorl and Junghanns (1971) and Pfirrman and Resnick (2001), they are similar to the prevalences of back pain seen in modern populations, where between 60-80% of individuals are affected at some point in their lives (Fairbank, 2002). In a study of the skeletal remains of prisoners of war from 18th century Quebec, Weiss found that 73% of the individuals examined had Schmorl's nodes (Weiss, 2005), a prevalence rate that is much closer to those seen in the present study. Although the higher frequencies of Schmorl's nodes in the four archaeological samples in the present study may be due to differences in spinal stress and activity levels in the past, the higher frequencies seen here may also be due to difficulties of identifying Schmorl's nodes in living populations. Up to 66% of larger Schmorl's nodes may not be visible on plain radiographs (Hamanishi *et al.*, 1994) and lesions that are less than $0.5cm^2$ may not be identified in up to 77% of cases (Malmivaara *et al.*, 1987), so it is possible that the prevalence rates in modern populations are artificially low.

In clinical studies, males have been shown to be more frequently affected than females and with more numerous and severe lesions (Goh *et al.*, 2000, Schmorl and Junghanns, 1971). At all four sites, males generally had more Schmorl's nodes that females, but this difference was only significant at Norton Bishopsmill (chi squared $p=0.1$). The reason for the sexual dimorphism in the frequency and severity of Schmorl's nodes is uncertain, but it may be related to differences in the forces experienced by male and female vertebral columns. During lifting, males produce significantly greater compressive forces in their spines than females, and the movement for the lift comes from different locations, with males moving more from the trunk while females move more from the hips (Marras *et al.*, 2003). It may be that these, and other differences in the posture and body weight between the sexes lead to more Schmorl's nodes in males than in females, and that this should be considered a "normal" dimorphism, rather than representing any specific differences in activity levels, and emphasises the need to compare same-sex groups when examining patters of lesions in relation to differences in physical activity.

The prevalence of individuals affected by Schmorl's nodes showed some similarities to the prevalence of OA and enthesopathies. Schmorl's nodes were most prevalent at Castledyke, where OA was also most prevalent, and the prevalence of enthesopathies was the second highest. The sites with the lowest percentage of individuals with Schmorl's nodes, Norton Bishopsmill and Norton Mill Lane also had the lowest percentages of individuals with OA and enthesopathies. There was a slight but not significant increase in the prevalence of Schmorl's nodes with age in all four skeletal samples, but particularly at Bamburgh and Norton Bishopsmill. The similarities in the percentage of individuals affected with these three conditions may reflect the influence of age upon these conditions. While there is a strong association between age and the prevalence of OA and enthesopathies (Claudepierre and Voisin, 2005, Radin *et al.*, 1972, Shaibani *et al.*, 1993, Sokoloff, 1969), the association between age and the aetiology of Schmorl's nodes is less clear (Goh *et al.*, 2000, Pfirrmann and Resnick, 2001). Therefore it is possible that the similarities between the percentage of individuals affected by Schmorl's nodes, and those affected by OA and enthesopathies may be an indication of the importance of other factors such as mechanical stress.

i) Surface Affected

In all four skeletal samples, the inferior surfaces of the vertebrae were significantly more frequently affected than the superior vertebral surfaces. Although there is anecdotal clinical evidence that Schmorl's nodes are most frequent on the inferior surface of the vertebra (Resnick and Niwayama, 1978, Saluja *et al.*, 1986), the reason for this is not known. As this pattern was seen at all four sites, it seems most likely that this is the "normal" appearance of Schmorl's nodes, and the preference of the lesion for the inferior surface of the cervical and thoracic vertebrae may be due to factors associated with anatomy and normal stresses of bipedalism and locomotion. It is possible that experiments to identify any differences in the pressure of the disc upon the superior and inferior surfaces of the vertebrae could shed light on this issue.

5.3.4: Asymmetry

i) Direction of Asymmetry

In all four skeletal samples, the measurements of the circumference of the humerus and femur showed the greatest degree of asymmetry, and showed the most consistency of the direction of asymmetry. While the direction of asymmetry could be different in the antero-posterior and medio-lateral diameters, the direction of the asymmetry of the circumference never disagreed with both the measurements of diameter. The circumference also tended to give the greatest degree of asymmetry of all three measurements. Therefore the circumference of the paired humeri or femora may give the best indication of the direction and degree of asymmetry between the paired elements.

The right humerus was larger on average than the left in all four samples, while the left femur was generally larger than the right. The elements of the right upper limb tend to be larger than the left due to the dominance of the right hand in the vast majority of humans (see Section 1.4.4). Although patterns of asymmetry in the lower limb are less well understood, and less frequently investigated than those seen in the upper limb, the left lower limb tends to be dominant in terms of size and mechanical strength, but any asymmetry is much less marked than that seen in the upper limb and does not show such clear trends (Larsen 1997 pp 213). At all four sites the average right –left asymmetry between the measurements of the femur was smaller than that seen in the upper limb, a finding that is common in anatomical studies (Chhibber and Singh, 1971).

ii) Degree of Asymmetry

Overall, the difference in average absolute asymmetry (larger side – smaller side) of the humerus was greater in males than in females, and was significantly different at Castledyke and Norton Mill Lane, indicating that males had a greater degree of asymmetry than females. Studies of asymmetry control intrinsically for differences in body mass (Roy *et al.*, 1994, Ruff, 2000b, Ruff *et al.*, 1994), as any influence brought about by body mass will impact equally upon both sides; if an individual is physically robust, that robusticity will affect both sides equally, and any asymmetry seen between the two sides will reflect the difference between the two sides rather than comparisons of raw measurements, which do not account for variations in robusticity or body mass. Therefore it is unlikely that the difference in the degree of asymmetry between males and females is due to the greater body and muscle mass of males and it is possible that this difference was due to other factors, particularly differences in limb use and mechanical stress (Mays, 1999). However, many archaeological studies from various different countries and time periods have identified similar variations in the patterns of asymmetry in the upper limb between females and males (Bridges, 1989, Bridges, 1991b, Fresia *et al.*, 1990, Larsen, 1997, Larsen *et al.*, 1995, Wada, 1998), and as it is somewhat unlikely that there was sexual dimorphism of activity at all these sites that required males to carry out more asymmetrical tasks than females, this sexual dimorphism may be "normal" rather than particularly related to differences in activity levels. However, by comparing with sex matched groups it may be possible to identify abnormal degrees of asymmetry that may be due to differences in physical activity. In the femur, while the degree of asymmetry tended to be greater in males, there was no significant difference between the sexes, and the degree of asymmetry was generally less marked than that seen in the humeri. This is not surprising, as locomotion requires the lower limbs to be more bilaterally symmetrical than the upper limbs (Ruff, 2000a). Therefore it is likely that asymmetry of the femora is less useful as an indicator of physical activity than asymmetry of the humeri.

Some studies have suggested that asymmetry of the long bones may decrease with age (Ruff and Jones, 1981), but this was not the case in the present study. Although some variation was seen in the average directional (right-left) asymmetry and the average absolute asymmetry (larger side – smaller side) of the humerus between individuals from different age groups, this variation was not statistically significant except at Castledyke where the Young/Middle age group were significantly more symmetrical than the other age groups. The results for asymmetry and age in the femur were similar, suggesting that age was not a factor in the development of bilateral asymmetry in either the humeri or femora.

5.4: Markers of Activity-Related Stress and Status

5.4.1 Castledyke and Norton Mill Lane

The patterns of skeletal changes showed some interesting variations between the artefact groups. At Castledyke and Mill Lane the most dramatic differences were seen in the Group 3 males, those buried with weapons, and in the individuals from Group 4.

i) Group 3 – the weapon burials

At Castledyke the Group 3 males had a significantly higher percentage of right elbow and wrist joints affected by osteoarthritis than all other males (chi squared; right elbow p= 0.01, right wrist p= 0.01), and were the only group to have any individuals with OA in the right elbow. In this group the percentage of left humeral flexor and extensor entheses with enthesopathies was significantly higher than all other males (chi squared p=0.04), but the entheses of the clavicle were not affected in any of the Group 3 males from Castledyke. In the lower limb, the percentage of joints and individuals affected by OA was higher in Group 3, than in all other males, particularly in the knee joints, although not significantly so. The prevalence of enthesopathies was also slightly higher in the left lower limb in Group 3, but on the right side all other males were more frequently affected. In comparison to all other males, the Group 3 males had on average more symmetrical humeri, and slightly more asymmetrical femora, and a higher average number of Schmorl's nodes in the vertebral column.

At Mill Lane Group 3 also had higher frequencies of osteoarthritis, and were the only males to show changes to upper limb joints other than the shoulder. As was seen at Castledyke the wrists and elbows were particularly affected, but at Mill Lane there was less asymmetry of involvement of the upper limb joints than was seen at Castledyke. However, the pattern of enthesopathies was rather different to that seen at Castledyke. On the right side of the upper limb, only the forearm flexors and extensors were more frequently affected in Group 3, and on the left side of the upper limb the prevalence of enthesopathies was lower in Group 3 than in all other males. The pattern of asymmetry in the humeri was also different to that seen at Castledyke; at Mill Lane Group 3 males were significantly more asymmetrical than all other males (circumference, ANOVA p=0.02). Overall, Group 3 individuals had a higher frequency of Schmorl's nodes in comparison to other males, particularly in the thoracic region where the difference was significant (ANOVA p=0.05). In the lower limb, Mill Lane Group 3 individuals also had higher frequencies of OA or possible OA, but in the joints of the hip, rather than the knees, as was seen at Castledyke. The entheses affected in the lower limb at Mill Lane were also different to those involved at Castledyke, in Mill Lane Group 3 the gluteus and adductor entheses were more frequently affected than in other males, significantly more so in the left side (chi squared p=0.001). On the right side of the lower limb, the quadriceps entheses were significantly more frequently affected in Group 3 than in all other males (p=0.001), but all other males had higher frequencies of changes in the femoral flexors and extensors and foot flexors and extensors. As was seen for the asymmetry of the humeri, the Mill Lane Group 3 males were significantly more asymmetrical in the circumference of the femora in comparison with all other males (ANOVA p=0.02).

Although there were some similarities in the patterns of these MSM in Group 3 individuals at Castledyke and Mill Lane, when compared to other males in the respective skeletal samples, there were also differences between the expression of the MSM between these two groups. Table 5.4.1a summarises the similarities and differences between these groups, and also Group C from Bamburgh (see below). Some possible explanations for these similarities and differences will be discussed below.

	Castledyke Group 3	Mill Lane Group 3	Bamburgh Group C
Upper Limb OA	More frequent	More frequent	More frequent
Upper limb Enthesopathy	More frequent	Varied	More frequent
Lower Limb OA	More frequent	More frequent	Varied
Lower Limb Enthesopathy	More frequent	More frequent	Varied
Humeral Asymmetry	More symmetrical	Less symmetrical	More symmetrical
Femoral Asymmetry	Less symmetrical	Less symmetrical	Similar
Schmorl's Nodes	More frequent	More frequent	Less frequent

Table 5.4.1.a: Summary of the MSM in Group 3 at Castledyke and Mill Lane, and Group C at Bamburgh, in comparison with all other males at each site.

ii) Group 4 – the "female gendered" burials

At both sites the frequency of functional joints affected by osteoarthritis in individuals from Group 4 was low. At Castledyke osteoarthritis was confined to the left side of the upper limb in Group 4, but the shoulder, elbow and wrist were all affected in at least one individual. However, the frequency of possible OA was significantly higher in the left wrist and elbow in Group 4, than in all other females, and significantly lower in the right elbow and wrist in comparison with other females. The divergence of the pattern of possible OA from the "normal" right dominant asymmetry is striking, and may indicate a degree of asymmetrical activity in this group from Castledyke. In contrast with the asymmetrical patterns of osteoarthritis, the enthesopathies from the upper limbs of Group 4 females at Castledyke were relatively symmetrical, and other than the entheses of the clavicle, Group 4 females were more frequently affected than all other females, a pattern which was repeated for the entheses of the lower limbs. Despite being more frequently affected by enthesopathies, Group 4 females at Castledyke were more symmetrical in the measurements of the humeri and femora than the other females in the sample, although the difference was less marked in the femora.

In contrast with Castledyke, no individuals from Group 4 at Mill Lane were affected by OA or possible OA in the upper limb, and the frequency of enthesopathies was lower and more symmetrical than that seen in all other individuals, with the exception of the right clavicle. The patterns of osteoarthritis in the lower limb were rather more similar between these two sites, with the joints of the right side of the lower limb being more frequently affected than those of the left, the reverse of which was seen amongst all other females from both sites. Again, this variation from the "normal" pattern of asymmetry may indicate differences in activity. Generally, Group 4 individuals from Mill Lane had lower frequencies of enthesopathies and were a little more symmetrical in their involvement than other individuals from this site. The degree of asymmetry seen in the humeri from Group 4 was very similar to that seen in the other groups at Mill Lane, with the exception of Group 3, but the asymmetry of the femora was considerably less than that seen in other individuals.

Both sets of Group 4 individuals had on average lower frequencies of Schmorl's nodes in comparison with other individuals, and in the lumber vertebrae of Group 4 from Castledyke this difference was significant (ANOVA p=0.02). These results suggest that there were differences in the patterns of physical activity undertaken by these individuals in comparison with other individuals from the same population. Both OA and enthesopathies showed variation in the pattern of asymmetry seen in other individuals and the degree of humeral asymmetry was small. Together with the low frequencies of Schmorl's nodes these results suggest that the Group 4 individuals had a less physically demanding lifestyle than other individuals, but may have been performing tasks that required symmetrical use of the upper limbs. Table 5.4.1b summarises the similarities and differences between these groups, and also Group D from Bamburgh and Group A from Norton Bishopsmill (see below).

	Castledyke Group 4	Mill Lane Group 4	Bamburgh Group D	Bishopsmill Group A
Upper Limb OA	More frequent Left, less frequent Right	Less frequent	More frequent	Less frequent
Upper limb Enthesopathy	More frequent	Less frequent	Less frequent	Less frequent except clavicle
Lower Limb OA	More frequent Right, less frequent left	More frequent Right, less frequent left	More frequent	? Less frequent
Lower Limb Enthesopathy	More frequent	Less frequent	More frequent	Less frequent
Humeral Asymmetry	More Symmetrical	Similar	Less symmetrical	Less symmetrical
Femoral Asymmetry	More Symmetrical	Less symmetrical	More symmetrical	Similar
Schmorl's Nodes	Less frequent	Less frequent	N/A	More frequent

Table 5.4.1.b: Summary of the MSM in Group 4 at Castledyke and Mill Lane, Group D at Bamburgh and Group A at Bishopsmill, in comparison with other individuals at each site.

5.4.2: Bamburgh and Norton Bishopsmill

Although the burial artefact groups at Bamburgh and Norton Bishopsmill were slightly different, it may be considered possible to compare the results from these sites, as there were some similarities, particularly in the age profiles of the artefact groups. In particular, the individuals who were buried without grave goods, Group A, should be comparable, as should the possibly higher status individuals in Group D, who had the most complex burial rites at both of the sites. However there were some striking differences in the patterns of MSM between these two sites. At Bamburgh, Groups C and D stood out as being particularly different to the other individuals, while at Bishopsmill Group A stood out as being different to the rest of the sample.

i) Bamburgh Group C and D

Group C from Bamburgh, the males buried with animal bones, had higher frequencies of left shoulder (significantly higher chi squared p=0.02), left elbow and right wrist joints affected by OA and possible OA than other males, but the frequency of changes to the lower limb was similar to other males. Enthesopathies were less frequent in the entheses of the left upper limb in Group C males, but were significantly more frequent in the right humeral flexors and extensors (chi squared p=0.02) and pronator and supinator entheses (p=0.005) than in all other males. On both sides of the lower limb, Group C had higher frequencies of femoral flexor and extensor entheses and interosseous membrane entheses affected, but lower frequencies of left quadriceps and right foot flexors affected. On average, humeri from Group C males were more symmetrical than other males, a pattern which was very similar to that seen in the Group 3 males from Castledyke. The femoral asymmetry was similar to that seen in other males from Bamburgh. In contrast with the results for the all male groups at Mill Lane and Castledyke, Group C males at Bamburgh had on average fewer Schmorl's nodes than all other males.

Individuals from Group D at Bamburgh had a higher percentage of joints from the upper limb with OA or possible OA than other females at the site, and this difference was significantly higher for the shoulder joints (chi squared p=0.02). In the lower limb too, Group D females were slightly more frequently affected, except for the knee joints and left ankle. In contrast, both sides of the upper limb were less frequently affected by enthesopathies in Group D, but the lower limb was more frequently affected on both sides, in all entheses groups except the right interosseous membrane. The humeri from Group D were on average more asymmetrical than all other females from Bamburgh, and the femora were a little less more symmetrical than other females. Group D appeared to have a very high frequency of Schmorl's nodes, but this was due to small sample size and should be discounted.

ii) Bishopsmill Group A

At Norton Bishopsmill the small number of individuals buried with artefacts led to some very small sample sizes, so to avoid this problem the largest group, Group A was compared with all other individuals, and this comparison produced some surprising results. In comparison with all other individuals, the prevalence of OA in the upper limb was much lower in Group A, with the exception of the right wrist, which was significantly more frequently affected (chi squared p=0.000001). The prevalence of OA was significantly less in Group A for the left wrist (p=0.001) and the right shoulder (p=0.01). In the lower limb, the results did not show such a clear trend, probably as a result of the small size of the sample of other individuals, but in Group A the hip joints were less frequently affected while the knee joints were more frequently affected than in other individuals.

Enthesopathies were less frequent on both sides of the upper limb of Group A than in all other individuals, with the exception of the clavicle where the changes in Group A were significantly greater (chi squared; left side p=0.001, right side p=0.001). Enthesopathies in the upper limb were also strikingly symmetrical in Group A, while the rest of the sample tended to show greater involvement on the right side. In the lower limb, enthesopathies were also less frequent in Group A, and significantly so in the left femoral flexors and extensors (p=0.03), the left quadriceps entheses (p=0.02) and left foot flexors (p=0.05). In contrast with the results for OA and enthesopathy the mean number of Schmorl's nodes was much higher in Group A than in all other individuals. This difference may have implications for the types of activity that these individuals may have been undertaking during life. Asymmetry of the humeri was slightly less marked in Group A individuals than in all others from Bishopsmill, and the asymmetry of the femora was very similar to that seen in Group B. However, Group D showed a significantly greater degree of femoral asymmetry (ANOVA p= 0.01) when compared with all other individuals.

Aside from the results for Schmorl's nodes, the pattern of changes seen in Group A from Norton Bishopsmill was very similar to that seen in Group 4 from Norton Mill Lane. Part of this similarity may be due to genetic similarity between these two samples, if Bishopsmill does represent a continuation of the same population from Mill Lane. However, it may be due to other similarities, such as landscape and environmental factors, or possibly similar ranges of activities.

5.5: Interpretations

Clearly there were differences in the patterns of MSM between the artefact groups from all four sites in this study, and it is possible that some or all of these differences in the skeletons are the result of differences in lifestyle and activity. There were also similarities between the skeletal samples. The following sections will examine the similarities and differences between the artefact groups, and suggest some interpretations of the patterns of MSM that have been identified.

5.5.1: Genetics and normal variation

As discussed in Section 1.4, genetic predisposition is a strong factor for the development of osteoarthritis and may also be a factor for enthesopathies and Schmorl's nodes. Social status in Early Medieval England was probably heavily influenced by family relationships; the evidence from the burial practices associated with children suggests that status (in death at least) was to some extent inherited (Dickinson, 2002, Härke, 1997, Lucy, 1998, Stoodley, 1999, Stoodley, 2000). Therefore it is highly likely that some of the individuals who were in the same status groups were related. Studies have shown that individuals from the same family are significantly more likely to develop symptomatic osteoarthritis than comparable non-related individuals (Chitnavis *et al.*, 1997), so if certain status groups were composed of members of the same family, the higher levels of osteoarthritis in these groups could be due to that family being genetically more predisposed towards developing osteoarthritis. A study of the DNA from individuals of the same burial practice groups could be used to identify familial relationships, and indicate whether the variation in frequency of osteoarthritis between the groups was influenced by genetic factors. However, where changes that have a less genetically influence aetiology, such as Schmorl's nodes and asymmetry are seen to correspond with patterns of osteoarthritis or enthesopathies, it becomes much more realistic to interpret these patterns as being the result of physical activity, rather than other factors.

One issue with trying to identify and interpret patterns of enthesopathies in archaeological material is the frequency of cases of involvement of the entheses. Enthesopathies as observed in skeletal material appear to be a "normal" part of skeletal variation, virtually all individuals from all four sites had some changes at one or more entheses. Therefore, in order to identify differences in the level of involvement it is necessary to either divide changes seen at the entheses by "severity" of the changes, or to compare the number of entheses affected between individuals and groups. Although systems of grading enthesopathies can be very subjective (Jurmain, 1999), in samples where changes to the entheses are common, it may be useful to use grading systems to exclude the least prolific changes, but as the aetiology of these lesions is so uncertain (Aufderheide and Rodrigues-Martin, 1998, Benjamin and McGonagle, 2001, Freemont, 2002, Jurmain, 1999, Resnick and Niwayama, 1983), the relative "severity" of a lesion should not be interpreted as being the result of a greater degree of mechanical stress, without supporting evidence from other skeletal indicators of physical activity.

The patterns of Schmorl's nodes may also be affected by normal human anatomy. A normal posture places the greatest compressive stresses upon the mid thoracic spine (Keller *et al.*, 2005), and this may be one of the reasons for the highest prevalence of Schmorl's nodes in the thoracic region of the vertebral column. Knusel et al (1997) found that degenerative changes in the intervertebral joints, including Schmorl's nodes, were most severe in the regions of the vertebral column where the spine was the most curved, and furthest away from gravity. When the normal curvature of the spine is altered by injury, changes in posture or excessive loading, the patterns of stress change (Keller *et al.*, 2005), and these factors may also have an impact upon the formation of Schmorl's nodes. In other archaeological studies, differences in the pattern of Schmorl's nodes have been associated with heavy lifting and carrying of loads (Lai and Lovell, 1992, Lovell and Dublenko, 1999), activities that also involve bending, and increase the stresses on the spine. In the four Early Medieval samples examined in the present study, the individuals are likely to have been exposed to many tasks that required bending and lifting. As agriculture was almost certainly the core of the economy at all four sites it is highly probably that some of the individuals from these sites were involved in tasks such as ploughing, sowing and reaping crops (Fowler, 2002), all of which require sustained periods of bending and alterations to the normal posture. Schmorl's nodes were least frequent in the Group 4 individuals from Castledyke and Mill Lane, and as these are likely to represent the one of the highest social groups at the sites, it may be possible to argue that these were the individuals least likely to be involved in ploughing and other heavy agricultural activities. Although it is not possible to conclude that the apparently lower status individuals with higher levels of Schmorl's nodes were definitely involved in these activities, it is more likely that the individuals buried with fewer grave goods were more involved in these agricultural activities than the apparently higher status individuals.

5.5.2: The weapon burials

To date, weapon burials are the only type of Early Medieval burials that have been examined in relation to levels of physical activity (Härke, 1990, Härke, 1992a, Härke, 1992b). Some of the flaws in Härke's arguments against the possibility that individuals buried with weapons were capable of using them in life have already been discussed in Chapter 2, and the results of the present study go a great deal further towards demonstrating not only that males buried with weapons were physically capable of using them, but that they may have been using them on a regular basis. The differences between the patterns of MSM from individuals with weapons and those without are striking, and may suggest both similarities in the level of physical activity undertaken by these individuals, and differences in the type of activity.

While there are similarities in patterns of MSM from Group 3 burials at Castledyke and Mill Lane, the differences that are seen in these results are potentially revealing, particularly the differences in the degree of humeral asymmetry. At both sites the weapon set was similar, with the only two major differences, these being the presence of two burials at Castledyke who had a seax instead of a spear, while all the weapon burials at Norton had spears, and the fact that there was little evidence for the presence of shields at Castledyke. The shields from Norton Mill Lane were small, buckler type shields, probably covered with leather, and were probably also light and easily manoeuvrable in a fight (Sherlock and Welch, 1992). The spearheads were also on the whole quite small and hence more likely to have been single-handed weapons, with the other hand occupied by the shield. However, as the only remains of the shield that survive at Norton Mill Lane are the metal boss and occasionally metal handles (Sherlock and Welch, 1992), it is possible that shields were present in the Castledyke burials, but that they were entirely wooden and hence left no archaeological remains. Carrying a shield, probably in the left hand (Stephenson, 2002), means that the spear must be used as a single-handed weapon or thrown, but if both hands are free it can be used as a two-handed thrusting weapon, with greater force, particularly on the trailing arm (Schmitt *et al.*, 2003), which is likely to be the left in a right handed individual. If these men actually used the weapons that they were buried with, whether for actual fighting, or on the basis of the scarcity of weapon injuries seen at both sites, for training or display, it is possible that these differences in burial assemblage represented differences in the patterns of use of their weapons, leading to differences in the risk of developing MSM.

At Norton Mill Lane, where several of the weapon burials included shields, the degree of humeral asymmetry was much greater than that seen at Castledyke, suggesting that at Mill Lane the loading of the humerus in this group was very asymmetrical and placed more stress on the right side. In contrast, as the degree of humeral asymmetry was much less marked at Castledyke in comparison with other males in the sample and with Group 3 from Mill Lane. This suggests either that the upper limbs of the individuals from Castledyke were exposed to less asymmetrical loading than their counterparts at Norton Mill Lane, or more symmetrical forces. The involvement of the entheses of the upper limb also reflects this pattern – at Mill Lane the right side was more frequently affected, but at Castledyke the pattern was more symmetrical. In both of these groups the joints of the upper limb were more frequently affected than those of other males, particularly on the right side. Both groups had relatively high frequencies of Schmorl's nodes, which also suggests regular physical exertion. Taken separately, it might be possible to argue that all these changes can be explained by factors other than activity, but put together with the evidence from the artefacts at these two sites they provide the basis for a compelling argument that these individuals were involved in specific physical activities, most likely involving their weapons. The difference between the two groups could be explained by differences in fighting style, necessitated by their different weapon sets. Using a two-handed spear might have caused the more symmetrical patterns seen at Castledyke, as this is a technique which places high levels of stress on both sides of the upper limb (Schmitt *et al.*, 2003), while the pairing of spear and small buckler shield at Mill Lane may be responsible for the greater degree of asymmetry in these individuals.

If possession of a seax or spear and shield was as indicative of the rank and social standing of the individual as the documentary sources suggest (Brooks, 2000), and important enough to his social identity to be buried with him, it is likely that these items were also a part of his daily life, even if he was not going off to war regularly (or at all as the scarcity of weapon injuries may suggest). Training or hunting with these weapons may have been sufficient demonstration of his ability to perform the role of "warrior" even if he was not involved in much actual fighting, as Härke's review of weapon injuries suggests (Härke, 1990, Härke, 1992b). Evidence from literary and documentary sources suggests that boys of noble birth began training with wooden weapons from as young as seven, and may have been involved in hunting and raiding from around 14 years (Davidson, 1989). Hunting was an activity reserved for the higher status individuals in Early Medieval society, but wild game probably provided a substantial proportion of the protein in the diet of all levels of society (Fowler, 2002), and is an activity that appeals to many small boys up to the present day. As bone is most responsive to loading during growth (Pearson and Lieberman, 2004), and higher levels of activity during development lead to greater bone size and density in adulthood (Bass *et al.*, 1998, Khan *et al.*, 1998, Ruff *et al.*, 1994), the high frequencies of enthesopathies and greater degree of asymmetry seen amongst the weapon burials may suggest high levels of physical activity undertaken at a young age, a concept which could be explored by examining the skeletal material from children buried with weapons in comparison to those without. While this activity may not have been actual warfare, the social display of weapon training and hunting may have served a similar purpose of demonstrating strength and bravery. Analysis of the patterns of MSM from other Early Medieval weapon burials may clarify whether these differences are representative of variations in weapon use, or simply anomalies in the patterns of changes at these particular sites.

The comparative study carried out by Rhodes and Knüsel (2005) on the paired humeri from blade-injured males from the medieval sites of Towton and Fishergate suggested that the variation seen in the diaphyseal shape and robusticity of the bones from the blade-injured males, when compared with uninjured males from Fishergate was the result of these individuals habitually training with weapons. Although this sample is much later in date, there are no samples of Early Medieval skeletons that are known to have been involved in warfare with which to compare the findings of the present study, and as the human body provides a universal element to all studies of physical activity, it is possible that there may be some similarities between the patterns of change in Early and Later medieval individuals who may have trained to fight with weapons. Rhodes and Knüsel suggested that the differences seen between the humeri from the two blade-injured samples was due to the males from Towton using weapons that required the use of both hands, while the Fishergate males trained with single-handed weapons (Rhodes and Knüsel, 2005). Rhodes and Knusel concluded that the two handed weapon most likely to be used by the Towton men was the longbow, while the Fishergate males were more likely to have been fighting with swords or spears, held in the right hand.

In two studies that examined relationships between status as indicated by grave goods, possible indicators of health such as dental enamel hypoplasia, cribra orbitalia and adult stature in combination with potential markers of activity related stress such as Schmorl's nodes, enthesopathies and trauma in a sample from Iron Age Italy, variations were seen in the pattern of enthesopathies between status groups (Robb, 1998, Robb *et al.*, 2001). The males buried with weapons and strigils, part of the equipment of athletes, did not differ significantly from the rest of the sample in terms of the severity of enthesopathies, but males who were buried in tiled tombs with grave goods did have more robust enthesopathies than males who were buried in pits without grave goods (Robb, 1998). Robb *et al* (2001) also found an inverse relationship between the prevalence of Schmorl's nodes and social status, with lower status males having higher incidences of Schmorl's nodes than males buried with weapons. While there are some similarities between the findings of the present study and those of Robb *et al*, the weapon burials from Norton Mill Lane and Castledyke had higher prevalences of Schmorl's nodes than the apparently lower status individuals. This may suggest that individuals from the Early Medieval period who were buried with weapons were exposed to higher levels of physical stress than individuals buried with weapons in the Italian Iron Age, or that the weapons buried in the Iron Age Italian graves were more symbolic of status than those at Castledyke and Mill Lane.

Although Robb resisted the temptation to try to correlate these differences with specific activity patterns, it was suggested that the elite males may have been undertaking more specific activities such as athletics than the lower classes who may have been artisans and labourers undertaking more generalised tasks (*ibid* pp 375; and Robb *et al* 2001, pp 220). As this study identified variations in enthesopathies that may have been associated with differences in activity resulting from social differences, it may be possible to interpret some of the patterns seen in the present study in terms of social differences in activity levels.

If the distinctive patterns of changes seen at Castledyke and Norton Mill Lane are the result of training with weapons from a young age, might it be possible to identify these patterns of changes in males who were not buried with weapons? As has been discussed in Chapter 2, the changes in social structure and burial practices from the 7th century AD appear to have greatly affected the use of weapons as social articles. Rather than being buried with their owners, weapons may have been passed to the heir or given to the king or church as *heriot*, or to gain or reaffirm social position (Brooks, 2000, Chadwick, 1924, Lillios, 1999, Stenton, 1971). Therefore it is possible that some of the individuals buried without weaponry in later cemeteries held the same social role as the weapon burials from sites like Castledyke and Mill Lane, but are effectively "invisible" in death. It is possible that Group C from Bamburgh are one of these groups; the burial practices distinguish them from other males in the cemetery, and the patterns of skeletal change are similar to those seen in the Group 3 weapon burials, particularly at Castledyke. Although it may be too far to stretch the argument that these individuals from Bamburgh are also "warriors", the possibility is interesting, especially considering that these individuals were almost certainly associated with the royal fortress at Bamburgh, and may have been retainers or *ceorls* to the kings. It would be very interesting to examine a larger sample of weapon burials from around the country to see if these patterns of skeletal change are also present.

5.5.3: Other Artefact Groups

Although the burial assemblages from the other artefact groups do not provide such appealing suggestions of the types of activity undertaken by the individuals as those seen in the weapon burials, the patterns of MSM may still represent differences in activity levels between status groups. Again, it is Castledyke and Mill Lane that provide the most compelling evidence for differences in activity between Group 4 individuals and the other artefact Groups.

Group 4 individuals from Castledyke and Mill Lane, and to some extent the Group A individuals from Bishopsmill appear to have been more symmetrical than individuals from other artefact groups, and to have had different patterns of osteoarthritis and enthesopathies, which particularly suggest differences in the patterns of use of the upper limb. A study of skeletal material from the Mesolithic period in Western Europe identified difference in the patterns of asymmetry between "high status" and "low status" individuals (Constandse-Westermann and Newell, 1989). Higher status females were found to have a lower degree of right dominance in the upper limb than low status females, a pattern that was interpreted as reflecting heavier work patterns amongst the lower status females. Conversely, high status males were more right dominant than low status males, and this pattern was interpreted as an indication that the acquisition of male status was based upon carrying out more demanding and more asymmetrical activities than those undertaken by lower status males (Constandse-Westermann and Newell, 1989). The patterns of asymmetry of the upper limb at Castledyke and Norton Mill Lane had some similarities with the results of the Mesolithic study; high status females were on average left dominant while lower status females were more asymmetrical and more right dominant. It may be the case that the higher status females just happened to include more left handed individuals than the lower status groups, but it is more appealing, and rather more realistic to seek an explanation from behavioural differences. The results from Group A at Bishopsmill are potentially anomalous in the light of the study discussed above. The burial practices associated with these individuals would suggest that they were lower in status in comparison with the individuals buried with artefacts or in coffins. The fact that Schmorl's nodes were more frequent in Group A than in other individuals from Bishopsmill, and less frequent in the Group 4 individuals suggests that Group A individuals may have been exposed to different, probably greater, levels of physical stress than those individuals in the apparently high status groups.

If the patterns of changes seen in the Group 4 individuals are due to differences in physical activity, which resulted in them being more symmetrical than their contemporaries, what might those activities have been? Weaving is often suggested as an activity that could lead to more symmetrical patterns of MSM, as it requires both hands to be equally active (Groves, 2001, Kennedy, 1989, Lawrence, 1961), although it has proven to be difficult to identify skeletally (Molleson and Cox, 1993). Weaving tools are sometimes found with high status female burials in the Early Medieval period (Lucy, 1998, Stoodley, 1999) and at settlement sites (Powesland, 1997), and weaving is considered to have been a significant industry, both locally and internationally during Early Medieval period (Powesland, 1997). The archaeological evidence suggests the use of warp weighted looms, which were probably used standing up, with the weaver constantly moving around the loom, using both hands to pass the weft or shuttle through the warp threads (Owen-Crocker, 1986). Weaving is assumed to be a female occupation in the Early Medieval period, primarily due to the presence of loom weights and other weaving apparatus in female graves, but the literary evidence also refers to some female slaves being "a woman-weaver and a seamstress" (Owen-Crocker, 1986, pp 183). If higher status females were primarily involved in weaving rather than other activities, this might explain the lower levels of asymmetry in the female upper limb in the higher status groups from Norton Mill Lane, as weaving with a handloom involves both sides of the upper limb, but primarily the hands (Mays, 2001, Munson Chapman, 1997). Of course, there are many other activities that require the use of both hands, including a wide range of agricultural tasks and crafts such as pottery production, and these cannot be excluded as potential activities these individuals may have undertaken. Examination of the patterns of asymmetry and enthesopathy in the hands might produce more evidence to support this theory. Overall, the degree of asymmetry in the humerus was high in the lower status groups, particularly at Castledyke and Bamburgh, suggesting that burial with fewer and less elaborate grave goods was associated with higher levels of asymmetrical stress in the upper limb, a pattern that is reflected in the frequencies of the other skeletal changes discussed above.

5.6: Social Status and Activity

The associations between markers of activity related stress and social status seem to be the strongest at the sites with the earliest date ranges. At Castledyke and Norton Mill Lane, there were correlations between all four skeletal changes in the individuals from Group 3, and to some extent the Group 4 individuals and Group D from Bamburgh. However, there was more variation in the MSM at the somewhat later sites of Bamburgh and Bishopsmill, and less agreement between the patterns of the four skeletal changes examined.

There are several possible explanations for these differences in the correlations between markers and physical activity and social status between the earlier and later sites. The differences in burial practice at Bamburgh and Bishopsmill, in comparison with the slightly earlier sites of Castledyke and Mill Lane may be indicative of a shift in the importance of social status over time, with social identities and roles becoming less well defined, and the social identity of the individual becoming less closely associated with lifestyle. Perhaps the number of ranks within society in the later phase was reduced, and hence the activity patterns of the social groups may have become more homogenous. The documentary sources that survive from the later phase of the Early Medieval period do not suggest a less stratified society; if anything the evidence suggests greater stratification, and the development of a more rigid social system (Dickinson, 2002, Stoodley, 1999, Wareham, 2001). However, the shift in the social structure from the 7th century, may have led to a reduction in the potential for social mobility, and less social variation at a local level, as the need to produce agricultural surplus intensified (Arnold, 1997). Competition for power between the highest ranking individuals, the aristocrats and landed nobility, may have led to aggregation of small farming communities under a single leader (Scull, 1993), and hence to less social variation on a local level.

It may also be the case that burial practices and grave goods were less representative of social status in the later sites, and factors such as the choice of burial location (Hadley, 2002), the distribution of the individual's personal possessions amongst the kin or Church (Wareham, 2001), or the manner in which the burial was carried out (Thompson, 2002) were more indicative of the individual's status in society. Unfortunately, these factors are much less archeologically visible than the inclusion of grave goods with the burial, so it may not be possible to accurately differentiate differences in social groupings within later cemeteries, although comparisons between different types of cemetery, i.e. churchyard burials as opposed to barrow cemeteries or burials that were not near a church may reveal differences in social status (Hadley, 2002).

If the less well defined associations between burial practice and the prevalence of MSM at the later sites are indicative of problems of identifying social groups in the later cemeteries, the stronger associations between artefact groups and MSM at the earlier sites may indicate that the burial assemblages at these sites are more representative of social identity. The groups that had the most well defined burial assemblages, Group 3- the weapon burials and the higher status, more "female" assemblages (Lucy, 1998, Stoodley, 1999), Group 4, stood out as having particularly different patterns of MSM. The two "lower" status groups, those with the fewest and least elaborate grave goods (Alcock, 1981, Härke, 1997), were more similar to each other, suggesting that either the activity patterns of these groups were more similar, or that the expression of subtle differences in status through burial practice was less important, or perhaps more importantly, less accessible to these individuals.

The specific answers to the question of what the people from these four Early Medieval burial sites were *actually* doing will remain unanswered, but the list of activities that they *might* have undertaken is long and varied. Burials may provide potential evidence for the activities of individuals buried with weapons, tools and other manufacturing equipment, but the main sources for the physical activates that the individuals in this study might have undertake are the documentary and archaeological evidence, which has been discussed in Section 2.1.5. Considering the nature of the sites in question, the majority of the activities undertaken by the individuals examined for this study are likely to have been agricultural, such as clearing the land, ploughing, weeding and caring for livestock. Many of these activities were seasonal and therefore it is probable that most people were involved in a range of activities. This may explain the apparent lack of variation in MSM between the lower status groups in comparison to the individuals buried with weapons and jewellery; perhaps these higher status individuals had the luxury of being able to specialise in particular activities while the lower status groups had to turn their hands to may different tasks.

Once soil is tilled, seeds sown and plants tended to maturity, the crop must be harvested, and while ploughing may have been primarily carried out by men due to the physically demanding nature of the work (Fowler, 2002), it is likely that the whole community was involved in the harvest (Lacey and Danziger, 1999). Harvesting crops can involve a range of physical activities; use of two-handed tools like scythes, rakes and flails and single-handed sickles and knives, bending and heavy lifting, walking and carrying loads over rough ground (Fowler, 2002). The possibilities for injury and skeletal changes amongst individuals involved in these activities must have been high. Other archaeological studies have interpreted patterns of MSM as indicating involvement in cereal processing (Bridges, 1989, Eshed *et al.*, 2004, Molleson, 1989, Munson Chapman, 1997), usually where females have been seen to have more symmetrical upper limbs, or symmetrical patterns of skeletal change. The low levels of asymmetry in the upper limb seen in females in some of the status groups may be due to the use of both arms to grind corn, but there is no reason to suggest that grinding was more responsible than any of the other bimanual tasks that Early Medieval women (and men) may have undertaken. Although skeletal changes may suggest variations in activity levels, they cannot be taken as direct evidence that an individual or group was involved in one particular activity. However, the variations seen in the patterns of changes between the individuals in the different status groups in this study suggest that there is a relationship between the social status of an individual as displayed through burial practice and the level and type of physical activity undertaken in life.

6: Conclusions and Further Work

The main aim of this study was to try to identify patterns of skeletal change that may have been the result of socially defined differences in activity levels and to interpret these patterns within the social and cultural context of Early Medieval North East England; to undertake "archaeological epidemiology", rather than the less scientific technique of constructing "osteobiographies" of individuals, identifying specific activities that the individual may have undertaken during life. Although "osteobiographies" are interesting and potentially valuable in a forensic context, where knowledge of the occupational activities of the individual may be valuable in obtaining an identification (Steele, 2000), it is very rarely possible to identify the specific activities undertaken by individuals from archaeological skeletal samples. The nature of archaeological skeletal material often means that information regarding the lifeways of the population, and even the types of activities that they might have undertaken may not be available, and in these cases reconstruction of specific activities from the patterns of skeletal changes should not be attempted. This however is not the case for the Early Medieval period in Britain; there is evidence from both archaeological and documentary sources for a wide range of physical activities, and also evidence for a variety of social identities. This work has attempted to use the skeletal and archaeological data in combination in order to identify correspondences between social identity, as expressed through burial practice, and lifestyle and activity as can be inferred from changes in the skeleton.

Despite the potential problems associated with the identification of physical activity from skeletal material, the results of this study suggest that it is possible to identify differences in activity patterns, as indicated by skeletal markers of activity related stress, between status groups in Early Medieval skeletal samples from the north of England. In particular, males buried with weapons presented a suite of skeletal changes that were significantly different to those seen in other males from the same skeletal sample. While standing out as being clearly different in their patterns of MSM from other males, variation was also identified in the patterns of changes within this burial group between the two sites of Castledyke and Norton Mill Lane, which may be due to differences in the types of weapons included with the burials. This finding suggests that weapon burial in the Early Medieval period in England may be representative both of the social identity of the individual, as a "warrior", but also representative of an actual physical role.

6.1: The Physical Dimension of Warrior Status in Early Medieval Society

Males buried with weapons at Castledyke South and Norton Mill Lane formed a distinct group that was distinguishable from other males not only by burial practice but also by the following skeletal changes:

- More frequently affected by osteoarthritis in the upper limb, particularly at the wrist and elbow, and more frequently affected by osteoarthritis in the lower limb
- More frequently affected by enthesopathies in both the upper and lower limbs
- More frequently affected by Schmorl's nodes in the vertebral column
- Paired femora were less symmetrical than other males, and at Mill Lane paired humeri were also less symmetrical, but at Castledyke the humeri were more symmetrical – this may be due to differences in the weapon assemblage

These findings suggest that these males led a more physically demanding life than other males at these two sites, the higher levels of osteoarthritis and enthesopathies suggesting that they were regularly exposed to physical stresses. However, the lack of trauma in these individuals indicates that they did not regularly take part in fighting, but may instead have used their weapons for training and social display. The differences seen in the degree of humeral asymmetry between the two sites may be the result of using different weapon sets – a spear and shield versus a spear alone. If this is the case, the findings of this study suggest that a single spear does not represent an "incomplete" weapon set as suggested by Härke (1990), but may simply represent differences in fighting style.

6.2: The Physical Dimension of the Wealthy Woman in Early Medieval Society

The patterns of changes seen in "female gendered" burials at Castledyke South and Norton Mill Lane were also distinctive, and different to those seen in other females from the same sample, but showed more variation between the two sites than was seen in the weapon burials. At both sites these "wealthy women" were less frequently affected by Schmorl's nodes than other females, and were more frequently affected by osteoarthritis in the right side of the lower limb than other females. However, there were also differences in the patterns of skeletal changes, with Group 4 females at Castledyke showing more symmetrical changes and more frequent enthesopathies in the upper limb while at Mill Lane this group was less frequently affected by enthesopathies than other females.

These patterns of MSM suggest that individuals buried with jewellery and associated items, the "wealthy women", may have been exposed to lower levels of physical activity than other females, and particularly at Castledyke, may have been involved in activities that required more symmetrical use of the upper limbs. While the lack of settlement evidence for these sites prevents the identification of any specific tasks that these women may have been undertaking, it is likely that they undertook activities such as weaving and other craftwork. It is also possible that the lower levels of asymmetry seen in these individuals was simply due to lower levels of physical stress in comparison to women of lower social status.

6.3: Physical Dimensions of Society at Bamburgh and Bishopsmill

At Bamburgh and Norton Bishopsmill the physical differences between the burial artefact groups were, on the whole, less distinctive than those seen at Castledyke and Mill Lane. However, some of the artefact groups did stand out as being physically different from the rest of the population. Group C at Bamburgh showed several similarities to the weapon burials; this group was entirely male and had higher frequencies of osteoarthritis and enthesopathies in the upper limb, and the paired humeri were more symmetrical than the other males. These findings suggest that Bamburgh Group C may have been exposed to similar levels of physical stress to the individuals buried with weapons, but as no weapons were included in the burials at Bamburgh it is not possible to be certain that these individuals held the same "warrior" status as those at Castledyke and Norton Mill Lane.

At Norton Bishopsmill the results for Group A individuals, those without grave goods showed striking similarities with the physical dimensions of Group 4 from Mill Lane, suggesting that these individuals did not lead as physically demanding life as those that were buried with more artefacts. This was surprising as at the other sites the individuals without grave goods tended to show high levels of skeletal changes. This was not the case at Bishopsmill, and these results suggest that the absence of grave goods does not necessarily indicate low status. It would be very interesting to examine individuals from other unfurnished burials of similar date to see if this pattern is repeated elsewhere.

6.4: Diachronic Changes in Social Organisation in Early Medieval North East England

It was also the aim of this study to attempt to identify differences in social status within and between four skeletal samples from the North East of England. The results show that, although it was relatively easy to identify groups with differing burial practices that may relate to differences in social status in the two sites dating from the 5^{th} to 7^{th} centuries AD, the burial practices at the sites spanning later date ranges may have been less socially meaningful, or less socially transparent. The burial practices at the Bowl Hole cemetery in Bamburgh may represent a transitional stage between the burial practices seen at Castledyke and Mill Lane, where burial artefacts reflect to some extent the biological sex of the individual, and hence aspects of their social persona, and practices at Early Christian cemeteries such as Norton Bishopsmill where there was no strong association between burial practice and sex.

It has been argued that the reduction in the use of grave goods in later Anglo-Saxon burials is representative of a shift towards a more egalitarian and less stratified society (Carver 1989), with an increased sense of national or regional identity (Geake 1992) but I believe that this explanation is too simplistic. Even if the changes in society resulting from the formation and strengthening of kingdoms were responsible for some shifts in social structure at the regional level, such as greater centralisation of power and resources, on a local level it would still have been necessary for individuals and families to demonstrate their position and role in the community. Burial practice appears to have provided a traditional outlet for this social display, but over time other means of social display became available, such as association with the church, leading to a reduction in the visibility of status in burial practice. Particularly wealthy individuals may have demonstrated their status by choosing to be buried in or in the churchyard of the nearest major church (Hadley 2002), rather than the traditionally used local cemetery.

The similarities between Group C at Bamburgh and the weapon burials from Castledyke and Norton Mill Lane provide a tantalising suggestion of what may have happened to the "warriors" in the later Anglo-Saxon period. These individuals may have continued to fulfil the warrior role in society, but were no longer buried with their weapons. Perhaps the weapons were now too valuable to the family to be lost to burial and instead became heirlooms. If this was the case for warrior males, there is no reason why it may not have also been the case for the assemblages of jewellery that served to distinguish the wealthy women. Alternatively, as Hadley suggests (2002), the higher status individuals may have been buried in churchyards, and then may be identifiable by their burial location within the higher status areas inside and around churches. An examination of the patterns of musculoskeletal stress markers in individuals buried in "high status" church contexts may help to answer the question of what happened to the higher status individuals in the later phase of the Early Medieval period, once these individuals are no longer identifiable by grave goods.

It is important to recognise that the inclusion of grave goods was not the only means of distinguishing one burial and hence one individual from another; later unfurnished burials show variation in the size, shape and depth of the grave, the inclusion of stones within burials, the deposition of the body within the grave and the location of the burial within the cemetery. All of these variations represent decisions made by the people carrying out the burial, decisions which were probably strongly associated with the social status of the deceased. If these subtle differences between unfurnished burials in Early Medieval cemeteries are influenced by the social persona of the individual, further study may well reveal associations between age, sex and other skeletal variations, which could shed further light upon Early Medieval social structures.

6.5: Markers of Activity Related Stress

A further aim of this work was to examine some of the conditions and changes that are most widely used as markers of activity-related stress in archaeological populations, and to evaluate the usefulness of these changes. Both osteoarthritis and enthesopathies have been shown to be associated with increasing age, but this does not mean that these conditions should be abandoned as potential indicators of physical activity. Where these changes are seen at high frequencies in younger individuals it is more likely that they are the result of physical stress and therefore by examining patterns of several conditions it may be possible to identify changes that are the result of activity rather than other factors. The prevalence of Schmorl's nodes and the degree and direction of asymmetries are independent of age and hence may be more useful indicators of relative levels of physical stress than osteoarthritis and enthesopathies, and can also serve as controls to assess the likelihood that changes are due to age. Consequently examining the value of examining multiple indicators of physical stress is demonstrated; a combination of skeletal changes may provide a more realistic picture of activity related stress throughout the skeleton. The use of a multiple indicator approach may identify complimentary patterns of changes in the skeleton, as different regions of the body can be examined, thus creating a more complete picture.

Further Work

There is the potential for a great deal more work in this area; few other studies have attempted to explore patterns of physical activity in the Early Medieval period, despite the existence of many well-excavated and well-preserved skeletal collections. Application of these techniques to other sites from other regions of the country could provide a useful comparison with this study, particularly to explore whether the patterns of changes seen amongst the weapon burials have parallels at other sites. It would also be useful to combine a study of the MSM in weapon burials with an assessment for trauma, and also to examine the individuals from Early Medieval cemeteries who have suffered from traumatic injuries but were not buried with weapons. If patterns of skeletal change similar to those seen in the weapon burials from Castledyke and Norton can be identified in individuals who were not buried with weapons, but who did have weapon injuries, this may help to shed further light upon the meaning of the weapon burial rite in Early Medieval England.

As many of the theories of migration and ethnic differences in the Early Medieval period are based upon differences seen in burial practices between different regions, particularly between the north and the south (Owen-Crocker, 1986, Wood, 1997), it would be interesting to see if the relationship between activity and status identified in the present work followed a similar pattern in other regions. As apparently highly stratified Early

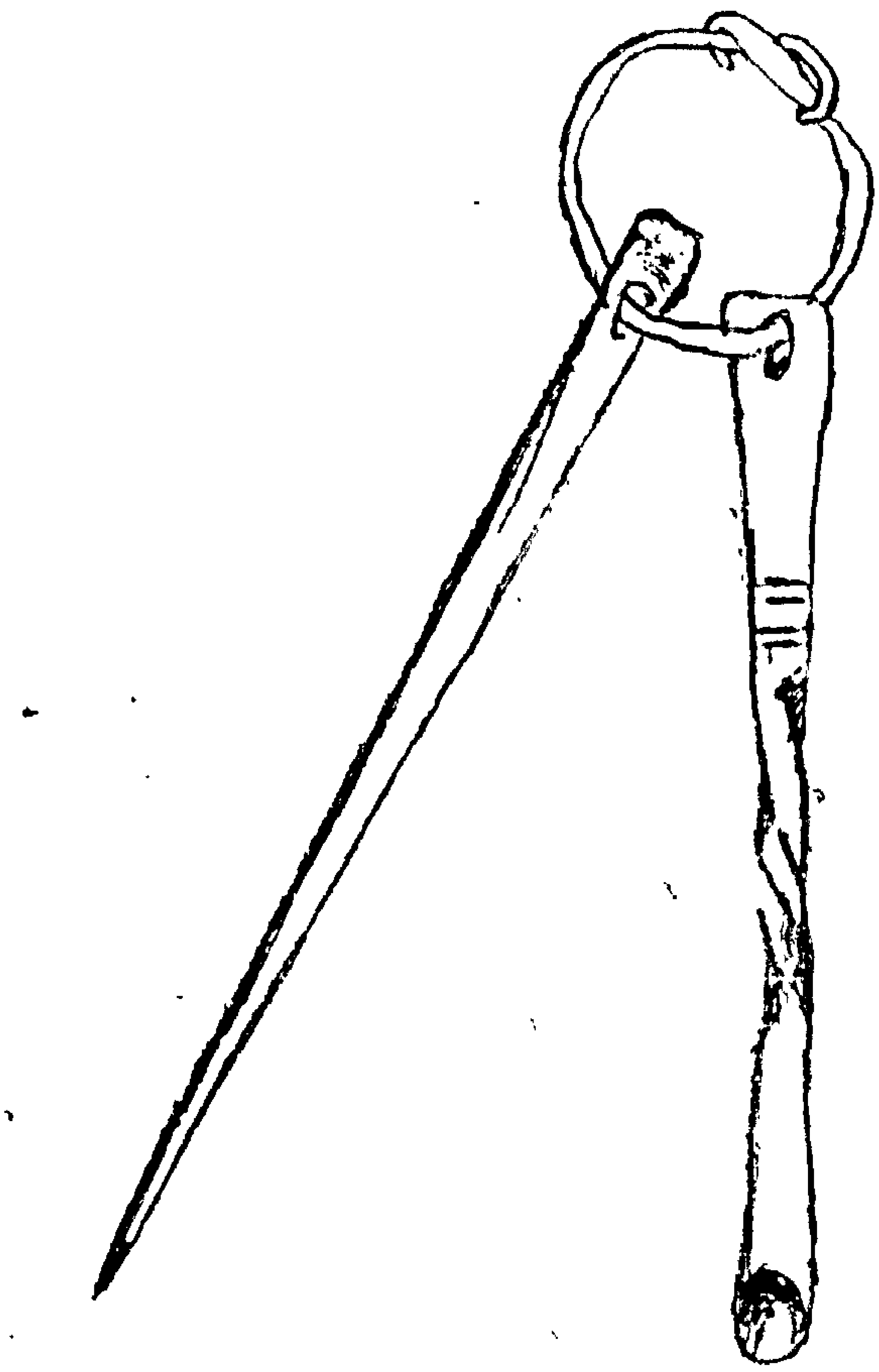
Medieval cemeteries are also present on the continent, examination of the skeletal material from these sites could provide more data for comparison with English sites, particularly where the populations in the English sites are thought to be Continental in origin.

It would also be particularly interesting to apply these techniques of recording multiple indicators of physical activity to skeletal samples of known age, sex and socio-economic status, such as the Spitalfields sample, or other skeletal samples where some of the life history of the individuals is known. Work of this kind could further enhance our understanding of the relationships between age, sex, activity and skeletal changes. A more detailed understanding of skeletal changes in individuals who are known to have specialised in particular activities would also be useful.

In 1997, Waldron wrote that the probability of being able to determine occupation from the skeleton was so remote that "the only sensible thing to do is abandon hope altogether". Although Waldron's cynicism is not entirely unjustified, there is still scope to find evidence for habitual and occupational activity from human skeletal material. In the majority of cases it may not be possible to identify the particular activity or occupation that an individual undertook during life, but I believe the results of this study show that it is possible to identify differences in the levels of activity between populations or sub-samples within populations; we do not need to abandon hope just yet.

The interpretation of activity patterns from skeletal material is beset with problems, many of which originate from the uncertainties surrounding the aetiology of the conditions that are used as markers of activity related stress. In order to reach valid conclusions, it is vital that osteologists make use of the ever-growing pool of clinical data relating to these conditions and changes, and place the skeletal evidence firmly within the context of the available archaeological and historical information. The study of activity patterns and social status in archaeological populations is rather like the riddle quoted at the beginning of this thesis; the clues are there to provide an answer, but they need to be interpreted in the light of all the available information. In the case of the riddle, an understanding of Early Medieval literature, mythology and history can help to provide the answer. When attempting to identify patterns of activity in archaeological populations it is vital to have an understanding of the aetiology of the conditions that are used as markers of activity related stress, to know as much as possible about the age and sex profile of the population under study, and to have an understanding of the activities they might have undertaken. There will always be an element of uncertainty in the conclusions that are drawn; the riddle may have more than one answer, depending upon who reads it, and how. Although the answer is likely to be "a spear", there is no definite solution. Likewise, the inference of activity patterns from skeletal material is highly dependant upon the methods used and the specific changes recorded. While we may be able to identify differences in activity levels, the riddle of *precisely* what people were doing, and *exactly* what burial practices meant will remain unsolved. However, by placing the skeletal data within a sound context provided by archaeological information - the dating evidence, an understanding of the significance of burial practices, cemetery organisation and body deposition, together with the evidence provided by historical sources and comparable sites it is possible to draw meaningful conclusions about the link between social status and physical activity in Early Medieval England.

Appendices and Bibliography



Recording Form

Site: **Skeleton number:**

Age: **Sex:**

Stature:

Asymmetry

Measurements of the humerus:

Measurement (mm)	Left	Right
Length		
M-L diameter		
A-P diameter		
Circumference		

Measurements of the femur:

Measurement (mm)	Left	Right
Length		
M-L diameter		
A-P diameter		
Circumference		

Do not record if only one element is present, or if any trauma to the limb bones is visible or suspected.

Trauma:

List and describe any spinal trauma (incl. clay shoveller's fractures and spondylolysis) and conditions such as non-fusion of the acromion.

Joint Disease:

Joint surface affected	Left	Right
Glenoid fossa		
Proximal humerus		
Distal humerus		
Proximal ulna		
Distal ulna		
Proximal radius		
Distal radius		
Acetabulum		
Femoral head		
Distal femur		
Patella		
Proximal tibia		
Distal tibia		
Proximal fibula		
Distal fibula		

Where P - porosity, OP -osteophytes and E -eburnation. OD - osteochondritis is present, S or SC-subchondral cysts. A blank - no change and N/P - joint surface is not present.

Schmorl's nodes:

Vertebra	Superior surface	Inferior surface
C2	N/A	
C3		
C4		
C5		
C6		
C7		
T1		
T2		
T3		
T4		
T5		
T6		
T7		
T8		
T9		
T10		
T11		
T12		
L1		
L2		
L3		
L4		
L5		
S1		

Where SN -Schmorl's node, a blank -absence of a Schmorl's node and N/P -surface is not present.

Enthesopathies:

Site present but not affected- blank, not present- N/P, bone formation- BF, lytic- L

Clavicle	Left	Right
Costal tuberosity		
Subclavian sulcus		
Conoid tubercle		
Trapeziod line		
Superior surface-T, D, P		

Ulna	Left	Right
Olecranon		
Ulna tuberosity		
Interosseous crest		
Pronator ridge		

Radius	Left	Right
Radial tuberosity		
Interosseous crest		
Oblique line		
Pronator teres insertion		
Dorsal tubercle		

Humerus	Left	Right
Lesser tubercle		
Greater tubercle		
Bicipital groove		
Crest of greater tubercle		
Crest of lesser tubercle		
Deltoid tuberosity		
Lateral epicondyle		
Medial epicondyle		

Femur	Left	Right
Greater trochanter		
Intertrochanteric line		
Trochanteric fossa		
Lesser trochanter		
Quadrate tubercle		
Gluteal tuberosity		
Spiral line		
Linea aspera		
Adductor tubercle		

Patella	Left	Right
Apex		
Proximal margin		
Distal margin		

Tibia	Left	Right
Tibial tuberosity		
Soleal/popliteal line		
Superior fibula		
Interosseous crest		
Fibula notch		

Appendix 2: Osteoarthritis

2.1: Castledyke South

From the total of 86 individuals with a possible total of 2580 joint surfaces, 1348 joints (52%) were sufficiently well preserved to be examined for joint disease, an average of 15.7 joints per individual. 694 of these joints (51%) were from the left side of the body, while 654 joints (49%) were from the right side.

Of the total 1348 joints, 368 joints (27.3%) showed no changes, 150 joints (11.1%) had porosity alone, 336 joints (24.9%) had osteophytes alone, 417 joints (30.9%) had porosity and osteophytes, 34 joints (2.5%) had porosity, osteophytes and eburnation, 9 joints (0.7%) had porosity and eburnation, 4 joints (0.3%) had osteophytes and eburnation, 7 joints (0.5%) had porosity and osteochondritis dissecans (OD), 11 joints (0.8%) had porosity, osteophytes and OD, 7 joints (0.5%) had osteophytes and OD and 5 joints (0.4%) had OD alone. In total 63 individuals (73%) had porosity and osteophytes, of which 27 individuals (31.4% of the total sample) also had eburnation in one or more joints.

From a possible total of 1204 joints from the upper limb, 536 joints (44.5%) were observed; 279 from the left side (52.1% of the total) and 257 (47.9%) from the right side. Of the seven joints that were observed from the left side of the upper limb, 12 individuals had all seven joints present, ten individuals had six joints present, seven individuals had five joints present, seven individuals had four joints present, 14 individuals had three joints present, ten individuals had two joints present and ten individuals had one joint present. On the right side of the upper limb, 11 individuals had all seven joints present, six individuals had six joints, 11 individuals had five joints present, eight individuals had four joints present, nine individuals had three joints present, 11 individuals had two joints and eight individuals had only one joint from the right side of the upper limb. Of these individuals, five individuals had all seven joints present from each side of the upper limb.

From a possible total of 1376 lower limb joints, 812 joints (59%) were examined, of which 415 joints (51.1%) were from the left side and 397 joints (48.9%) were from the right side. Of the eight joints observed from the left side of the lower limb, 11 individuals had all eight joints present, 12 individuals had seven joints present, 12 individuals had six joints present, 15 individuals had five joints present, 11 individuals had four joints present, eight individuals had three joints present, ten individuals had two joints present and five individuals had one joint present. On the right side of the lower limb, seven individuals had eight joints present, 14 individuals had seven joints, eight individuals had six joints present, 14 individuals had five joints present, 20 individuals had four joints present, nine individuals had three joints present, seven individuals had two joints and four individuals had one joint present. Of these individuals, three individuals had all eight joints present from both sides of the lower limb.

Of the 86 individuals examined for the presence of joint disease from Castledyke South, only one individual had all 30 of the joints that were to be examined present. The following tables show the number and percentage of joint surfaces affected from the left and right sides of the upper and lower limbs.

	No. of Joints	No change		?OA		OA	
Left		No.	%	No.	%	No.	%
Glenoid fossa	46	15	**32.6**	11	**23.9**	2	**4.3**
Proximal humerus	44	8	**18.2**	16	**36.4**	1	**2.3**
Distal humerus	44	16	**36.4**	10	**22.7**	0	**0**
Proximal ulna	45	9	**20**	14	**31.1**	1	**2.2**
Distal ulna	20	6	**30**	4	**20**	2	**10**
Proximal radius	40	26	**65**	6	**15**	0	**0**
Distal radius	40	17	**42.5**	9	**22.5**	3	**7.5**
TOTAL	279	97	**35**	70	**25**	9	**3**

Table A2.1a: Joint disease in the left upper limb

Right	No. of Joints	No change		?OA		OA	
		No.	%	No.	%	No.	%
Glenoid fossa	43	12	**27.9**	15	**34.9**	3	**7**
Proximal humerus	35	4	**11.4**	14	**40**	2	**5.7**
Distal humerus	41	11	**26.8**	10	**24.4**	0	**0**
Proximal ulna	45	12	**26.7**	16	**35.6**	1	**2.2**
Distal ulna	23	1	**4.3**	7	**30.4**	4	**17.4**
Proximal radius	38	21	**55.3**	5	**13.2**	1	**2.6**
Distal radius	32	8	**25**	10	**31.3**	2	**6.3**
TOTAL	257	69	**27**	77	**30**	13	**5**

Table A2.1b: Joint disease in the right upper limb

Left	No. of Joints	No change		?OA		OA	
		No.	%	No.	%	No.	%
Acetabulum	71	10	**14.1**	37	**52.1**	3	**4.2**
Femoral head	58	14	**24.1**	22	**37.9**	1	**1.7**
Distal femur	63	11	**17.5**	18	**28.6**	3	**4.8**
Patella	41	9	**22**	15	**36.6**	2	**4.9**
Proximal tibia	53	13	**24.5**	17	**32.1**	3	**5.7**
Distal tibia	58	17	**29.3**	13	**22.4**	1	**1.7**
Proximal fibula	25	14	**56**	2	**8**	0	**0**
Distal fibula	46	20	**43.5**	5	**10.9**	1	**2.2**
TOTAL	415	108	**26**	129	**31**	14	**3.4**

Table A2.1c: Joint disease in the left lower limb

Right	No. of Joints	No change		?OA		OA	
		No.	%	No.	%	No.	%
Acetabulum	68	7	**10.3**	32	**47.1**	4	**5.9**
Femoral head	59	12	**20.3**	22	**37.3**	1	**1.7**
Distal femur	56	14	**25**	21	**37.5**	1	**1.8**
Patella	36	6	**16.7**	16	**44.4**	3	**8.3**
Proximal tibia	55	12	**21.8**	20	**36.4**	1	**1.8**
Distal tibia	59	11	**18.6**	18	**30.5**	1	**1.7**
Proximal fibula	22	14	**63.6**	0	**0**	0	**0**
Distal fibula	42	18	**42.9**	12	**28.6**	0	**0**
TOTAL	397	94	**24**	141	**36**	11	**3**

Table A2.1d: Joint disease in the right lower limb

The following tables show the number (in brackets) and the percentage of joints from the left and right sides of the upper and lower limbs affected with osteoarthritis and possible osteoarthritis, and the percentage and number of individuals affected from each of the burial artefact groups in the skeletal sample from Castledyke South.

	Group 1	Group 2	Group 3	Group 4
L Shoulder	0 (0)	0 (0)	0 (0)	15 (2)
L Elbow	8 (1)	13 (3)	17 (1)	14 (2)
L Wrist	7 (1)	19 (3)	0 (0)	13 (1)
R Shoulder	8 (1)	10 (2)	0 (0)	0 (0)
R Elbow	0 (0)	0 (0)	50 (2)	0 (0)
R Wrist	7 (1)	33 (4)	33 (1)	0 (0)
Sk	16 (4)	27 (9)	25 (2)	20 (4)

Table A2.1e: The number (in brackets) and percentage of joints from the left and right sides of the upper limb from females and males with OA, and the percentage and number of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

	Group 1	Group 2	Group 3	Group 4
L Shoulder	36 (5)	45 (9)	33 (2)	31 (4)
L Elbow	25 (3)	42 (10)	50 (3)	43 (6)
L Wrist	36 (5)	13 (2)	25 (1)	38 (3)
R Shoulder	42 (5)	45 (9)	40 (2)	30 (3)
R Elbow	28 (5)	58 (11)	25 (1)	30 (3)
R Wrist	29 (4)	58 (7)	67 (2)	13 (1)
Sk	44 (11)	52 (17)	50 (4)	40 (8)

Table A2.1f: The number (in brackets) and percentage of joints from the left and right sides of the upper limb from females and males with ?OA and the percentage and number of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

	Group 1	Group 2	Group 3	Group 4
L Hip	5 (1)	4 (1)	0 (0)	5 (1)
L Knee	11 (2)	11 (3)	25 (2)	0 (0)
L Ankle	0 (0)	4 (1)	13 (1)	6 (1)
R Hip	11 (2)	0 (0)	0 (0)	6 (1)
R Knee	12 (2)	4 (1)	13 (1)	6 (1)
R Ankle	0 (0)	0 (0)	0 (0)	7 (1)
Sk	16 (4)	18 (6)	25 (2)	20 (4)

Table A2.1g: The number (in brackets) and percentage of joints from the left and right sides of the lower limb from females and males, and the number and percentage of individuals affected with OA in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 – knives, pins and personal items, dress items and jewellery.

	Group 1	Group 2	Group 3	Group 4
L Hip	64 (14)	50 (13)	63 (5)	53 (10)
L Knee	47 (9)	36 (10)	63 (5)	60 (9)
L Ankle	15 (2)	46 (11)	50 (4)	6 (1)
R Hip	42 (8)	45 (13)	71 (5)	61 (11)
R Knee	47 (8)	36 (10)	50 (4)	56 (9)
R Ankle	11 (2)	34 (10)	63 (5)	60 (9)
Sk	60 (15)	67 (22)	100 (8)	80 (16)

Table A2.1h: The number (in brackets) and percentage of joints from the left and right sides of the lower limb from females and males with ?OA in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

2.2: Norton Mill Lane

From the total sample of 51 individuals, 50 individuals had joint surfaces preserved, the maximum possible number of joint surfaces being 1500. A total of 651 joints were observed, 43% of the possible total, and an average of 13 joint surfaces per individual. 336 (52 %) of these joints were from the left side of the body, while 315 joints (48 %) were from the right side. Of the total 651 joints, 537 (82.5 %) showed no changes, 29 joints (4.5%) had porosity alone, 23 joints (3.5%) showed osteophytes alone, one joint (0.2%) had eburnation alone, 33 joints (5.1%) had porosity and osteophytes, 16 joints (2.5%) had porosity, osteophytes and eburnation, one joint (0.2%) had porosity and eburnation and 11 joints (1.7%) had osteochondritis dissecans. In total 11 individuals (22%) had porosity and osteophytes, and nine individuals (18% of the total sample) had eburnation in one or more joints.

From a possible total of 700 joints from the upper limb, 263 joints (38%) were observed; 144 from the left side (55% of the total) and 119 (45%) from the right side. Of the seven joints that were observed from the left side of the upper limb, five individuals had all seven joints present, six individuals had six joints present, three individuals had five joints present, three individuals had four joints present, nine individuals had three joints present, six individuals had two joints present and six individuals had one joint present. On the right side of the upper limb, one individual had all seven joints present, six individuals had six joints, two individuals had five joints present, four individuals had four joints present, six individuals had three joints present, nine individuals had two joints and eight individuals had only one joint from the right side of the upper limb. Of these individuals, none had all seven joints present from each side of the upper limb.

From a possible total of 800 lower limb joints, 388 joints (49%) were examined, of which 192 joints (49%) were from the left side and196 joints (51%) were from the right side. Of the eight joints observed from the left side of the lower limb, none of the individuals had all eight joints present, four individuals had seven joints present, seven individuals had six joints present, nine individuals had five joints present, 12 individuals had four joints present, five individuals had three joints present, seven individuals had two joints present and six individuals had one joint present. On the right side of the lower limb, none of the individuals had all eight joints present, seven individuals had seven joints, eight individuals had six joints present, three individuals had five joints present, 12 individuals had four joints present, eight individuals had three joints present, nine individuals had two joints and two individuals had one joint present. Of these individuals, none had all eight joints present from both sides of the lower limb, and three had seven joint surfaces present from each side of the lower limb.

Of the 50 individuals examined for the presence of joint disease from Norton Mill Lane, none had all 30 of the joints that were to be examined present. The following tables show the number and percentage of joint surfaces affected from the left and right sides of the upper and lower limbs.

Left	No. of Joints	no change		?OA		OA	
		No.	%	No.	%	No.	%
Glenoid fossa	22	14	**64**	2	**9**	1	**5**
Proximal humerus	17	13	**76**	0	**0**	0	**0**
Distal humerus	22	20	**91**	1	**5**	0	**0**
Proximal ulna	23	19	**83**	2	**9**	0	**0**
Distal ulna	16	12	**75**	3	**19**	0	**0**
Proximal radius	22	19	**86**	1	**5**	1	**5**
Distal radius	22	21	**95**	0	**0**	0	**0**
TOTAL	144	118	**82**	9	**6**	2	**1.4**

Table A2.2a: Joint disease in the left upper limb. ?OA = porosity and osteophytes, OA = porosity, osteophytes and eburnation

Right	No. of Joints	no change		?OA		OA	
		No.	%	No.	%	No.	%
Glenoid fossa	24	19	**79**	3	**13**	1	**4**
Proximal humerus	16	13	**81**	0	**0**	0	**0**
Distal humerus	18	15	**83**	0	**0**	1	**6**
Proximal ulna	21	17	**81**	1	**5**	0	**0**
Distal ulna	9	5	**56**	2	**22**	0	**0**
Proximal radius	18	15	**83**	1	**6**	0	**0**
Distal radius	13	13	**100**	0	**0**	0	**0**
TOTAL	119	97	**82**	7	**6**	2	**1.7**

Table A2.2b: Joint disease in the right upper limb. ?OA = porosity and osteophytes, OA = porosity, osteophytes and eburnation

Left	No. of joints	No change		?OA		OA	
		No.	%	No.	%	No.	%
Acetabulum	35	24	**69**	3	**9**	4	**11**
Femoral head	35	26	**74**	1	**3**	4	**11**
Distal femur	30	23	**77**	1	**3**	0	**0**
Patella	21	19	**90**	1	**5**	1	**5**
Proximal tibia	28	27	**96**	1	**4**	0	**0**
Distal tibia	27	26	**96**	0	**0**	0	**0**
Proximal fibula	3	2	**67**	0	**0**	0	**0**
Distal fibula	13	12	**92**	0	**0**	0	**0**
TOTAL	192	159	**83**	7	**4**	9	**5**

Table A2.2c: Joint disease in the left lower limb. ?OA= porosity and osteophytes, OA = porosity, osteophytes and eburnation

Right	No. of Joints	no change		?OA		OA	
		No.	%	No.	%	No.	%
Acetabulum	35	25	**71**	4	**11**	2	**6**
Femoral head	39	32	**82**	3	**8**	1	**3**
Distal femur	33	28	**85**	1	**3**	1	**3**
Patella	20	15	**75**	2	**10**	1	**5**
Proximal tibia	29	27	**93**	0	**0**	0	**0**
Distal tibia	24	21	**88**	0	**0**	0	**0**
Proximal fibula	4	4	**100**	0	**0**	0	**0**
Distal fibula	12	11	**92**	0	**0**	0	**0**
TOTAL	196	163	**83**	10	**5**	5	**3**

Table A2.2d: Joint disease in the right lower limb. ?OA= porosity and osteophytes, OA= porosity, osteophytes and eburnation

The following tables show the number (in brackets) and the percentage of joints from the left and right sides of the upper and lower limbs affected with osteoarthritis and possible osteoarthritis, and the percentage and number of individuals affected from each of the burial artefact groups in the skeletal sample from Norton Mill Lane.

	Group 1	Group 2	Group 3	Group 4
L Shoulder	0 (0)	0 (0)	17 (1)	0 (0)
L Elbow	0 (0)	10 (1)	14 (1)	0 (0)
L Wrist	0 (0)	0 (0)	0 (0)	0 (0)
R Shoulder	0 (0)	14 (1)	0 (0)	0 (0)
R Elbow	0 (0)	0 (0)	14 (1)	0 (0)
R Wrist	0 (0)	0 (0)	0 (0)	0 (0)
Sk	0 (0)	1 (7)	2 (25)	0 (0)

Table A2.2e: The number (in brackets) and percentage of joints from the left and right sides of the upper limb from females and males with OA and the number and percentage of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

	Group 1	Group 2	Group 3	Group 4
L Shoulder	0 (0)	22 (2)	0 (0)	0 (0)
L Elbow	0 (0)	20 (2)	14 (1)	0 (0)
L Wrist	0 (0)	13 (1)	40 (2)	0 (0)
R Shoulder	0 (0)	29 (2)	17 (1)	0 (0)
R Elbow	0 (0)	11 (1)	14 (1)	0 (0)
R Wrist	0 (0)	0 (0)	67 (2)	0 (0)
Sk	0 (0)	14 (2)	38 (3)	0 (0)

Table A2.2f: The number (in brackets) and percentage of joints from the left and right sides of the upper limb from females and males with ?OA and the number and percentage of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

	Group 1	Group 2	Group 3	Group 4
L Hip	20 (1)	0 (0)	33 (2)	6 (1)
L Knee	0 (0)	0 (0)	0 (0)	6 (1)
L Ankle	0 (0)	0 (0)	0 (0)	0 (0)
R Hip	25 (1)	0 (0)	0 (0)	5 (1)
R Knee	0 (0)	0 (0)	0 (0)	6 (1)
R Ankle	0 (0)	0 (0)	0 (0)	0 (0)
Sk	20 (1)	0 (0)	25 (2)	10 (2)

Table A2.2g: The number (in brackets) and percentage of joints from the left and right sides of the lower limb from females and males with OA, and the number and percentage of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

	Group 1	Group 2	Group 3	Group 4
L Hip	0 (0)	8 (1)	17 (1)	6 (1)
L Knee	0 (0)	20 (2)	0 (0)	0 (0)
L Ankle	0 (0)	0 (0)	0 (0)	0 (0)
R Hip	0 (0)	8 (1)	40 (2)	11 (2)
R Knee	0 (0)	20 (2)	0 (0)	0 (0)
R Ankle	0 (0)	0 (0)	0 (0)	0 (0)
Sk	20 (1)	7 (1)	38 (3)	10 (2)

Table A2.2h: The number (in brackets) and percentage of joints from the left and right sides of the lower limb from females and males with ?OA and the number and percentage of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

2.3: Bamburgh

From the total of 40 individuals with a possible total of 1200 major appendicular joint surfaces, 810 joints (67.5%) were sufficiently well preserved to be examined for joint disease, an average of 20.25 joints per individual. Of these, 410 joints (50.4%) were from the left side of the body, while 400 joints (49.6%) were from the right side.

Of the total 810 joints, 238 joints (29.4%) showed no changes, 158 joints (19.5%) had porosity alone, 83 joints (10.2%) had osteophytes alone, 286 joints (35.3%) had porosity and osteophytes, 33 joints (4.1%) had porosity, osteophytes and eburnation, three joints (0.4%) had porosity and osteochondritis dissecans (OD), six joints (0.7%) had porosity, osteophytes and OD, one joint (0.1%) had osteophytes and OD and two joints (0.2%) had OD alone. In total 30 individuals (75%) had porosity and osteophytes, of which 10 individuals (25% of the total sample) also had eburnation in one or more joints.

From a possible total of 546 joints from the upper limb, 395 joints (72.3%) were observed; 199 from the left side (50.4% of the total) and 196 (49.6%) from the right side. Of the seven joints from the left side of upper limb that were examined in this study, 14 individuals had all seven joints present, nine individuals had six of the joints present, five individuals had five joints present, two individuals had four joints, six individuals has two joints present and two individuals had one joint. From the right side of the upper limb, 12 individuals had all seven joints present; ten individuals had six joints present, four individuals had five joints present, five individuals had four joints present, three individuals had three joints present, one individual had two joints present and one individual had one joint present. Of these individuals, nine had all 14 joints from both sides of the upper limb present.

From a possible total of 640 lower limb joints, 415 joints (64.8%) were examined, of which 211 joints (50.8%) were from the left side and 204 joints (49.2%) were from the right side. Of the total of eight joints that were observed from the left side of the lower limb, seven individuals had all eight joints present, eight individuals had seven joints present, four individuals had six joints present, ten individuals had five joints present, two individuals had four joints present, two individuals had three joints present, five individuals had two joints present and one individual had one joint from the left side present. From the right side of the lower limb, two individuals had all eight joints present, thirteen individuals had seven joints present, eight individuals had six joints present, two individuals had five joints present, five individuals had four joints present, three individuals had three joints present and five individuals had two joints present. Of these individuals, only one individual had all 16 joints from the lower limb present for observation.

Of the 40 individuals from the Bamburgh sample, only one individual had all 30 joints present. The following tables show the number and percentage of joint surfaces affected from the left and right sides of the upper and lower limbs.

	No. of joints	No change		?OA		OA	
Left		No.	%	No.	%	No.	%
Glenoid fossa	30	5	**16.7**	13	**43.3**	1	**3.3**
Proximal humerus	25	8	**32**	4	**16**	2	**8**
Distal humerus	31	9	**29**	6	**19.4**	2	**6.5**
Proximal ulna	32	10	**31.3**	13	**40.6**	0	**0**
Distal ulna	27	8	**29.6**	8	**29.6**	1	**3.7**
Proximal radius	32	10	**31.3**	6	**18.8**	2	**6.3**
Distal radius	29	8	**27.6**	10	**34.5**	0	**0**
TOTAL	206	58	**28**	60	**29**	8	**4**

Table A2.3a: Joint disease in the left upper limb. ?OA = porosity and osteophytes, OA = porosity, osteophytes and eburnation

	No. of joints	No change		?OA		OA	
Right		No.	%	No.	%	No.	%
Glenoid fossa	30	4	**13.3**	13	**43.3**	1	**3.3**
Proximal humerus	22	8	**36.4**	7	**31.8**	2	**9.1**
Distal humerus	29	9	**31**	9	**31**	1	**3.4**
Proximal ulna	34	11	**32.4**	16	**47.1**	1	**2.9**
Distal ulna	26	9	**34.6**	9	**34.6**	2	**7.7**
Proximal radius	31	7	**22.6**	8	**25.8**	3	**9.7**
Distal radius	31	9	**29**	11	**35.5**	2	**6.5**
TOTAL	203	57	**28**	73	**36**	12	**6**

Table A2.3b: Joint disease in the right upper limb ?OA = porosity and osteophytes, OA = porosity, osteophytes and eburnation

Left	No. of joints	No change		?OA		OA	
		No.	%	No.	%	No.	%
Acetabulum	35	6	**17.1**	21	**60**	0	**0**
Femoral head	33	6	**18**	12	**36**	0	**0**
Distal femur	30	7	**23**	11	**36.7**	3	**10.0**
Patella	26	6	**23.1**	10	**38.5**	1	**4**
Proximal tibia	28	10	**35.7**	9	**32.1**	1	**3.6**
Distal tibia	30	12	**40**	7	**23.3**	0	**0**
Proximal fibula	8	2	**25**	2	**25**	0	**0**
Distal fibula	21	11	**52.4**	5	**23.8**	0	**0**
TOTAL	211	60	**28**	77	**36**	5	**2**

Table A2.3c: Joint disease in the left lower limb ?OA = porosity and osteophytes, OA = porosity, osteophytes and eburnation

Right	No. of joints	No change		?OA		OA	
		No.	%	No.	%	No.	%
Acetabulum	34	4	**11.8**	16	**47.1**	1	**2.9**
Femoral head	34	6	**17.6**	15	**44.1**	0	**0**
Distal femur	29	11	**37.9**	8	**27.6**	3	**10.3**
Patella	28	8	**28.6**	11	**39.3**	2	**7.1**
Proximal tibia	26	10	**38.5**	10	**38.5**	2	**7.7**
Distal tibia	27	10	**37**	10	**37**	0	**0**
Proximal fibula	5	4	**80**	1	**20**	0	**0**
Distal fibula	21	10	**47.6**	5	**23.8**	0	**0**
TOTAL	204	63	**31**	76	**37**	8	**4**

Table A2.3d: Joint disease in the right lower limb ?OA = porosity and osteophytes, OA = porosity, osteophytes and eburnation

The following tables show the number (in brackets) and the percentage of joints from the left and right sides of the upper and lower limbs affected with osteoarthritis and possible osteoarthritis, and the percentage and number of individuals affected from each of the burial artefact groups in the skeletal sample from Bamburgh.

	Group A	Group B	Group C	Group D
L Shoulder	0 (0)	14 (1)	0 (0)	33 (1)
L Elbow	17 (3)	17 (1)	33 (2)	17 (1)
L Wrist	0 (0)	17 (1)	0 (0)	0 (0)
R Shoulder	0 (0)	14 (1)	0 (0)	25 (1)
R Elbow	18 (3)	14 (1)	0 (0)	0 (0)
R Wrist	18 (3)	0 (0)	0 (0)	33 (1)
Sk	29 (6)	14 (1)	33 (2)	17 (1)

Table A2.3e: The number (in brackets) and percentage of joints from the left and right sides of the upper limb from females and males with OA and the number and percentage of individuals affected in each of the artefact groups. Group A - no artefacts, Group B – single animal bone, tooth or shells, Group C –multiple animal bones, Group D – Multiple iron objects.

	Group A	Group B	Group C	Group D
L Shoulder	35 (6)	29 (2)	80 (4)	67 (2)
L Elbow	44 (8)	50 (3)	67 (4)	17 (1)
L Wrist	53 (9)	17 (1)	50 (3)	50 (1)
R Shoulder	67 (10)	0 (0)	50 (2)	75 (3)
R Elbow	71 (12)	29 (2)	67 (4)	25 (1)
R Wrist	59 (10)	0 (0)	83 (5)	67 (2)
Sk	57 (12)	43 (3)	83 (5)	83 (5)

Table A2.3f: The number (in brackets) and percentage of joints from the left and right sides of the upper limb from females and males with ?OA and the number and percentage of individuals affected in each of the artefact groups.. Group A - no artefacts, Group B – single animal bone, tooth or shells, Group C –multiple animal bones, Group D – Multiple iron objects.

	Group A	Group B	Group C	Group D
L Hip	0 (0)	0 (0)	0 (0)	0 (0)
L Knee	12 (2)	0 (0)	0 (0)	25 (1)
L Ankle	0 (0)	0 (0)	0 (0)	0 (0)
R Hip	5 (1)	0 (0)	0 (0)	0 (0)
R Knee	6 (1)	14 (1)	0 (0)	50 (2)
R Ankle	0 (0)	0 (0)	0 (0)	0 (0)
Sk	14 (3)	14 (1)	0 (0)	33 (2)

Table A2.3g: The number (in brackets) and percentage of joints from the left and right sides of the lower limb from females and males with OA in each of the artefact groups. Group A - no artefacts, Group B – single animal bone, tooth or shells, Group C –multiple animal bones, Group D – Multiple iron objects.

	Group 1	Group 2	Group 3	Group 4
L Hip	61 (11)	29 (2)	67 (4)	80 (4)
L Knee	53 (9)	57 (4)	50 (3)	50 (2)
L Ankle	25 (4)	50 (2)	50 (3)	50 (2)
R Hip	58 (11)	29 (2)	67 (4)	60 (3)
R Knee	47 (8)	43 (3)	67 (4)	75 (1)
R Ankle	43 (6)	40 (2)	40 (2)	33 (1)
Sk	71 (15)	57 (4)	83 (5)	83 (5)

Table A2.3h: The number (in brackets) and percentage of joints from the left and right sides of the lower limb from females and males with ?OA in each of the artefact groups.. Group A - no artefacts, Group B – single animal bone, tooth or shells, Group C –multiple animal bones, Group D – Multiple iron objects.

2.4: Norton Bishopsmill

From the total sample of 40 individuals with a possible total of 1200 major appendicular joint surfaces, 615 joints (51%) were sufficiently well preserved to be examined for joint disease, an average of 15 joints per individual. 314 of these joints (51%) were from the left side of the body, while 301 joints (49%) were from the right side. From a possible total of 560 joints from the upper limb, 220 joints (39%) were observed; 121 from the left side (55% of the total) and 99 (45%) from the right side. Of the seven joints from the left side of upper limb that were examined in this study, five individuals had all seven joints present, two individuals had six of the joints present, five individuals had five joints present, six individuals had four joints, three individuals had three joint surfaces present, five individuals has two joints present and six individuals had one joint. From the right side of the upper limb, four individuals had all seven joint surfaces present, seven individuals had five joints present, two individuals had four joints present, three individuals had three joints present, five individuals had two joints present and nine individuals had one joint present. Of these individuals, three had all 14 joints from both sides of the upper limb present.

From a possible total of 640 lower limb joints, 395 joints (62%) were examined, of which 193 joints (49%) were from the left side and 202 joints (51%) were from the right side. Of the total of eight joints that were observed from the left side of the lower limb, two individuals had all eight joints present, three individuals had seven joints present, 13 individuals had six joints present, seven individuals had five joints present, six individuals had four joints present, four individuals had three joints present, three individuals had two joints present and one individual had one joint from the left side present. From the right side of the lower limb, four individuals had all eight joints present, eight individuals had seven joints present, five individuals had six joints present, ten individuals had five joints present, three individuals had four joints present, five individuals had three joints present, three individuals had two joints present and one individual had one joint surface present. Of these individuals, none had all 16 joints from the lower limb present for observation.

From the total of 615 joints observed, 382 (62.1%) joints showed no changes, 83 joints (14%) had porosity alone, 49 joints (8%) had osteophytes alone, 74 joints

(12%) had porosity and osteophytes, and 21 joints (3.4%) had porosity, osteophytes and eburnation. In total 19 individuals (46%) had porosity and osteophytes, of which 9 individuals (23% of the total sample) also had eburnation in one or more joints. The following tables show the number and percentage of joint surfaces affected from the left and right sides of the upper and lower limbs.

Left	no. of Joints	no change		?OA		OA	
		no.	%	no.	%	no.	%
Glenoid fossa	18	13	**72**	1	**5.6**	0	**0**
Proximal humerus	16	11	**68.8**	1	**6.3**	0	**0**
Distal humerus	16	12	**75**	2	**12.5**	1	**6.3**
Proximal ulna	25	17	**68**	5	**20**	0	**0**
Distal ulna	11	6	**54.4**	1	**9.1**	1	**9.1**
Proximal radius	17	12	**70.6**	0	**0**	1	**5.9**
Distal radius	18	14	**77.8**	2	**11.1**	0	**0**
TOTAL	121	85	**70**	12	**10**	3	**2**

Table A2.4a: Joint disease in the left upper limb: ?OA = porosity and osteophytes, OA = Porosity, osteophytes and eburnation

Right	no. of Joints	no change		?OA		OA	
		no.	%	no.	%	no.	%
Glenoid fossa	11	7	**63.6**	3	**27.3**	0	**0**
Proximal humerus	14	9	**64.3**	3	**21.4**	0	**0**
Distal humerus	16	8	**50**	2	**12.5**	2	**12.5**
Proximal ulna	20	8	**40**	7	**35**	0	**0**
Distal ulna	9	3	**33.3**	2	**22.2**	2	**22.2**
Proximal radius	14	8	**57.1**	1	**7.1**	1	**7.1**
Distal radius	15	9	**60**	2	**13.3**	1	**6.7**
TOTAL	99	52	**52**	10	**10**	6	**6**

Table A2.4b: Joint disease in the right upper limb: ?OA = porosity and osteophytes, OA = Porosity, osteophytes and eburnation

Left	no. of Joints	no change		?OA		OA	
		no.	%	no.	%	no.	%
Acetabulum	29	12	**41.4**	6	**20.7**	3	**10.3**
Femoral head	34	21	**61.8**	4	**11.8**	1	**2.9**
Distal femur	30	17	**56.7**	3	**10**	0	**0**
Patella	15	6	**40**	4	**26.7**	0	**0**
Proximal tibia	27	17	**63**	3	**11.1**	0	**0**
Distal tibia	30	23	**76.7**	1	**3.3**	0	**0**
Proximal fibula	7	6	**85.7**	0	**0**	0	**0**
Distal fibula	21	19	**90.5**	0	**0**	0	**0**
TOTAL	193	121	**63**	21	**11**	4	**2**

Table A2.4c: Joint disease in the left lower limb: ?OA = porosity and osteophytes, OA = Porosity, osteophytes and eburnation

Right	no. of Joints	no change		?OA		OA	
		no.	%	no.	%	no.	%
Acetabulum	31	16	**51.6**	6	**19.4**	3	**9.7**
Femoral head	34	19	**55.9**	4	**11.8**	2	**5.9**
Distal femur	31	15	**48.4**	6	**19.4**	3	**9.7**
Patella	18	8	**44.4**	3	**16.7**	3	**16.7**
Proximal tibia	27	17	**63**	1	**3.7**	1	**3.7**
Distal tibia	30	22	**73.3**	1	**3.3**	0	**0**
Proximal fibula	9	8	**88.9**	0	**0**	0	**0**
Distal fibula	22	19	**86.4**	0	**0**	0	**0**
TOTAL	202	124	**61**	21	**10**	12	**6**

Table 4.3.4d: Joint disease in the right lower limb: ?OA = porosity and osteophytes, OA = Porosity, osteophytes and eburnation

The following tables show the number (in brackets) and the percentage of joints from the left and right sides of the upper and lower limbs affected with osteoarthritis and possible osteoarthritis, and the percentage and number of individuals affected from each of the burial artefact groups in the skeletal sample from Norton Bishopsmill.

	Group A	Group B +C	Group D
L Shoulder	0 (0)	0 (0)	0 (0)
L Elbow	5 (1)	0 (0)	0 (0)
L Wrist	8 (1)	0 (0)	0 (0)
R Shoulder	0 (0)	0 (0)	0 (0)
R Elbow	8 (1)	25 (1)	20 (1)
R Wrist	18 (2)	100 (1)	0 (0)
Sk	12 (3)	13 (1)	14 (1)

Table A2.4e: The number (in brackets) and percentage of joints from the left and right sides of the upper limb from females and males with OA and the number and percentage of individuals affected in each of the artefact groups. Group A – no artefacts, Group B – animal bones or teeth, Group C – Pottery, worked stone or flint, Group D – iron objects or coffin fittings.

	Group A	Group B +C	Group D
L Shoulder	7 (1)	50 (1)	0 (0)
L Elbow	21 (4)	0 (0)	33 (2)
L Wrist	8 (1)	100 (1)	20 (1)
R Shoulder	9 (1)	50 (1)	50 (2)
R Elbow	31 (4)	25 (1)	40 (2)
R Wrist	27 (3)	0 (0)	0 (0)
Sk	28 (7)	38 (3)	43 (3)

Table A2.4f: The number (in brackets) and percentage of joints from the left and right sides of the upper limb3from females and males with ?OA and the number and percentage of individuals affected in each of the artefact groups. Group A – no artefacts, Group B – animal bones or teeth, Group C – Pottery, worked stone or flint, Group D – iron objects or coffin fittings.

	Group A	Group B +C	Group D
L Hip	5 (1)	14 (1)	14 (1)
L Knee	0 (0)	0 (0)	0 (0)
L Ankle	0 (0)	0 (0)	0 (0)
R Hip	4 (1)	33 (2)	0 (0)
R Knee	15 (3)	14 (1)	0 (0)
R Ankle	0 (0)	0 (0)	0 (0)
Sk	16 (4)	25 (2)	14 (1)

Table A2.4g: The number (in brackets) and percentage of joints from the left and right sides of the lower limb from females and males with OA and the number and percentage of individuals affected in each of the artefact groups. Group A – no artefacts, Group B – animal bones or teeth, Group C – Pottery, worked stone or flint, Group D – iron objects or coffin fittings.

	Group A	Group B +C	Group D
L Hip	18 (4)	14 (1)	43 (3)
L Knee	23 (5)	14 (1)	17 (1)
L Ankle	5 (1)	0 (0)	0 (0)
R Hip	17 (4)	0 (0)	29 (2)
R Knee	25 (5)	29 (2)	33 (2)
R Ankle	5 (1)	0 (0)	0 (0)
Sk	32 (8)	25 (2)	57 (4)

Table A2.4h: The number (in brackets) and percentage of joints from the left and right sides of the lower limb from females and males with ?OA and the number and percentage of individuals affected in each of the artefact groups. Group A – no artefacts, Group B – animal bones or teeth, Group C – Pottery, worked stone or flint, Group D – iron objects or coffin fittings.

Appendix 3: Enthesopathy

3.1: Castledyke South

The 82 individuals which could be sexed from Castledyke South had a possible total of 6395 entheses, of which 3458 entheses (54%) were sufficiently well preserved to be examined for changes, an average of 42 entheses per individual, from a possible total of 78 per individual. 1750 of these entheses (51%) were from the left side of the body, while 1708 entheses (49%) were from the right side. Of the total 3458 entheses observed, 1293 (37.4%) showed no changes, 1563 (45.2%) had some bone formation or robusticity (possible enthesopathies- ?Enth), and 602 entheses (17.4%) had robust bone formation, lytic changes or both (enthesopathies - Enth).

From a possible total of 3607 entheses from the upper limb, 1848 sites of muscle or ligament attachment (51%) were observed; 934 from the left side (51% of the total) and 914 (49%) from the right side. Of the 22 entheses observed from the left side of the upper limb, four individuals had all 22 entheses present, two individuals had 21 entheses, three individuals had 20 entheses, seven individuals had 19 entheses present, nine individuals had 18 entheses present, one individual had 17 entheses, two individuals had 16 entheses, two individuals had 15 entheses, two individuals had 14 entheses present, three individuals had 13 entheses, four individuals had 12 entheses, seven individuals had 11 entheses, three individuals had ten entheses, six individuals had nine entheses, five individuals had eight entheses, two individuals had seven entheses, two individuals had six entheses present, three individuals had five entheses, four individuals had four entheses, two individuals had three entheses present, one individual had two entheses and four individuals had one enthesis from the left side of the upper limb. Of the 22 entheses from the right side of the upper limb, three individuals had all 22 entheses present, five individuals had 21 entheses, three individuals had 20 entheses, three individuals had 19 entheses present, four individuals had 18 entheses present, three individuals had 17 entheses, two individuals had 16 entheses, three individuals had 15 entheses, ten individuals had 14 entheses present, three individuals had 13 entheses, three individuals had 12 entheses, three individuals had 11 entheses, three individuals had ten entheses, seven individuals had nine entheses, two individuals had eight entheses, four individuals had seven entheses, five individuals had six entheses present, two individuals had five entheses, three individuals had four entheses, two individuals had two entheses present and three individuals had one enthesis from the right side of the upper limb. Of these individuals, only one had all 44 entheses present from both sides of the upper limb. 77% of the individuals had possible enthesopathies in upper limb, and 33% had enthesopathies.

From a possible total of 2788 lower limb entheses, 1610 sites (58%) were examined, of which 816 (51%) were from the left side and 794 (49%) were from the right side. Of the 17 entheses observed from the left side of the lower limb, six individuals had all 17 entheses present, five individuals had 16 entheses, four individuals had 15 entheses, seven individuals had 14 entheses present, eight individuals had 13 entheses, five individuals had 12 entheses, nine individuals had 11 entheses, four individuals had ten entheses, eight individuals had nine entheses, three individuals had eight entheses, five individuals had seven entheses, four individuals had six entheses present, four individuals had five entheses, two individuals had four entheses, two individuals had three entheses present and two individuals had two entheses from the left side of the lower limb. Of the 17 entheses observed from the right side of the lower limb, six individuals had all 17 entheses present, two individuals had 16 entheses, eight individuals had 15 entheses, four individuals had 14 entheses present, four individuals had 13 entheses, three individuals had 12 entheses, six individuals had 11 entheses, 11 individuals had ten entheses, six individuals had nine entheses, seven individuals had eight entheses, eight individuals had seven entheses, four individuals had six entheses present, seven individuals had five entheses, two individuals had four entheses, one individual had three entheses present and one individual had one enthesis present from the right side of the lower limb. Of these individuals, only one had all 34 entheses from both sides of the lower limb. 66% of the individuals examined had possible enthesopathies in the lower limb and 20% had enthesopathies.

The following tables show the number and percentage of entheses groups affected from the left and right sides of the upper and lower limbs.

Left	Number	Possible Enthesopathy no.	%	Enthesopathy no.	%
Clavicle	187	89	**48.**	29	**16**
Humerus flex/ ext	273	113	**41**	57	**21**
Forearm flex/ ext	126	60	**48**	22	**17**
Pronators/ supinators	210	92	**44**	25	**12**
Hand flex / ext	73	24	**33**	2	**3**
TOTAL	869	378	**43**	135	**16**

Table A3.1a: Number of entheses groups present in the left elements of the upper limb in the Castledyke sample, and the number and percentage of possible enthesopathies and enthesopathies.

Right	Number	Possible Enthesopathy no.	%	Enthesopathy no.	%
Clavicle	173	90	**52**	36	**21**
Humerus flex / ext	242	90	**37**	73	**30**
Forearm flex / ext	115	63	**55**	27	**23**
Pronators/ supinators	219	111	**51**	40	**18**
Hand Flex/ ext	88	31	**35**	5	**6**
TOTAL	837	385	**46**	181	**22**

Table A3.1b: Number of entheses groups present in the right elements of the upper limb in the Castledyke sample, and the number and percentage of possible enthesopathies and enthesopathies.

Left	Number	Possible Enthesopathy no.	%	Enthesopathy no.	%
Gluteus /adductor	89	45	**51**	13	**15**
Hip rotators	116	62	**53**	11	**9**
Flexors /extensors	239	120	**50**	57	**24**
Quadriceps	160	65	**41**	8	**5**
Foot Flexors	110	47	**43**	16	**15**
Interosseous	121	47	**39**	3	**2**
TOTAL	835	386	**46**	108	**13**

Table A3.1c: Number of entheses groups present in the left elements of the lower limb from Castledyke South, and the number and percentage of possible enthesopathies and enthesopathies.

Right	Number	Possible Enthesopathy		Enthesopathy	
		no.	%	no.	%
Gluteus /adductor	85	38	**45**	14	**16**
Hip rotators	117	52	**44**	16	**14**
Flexors /extensors	228	97	**43**	74	**32**
Quadriceps	153	41	**27**	14	**9**
Foot Flexors	106	42	**40**	17	**16**
Interosseous	122	68	**56**	4	**3**
TOTAL	811	338	**42**	139	**17**

Table 4.4.1d: Number of entheses present in the right elements of the lower limb from Castledyke South, and the number and percentage of possible enthesopathies and enthesopathies.

The following tables show the number (in brackets) and the percentage of enthesis groups from the left and right sides of the upper and lower limbs affected with enthesopathies and possible enthesopathies, and the percentage and number of individuals affected from each of the burial artefact groups in the skeletal sample from Castledyke South.

	Group 1	Group 2	Group 3	Group 4
L Clavicle	15 (8)	27 (18)	0 (0)	6 (3)
L Humerus flex / ext	21 (13)	18 (16)	46 (11)	24 (17)
L Forearm flex / ext	27 (7)	13 (7)	19 (3)	17 (5)
L Pronator / supinator	13 (7)	8 (7)	23 (5)	12 (6)
L Hand flex / ext	0 (0)	4 (1)	14 (1)	0 (0)
R Clavicle	29 (17)	22 (14)	0 (0)	10 (5)
R Humerus flex / ext	40 (27)	30 (26)	41 (7)	26 (13)
R Forearm flex / ext	23 (9)	18 (8)	36 (4)	30 (6)
R Pronator/ supinator	14 (11)	21 (18)	19 (3)	19 (8)
R Hand flex / ext	3 (1)	9 (3)	14 (1)	0 (0)
Sk affected	68 (17)	76 (25)	63 (5)	75 (15)

Table A3.1e: The number (in brackets) and percentage of entheses from the left and right sides of the upper limb from females and males with enthesopathies, and the number and percentage of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

	Group 1	Group 2	Group 3	Group 4
L Clavicle	52 (28)	41 (27)	46 (6)	52 (28)
L Humerus flex / ext	51 (32)	48 (42)	38 (9)	43 (30)
L Forearm flex / ext	50 (13)	48 (26)	56 (9)	40 (12)
L Pronator / supinator	36 (20)	50 (42)	41 (9)	43 (21)
L Hand flex / ext	24 (6)	31 (8)	29 (2)	53 (8)
R Clavicle	45 (26)	22 (35)	50 (2)	56 (27)
R Humerus flex / ext	40 (27)	30 (36)	29 (5)	44 (22)
R Forearm flex / ext	68 (27)	18 (25)	27 (3)	40 (8)
R Pronator/ supinator	53 (40)	21 (40)	50 (8)	53 (23)
R Hand flex / ext	34 (11)	9 (12)	14 (1)	44 (7)
Sk affected	92 (23)	91 (30)	100 (8)	95 (19)

Table A31f: The number (in brackets) and percentage of entheses from the left and right sides of the upper limb from females and males with possible enthesopathies and the number and percentage of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

	Group 1	Group 2	Group 3	Group 4
L Gluteus/ adductor	10 (3)	13 (4)	27 (3)	18 (3)
L Hip rotators	10 (4)	6 (3)	9 (1)	16 (3)
L Femur Flex /ext	24 (18)	19 (18)	33 (9)	29 (12)
L Quadriceps	0 (0)	9 (6)	11 (2)	0 (0)
L Foot flexors	10 (3)	20 (8)	29 (4)	4 (1)
L Tibia interosseous	6 (2)	2 (1)	0 (0)	0 (0)
R Gluteus/ adductor	19 (4)	23 (4)	20 (2)	17 (4)
R Hip rotators	22 (7)	7 (3)	9 (1)	16 (5)
R Femur Flex /ext	34 (22)	30 (27)	33 (7)	34 (18)
R Quadriceps	8 (3)	13 (7)	9 (2)	5 (2)
R Foot flexors	12 (3)	17 (7)	33 (5)	8 (2)
R Tibia interosseous	7 (2)	2 (1)	6 (1)	0(0)
Sk affected	68 (17)	73 (24)	88 (7)	70 (14)

Table A3.1g: The number (in brackets) and percentage of enthesopathies from the left and right sides of the lower limb, and the number and percentage of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

	Group 1	Group 2	Group 3	Group 4
L Gluteus/ adductor	60 (18)	52 (16)	45 (5)	35 (6)
L Hip rotators	51 (20)	49 (23)	64 (7)	63 (12)
L Femur Flex /ext	47 (35)	54 (52)	33 (9)	59 (24)
L Quadriceps	49 (18)	38 (25)	58 (11)	29 (11)
L Foot flexors	50 (15)	40 (16)	43 (6)	38 (10)
L Tibia interosseous	32 (10)	40 (19)	44 (7)	41 (11)
R Gluteus/ adductor	43 (9)	47 (14)	30 (3)	50 (12)
R Hip rotators	47 (15)	42 (18)	45 (5)	45 (14)
R Femur Flex /ext	42 (27)	45 (40)	38 (8)	42 (22)
R Quadriceps	11 (4)	22 (12)	39 (9)	41 (16)
R Foot flexors	40 (10)	38 (16)	27 (4)	50 (12)
R Tibia interosseous	52 (15)	52 (25)	63 (10)	62 (18)
Sk affected	88 (22)	94 (31)	100 (8)	90 (18)

Table A3.1g: The number (in brackets) and percentage of possible enthesopathies from the left and right sides of the lower limb, and the number and percentage of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

3.2: Norton Mill Lane

Of the 48 individuals which could be sexed, with a possible total of 3744 entheses, 2444 entheses (65%) were sufficiently well preserved to be examined for changes; an average of 50 entheses per individual, from a possible total of 78 per individual. 1239 of these entheses (51%) were from the left side of the body, while 1205 entheses (49%) were from the right side. Of the total 2444 entheses observed, 1721 (70%) showed no changes, 538 (22%) had some bone formation or robusticity (possible enthesopathy - ?Enth), and 185 entheses (8%) had robust bone formation, lytic changes or both (enthesopathy - Enth).

From a possible total of 2112 entheses from the upper limb, 1228 entheses (58%) were observed; 624 were from the left side (51% of the total) and 604 (49%) were from the right side. Of the 22 entheses observed from the left side of the upper limb, 13 individuals had all 22 entheses present, one individual had 20 entheses, one individual had 19 entheses present, eight individuals had 17 entheses, one individual had 15 entheses, three individuals had 14 entheses present, five individuals had 13 entheses, two individuals had 12 entheses, one individuals had eight entheses, one individual had seven entheses, two individuals had six entheses present and one individual had five entheses from the left side of the upper limb. Of the 22 entheses from the right side of the upper limb, 13 individuals had all 22 entheses present, one individual had 20 entheses, one individual had 19 entheses present, six individuals had 17 entheses, one individual had 16 entheses, two individuals had 15 entheses, two individuals had 14 entheses present, one individual had 13 entheses, two individuals had 12 entheses, one individual had 11 entheses, one individual had ten entheses, three individuals had eight entheses, two individuals had seven entheses, two individuals had six entheses present and two individuals had five entheses from the right side of the upper limb. Of these individuals, eight had all 44 entheses present from both sides of the upper limb. 19% of the individuals examined had enthesopathies and 48% had possible enthesopathies in the upper limb.

From a possible total of 1632 lower limb entheses, 1216 sites (74%) were examined, of which 615 (51%) were from the left side and 589 (49%) were from the right side. Of the 17 entheses observed from the left side of the lower limb, 13 individuals had all 17 entheses present, one individual had 16 entheses, 16 individuals had 14 entheses present, one individual had 13 entheses, seven individuals had 12 entheses, one individual had ten entheses, seven individuals had nine entheses, one individual had five entheses and one individual had two entheses from the left side of the lower limb. Of the 17 entheses observed from the right side of the lower limb, 14 individuals had all 17 entheses present, one individual had 16 entheses, 13 individuals had 14 entheses present, two individuals had 13 entheses, four individuals had 12 entheses, one individual had 11 entheses, seven individuals had nine entheses, one individual had eight entheses, three individuals had five entheses and two individuals had three entheses present from the right side of the lower limb. Of these individuals, ten had all 34 entheses from both sides of the lower limb. Two percent of the individuals examined had enthesopathies in the lower limb, and 42% had possible enthesopathies. From the 51 individuals examined, one had all 78 entheses present for observation.

The following tables show the number and percentage of entheses groups affected from the left and right sides of the upper and lower limbs.

Left	Number	Possible Enthesopathy		Enthesopathy	
		no.	%	no.	%
Clavicle	132	41	**31**	17	**13**
Humerus flex/ ext	159	39	**25**	7	**4**
Forearm flex/ ext	91	21	**23**	14	**15**
Pronators/ supinators	143	27	**19**	6	**4**
Hand flex/ ext	55	3	**5**	0	**0**
TOTAL	580	131	**23**	44	**8**

Table A3.2a: Number of entheses present in the left elements of the upper limb in the Norton Mill Lane sample, and the number and percentage of entheses showing possible enthesopathies and enthesopathies.

Right	Number	Possible Enthesopathy		Enthesopathy	
		no.	%	no.	%
Clavicle	123	29	**24**	24	**20**
Humerus flex/ ext	152	38	**25**	13	**9**
Forearm flex/ ext	92	20	**22**	23	**25**
Pronators/ supinators	142	27	**19**	12	**8**
Hand flex/ ext	52	5	**20**	0	**0**
TOTAL	561	119	**21**	72	**13**

Table A3.2b: Number of entheses present in the right elements of the upper limb in the Norton Mill Lane, and the number and percentage of entheses showing possible enthesopathies and enthesopathies.

Left	Number	Possible Enthesopathy		Enthesopathy	
		no.	%	no.	%
Gluteus /adductor	92	24	**26**	5	**5**
Hip rotators	138	15	**11**	0	**0**
Flexors /extensors	185	62	**34**	16	**9**
Quadriceps	94	16	**17**	2	**2**
Foot Flexors	64	13	**20**	3	**5**
Interosseous	65	19	**29**	1	**2**
TOTAL	638	149	**23**	27	**4**

Table A3.2c: Number of entheses present in the left elements of the lower limb from Mill Lane, and the number and percentage of entheses showing possible enthesopathies and enthesopathies.

Right	Number	Possible Enthesopathy		Enthesopathy	
		no.	%	No.	%
Gluteus /adductor	84	20	**24**	5	**6**
Hip rotators	129	11	**9**	0	**0**
Flexors /extensors	171	51	**30**	21	**12**
Quadriceps	95	18	**19**	6	**6**
Foot Flexors	68	12	**18**	6	**9**
Interosseous	66	12	**18**	1	**2**
TOTAL	613	124	**20**	39	**6**

Table A3.2d: Number of entheses present in the right elements of the lower limb from Mill Lane, and the number and percentage of entheses showing possible enthesopathies and enthesopathies.

The following tables show the number (in brackets) and the percentage of enthesis groups from the left and right sides of the upper and lower limbs affected with enthesopathies and possible enthesopathies, and the percentage and number of individuals affected from each of the burial artefact groups in the skeletal sample from Norton Mill Lane.

	Group 1	Group 2	Group 3	Group 4
L Clavicle	20 (3)	11 (4)	13 (2)	12 (8)
L Humerus flex / ext	0 (0)	5 (3)	6 (2)	4 (2)
L Forearm flex / ext	29 (4)	10 (3)	20 (4)	12 (3)
L Pronator / supinator	0 (0)	8 (4)	3 (1)	2 (1)
L Hand flex / ext	0 (0)	0 (0)	0 (0)	0 (0)
R Clavicle	14 (2)	23 (8)	14 (3)	21 (11)
R Humerus flex / ext	0 (0)	9 (4)	14 (5)	7 (13)
R Forearm flex / ext	36 (5)	32 (10)	22 (4)	14 (13)
R Pronator/ supinator	6 (1)	14 (7)	10 (3)	2 (11)
R Hand flex / ext	0 (0)	0 (0)	0 (0)	0 (0)
Sk affected	71 (5)	63 (10)	88 (7)	60 (12)

Table A3.2e: The number (in brackets) and percentage of enthesopathies from the left and right sides of the upper limb, and the number and percentage of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

	Group 1	Group 2	Group 3	Group 4
L Clavicle	40 (6)	34 (12)	33 (5)	27 (18)
L Humerus flex / ext	30 (6)	31 (17)	26 (9)	14 (7)
L Forearm flex / ext	21 (3)	32 (10)	20 (4)	15 (4)
L Pronator / supinator	25 (4)	22 (11)	23 (7)	11 (5)
L Hand flex / ext	0 (0)	11 (2)	9 (1)	0 (0)
R Clavicle	43 (6)	34 (12)	5 (1)	19 (10)
R Humerus flex / ext	6 (1)	28 (13)	23 (8)	29 (16)
R Forearm flex / ext	14 (2)	23 (7)	28 (5)	21 (6)
R Pronator/ supinator	25 (4)	20 (10)	20 (6)	15 (7)
R Hand flex / ext	0 (0)	15 (3)	18 (2)	0 (0)
Sk affected	57 (4)	69 (11)	88 (7)	75 (15)

Table A3.2f: The number (in brackets) and percentage of possible enthesopathies from the left and right sides of the upper limb, and the number and percentage of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

	Group 1	Group 2	Group 3	Group 4
L Gluteus/ adductor	0 (0)	3 (1)	21 (3)	3 (1)
L Hip rotators	0 ()	0 (0)	0 (0)	0 (0)
L Femur Flex /ext	29 (7)	5 (3)	0 (0)	8 (6)
L Quadriceps	0 (0)	3 (1)	0 (0)	3 (1)
L Foot flexors	25 (2)	0 (0)	0 (0)	4 (1)
L Tibia interosseous	0 (0)	5 (1)	0 (0)	0 (0)
R Gluteus/ adductor	0 (0)	8 (2)	14 (2)	3 (1)
R Hip rotators	0 (0)	0 (0)	0 (0)	0 (0)
R Femur Flex /ext	35 (7)	10 (5)	0 (0)	13 (9)
R Quadriceps	14 (1)	6 (2)	18 (3)	0 (0)
R Foot flexors	25 (2)	11 (2)	7 (1)	4 (1)
R Tibia interosseous	0 (0)	0 (0)	0 (0)	4 (1)
Sk affected	71 (5)	56 (9)	50 (4)	30 (6)

Table A3.2g: The number (in brackets) and percentage of enthesopathies from the left and right sides of the lower limb and the number and percentage of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

	Group 1	Group 2	Group 3	Group 4
L Gluteus/ adductor	0 (0)	38 (11)	29 (4)	24 (9)
L Hip rotators	0 (0)	20 (9)	19 (4)	4 (2)
L Femur Flex /ext	17 (4)	42 (25)	32 (9)	33 (24)
L Quadriceps	14 (1)	19 (6)	24 (4)	13 (5)
L Foot flexors	13 (1)	30 (6)	17 (2)	17 (4)
L Tibia interosseous	25 (2)	27 (6)	33 (4)	30 (7)
R Gluteus/ adductor	0 (0)	38 (10)	14 (2)	24 (8)
R Hip rotators	7 (1)	15 (6)	10 (2)	4 (2)
R Femur Flex /ext	20 (4)	38 (20)	29 (8)	27 (19)
R Quadriceps	29 (2)	14 (5)	24 (4)	20 (7)
R Foot flexors	13 (1)	17 (3)	29 (4)	14 (4)
R Tibia interosseous	0 (0)	22 (4)	21 (3)	19 (5)
Sk affected	71 (5)	88 (14)	100 (8)	90 (18)

Table A3.2h: The number (in brackets) and percentage of possible enthesopathies from the left and right sides of the lower limb and the number and percentage of individuals affected in each of the artefact groups. Group 1 – No items or a single bead, potsherd or animal bone, Group 2 – A knife, with or without buckle or pin, one or more brooches/simple dress items, Group 3 – A weapon or weapons, Group 4 - knives, pins and personal items, dress items and jewellery.

3.3: Bamburgh

From the total of 40 individuals with a possible total of 3120 entheses, 2199 entheses (70.5%) were sufficiently well preserved to be examined for changes, an average of 55 entheses observed per individual, from a possible total of 78 entheses per individual. 1117 of these entheses (50.8%) were from the left side of the body, while 1082 entheses (49.2%) were from the right side. Of the total 2199 entheses, 782 (35.6%) showed no changes, 790 (35.9%) had some changes to the enthesis, as defined in Chapter 3, but not the most dramatic changes (possible enthesopathy - ?Enth), and 627 entheses (28.5%) had robust bone formation, lytic changes or both (enthesopathy - Enth).

From a possible total of 1760 entheses from the upper limb, 1221 entheses (69.4%) were observed; 607 from the left side (49.7% of the total) and 614 (50.3%) from the right side. Of the 22 entheses that were examined from the left side of the upper limb, nine individuals had all 22 entheses present, five individuals had 21 entheses present, three individuals had 20 entheses present, four individuals had 19 entheses, one individual had 18 entheses present, three individuals had 17 entheses, one individual had 14 entheses present, one individual had 12 entheses, two individuals had 11 entheses, one individual had ten entheses, two individuals had seven entheses present, one individual had six entheses, three individuals had five entheses present, one individual had 3 entheses, one individual had two entheses and one individual had 1 enthesis present from the left side of the upper limb. On the right side of the upper limb, nine individuals had all 22 entheses present, two individuals had 21 entheses, five individuals had 20 entheses present, one individual has 19 entheses, two individuals had 18 entheses present, five individuals had 17 entheses, two individuals had 16 entheses, one individual had 14 entheses, three individuals had 13 entheses present, one individual had 12 entheses, one individual had 11 entheses, one individual had eight entheses, one individual had seven entheses present, one individual had five entheses, one individual had three entheses, one individual had two entheses and one individual had one enthesis from the right side of the upper limb. Of these individuals, four individuals had all 44 entheses from both sides of the upper limb present for observation. Of the individuals examined, 58% had enthesopathies and 78% had possible enthesopathies in the upper limb.

From a possible total of 1360 lower limb entheses, 978 sites (71.9%) were examined; of which 510 (52.1%) were from the left side and 468 (47.9%) were from the right side. Of the total of 17 entheses observed from the left side of the lower limb, seven individuals had all 17 entheses present, four individuals had 16 entheses, nine individuals had 15 entheses, four individuals had 14 entheses, two individuals had 13 entheses present, two individuals had 12 entheses, two individuals had ten entheses, two individuals had 9 entheses, three individuals had 8 entheses, two individuals had seven entheses and two individuals had five entheses present from the left side of the lower limb. For the right side of the lower limb, seven individuals had all 17 entheses present, eight individuals had 16 entheses present, one individual had 15 entheses, three individuals had 14 entheses, three individuals had 13 entheses present, one individual had 12 entheses, three individuals had ten entheses present, four individuals had nine entheses present, one individual had eight entheses, one individual had six entheses, two individuals had five entheses present, one individuals had four entheses and one individuals had three entheses present from the lower limb. Of these individuals, only two had all 34 entheses present from both sides of the lower limb. Of the individuals examined, 48% had enthesopathies and 65% had possible enthesopathies in the lower limb

The following tables show the number and percentage of entheses groups affected from the left and right sides of the upper and lower limbs.

Left	Number	Possible Enthesopathy		Enthesopathy	
		no.	%	no.	%
Clavicle	122	50	**41**	32	**26**
Humerus flex/ ext	128	44	**34**	53	**41**
Forearm flex/ ext	96	43	**45**	26	**27**
Pronators/ supinators	141	57	**40**	26	**18**
Hand flex / ext	55	17	**31**	3	**5**
TOTAL	542	211	**39**	140	**26**

Table A3.3a: Number of entheses present in the left elements of the upper limb in the Bamburgh sample, and the number and percentage of entheses showing possible enthesopathies and enthesopathies.

Right	Number	Possible Enthesopathy no.	%	Enthesopathy no.	%
Clavicle	137	45	**33**	51	**37**
Humerus flex / ext	119	43	**36**	55	**46**
Forearm flex / ext	99	32	**32**	40	**40**
Pronators/ supinators	143	51	**36**	41	**29**
Hand Flex/ ext	51	19	**37**	3	**6**
TOTAL	549	190	**35**	190	**35**

Table A3.3b: Number of entheses present in the right elements of the upper limb in the Bamburgh sample, and the number and percentage of entheses showing possible enthesopathies and enthesopathies.

Left	Number	Possible Enthesopathy no.	%	Enthesopathy no.	%
Gluteus /adductor	60	25	**42**	19	**32**
Hip rotators	86	32	**37**	19	**22**
Flexors /extensors	133	37	**28**	52	**39**
Quadriceps	108	34	**31**	20	**19**
Foot Flexors	58	21	**36**	16	**28**
Interosseous	68	32	**47**	7	**10**
TOTAL	513	181	**35**	133	**26**

Table A3.3c: Number of entheses present in the left elements of the lower limb from Bamburgh, and the number and percentage of entheses showing possible enthesopathies and enthesopathies.

Right	Number	Possible Enthesopathy no.	%	Enthesopathy no.	%
Gluteus /adductor	54	19	**35**	15	**28**
Hip rotators	69	29	**42**	14	**20**
Flexors /extensors	123	37	**30**	50	**41**
Quadriceps	116	37	**32**	22	**19**
Foot Flexors	50	13	**26**	15	**30**
Interosseous	58	20	**34**	7	**12**
TOTAL	470	155	**33**	123	**26**

Table A3.3d: Number of entheses present in the right elements of the lower limb from Bamburgh, and the number and percentage of entheses showing possible enthesopathies and enthesopathies.

The following tables show the number (in brackets) and the percentage of enthesis groups from the left and right sides of the upper and lower limbs affected with enthesopathies and possible enthesopathies, and the percentage and number of individuals affected from each of the burial artefact groups in the skeletal sample from Bamburgh

	Group A	Group B	Group C	Group D
L Clavicle	34 (23)	27 (8)	5 (1)	0 (0)
L Humerus flex / ext	45 (30)	37 (10)	45 (9)	27 (4)
L Forearm flex / ext	33 (16)	22 (4)	21 (3)	20 (3)
L Pronator / supinator	21 (15)	11 (3)	25 (6)	12 (2)
L Hand flex / ext	4 (1)	8 (1)	10 (1)	0 (0)
R Clavicle	40 (29)	49 (17)	14 (3)	25 (2)
R Humerus flex / ext	52 (26)	38 (13)	59 (10)	33 (6)
R Forearm flex / ext	46 (22)	40 (8)	41 (7)	21 (3)
R Pronator/ supinator	29 (20)	19 (6)	46 (12)	20 (3)
R Hand flex / ext	13 (3)	0 (0)	0 (0)	0 (0)
Sk affected	81 (17)	100 (7)	100 (6)	67 (4)

Table A3.3e: The number (in brackets) and percentage of entheses from the left and right sides of the upper limb from females and males with enthesopathies and the number and percentage of individuals affected in each of the artefact groups. Group A - no artefacts, Group B – single animal bone, tooth or shells, Group C – multiple animal bones, Group D – Multiple iron objects.

	Group A	Group B	Group C	Group D
L Clavicle	43 (29)	30 (9)	50 (10)	40 (2)
L Humerus flex / ext	26 (17)	30 (8)	50 (10)	60 (9)
L Forearm flex / ext	33 (16)	44 (8)	64 (9)	67 (10)
L Pronator / supinator	36 (26)	37 (10)	63 (15)	35 (6)
L Hand flex / ext	36 (10)	25 (3)	40 (4)	0 (0)
R Clavicle	34 (25)	17 (6)	43 (9)	63 (5)
R Humerus flex / ext	30 (15)	38 (13)	41 (7)	44 (8)
R Forearm flex / ext	23 (11)	25 (5)	41 (7)	63 (9)
R Pronator/ supinator	37 (26)	34 (11)	38 (10)	27 (4)
R Hand flex / ext	29 (7)	36 (4)	55 (6)	40 (2)
Sk affected	100 (21)	100 (7)	100 (6)	100 (6)

Table A3.3f: The number (in brackets) and percentage of entheses from the left and right sides of the upper limb from females and males with possible enthesopathies and the number and percentage of individuals affected in each of the artefact groups. Group A - no artefacts, Group B – single animal bone, tooth or shells, Group C –multiple animal bones, Group D – Multiple iron objects.

	Group A	Group B	Group C	Group D
L Gluteus/ adductor	38 (12)	7 (1)	33 (3)	60 (3)
L Hip rotators	31 (14)	0 (0)	13 (2)	38 (3)
L Femur Flex /ext	42 (30)	27 (7)	40 (8)	44 (7)
L Quadriceps	22 (12)	6 (1)	10 (2)	29 (5)
L Foot flexors	23 (7)	38 (3)	30 (3)	33 (3)
L Tibia interosseous	11 (4)	0 (0)	17 (2)	11 (1)
R Gluteus/ adductor	36 (10)	9 (1)	22 (2)	33 (2)
R Hip rotators	29 (10)	0 (0)	20 (2)	29 (2)
R Femur Flex /ext	38 (23)	37 (10)	43 (9)	57 (8)
R Quadriceps	21 (13)	5 (1)	20 (4)	25 (4)
R Foot flexors	30 (8)	50 (4)	11 (1)	33 (2)
R Tibia interosseous	7 (2)	17 (2)	33 (3)	0(0)
Sk affected	90 (19)	71 (5)	100 (6)	83 (6)

Table A3.3g: The number (in brackets) and percentage of entheses from the left and right sides of the lower limb from females and males with enthesopathies, and the number and percentage of individuals affected in each of the artefact groups. Group A - no artefacts, Group B – single animal bone, tooth or shells, Group C – multiple animal bones, Group D – Multiple iron objects.

	Group A	Group B	Group C	Group D
L Gluteus/ adductor	41 (13)	36 (5)	56 (5)	40 (2)
L Hip rotators	33 (15)	28 (5)	60 (9)	38 (3)
L Femur Flex /ext	25 (18)	19 (5)	30 (6)	50 (8)
L Quadriceps	28 (15)	24 (4)	45 (9)	35 (6)
L Foot flexors	42 (13)	38 (3)	20 (2)	33 (3)
L Tibia interosseous	46 (16)	42 (5)	33 (4)	78 (7)
R Gluteus/ adductor	32 (9)	27 (3)	56 (5)	33 (2)
R Hip rotators	41 (14)	28 (5)	60 (6)	57 (4)
R Femur Flex /ext	28 (17)	22 (6)	38 (8)	43 (6)
R Quadriceps	30 (18)	21 (4)	40 (8)	44 (7)
R Foot flexors	26 (7)	13 (1)	33 (3)	33 (2)
R Tibia interosseous	34 (10)	17 (2)	22 (2)	75 (6)
Sk affected	100 (21)	100 (7)	100 (6)	100 (6)

Table A3.3h: The number (in brackets) and percentage of entheses from the left and right sides of the lower limb from females and males with possible enthesopathies, and the number and percentage of individuals affected in each of the artefact groups. Group A - no artefacts, Group B – single animal bone, tooth or shells, Group C –multiple animal bones, Group D – Multiple iron objects.

3.4: Norton Bishopsmill

From the total sample of 40 individuals with a possible total of 3120 entheses, 1836 entheses (59%) were sufficiently well preserved to be examined for changes to the muscle insertions, an average of 46 entheses per individual, from a possible total of 78 per individual. 968 of these entheses (53%) were from the left side of the body, while 868 entheses (47%) were from the right side. Of the total 1836 entheses, 1148 (63%) showed no changes, 578 (31%) had some bone formation or robusticity (possible enthesopathies - ?Enth), and 110 entheses (6%) had robust bone formation, lytic changes or both (enthesopathies - Enth). Of the individuals examined, 64% had possible enthesopathies and 3% had enthesopathies.

From a possible total of 1760 entheses from the upper limb, 759 sites of muscle or ligament attachment (43%) were observed; 422 were from the left side (55.6% of the total) and 337 (44.4%) from the right side. Of the 22 entheses that were examined from the left side of the upper limb, three individuals had all 22 entheses present, two individuals had 20 entheses present, one individual had 19 entheses, one individual had 18 entheses present, four individuals had 17 entheses, one individual had 16 entheses present, one individual had 15 entheses, one individual had 14 entheses present, three individuals had 13 entheses, six individuals had 12 entheses, one individual had 11 entheses, one individual had eight entheses, one individual had seven entheses present, two individuals had six entheses, two individuals had five entheses present, one individual had four entheses, and one individual had three entheses present from the left side of the upper limb. On the right side of the upper limb, two individuals had all 22 entheses present, five individuals had 17 entheses, two individuals had 16 entheses, one individual had 15 entheses, two individuals had 14 entheses, two individuals had 12 entheses, four individuals had 11 entheses, one individual had nine entheses, two individuals had eight entheses, two individuals had seven entheses present, two individuals had six entheses present, one individual had five entheses, one individual had four entheses, one individual had three entheses and one individual had two entheses from the right side of the upper limb. Of these individuals, only one had all 44 entheses from both sides of the upper limb present for observation. Of the individuals examined, 47% had possible enthesopathies and 6% had enthesopathies in the upper limb.

From a possible total of 1360 lower limb entheses, 1077 sites (79%) were examined, of which 546 (51%) were from the left side and 531 (49%) were from the right side. Of the total of 17 entheses observed from the left side of the lower limb, ten individuals had all 17 entheses present, one individual had 16 entheses, 19 individuals had 14 entheses, one individual had 13 entheses present, three individuals had 12 entheses, one individual had 11 entheses present, two individuals had 9 entheses, one individual had six entheses and two individuals had five entheses present from the left side of the lower limb. For the right side of the lower limb, 15 individuals had all 17 entheses present, 14 individuals had 14 entheses, two individuals had 13 entheses present, one individual had 12 entheses, two individuals had nine entheses present, four individuals had five entheses present, and one individual had four entheses present from the lower limb. Of these individuals, eight had all 34 entheses present from both sides of the lower limb. Of the individuals examined, 38% had possible enthesopathies and 3% had enthesopathies in the lower limb.

The following tables show the number and percentage of entheses groups affected from the left and right sides of the upper and lower limbs.

Left	Number	Possible Enthesopathy		Enthesopathy	
		no.	%	no.	%
Clavicle	52	8	**15**	6	**12**
Humerus flex/ ext	116	39	**34**	6	**5**
Forearm flex/ ext	69	20	**29**	8	**12**
Pronators/ supinators	104	32	**31**	7	**7**
Hand flex/ ext	38	8	**21**	0	**0**
TOTAL	379	107	**28**	27	**7**

Table A3.4a: Number of entheses present in the left elements of the upper limb in the Norton Bishopsmill sample, and the number and percentage of entheses showing possible enthesopathies and enthesopathies.

Right	Number	Possible Enthesopathy		Enthesopathy	
		no.	%	no.	%
Clavicle	39	10	**26**	6	**15**
Humerus flex/ ext	84	30	**36**	4	**5**
Forearm flex/ ext	57	20	**35**	5	**9**
Pronators/ supinators	85	25	**29**	9	**11**
Hand flex/ ext	33	6	**18**	0	**0**
TOTAL	298	91	**31**	24	**8**

Table A3.4b: Number of entheses present in the right elements of the upper limb in the Norton Bishopsmill sample, and the number and percentage of entheses showing possible enthesopathies and enthesopathies.

Left	Number	Possible Enthesopathy no.	Possible Enthesopathy %	Enthesopathy no.	Enthesopathy %
Gluteus /adductor	70	23	**33**	3	**4**
Hip rotators	105	20	**19**	0	**0**
Flexors /extensors	150	61	**41**	13	**9**
Quadriceps	78	19	**24**	2	**3**
Foot Flexors	72	26	**36**	5	**7**
Interosseous	71	18	**25**	0	**0**
TOTAL	546	167	**31**	23	**4**

Table A3.4c: Number of entheses present in the left elements of the lower limb from Bishopsmill, and the number and percentage of entheses showing possible enthesopathies and enthesopathies.

Right	Number	Possible Enthesopathy no.	Possible Enthesopathy %	Enthesopathy no.	Enthesopathy %
Gluteus /adductor	67	25	**37**	4	**6**
Hip rotators	97	18	**19**	3	**3**
Flexors /extensors	137	55	**40**	14	**10**
Quadriceps	88	21	**24**	2	**2**
Foot Flexors	72	22	**31**	4	**6**
Interosseous	70	24	**34**	1	**1**
TOTAL	531	165	**31**	28	**5**

Table A3.4d: Number of entheses present in the right elements of the lower limb from Bishopsmill, and the number and percentage of entheses showing possible enthesopathies and enthesopathies.

The following tables show the number (in brackets) and the percentage of enthesis groups from the left and right sides of the upper and lower limbs affected with enthesopathies and possible enthesopathies, and the percentage and number of individuals affected from each of the burial artefact groups in the skeletal sample from Norton Bishopsmill.

	Group A	Group B +C	Group D
L Clavicle	12 (4)	20 (1)	7 (1)
L Humerus flex / ext	5 (4)	0 (0)	8 (2)
L Forearm flex / ext	7 (3)	11 (1)	24 (4)
L Pronator / supinator	3 (2)	9 (1)	15 (4)
L Hand flex / ext	0 (0)	0 (0)	0 (0)
R Clavicle	15 (5)	0 (0)	20 (1)
R Humerus flex / ext	5 (3)	0 (0)	5 (1)
R Forearm flex / ext	6 (2)	29 (2)	7 (1)
R Pronator/ supinator	9 (5)	0 (0)	18 (4)
R Hand flex / ext	0 (0)	0 (0)	0 (0)
Sk affected	58 (14)	60 (3)	100 (6)

Table A3.4e: The number (in brackets) and percentage of entheses from the left and right sides of the upper limb from females and males with enthesopathies, and the number and percentage of individuals affected in each of the artefact groups. Group A – no artefacts, Group B – animal bones or teeth, Group C – Pottery, worked stone or flint, Group D – iron objects or coffin fittings.

	Group A	Group B +C	Group D
L Clavicle	18 (6)	0 (0)	14 (2)
L Humerus flex / ext	27 (22)	50 (5)	48 (12)
L Forearm flex / ext	26 (11)	11 (1)	47 (8)
L Pronator / supinator	27 (18)	45 (5)	33 (9)
L Hand flex / ext	14 (3)	0 (0)	42 (5)
R Clavicle	29 (10)	0 (0)	0 (0)
R Humerus flex / ext	22 (13)	60 (3)	67 (14)
R Forearm flex / ext	31 (11)	0 (0)	60 (9)
R Pronator/ supinator	23 (13)	50 (3)	41 (9)
R Hand flex / ext	17 (4)	0 (0)	25 (2)
Sk affected	83 (20)	80 (4)	100 (6)

Table A3.4f: The number (in brackets) and percentage of entheses from the left and right sides of the upper limb from females and males with possible enthesopathies, and the number and percentage of individuals affected in each of the artefact groups. Group A – no artefacts, Group B – animal bones or teeth, Group C – Pottery, worked stone or flint, Group D – iron objects or coffin fittings.

	Group A	Group B +C	Group D
L Gluteus/ adductor	2 (1)	8 (1)	7 (1)
L Hip rotators	0 (0)	0 (0)	0 (0)
L Femur Flex /ext	4 (4)	10 (3)	21 (6)
L Quadriceps	3 (2)	0 (0)	0 (0)
L Foot flexors	5 (2)	14 (2)	7 (1)
L Tibia interosseous	0 (0)	0 (0)	0 (0)
R Gluteus/ adductor	2 (1)	8 (1)	17 (2)
R Hip rotators	2 (1)	6 (1)	6 (1)
R Femur Flex /ext	8 (7)	15 (4)	13 (3)
R Quadriceps	2 (1)	0 (0)	6 (1)
R Foot flexors	5 (2)	14 (2)	0 (0)
R Tibia interosseous	0 (0)	8 (1)	0 (0)
Sk affected	48 (12)	63 (5)	57 (4)

Table A3.4g: The number (in brackets) and percentage of entheses from the left and right sides of the lower limb from females and males with enthesopathies, and the number and percentage of individuals affected in each of the artefact groups. Group A – no artefacts, Group B – animal bones or teeth, Group C – pottery, worked stone or flint, Group D – iron objects or coffin fittings.

	Group A	Group B +C	Group D
L Gluteus/ adductor	33 (14)	31 (4)	36 (5)
L Hip rotators	14 (9)	16 (3)	38 (8)
L Femur Flex /ext	42 (38)	39 (12)	39 (11)
L Quadriceps	18 (11)	43 (3)	50 (5)
L Foot flexors	36 (16)	29 (4)	43 (6)
L Tibia interosseous	28 (12)	21 (3)	21 (3)
R Gluteus/ adductor	31 (13)	54 (7)	42 (5)
R Hip rotators	14 (9)	19 (3)	33 (6)
R Femur Flex /ext	40 (35)	35 (9)	46 (11)
R Quadriceps	16 (9)	44 (7)	31 (5)
R Foot flexors	25 (11)	29 (4)	50 (7)
R Tibia interosseous	37 (16)	38 (5)	21 (3)
Sk affected	100 (25)	88 (7)	100 (7)

Table A3.4h: The number (in brackets) and percentage of entheses from the left and right sides of the lower limb from females and males with possible enthesopathies, and the number and percentage of individuals affected in each of the artefact groups. Group A – no artefacts, Group B – animal bones or teeth, Group C – pottery, worked stone or flint, Group D – iron objects or coffin fittings.

Appendix 4: Schmorl's Nodes

4.1: Castledyke South

From the total sample of 86 individuals, 58 individuals had vertebral columns with vertebral surfaces that were sufficiently well preserved to be examined for the presence of Schmorl's nodes. These individuals had between nine and 47 vertebral surfaces present, from the possible 47 surfaces per vertebral column (including the inferior surface of S1 in four individuals, where this was not fused to the sacrum). A total of 1782 vertebral surfaces (67% of the possible surfaces) were examined, of which 475 surfaces (27%) were affected by Schmorl's nodes. On average, 31 surfaces were present per vertebral column. Of the individuals examined, 88% (50 individuals) had one or more Schmorl's nodes, 87% of the females were affected and 85% of the males. 61% of the individuals examined had over five Schmorl's nodes and, 58% of females had over five Schmorl's nodes and 65% of males had over five Schmorl's nodes.

The following figures show the location of Schmorl's nodes in each of the four artefact groups.

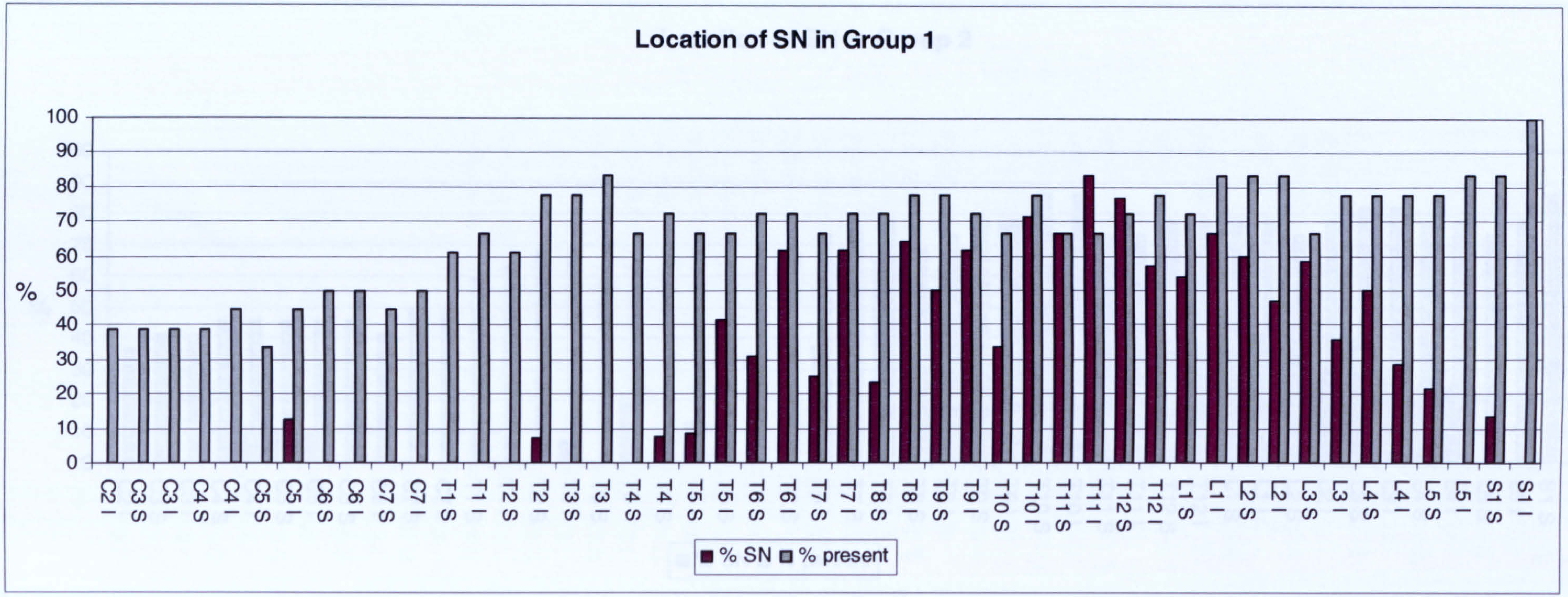


Figure A4.1a: The percentage of the total vertebral surfaces present from Group 1 individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface.

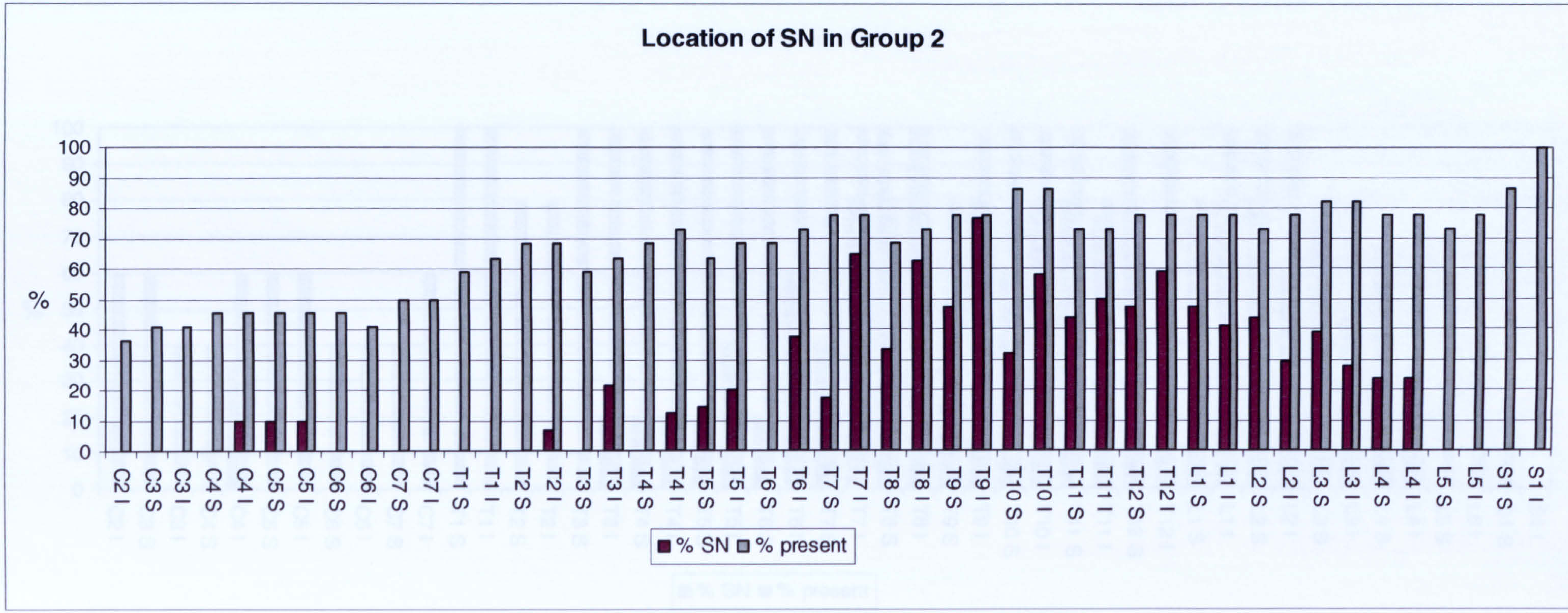


Figure A4.1b: The percentage of the total vertebral surfaces present from Group 2 individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface.

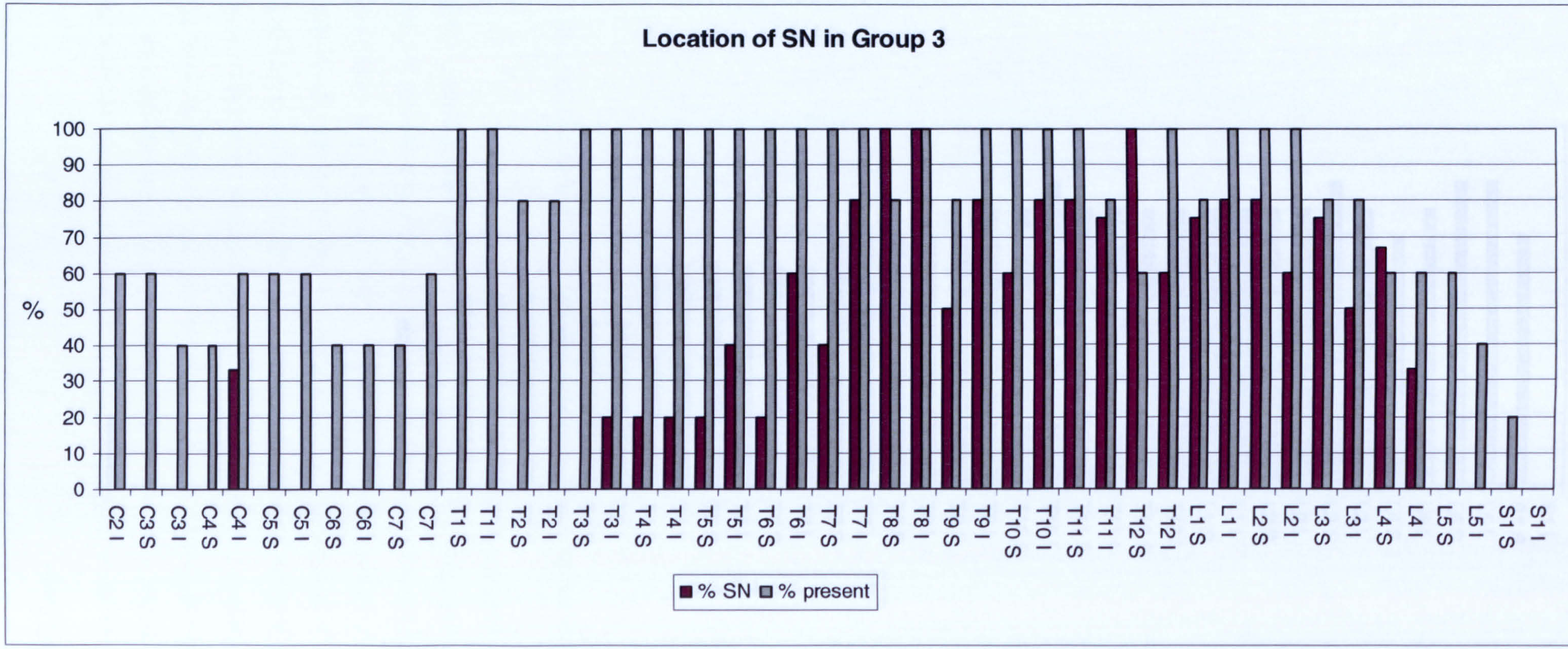


Figure A41c: The percentage of the total vertebral surfaces present from Group 3 individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface.

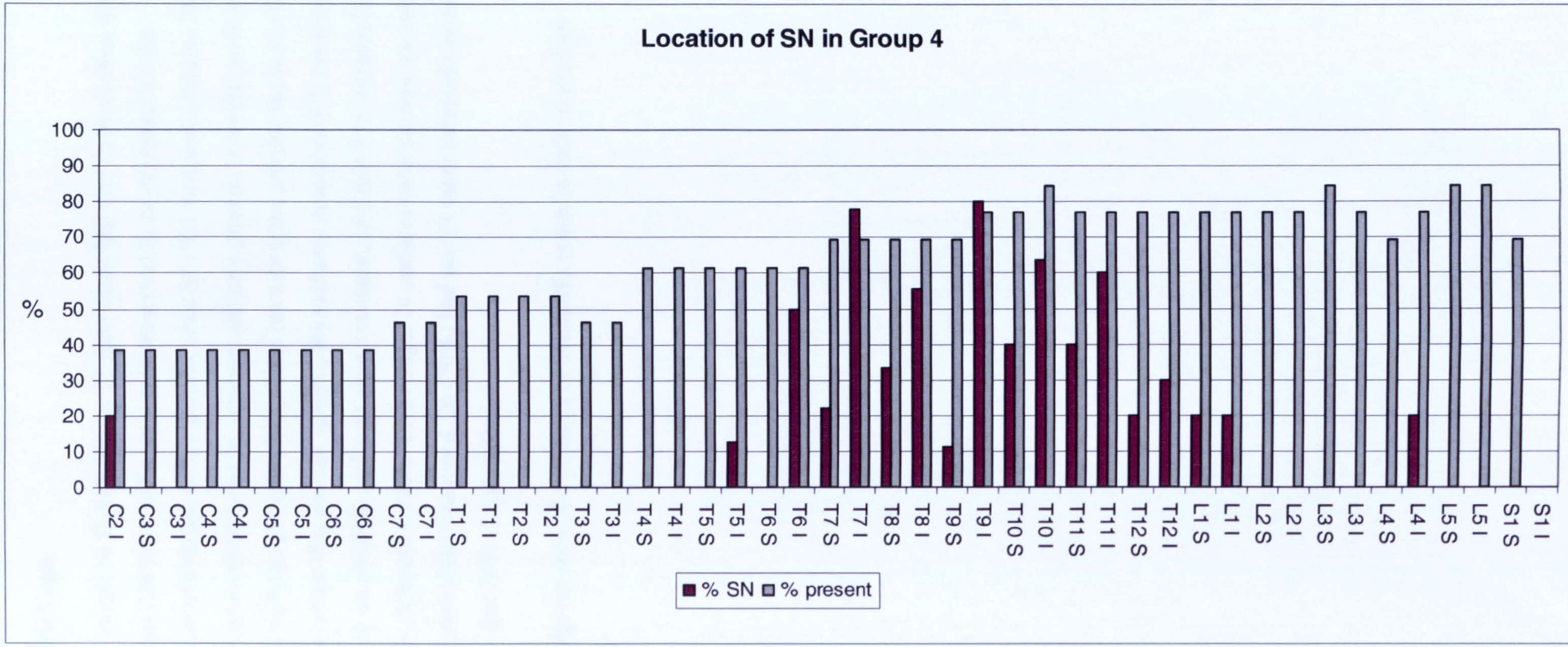


Figure A 4.1d: The percentage of the total vertebral surfaces present from Group 4 individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface.

4.2: Norton Mill Lane

From the total sample of 51 individuals, 37 individuals had vertebral columns with vertebral surfaces that were sufficiently well preserved to be examined for the presence of Schmorl's nodes, with a possible total of 1704 vertebral surfaces. These individuals had between four and 46 vertebral surfaces present, from the possible maximum of 47 surfaces per vertebral column (including the inferior surface of S1 in two individuals, where this was not fused to the sacrum). A total of 875 vertebral surfaces (51% of the possible surfaces) were examined, of which 175 surfaces (20%) were affected by Schmorl's nodes. On average, 24 surfaces were present per vertebral column. Of the individuals examined, 26 (70%) had one or more Schmorl's nodes; 62% of females and 74% of the males.

The following figures show the location of Schmorl's nodes in each of the four artefact groups.

Page missing

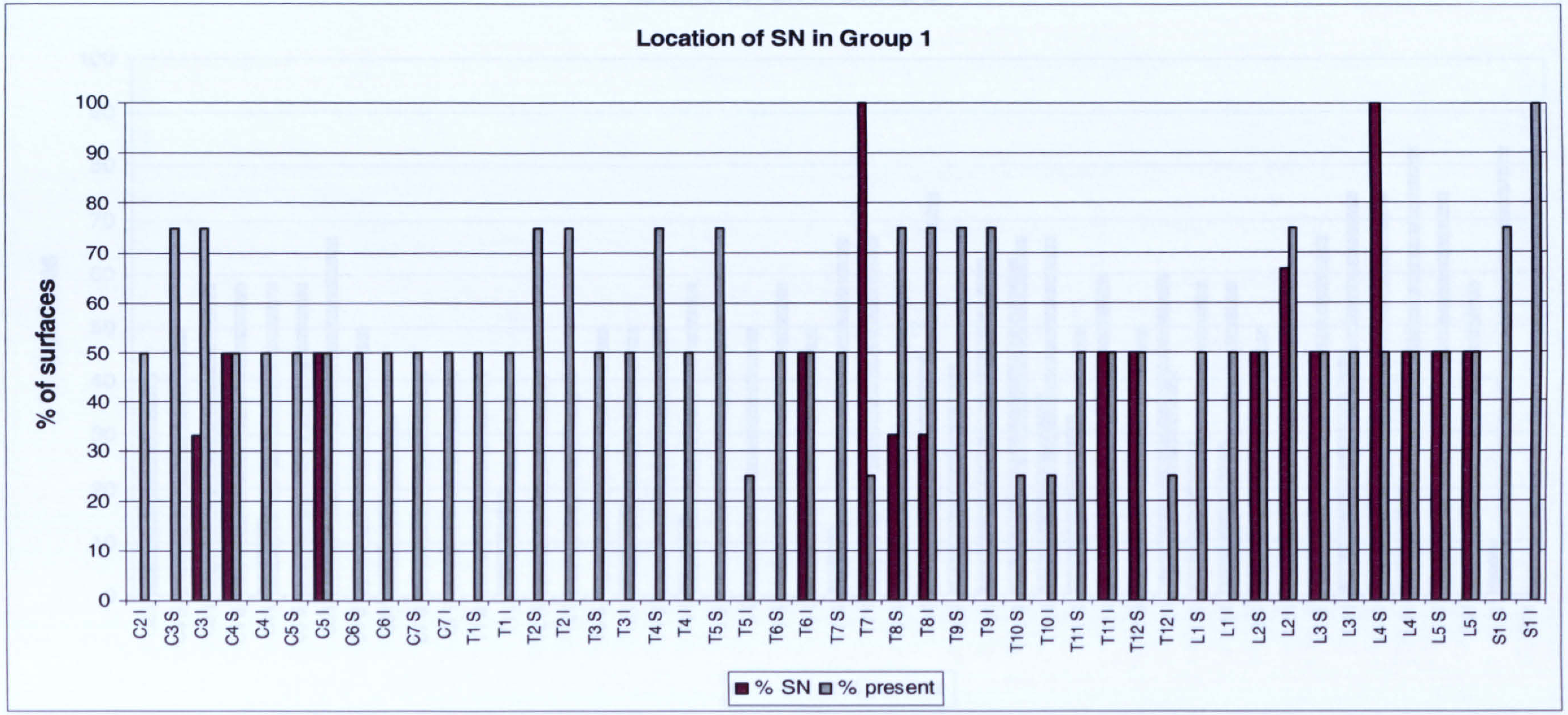


Figure A4.2a: The percentage of the total vertebral surfaces present from Group 1 individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface.

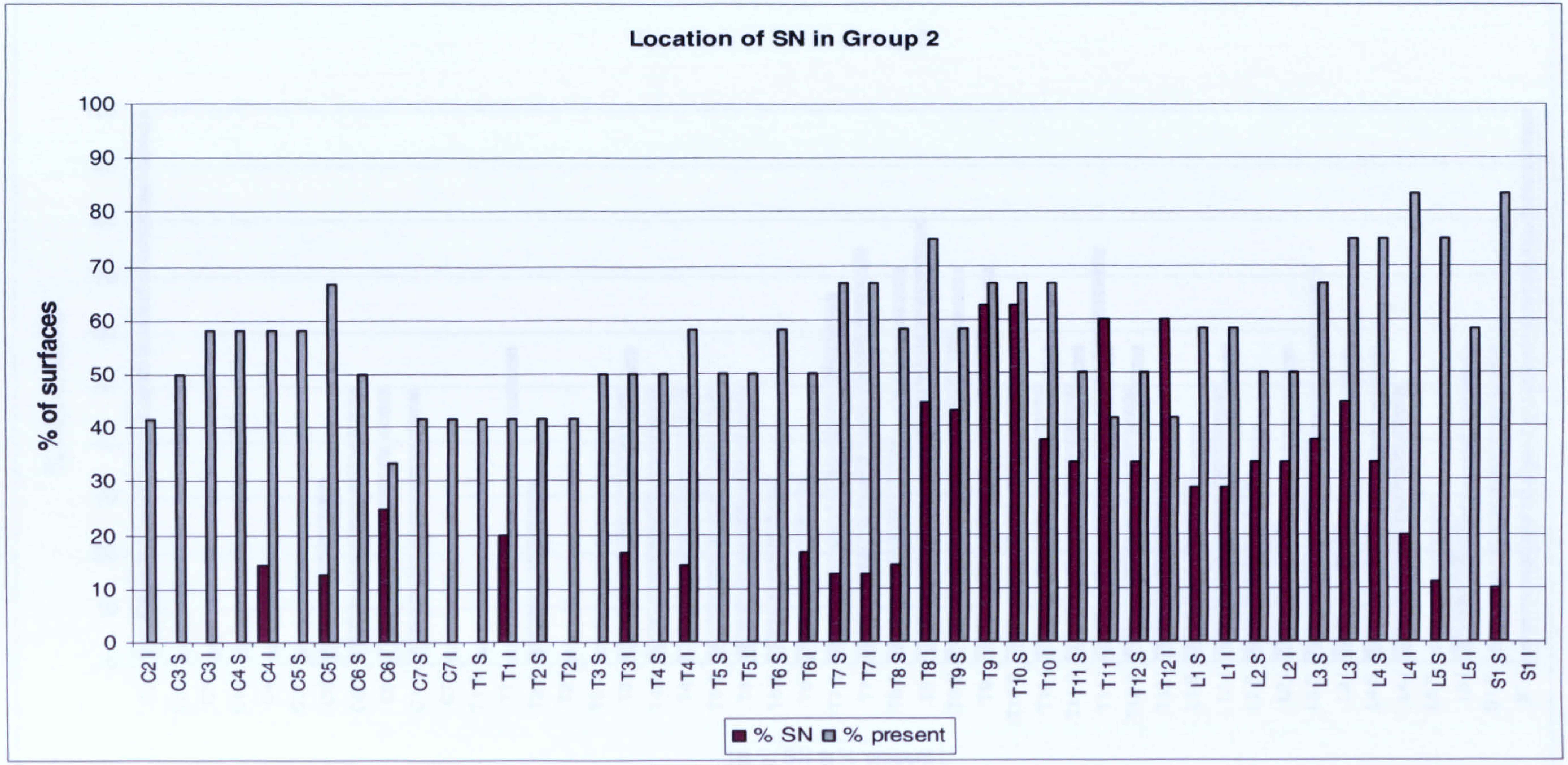


Figure A4.2b: The percentage of the total vertebral surfaces present from Group 2 individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface.

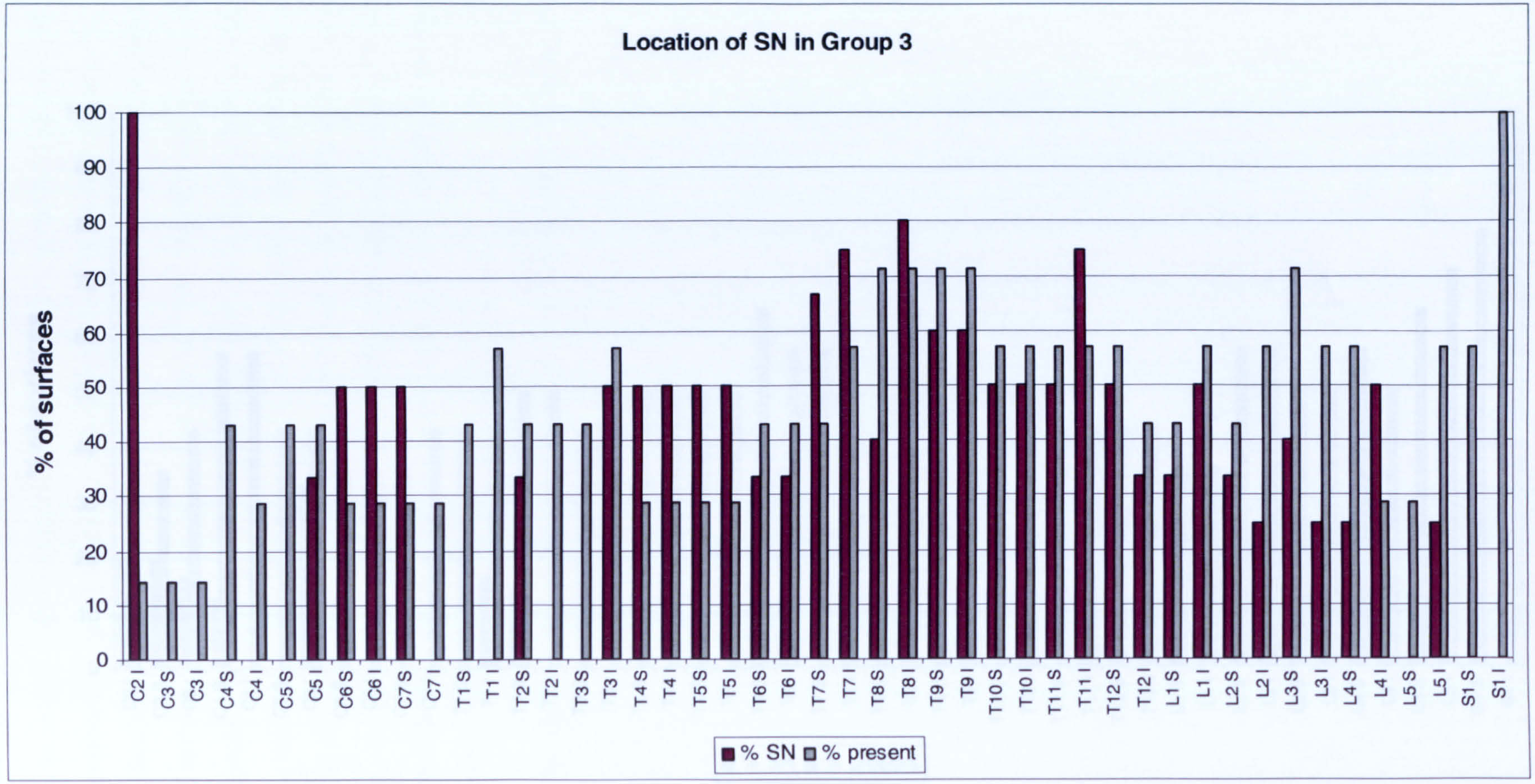


Figure A 4.2c: The percentage of the total vertebral surfaces present from Group 3 individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface.

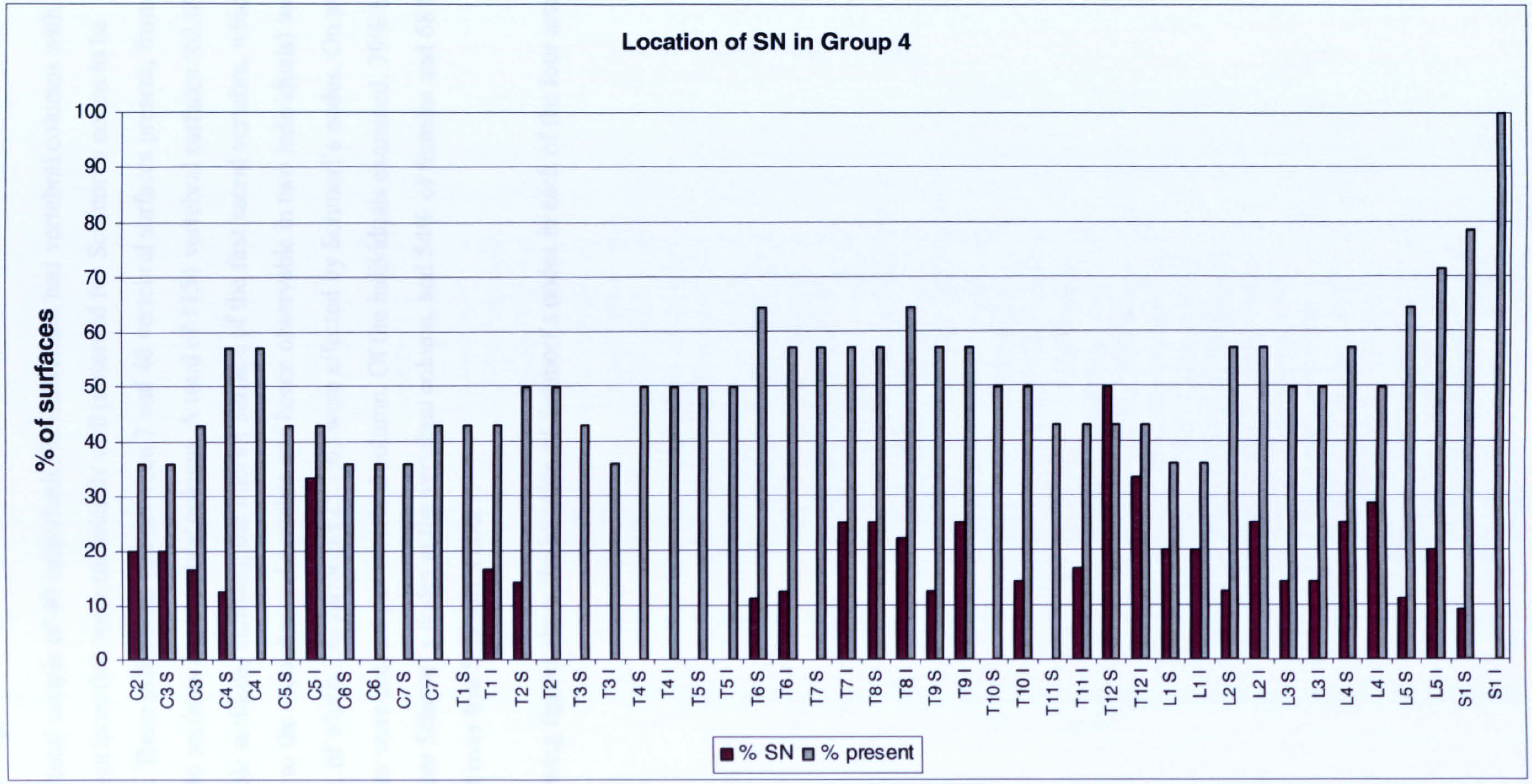


Figure A4.2d: The percentage of the total vertebral surfaces present from Group 4 individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface.

4.3: Bamburgh

From the total sample of 40 individuals, 32 individuals had vertebral columns with vertebral surfaces that were sufficiently well preserved for Schmorl's nodes to be identified. These individuals had between 7 and 46 vertebral surfaces present, from a possible 46 surfaces per vertebral column. A total of 1154 vertebral surfaces (62.6% of the possible surfaces, including the inferior surface of the first sacral vertebra, which was not fused to the second sacral vertebra and hence observable in two individuals) were examined, of which 290 surfaces (25.1%) were affected by Schmorl's nodes. On average, 36 surfaces were present per vertebral column. Of the individuals examined, 79% had one or more Schmorl's nodes in the vertebral column, and 54% of females and 68% of males had over five Schmorl's nodes.

The following figures show the location of Schmorl's nodes in each of the four artefact groups.

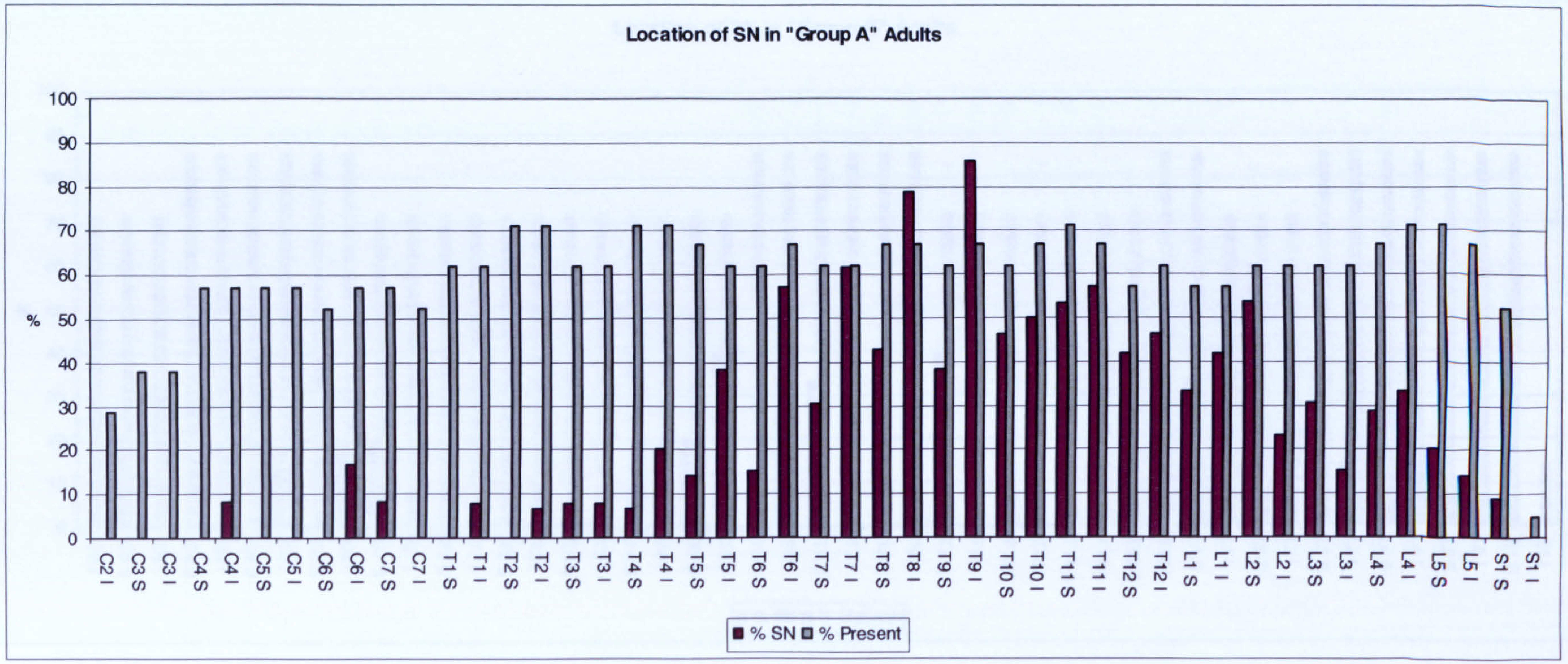


Figure A4.3.a: The percentage of the total vertebral surfaces from Group A individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface.

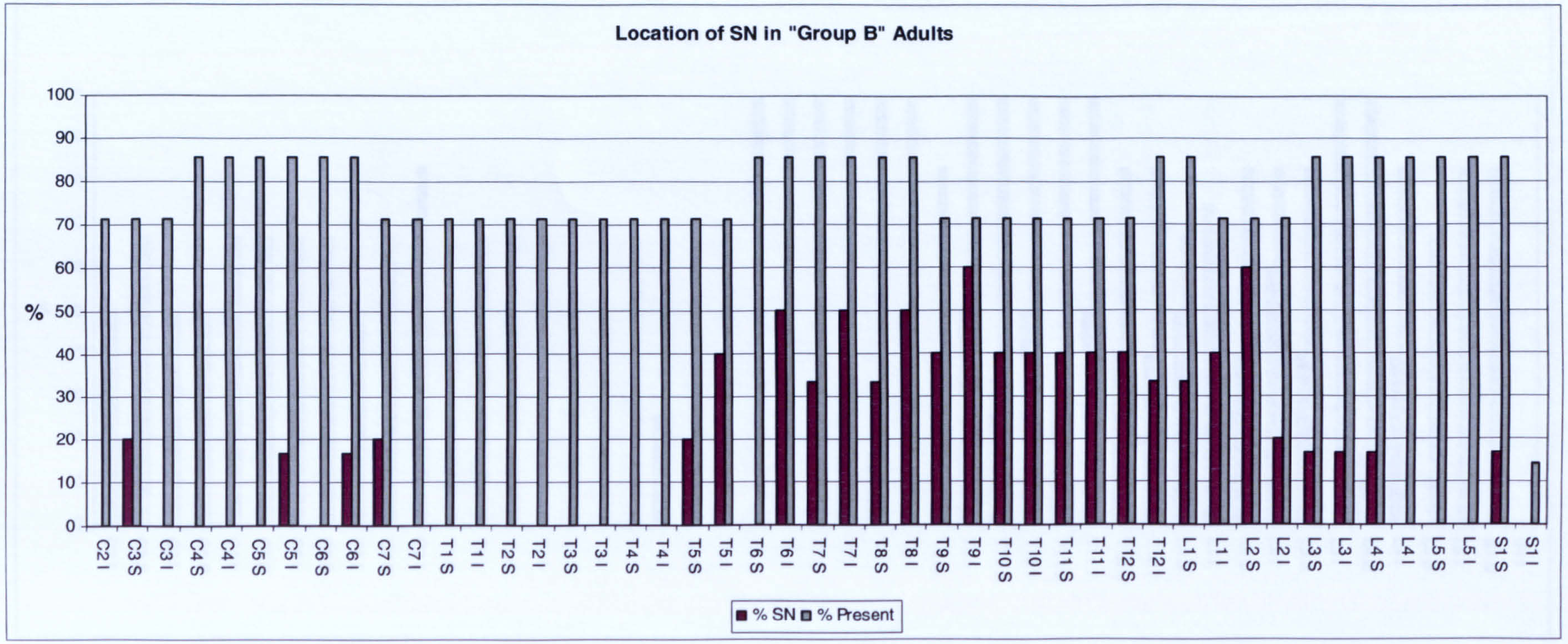


Figure A4.3b: The percentage of the total vertebral surfaces from Group B individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface.

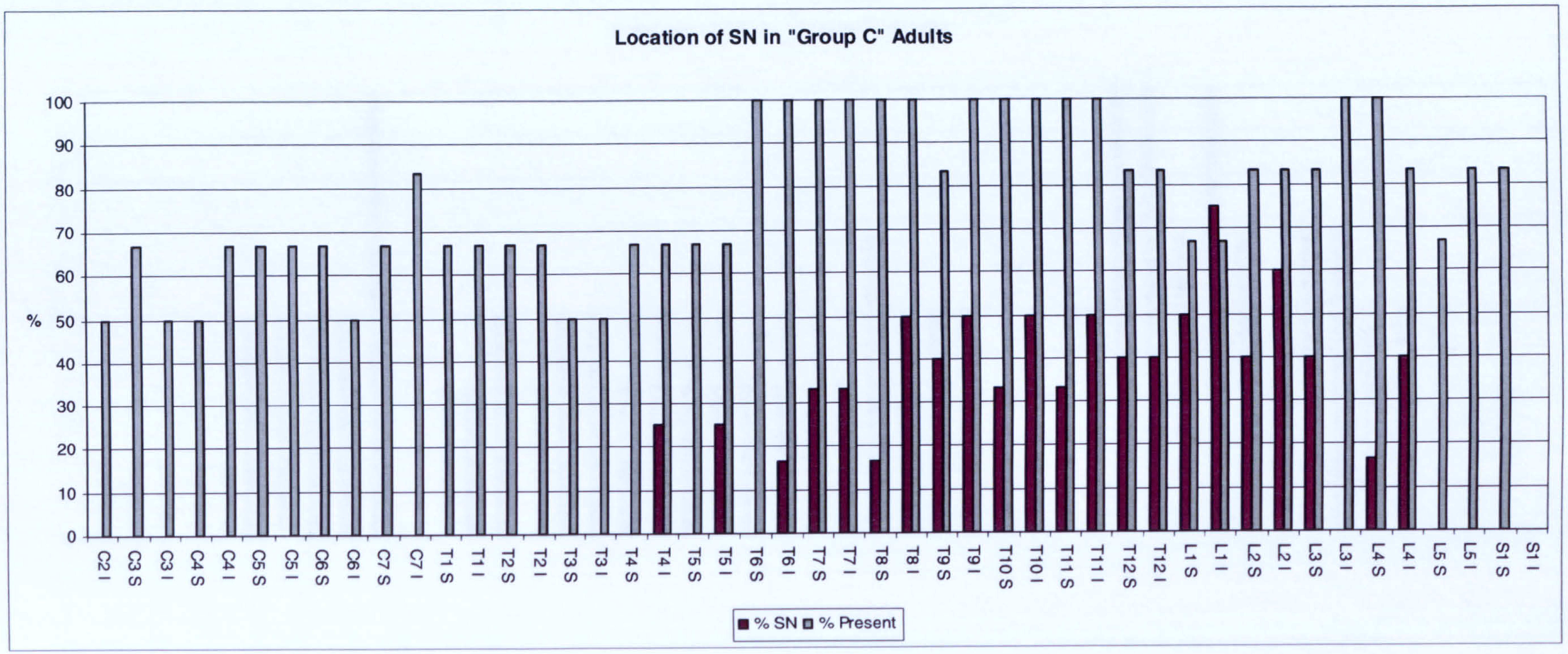


Figure A4.3c: The percentage of the total vertebral surfaces from Group C individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface.

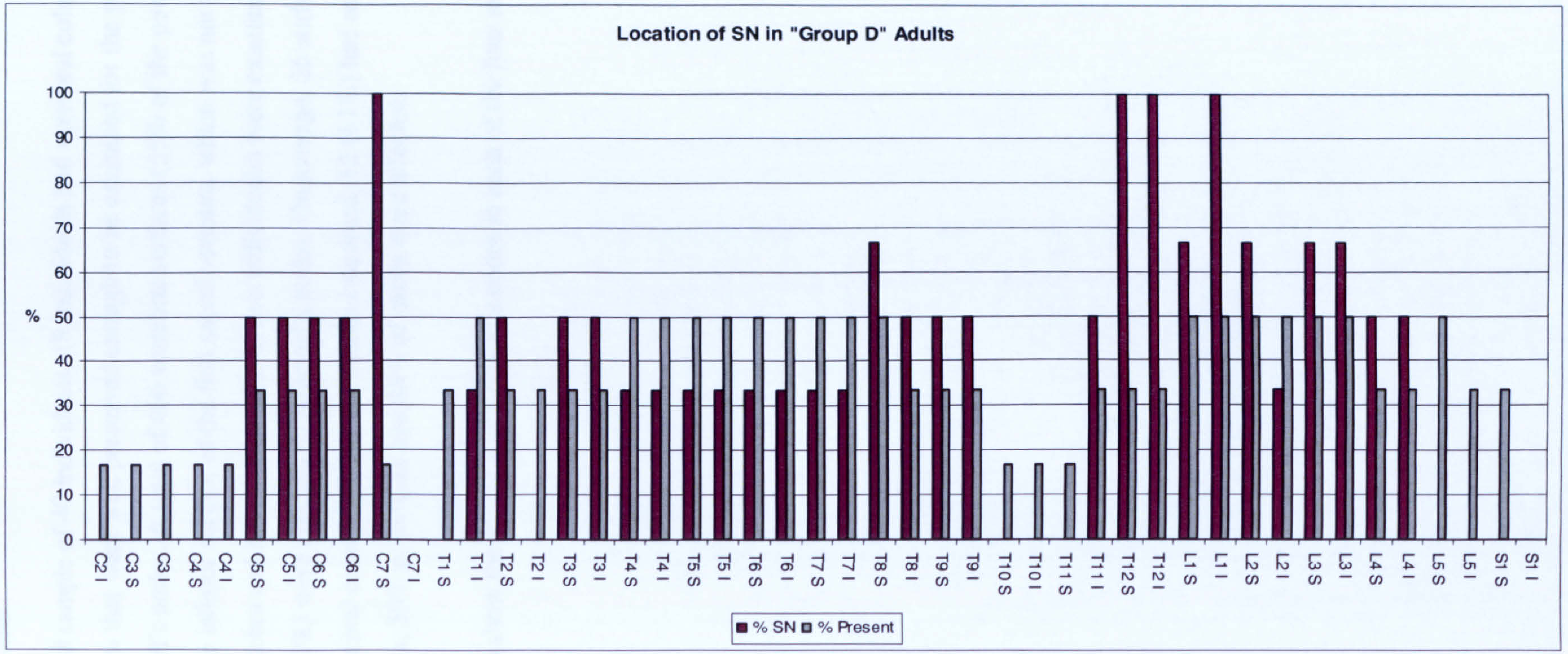


Figure A4.3d: The percentage of the total vertebral surfaces from Group D individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface

4.4: Norton Bishopsmill

From the total skeletal sample of 40 individuals, 18 individuals had vertebral columns with vertebral surfaces that were well preserved enough to be examined for the presence or absence of Schmorl's nodes. A total of 466 vertebral surfaces (55% of the possible surfaces, including the inferior surface of the first sacral vertebra, which was not fused to the second sacral vertebra and hence observable in two individuals) were examined, of which 95 surfaces (20%) were affected by Schmorl's nodes. On average, 26 surfaces were present per vertebral column. Of the individuals examined, 12 (67%) had one or more Schmorl's nodes, 50% of females and 88% of males were affected.

The following figures show the location of Schmorl's nodes in each of the four artefact groups.

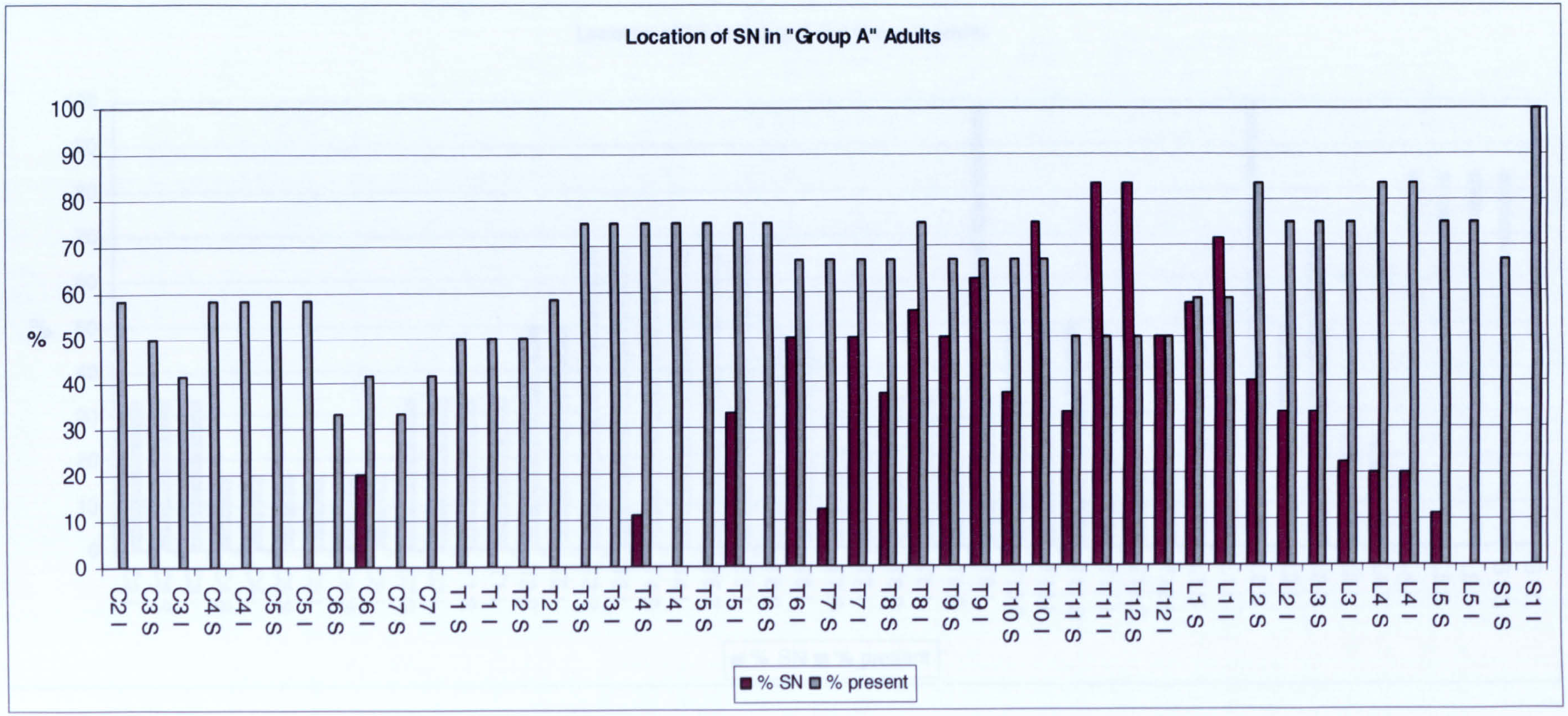


Figure A4.4a: The percentage of the total vertebral surfaces from Group A individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface.

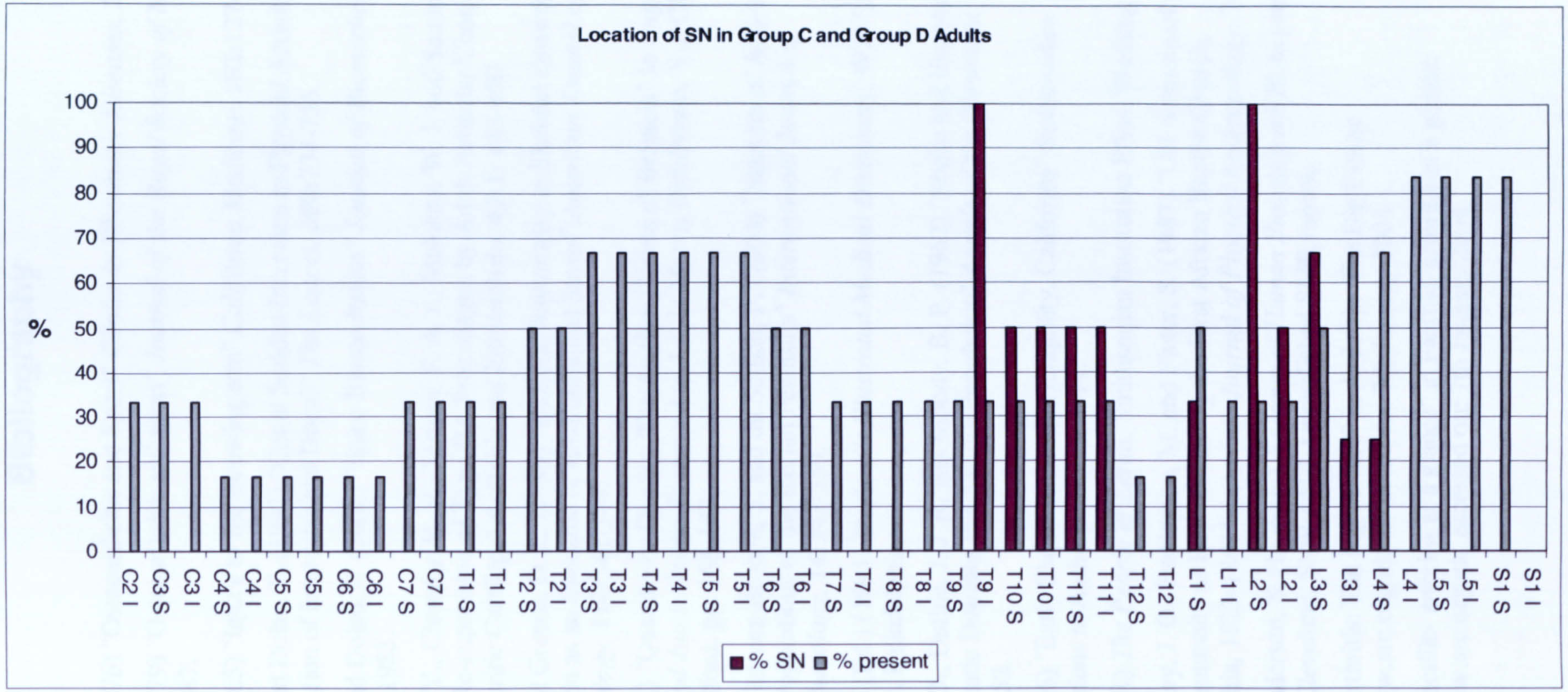


Figure A4.4b: The percentage of the total vertebral surfaces from Groups C and D individuals that were observed and the percentage of these that were affected by Schmorl's nodes. "S" indicates a superior surface while "I" indicates an inferior surface

Bibliography

Adams, I. D. (1976) "Osteoarthritis and Sport" *Clinics in Rheumatic Diseases,* **2**:523-541.

Adams, I. D. (1979) "Osteoarthritis and sport" *Journal of the Royal Society of Medicine,* **72**:185-187.

Adams, J. E. (1965) "Injury to the throwing arm" *California Medicine,* **102**:127-132.

Adams, M. A. and Dolan, P. (1997) "Could Sudden Increases in Physical Activity Cause Degeneration of Intervertebral Discs?" *The Lancet,* **350**:734-735.

Adams, M. A. and Dolan, P. (2005) "Spine Biomechanics" *Journal of Biomechanics,* **38**:1972-1983.

Aigner, T., Zhu, Y., Chansky, H. H., Matsen, F. A. r., Maloney, W. J. and Sandell, L. J. (1999) "Re-expression of Type IIA Procollagen by Adult Articular Chondrocytes in Osteoarthritic Cartilage" *Arthritis and Rheumatism,* **42:1**: 443-450.

Albert, A. M. and Greene, D. L. (1999) "Bilateral Asymmetry in Skeletal Growth and Maturation as an Indicator of Environmental Stress" *American Journal of Physical Anthropology,* **110**:341-349.

Alcock, L. (1981) "Quantity or Quality: The Anglian Graves of Bernicia" In *Angles, Saxons and Jutes: Essays Presented to J.N.L. Myers,* (Ed:Evison, V.): Clarendon Press, Oxford, pp. 168-183.

al-Oumaoui, I., Jimenez-Brobeil, S. and du Souich, P. (2004) "Markers of Activity Patterns in some Populations of the Iberian Peninsula" *International Journal of Osteoarchaeology,* **14**:343-359.

Anderson, D. M. (Ed.) (1994) *Dorland's Illustrated Medical Dictionary,* W.B Saunders Company, Philadelphia.

Anderson, J. A. D., Duthie, J. J. R. and Moody, B. P. (1962) "Social and Economic Effects of Rheumatic Diseases in a Mining Population" *Annals of the Rheumatic Diseases.,* **21**:342-352.

Angel, J. L. (1966) "Early Skeletons From Tranquility, California" *Smithsonian Contributions to Anthropology,* **2**:1-19.

Angel, J. L. (1971) *The People of Lerna,* Smithsonian Institution Press, Washington D.C.

Angel, J. L., Kelley, J. O., Parrington, M. and Pinter, S. (1987) "Life Stresses of the Free Black Community as Represented by the First African Baptist Church, Philadelphia, 1823-1841" *American Journal of Physical Anthropology,* **74**:213-229.

Annis, R. and Anderson, S. (In Press) *A Group of Human Burials from Bishopsmill School, Norton, Cleveland,* SMR 3412, Unpublished SMR report.

ARC (2002a) "Arthritis: The Big Picture" in Arthritis: The Big Picture: http://www.arc.org.uk accessed on: 7th January 2004

ARC (2002b) "Factfile- arthritis at a glance" in Factfile- arthritis at a glance: http://www.arc.org.uk accessed on: 7th January 2004

Arnold, C. J. (1980) "Wealth and Social Structure: A matter of life and death" In *Anglo-Saxon Cemeteries 1979: The Fourth Anglo-Saxon Symposium at Oxford,* (Ed:Rahtz, P., Dickinson, T. and Watts, L.): **B.A.R. British Series 82** British Archaeological Reports, Oxford, pp. 81-142.

Arnold, C. J. (1984) *Roman Britain to Saxon England,* Croom Helm, London.

Arnold, C. J. (1997) *An Archaeology of the Early Anglo-Saxon Kingdoms,* Second edition, Routledge, London.

Arriaza, B. T. (1997) "Spondylolysis in Prehistoric Human Remains from Guam and its Possible Etiology" *American Journal of Physical Anthropology,* **104**:393-397.

Attenborough, F. L. (1922) *The Laws of the Earlist English Kings,* Cambridge University Press, Cambridge.

Aufderheide, A. C. and Rodrigues-Martin, C. (1998) *The Cambridge Encyclopedia of Human Palaeopathology.,* University Press, Cambridge.

Baldwin, K. M., White, T. P., Arnaud, S. B., Edgerton, V. R., Kraemer, W. J., Kram, R., Raab-Cullen, D. and Snow, C. M. (1996) "Musculoskeletal Adaptations to Weightlessness and Development of Effective Countermeasures" *Med Sci Sports Exerc,* **28**:1247-1253.

Bass, S., Pearce, G., Bradney, M., Hendrich, E., Delmas, P. D., Harding, A. and Seeman, E. (1998) "Exercise Before Puberty May Confer Residual Benefits in Bone Density in Adulthood: Studies in Active Prepubertal and Retired Female Gymnasts" *Journal of Bone Mineral Research,* **13**:500-507.

Bass, W. M. (1995) *Human Osteology: A Laboratory and Field Manual,* Third edition, Missouri Archaeological Society, Columbia, Missouri.

Bateson, E. (1893) *A History of Northumberland Volume 1: The Parish of Bamburgh,*, Newcastle-upon-Tyne.

Beard, B. L. and Johnson, C. M. (2000) "Strontium Isotope Composition of Skeletal Material can Determine the Birth Place and Geographic Mobility of Humans and Animals" *Journal of Forensic Sciences,* **45**:1049-1061.

Begg, A. C. (1954) "Nuclear herniations of the intervertebral disc: Their radiological manifestation and significance" *Journal of Bone and Joint Surgery,* **36B**:180-193.

Benjamin, M., Kumai, T., Milz, S., Boszczyk, B. M., Boszczyk, A. A. and Ralphs, J. R. (2002) "The Skeletal Attachment of Tendons - Tendon 'Entheses'" *Comparative Biochemistry and Physiology Part A,* **133**:931-945.

Benjamin, M. and McGonagle, D. (2001) "The Anatomical Basis for Disease Localisation in Seronegative Spondyloarthropathy at Entheses and Related Sites" *Journal of Anatomy,* **199**:503-526.

Benjamin, M. and Ralphs, J. R. (1996) "Tendons in Health and Disease" *Manual Therapy,* **1:4**: 186-191.

Bermudez de Castro, J. M., Bromage, T. G. and Fernandez Jalvo, Y. (1988) "Buccal Striations on Fossil Human Anterior Teeth: Evidence of Handedness in the Middle and Early Upper Pleistocene" *Journal of Human Evolution,* **17**:403-412.

Bertram, J. E. A. and Swartz, S. M. (1991) "The Law of Bone Transformation: A Case of Crying Wolff?" *Biological Reviews,* **66**:245-273.

Bibby, S. R. S., Jones, D. A., Lee, R. B., Yu, J. and Urban, J. P. G. (2001) "The Pathophysiology of the Intervertebral Disc" *Joint Bone Spine,* **68**:537-542.

Binford, L. R. (1972) "Mortuary Practices: Their Study and Their Potential" In *An Archeological Perspective,* (Ed: Binford, L. R.): Seminar Press, New York, pp. 208-243.

Birkett, D. (1992) "Skeletal Pathology" In *An Anglo-Saxon cemetery at Norton, Cleveland,* (Ed: Sherlock, S. J. and Welch, M.): Council for British Archaeology, London, pp. 118 - 119.

Birrell, F. N. (2004) "Patterns of Joint Pain: lessons from epidemiology" *Rheumatology,* **43**:408-409.

Boddington, A. (1992) "Pagans, Christians and Agnostics. Patterns of Anglo-Saxon Burial Practice", in *Early Medieval Europe 1992* University of York, Medieval Europe, pp. 99-104

Boegard, T., Rudling, O., Petersson, I. F. and Jonsson, K. (1998) "Correlation Between Radiographically Diagnosed Osteophytes and Magnetic Resonance Detected Cartilage Defects in the Tibiofemoral Joint" *Annals of the Rheumatic Diseases.,* **57**:401-407.

Boulle, E.-L. (2001) "Osteological Features Associated With Ankle Hyperdorsiflexion" *International Journal of Osteoarchaeology,* **11**:345-349.

Boylston, A., Wiggins, R., Foreman, M. and Roberts, C. (1996) "Difficult Births and Brief Lives at Castledyke, Barton-on-Humber, England" In *Proceedings of the Twenty-Third Annual Meeting of the Paleopathology Association,* (Ed:Cockburn, E.): PPA, Durham, North Carolina, pp. 16.

Boylston, A., Wiggins, R. and Roberts, C. (1998) "Human Skeletal Remains" In *The Anglo-Saxon Cemetery at Castledyke South, Barton-on-Humber,* (Ed: Drinkall, G. and Foreman, M.): Sheffield Academic Press, Sheffield, pp. 221-235.

Brenan, J. (1991) *Hanging Bowls and their Contexts: An archaeological survey of their socio-economic significance from the fifth to seventh centuries AD,* B.A.R. British Series no.220, Oxford.

Brenan, J. (1998) "4.10 Social Structure" In *The Anglo-Saxon Cemetery at Castledyke South, Barton-on-Humber,* (Ed: Drinkall, G. and Foreman, M.): Sheffield Academic Press, Sheffield, pp. 341-353.

Bridges, P. S. (1989a) "Changes in Activities With the Shift to Agriculture in the Southeastern United States" *Current Anthropology,* **30**:385-394.

Bridges, P. S. (1989b) "Spondyloysis and its relationship to degenerative joint disease in the prehistoric southeastern United States" *American Journal of Physical Anthropology,* **79**:321-329.

Bridges, P. S. (1991a) "Degenerative Joint Disease in Hunter-Gatherers and Agriculturalists From the Southeastern United States" *American Journal of Physical Anthropology,* **85**:379-391.

Bridges, P. S. (1991b) "Skeletal Evidence of Changes in Subsistence Activities Between the Archaic and Mississippian Time" In *What Mean These Bones? Studies in Southeastern Bioarchaeology,* (Ed: Powell, M. L., Bridges, P. S. and Mires, A. M. W.): University of Alabama Press, Tuscaloosa, pp. 89-101.

Bridges, P. S. (1996) "Warfare and Mortality at Koger's Island, Alabama" *International Journal of Osteoarchaeology,* **6**:66-75.

Brooks, N. (2000) "Arms, Status and Warfare in Late-Saxon England" In *Communities and Warfare 700-1400,* (Ed: Brooks, N.): Hambledon Press, London, pp. 138-161.

Brooks, S. T. and Suchey, J. M. (1990) "Skeletal Age Determination Based upon the Os Pubis: A Comparison of the Acsadi-Nemeskeri and Suchey-Brooks Methods" *Human Evolution,* **5**:227-238.

Brothwell, D. (1989) "The Relationship of Tooth Wear to Ageing" In *Age Markers in the Human Skeleton,* (Ed: Iscan, M. Y.): C.C. Thomas, Springfield, Illinois, pp. 303-316.

Brothwell, D. (2000) "Studies on Skeletal and Dental Variation: A Veiw Across Two Centuries" In *Human Osteology in Archaeology and Forensic Science,* (Ed: Cox, M. and Mays, S.): Greenwich Medical Media, London, pp. 1-6.

Brothwell, D. R. (1963) *Digging Up Bones: the excavation, treatment and study of human remains,* British Museum (Natural History)., London.

Brown, J. (1995) "On Mortuary Analysis - with special reference to the Saxe-Binford Research Program" In *Regional Approaches to Mortuary Analysis,* (Ed: Beck, L. A.): Plenum Press, London, pp. 3-28.

Brown, K. (2000) "Ancient DNA Applications in Human Osteoarchaeology: Achievements, Problems and Potential" In *Human Osteology in Archaeology and Forensic Science,* (Ed: Cox, M. and Mays, S.): Greenwich Medical Media, London, pp. 455-473.

Brugmann, B. (2004) *Glass Beads from Anglo-Saxon Graves: A Study on the Provenance and Chronology of Glass Beads from Anglo-Saxon Graves,* Oxbow Books, Oxford.

Buckland-Wright, J. C., Macfarlane, D. G. and Lynch, J. A. (1991) "Osteophytes in the osteoarthritic hand - their incidence, size, distribution and progression" *Annals of the Rheumatic Diseases.,* **50**:627-630.

Budd, P., Millard, A., Chenery, C., Lucy, S. and Roberts, C. (2004) "Investigating population movement by stable isotope analysis: a report from Britain" *Antiquity,* **78:299:** 127-141.

Buffa, R., Marini, E. and Floris, G. (2001) "Variation in Sexual Dimorphism in Relation to Physical Activity" *American Journal of Human Biology,* **13**:341-348.

Buikstra, J. E. and Ubelaker, D. H. (1994) *Standards for Data Collection from Human Skeletal Remains,* Arkansas Archaeological Survey Research Series No. 44, Arkansas Archaeological Survey, Arkansas.

Bullough, P. G. and Boachie-Adjei, O. (1988) *Atlas of Spinal Diseases,* Gower Medical Publishing, London.

Burnett, A. F., Khangure, M. S., Elliott, B. C., Foster, D. H., Marshall, R. N. and Hardcastle, P. H. (1996) "Thoracolumbar Disc Degeneration in Young Fast Bowlers in Cricket: A Follow-Up Study" *Clinical Biomechanics,* **11:6:** 305-310.

Bury, J. B. and Meiggs, R. (1975) *A History of Greece,* Fourth Edition, Macmillan Press Ltd, London.

Caffell, A. C., Roberts, C. A., Janaway, R. C. and Wilson, A. S. (2001) "Pressures on Osteological Collections- the Importance of Damage Limitation" In *Human Remains: Conservation, Retrieval and Analysis*, (Ed: Williams, E.): **934** British Archaeological Reports International Series, Oxford, pp. 187-197.

Cambridge, E. (1995) "Archaeology and the Cult of St. Oswald in Pre-Conquest Northumbria" In *Oswald: Northumbrian King to European Saint*, (Ed: Stancliffe, C. and Cambridge, E.): Stamford.

Carver, M. (2004) "An Iona of the East: The Early-medieval Monastery at Portmahomak, Tarbat Ness" *Medieval Archaeology*, 1-30.

Carver, M. O. H. (1994) "Environment and Commodity in Anglo-Saxon England" In *Environment and Economy in Anglo-Saxon England*, (Ed: Rackham, J.): Council for British Archaeology, York, pp. 1-6.

Cave, R. C. and Coulson, H. H. (1965) *A Source Book for Medieval Economic History*, Biblo and Tannen, New York.

Chadwick, H. M. (1924) *The Origin of the English Nation*, Cambridge University Press, Cambridge.

Chambler, A. F. W., Pitsillides, A. A. and Emery, R. J. H. (2003) "Acromial Spur Formation in Patients with Rotator Cuff Tears" *Journal of Shoulder and Elbow Surgery*, **12:4:** 314-321.

Chandraraj, S., Briggs, C. A. and Opeskin, K. (1998) "Disc Herniations in the Young and End-Plate Vascularity" *Clinical Anatomy*, **11:**171-176.

Chhibber, S. R. and Singh, I. (1971) "Asymmetry in Muscle Weight and One Sided Dominance in the Human Lower Limbs" *Journal of Anatomy*, **106:**553-556.

Chilibeck, P. D., Davison, K. S., Sale, D. G., Webber, C. E. and Faulkner, R. A. (2000) "Effect of Physical Activity on Bone Mineral Density Assessed by Limb Dominance Across the Lifespan" *American Journal of Human Biology*, **12:**633-637.

Chitnavis, J., Sinsheimer, J. S., Clipsham, K., Loughlin, J., Sykes, B., Burge, P. D. and Carr, A. J. (1997) "Genetic Influences in End-Stage Osteoarthritis: Sibling Risks of Hip and Knee Replacement for Idiopathic Osteoarthritis" *Journal of Bone and Joint Surgery*, **79: British edition:** 660-604.

Churchill, S. E. and Formicola, V. (1997) "A Case of Marked Bilateral Asymmetry in the Upper Limbs of an Upper Palaeolithic Male from Barma Grande (Liguria), Italy" *International Journal of Osteoarchaeology*, **7:**18-38.

Churchill, S. E. and Morris, A. G. (1998) "Muscle Marking Morphology and Labour Intensity in Prehistoric Khoisan Foragers" *International Journal of Osteoarchaeology*, **8:**390-411.

Claudepierre, P. and Voisin, M.-C. (2005) "The Entheses: Histology, Pathology and Pathophysiology" *Joint Bone Spine*, **72:**32-37.

Cobb, S., Merchant, W. R. and Rubin, T. (1957) "The relation of symptoms to osteoarthritis" *Journal of Chronic Diseases*, **5:**197-204.

Cohen, M. N. and Armelagos, G. J. (Eds.) (1984) *Paleopathology at the Origins of Agriculture*, Academic Press, Orlando.

Colgrave, B. and Mynors, R. A. B. (Eds.) (1969) *Bede's Ecclesiastical History of the English People,* Clarendon Press, Oxford.

Collet, P., Uebelhart, D., Vico, L., Moro, L., Hartmann, D., Roth, M. and Alexandre, C. (1997) "Effects of 1- and 6-Month Spaceflight on Bone Mass and Biochemistry in Two Humans" *Bone,* **20**:547-551.

Conaghan, P. G. (2002) "Update in Osteoarthritis Part 1: Current Concepts and the Relation to Exercise" *British Journal of Sports Medicine,* **36**:330-333.

Conrozier, T., Saxne, T., Fan, C., Mathieu, P., Tron, A. M., Heinegard, D. and al, e. (1998) "Serum Concentrations of Cartilage Oligomeric Matrix Protein and Bone Sialoprotein in Hip Osteoarthritis: a One Year Prospective Study" *Annals of the Rheumatic Diseases.,* **57**:527-532.

Constandse-Westermann, T. S. and Newell, R. R. (1989) "Limb Lateralization and Social Stratification in Western European Mesolithic Societies" In *People and Culture in Change* BAR International Series 508, (Ed: Hershkovitz, I.): British Archaeological Reports, Oxford, pp. 405-433.

Cooper, C., McAlindon, T., Coggon, D., Egger, P. and Dieppe, P. (1994) "Occupational activity and Osteoarthritis of the Knee." *Annals of the Rheumatic Diseases.,* **53**:90-93.

Cox, M. (2000) "Ageing Adults From the Skeleton" In *Human Osteology in Archaeology and Forensic Science,* (Ed: Cox, M. and Mays, S.): Greenwich, London, pp. 61-82.

Cramp, R. (1988) "Northumbria: the archaeological evidence" In *Power and Politics in Early Medieval Britain and Ireland,* (Ed: Driscoll, S. T. and Nieke, M. R.): Edinburgh University Press, Edinburgh, pp. 69-78.

Crawford, C. (1991) "When do Anglo-Saxon Children Count?" *Journal of Theoretical Archaeology,* **2**:17-24.

Crawford, S. (1997) "Britons, Anglo-Saxons and the Germanic Burial Ritual" In *Migrations and Invasions in Archaeological Explanation,* (Ed: Chapman, J. and Hamerow, H.): **664** British Archaeological Reports International Series, Oxford, pp. 45-72.

Croft, P., Coggon, D., Cruddas, M. and Cooper, C. (1992) "Osteoarthritis of the hip; an occupational disease in farmers" *British Medical Journal,* **304**:1269-1272.

Crubezy, E., Goulet, J., Bruzek, J., Jelinek, J., Rouge, D. and Ludes, B. (2002) "Epidemiology of Osteoarthritis and Enthesopathies in a European Population Dating Back 7700 Years" *Joint Bone Spine,* **69**:580-588.

Cyron, B. M. and Hutton, W. C. (1978) "The Fatigue Strength of the Lumbar Neural Arch in Spondylolysis" *Journal of Bone and Joint Surgery,* **60B**:234-238.

Cyron, B. M., Hutton, W. C. and Troup, J. D. G. (1976) "Spondylolytic Fractures" *Journal of Bone and Joint Surgery,* **58B**:462-466.

Dahlberg, G. (1940) *Statistical Methods for Medical and Biological Students,* Allen and Unwin, London.

Davidson, H. E. (1989) "The Training of Warriors" In *Weapons and Warfare in Anglo-Saxon England,* (Ed: Hawkes, S. C.): Oxford University Committee for Archaeology, Oxford, pp. 11-23.

Dawson, J. E. and Trinkaus, E. (1997) "Vertebral Osteoarthritis of the La Chapelle-aux-Saints 1 Neanderthal" *Journal of Archaeological Science,* **24:**1015-1021.

de Vingo, P. (2003) "Personal Equipment and Fighting Techniques Among the Anglo-Saxon Population in Northern Europe During the Early Middle Ages" *The Heroic Age,* **6:**Online at: http://www.mun.ca/mst/heroicage/issues/6/toc.html.

Dickinson, T. M. (2002) "Review Article: What's New in Early Medieval Burial Archaeology" *Early Medieval Europe,* **11:1:** 71-87.

Dickinson, T. M. and Härke, H. (1992) *Early Anglo-Saxon Shields,* Archaeologica 110, Society of Antiquaries, London.

Dieppe, P. and Rogers, J. (1989) "Skeletal Paleopathology of Rheumatic Disorders" In *Arthritis and Allied Conditions* 11th, (Ed: McCarty, D. J.): Lea and Febinger, Philadelphia.

Down, A. and Welch, M. (1990) *Chichester Excavations VII: Apple Down and The Mardens,* Chichester District Council, Chichester.

Drinkall, G. (1998) "Dating and phasing of graves" In *The Anglo-Saxon Cemetery at Castledyke South, Barton-on-Humber,* (Ed: Drinkall, G. and Foreman, M.): Sheffield Academic Press, Sheffield, pp. 314-331.

Drinkall, G. and Foreman, M. (1998) *The Anglo-Saxon Cemetery at Castledyke South, Barton-on-Humber,* Sheffield Academic Press, Sheffield.

Duhig, C. (1998) "The Human Skeletal Material" In *The Anglo-Saxon Cemetery at Edix Hill (Barrington A), Cambridgeshire,* (Ed: Malim, T. and Hines, J.): Council for British Archaeology, London, pp. 154 - 196.

Dutour, O. (1986) "Enthesopathies (Lesions of Muscular Insertions) as Indicators of the Activities of Neolithic Saharan Populations" *American Journal of Physical Anthropology,* **71:**221-224.

Eachus, J., Williams, M., Chan, P., Davey Smith, G., Grainge, M., Donovan, J. and Frankel, S. (1996) "Deprivation and cause specific morbidity: evidence from the Somerset and Avon survey of health" *British Medical Journal,* **312:**287-292.

Effros, B. (1997) "Beyond Cemetery Walls: Early Medieval Funerary Topography and Christian Salvation" *Early Medieval Europe,* **6:1:** 1-23.

Ernst, C. W., Stadnik, T. W., Peeters, E., Breucq, C. and Osteaux, M. J. C. (in press) "Prevalence of Annular Tears and Disc Herniations on MR Images of the Cervical Spine in Symptom Free Volunteers" *European Journal of Radiology,* **online at www.elsevier.com/locate/ejrad 11/08/05.**

Eshed, V., Gopher, A., Galili, E. and Hershkovitz, I. (2004) "Musculoskeletal Stress Markers in Natufian Hunter-Gatherers and Neolithic Farmers in the Levant: The Upper Limb" *American Journal of Physical Anthropology,* **123:**303-315.

Evison, V. (1987) *Dover: The Buckland Anglo-Saxon Cemetery,* English Heritage, London.

Evison, V. (1994) *An Anglo-Saxon Cemetery at Great Chesterford, Essex,* CBA Research Report 91, Council for British Archaeology, York.

Fahey, V., Opeskin, K., Silberstein, M., Anderson, R. and Briggs, C. (1998) "The Pathogenesis of Schmorl's Nodes in Relation to Acute Trauma: An Autopsy Study" *Spine,* **23:21:** 2272-2275.

Fairbank, J. (2002) "Clinical importance of the intervertebral disc, or back pain for biochemists" *Biochemical Society Transactions,* **30:6:** 829-831.

Felson, D. T. (1994) "Do Occupation-Related Physical Factors Contribute to Arthritis?" *Baillieres Clinical Rheumatology: International Practice and Research,* **8:1:** 63-77.

Felson, D. T. (2001) "Epidemiology of the Rheumatic Diseases" In *Arthritis and Allied Conditions* 14th Edition, (Ed: Koopman, W. J.): **Volume 1** Lippincott Williams & Wilkins, Philadelphia, pp. 3-38.

Feuerstein, M., Miller, V., Burrell, L. M. and Berger, R. (1998) "Occupational Upper Extremity Disorders in the Federal Workforce- Prevalence, Health Care Expenditures, and Patterns of Work Disability" *Journal of Occupational and Environmental Medicine,* **40:6:** 546-555.

Fibiger, L. and Knüsel, C. (2005) "Prevalence Rates of Spondylolysis in British Skeletal Populations" *International Journal of Osteoarchaeology,* **15:**164-174.

Fiorato, V., Boylston, A. and Knüsel, C. (Eds.) (2000) *Blood Red Roses: the archaeology of a mass grave from the Battle of Towton AD 1461,* Oxbow Books, Oxford.

Foreman, M. (1998a) "The Excavations" In *The Anglo-Saxon Cemetery at Castledyke South, Barton-on-Humber,* (Ed: Drinkall, G. and Foreman, M.): Sheffield Academic Press, Sheffield, pp. 18-30.

Foreman, M. (1998b) "vi Weapon Burials - Conclusions" In *The Anglo-Saxon Cemetery at Castledyke South, Barton-on-Humber,* (Ed: Drinkall, G. and Foreman, M.): Sheffield Academic Press, Sheffield, pp. 252.

Fournie, B. (2004) "Pathology and Clinico-Pathologic Correlations in Spondyloarthropathies" *Joint Bone Spine,* **71:**525-529.

Fowler, P. (2002) *Farming in the First Millennium AD: British Agriculture Between Julius Caesar and William the Conqueror,* Cambridge University Press, Cambridge.

Fowler, P. J. (1997) "Farming in Early Medieval England: Some Fields for Thought" In *The Anglo-Saxons from the Migration Period to the Eighth Century: an Ethnographic Perspective,* (Ed: Hines, J.): The Boydell Press, Woodbridge, pp. 245-268.

Freemont, A. J. (2002) "Enthesopathies" *Current Diagnostic Pathology,* **8:**1-10.

Fresia, A. E., Ruff, C. B. and Larsen, C. S. (1990) "Temporal decline in bilateral asymmetry of the upper limb on the Georgia Coast" In *The Archaeology of the Mission Santa Catalina De Guale: 2. Biocultural Interpretations of a Population in Transition,* (Ed: Larsen, C. S.): The American Museum of Natural History, New York, pp. 121-132.

Garn, S. M. (1970) *The Earlier Gain and Later Loss of Cortical Bone: In Nutritional Perspective,* Charles C Thomas, Springfield.

Garn, S. M., Mayor, G. H. and Shaw, H. A. (1976) "Paradoxical Bilateral Asymmetry in Bone Size and Bone Mass in the Hand" *American Journal of Physical Anthropology,* **45:**209-210.

Geake, H. (1992) "Burial Practice in Seventh- and Eighth-Century England" In *The Age of Sutton Hoo: The Seventh Century in North-Western Europe,* (Ed: Carver, M. O. H.): The Boydell Press, pp. 83-94.

Geake, H. (1997) *The Use of Grave-Goods in Conversion-Period England, c.600-c.850,* B.A.R British Series 261, British Archaeological Reports, Oxford.

Geake, H. (2002) "Persistent Problems in the Study of Conversion-Period Burials in England" In *Burial in Early Medieval England and Wales*, (Ed: Lucy, S. and Reynolds, A.): Society for Medieval Archaeology, Leeds, pp. 144-155.

Geake, H. (2003) "The Control of Burial Practice in Anglo-Saxon England" In *The Cross Goes North: Processes of Conversion in Northern Europe, AD 300-1300*, (Ed: Carver, M): York Medieval Press, York, pp 259-270.

Goh, S., Tan, C., Price, R. I., Edmondston, S. J., Song, S., Davis, S. and Singer, K. P. (2000) "Influence of Age and Gender on Thoracic Vertebral Body Shape and Disc Degeneration: an MR Investigation of 169 cases." *Journal of Anatomy,* **197:**647-657.

Goodship, A. E., Lanyon, L. E. and McFie, H. (1979) "Functional Adaptation of Bone to Increased Stress" *Journal of Bone and Joint Surgery,* **61-A:**539-208.

Gowland, R. L. (2002) *Age as an aspect of social identity in fourth- to sixth-century AD England; the archaeological funerary evidence,* Archaeology, University of Durham, Durham

Grauer, A. L. and Roberts, C. A. (1996) "Paleoepidemiology, Healing, and Possible Treatment of Trauma in the Medieval Cemetery Population of St Helen-on-the-Walls, York, England" *American Journal of Physical Anthropology,* **100:**531-544.

Gray, P. B. and Marlowe, F. (2002) "Fluctuating Asymmetry of a Foraging Population: The Hadza of Tanzania" *Annals of Human Biology,* **29:5:** 495-501.

Groves, S. E. (2001) *Bilateral asymmetry of the upper limb in a skeletal population from Hanging Ditch, Manchester,* Department of Archaeology, University of Durham, Durham

Haapasalo, H., Kontulainen, S., Sievanen, H., Kannus, P., Jarvinen, M. and Vuori, I. (2000) "Exercise-Induced Bone Gain is due to Enlargement in Bone Size Without a Change in Volumetric Bone Density: a Peripheral Quantitative Computed Tomography Study of the Upper Arms of Male Tennis Players" *Bone,* **27:**351-357.

Hadler, N. M., Gillings, D. B., Imbus, H. R. and al, e. (1978) "Hand Structure and Function in an Industrial Setting" *Arthritis and Rheumatism,* **21:**210-220.

Hadley, D. M. (2002) "Burial Practices in Northern England in the Later Anglo-Saxon Period" In *Burial in Early Medieval England and Wales*, (Ed: Lucy, S. and Reynolds, A.): The Society for Medieval Archaeology, London, pp. 209-228.

Hager, L. (1996) "Sex differences in the sciatic notch of great apes and modern humans" *American Journal of Physical Anthropology,* **99:**287-300.

Haines, R. W. and Mohuiddin, A. (1968) "Metaplastic Bone" *Journal of Anatomy,* **103:**527-538.

Halsall, G. (1995a) *Early Medieval Cemeteries: An introduction to burial archaeology in the post-Roman West,* Cruithne Press, Glasgow.

Halsall, G. (1995b) *Settlement and Social Organisation: The Merovingian Region of Metz,*, Cambridge.

Hamanishi, C., Kawabata, T., Yosii, T. and Tanaka, S. (1994) "Schmorl's Nodes on Magnetic Resonance Imaging. Their Incidence and Clinical Relevance" *Spine,* **19:4:** 450-453.

Hamerow, H. (1997) "Migration Theory and the Anglo-Saxon "identity crisis"." In *Migrations and Invasions in Archaeological Explanation,* (Ed: Chapman, J. and Hamerow, H.): **664** British Archaeological Reports International Series, Oxford, pp. 33-44.

Hannan, M. T., Felson, D. T., Anderson, J. J. and Naimark, A. (1993) "Habitual Physical Activity is Not Associated with Knee Osteoarthritis: the Framingham Study" *Journal of Rheumatology,* **20:**704-709.

Hansson, T. and Roos, B. (1983) "The Amount of Bone Mineral and Schmorl's Nodes in Lumbar Vertebrae" *Spine,* **8:3:** 266-271.

Härke, H. (1989a) "Early Saxon Weapon Burials: Frequencies, Distributions and Weapon Combinations" In *Weapons and Warfare in Anglo-Saxon England,* (Ed: Hawkes, S. C.): Oxford University Committee for Archaeology, Oxford, pp. 49-61.

Härke, H. (1989b) "Knives in Early Saxon Burials: Blade Length and Age at Death" *Medieval Archaeology,* **33:**144-148.

Härke, H. (1990) ""Warrior Graves"? The Background of the Anglo-Saxon Weapon Burial Rite" *Past and Present,* **126:**22-43.

Härke, H. (1992a) *Anglesachsische Waffengraber des 5.bis 7. Jahrhunderts,* Rheinland-Verlag GMBH, Koln.

Härke, H. (1992b) "Changing Symbols in a Changing Society: The Anglo-Saxon Weapon Burial Rite in the Seventh Century" In *The Age of Sutton Hoo: The Seventh Century in North-Western Europe,* (Ed: Carver, M. O. H.): The Boydell Press,, pp. 149-165.

Härke, H. (1997a) "Early Anglo-Saxon Social Structure" In *The Anglo-Saxons from the Migration Period to the Eighth Century: an Ethnographic Perspective,* (Ed: Hines, J.): The Boydell Press, Woodbridge, pp. 125-170.

Härke, H. (1997b) "Material Culture as Myth: Weapons in Anglo-Saxon Graves" In *Burial and Society: The Chronological and Social Analysis of Archaeological Burial Data,* (Ed: Kjeid Jensen, C. and Hoilund Nielsen, K.): Aarhus,, pp. 119-128.

Härke, H. (2000) "Social Analysis of Mortuary Evidence in German Protohistoric Archaeology" *Journal of Anthropological Archaeology,* **19:**369-384.

Harman, M. (1990) "The Human Remains" In *Chichester Excavations VII: Apple Down and the Mardens,* (Ed:Down, A. and Welch, M.): Chichester District Council, Chichester, pp. 181-194.

Hawkey, D. E. (1988) *Use of upper extremity enthesopathies to indicate habitual activity patterns,* Unpublished MA thesis, Arizona State University, Tempe

Hawkey, D. E. (1998) "Disability, Compassion and the Skeletal Record: Using Musculoskeletal Stress Markers (MSM) to Construct an Osteobiography from Early New Mexico" *International Journal of Osteoarchaeology,* **8:**326-340.

Hawkey, D. E. and Merbs, C. F. (1995) "Activity-induced Musculoskeletal Stress Markers (MSM) and Subsistence Strategy Changes among Ancient Hudson Bay Eskimos" *International Journal of Osteoarchaeology,* **5:**324-338.

Hedeager, L. (1992) "Social and Political Systems" In *Iron Age Societies: From Tribe to State in Northern Europe, 500 BC to AD 700,*Blackwell, Oxford, pp. 83 - 179.

Higgins, J. (in press) *Human remains from Bishopsmill School, Norton,* Unpublished site report Tees Archaeology,

Higham, N. (1986) *The Northern Counties to AD 1000,* Longman, London.

Higham, N. (1993) *The Kingdom of Northumbria: AD 350-1100,* Alan Sutton, Stroud.

Hill, P. (1997) *Whithorn and St. Ninian; The Excavation of a Monastic Town, 1984-91,*, Stroud.

Hillson, S. (2000) "Dental Pathology" In *Biological Anthropology of the Human Skeleton,* (Ed: Katzenberg, M. A. and Saunders, S. R.): Wiley-Liss, New York, pp. 249-286.

Hilton, R. C. and Benn, R. T. (1976) "Vertebral End-Plate Lesions (Schmorl's Nodes) in the Dorsolumbar Spine" *Annals of the Rheumatic Disease.,* **35:**127-132.

Hines, J. (1984) *The Scandinavian Character of Anglian England in the pre-Viking period.,* BAR British Series 124, British Archaeological Reports, Oxford.

Hines, J. (1997) "Religion: the Limits of Knowledge" In *The Anglo-Saxons from the Migration Period to the Eighth Century: an Ethnographic Perspective,* (Ed: Hines, J.): The Boydell Press, Woodbridge, pp. 375-410.

Hines, J. (1998) "The Finds" In *The Anglo-Saxon Cemetery at Edix Hill (Barrington A, Cambridgeshire,* (Ed: Malim, T. and Hines, J.): Council for British Archaeology, London, pp. 200-228.

Hirst, S. M. (1985) *An Anglo-Saxon Inhumation Cemetery at Sewerby, East Yorkshire,* York University Archaeological Publications, York.

Hope-Taylor, B. (1962) "University of Durham Gazette" **Vol IX (New Series):No. 4.**

Hope-Taylor, B. (1977) *Yeavering: an Anglo-British Centre of Early Northumbria,* Her Majesty's Stationary Office, London.

Hough, A. J. (1996) "Pathology of Osteoarthritis" In *Arthritis and Allied Conditions* 13th Edition, (Ed: Koopman, W. J.): Lea and Febinger, Philadelphia, pp. 1945-1968.

Hough, A. J. (2001) "Pathology of Osteoarthritis" In *Arthritis and Allied Conditions* 14th Edition, (Ed: Koopman, W. J.): **Volume 2** Lippincott, Williams & Wilkins, Philadelphia, pp. 2167-2194.

Hough, A. J. and Sokoloff, L. (1989) "Pathology of Osteoarthritis" In *Arthritis and Allied Conditions* 11th Edition, (Ed: McCarty, D. J.): Lea and Febiger, Philadelphia, pp. 1571-1594.

Hoyte, D. A. N. and Enlow, D. H. (1966) "Wolff's Law and the Problem of Muscle Attachments on Resorptive Surfaces of Bone" *American Journal of Physical Anthropology,* **24:**205-214.

Humphrey, L. (2000) "Growth Studies of Past Populations: An Overview and an Example" In *Human Osteology in Archaeology and Forensic Science,* (Ed: Cox, M. and Mays, S.): Greenwich Medical Media Ltd, London, pp. 23-38.

Hurwitz, D. E., Foucher, K. C., Sumner, D. R., Andriacchi, T. P., Rosenberg, A. G. and Galante, J. O. (1998) "Hip Motion and Moments During Gait Relate Directly to Proximal Femoral Bone Mineral Density in Patients with Hip Osteoarthritis." *Journal of Biomechanics,* **31:**919-925.

Ingvarsson, T., Hagglund, G. and Lohmander, L. S. (1999) "Prevalence of Hip Osteoarthritis in Iceland" *Annals of the Rheumatic Diseases,* **58:**201-207.

Iscan, M. Y. and Loth, S. R. (1986) "Estimation of Age and Determination of Sex from the Sternal Rib" In *Forensic Osteology: Advances in the Identification of Human Remains,* (Ed: Reichs, K. J.): **68-89** C.C. Thomas, Springfield, Illinois.

Jakab, G. (1989) "Occupational Spondylolysis and Spondylolisthesis" *Baillieres Clinical Rheumatology: International Practice and Research,* **3:1:** 89-98.

James, E. (1989) "Burial and Status in the Early Medieval West" *Transactions of the Royal Historical Society* 5th ser, **39:**23-40.

James, E. (2001) *Britain in the First Millennium,* Arnold, London.

Jankauskas, R. (2003) "The Incidence of Diffuse Ideopathic Skeletal Hyperostosis and Social Status Correlations in Lithuanian Skeletal Materials" *International Journal of Osteoarchaeology,* **13:**289-293.

Jones, H. H., Priest, J. D., Hayes, W. C., Chinn Tichenor, C. and Nagel, D. A. (1977) "Humeral Hypertrophy in Response to Exercise" *Journal of Bone and Joint Surgery,* **59-A:**204-208.

Judd, M. A. and Roberts, C. (1999) "Fracture Trauma in a Medieval British Farming Village" *American Journal of Physical Anthropology,* **109:**229-243.

Judge, T. A. and Cable, D. M. (2004) "The Effect of Height on Workplace Success and Income: A Preliminary Test of a Theoretical Model" *Journal of Applied Psychology,* **89:3:** 428-442.

Jurmain, R. (1977) "Stress and the Etiology of Osteoarthritis" *American Journal of Physical Anthropology,* **46:**353-366.

Jurmain, R. (1990) "Palaeoepidemiology of a Central California Prehistoric Population from CA-ALA-329. II Degenerative Disease" *American Journal of Physical Anthropology,* **83:**83-94.

Jurmain, R. (1991) "Degenerative Changes in Peripheral Joints as Indicators of Mechanical Stress: Opportunities and Limitations" *International Journal of Osteoarchaeology,* **1:**247-252.

Jurmain, R. (1999) *Stories from the Skeleton: Behavioural Reconstruction in Human Osteology,* Gordon and Breech, Amsterdam.

Kamp, K. A. (2001) "Where Have All the Children Gone?: The Archaeology of Childhood" *Journal of Archaeological Method and Theory,* **8:1:** 1-34.

Keller, T. S., Colloca, C. J., Harrison, D. E., Harrison, D. D. and Janik, T. J. (2005) "Influence of Spine Morphology on Intervertebral Disc Loads and Stresses in Asymptomatic Adults: Implications for the Ideal Spine" *The Spine Journal,* **5:**297-309.

Kelley, J. O. and Angel, J. L. (1987) "Life Stresses of Slavery" *American Journal of Physical Anthropology,* **74:**199-211.

Kelley, M. A. (1982) "Intervertebral osteochondrosis in ancient and modern populations" *American Journal of Physical Anthropology,* **59:**271-279.

Kellgren, J. H. and Lawrence, J. S. (1957) "Radiological assessment of osteo-arthrosis" *Annals of the Rheumatic Diseases.,* **16:**494-451.

Kemkes-Grottenthaler, A. (2005) "The Short Die Young: The Interrelationship Between Stature and Longevity - Evidence from Skeletal Remains" *American Journal of Physical Anthropology,* **In Press.**

Kennedy, K. A. R. (1983) "Morphological variations in ulnar supinator crests and fossae as identifying markers of occupational stress" *Journal of Forensic Sciences,* **28:**871-876.

Kennedy, K. A. R. (1989) "Skeletal Markers of Occupational Stress" In *Reconstruction of Life From the Skeleton,* (Ed: Iscan, M. Y. and Kennedy, K. A. R.): Alan R. Liss, Inc., New York, pp. 129-160.

Kennedy, K. A. R. (1998) "Markers of Occupational Stress: Conspectus and Prognosis of Research" *International Journal of Osteoarchaeology,* **8:**305-310.

Khan, K. M., Bennell, K. L., Hopper, J. L., Flicker, L., Nowson, C. A., Sherwin, A. J., Crichton, K. J., Harcourt, P. R. and Wark, J. D. (1998) "Self-Reported Ballet Classes Undertaken at Age 10-12 Years and Hip Bone Mineral Density in Later Life" *Osteoporosis International,* **8:**165-173.

Kilgore, L., Jurmain, R. and van Gerven, D. P. (1997) "Paleoepidemiological Patterns of Trauma in a Medieval Nubian Skeletal Population" *International Journal of Osteoarchaeology,* **7:**103-114.

King, J. M. (2004) "Grave Goods as Gifts in Early Saxon Burials (ca. AD 450-600)" *Journal of Social Archaeology,* **4:2:** 214-238.

King, J. W., Brelsford, H. J. and Tullos, H. S. (1969) "Analysis of the Pitching Arm of the Professional Pitcher" *Clinical Orthopaedics and Related Research,* **67:**116-123.

Klar, A. J. S. (2003) "Human Handedness and Scalp Hair-Whorl Direction Develop From a Common Genetic Mechanism" *Genetics,* **165:**269-276.

Knapp, T. R. (1992) "Technical Error of Measurement: A Methodological Critique" *American Journal of Physical Anthropology,* **87:**235-236.

Knüsel, C. (2000a) "Activity-related skeletal change (Chapter 9)" In *Blood Red Roses: the archaeology of a mass grave from the Battle of Towton AD 1461,* (Ed: Fiorato, V., Boylston, A. and Knusel, C.): Oxbow Books, Oxford, pp. 103-118.

Knüsel, C. (2000b) "Bone Adaptation and its Relationship to Physical Activity in the Past" In *Human Osteology in Archaeology and Forensic Science,* (Ed: Cox, M. and Mays, S.): Greenwich Medical Media, London, pp. 381-401.

Knüsel, C., Goggel, S. and Lucy, D. (1997) "Comparative Degenerative Joint Disease of the Vertebral Column in the Medieval Monastic Cemetery of the Gilbertine Priory of St. Andrew, Fishergate, York, England" *American Journal of Physical Anthropology,* **103:**481-495.

Knüsel, C., Roberts, C. and Boylston, A. (1996) "Brief Communication: When Adam Delved... An Activity-Related Lesion in Three Human Skeletal Populations" *American Journal of Physical Anthropology,* **100:**427-434.

Kontulainen, S., Sievanen, H., Kannus, P., Pasanen, M. and Vuori, I. (2003) "Effect of Long-Term Impact-Loading on Mass, Size, and Estimated Strength of Humerus and Radius of Female Raquet-Sports Players: A Peripheral Quantitative Computed Tomography Study Between Young and Old Starters and Controls" *Journal of Bone Mineral Research,* **18**:352-259.

Kujala, U. M., Kettunen, H., Paananen, H. and al, e. (1995) "Knee Osteoarthritis in Former Runners, Soccer Players, Weight Lifters and Shooters" *Arthritis and Rheumatism,* **38**:539-546.

Lacey, R. and Danziger, D. (1999) *The Year 1000,* Abacus, London.

Lai, P. and Lovell, N. C. (1992) "Skeletal Markers of Occupational Stress in the Fur Trade: a Case Study from a Hudson's Bay Company Fur Trade Post" *International Journal of Osteoarchaeology,* **2**:221-234.

Lane, N. E., Bloch, P. D., Jones, H. H. *et al.* (1987) "Ageing, Long-Distance Running and the Development of Musculoskeletal Disability. A Controlled Study" *American Journal of Medicine,* **82**:772-780.

Lane, N. E., Bloch, P. D., Jones, H. H. *et al.* (1989) "Osteoarthritis in the hand: a comparison of handedness and hand use" *Journal of Rheumatology,* **16**:637-642.

Lanyon, P., Muir, K., Doherty, S. and Doherty, M. (2000) "Assessment of a Genetic Contribution to Osteoarthritis of the Hip: Sibling Study" *British Medical Journal,* **321**:1179 - 1183.

Larsen, C. S. (1997) *Bioarchaeology: Interpreting Behaviour from the Human Skeleton,* Cambridge University Press, Cambridge.

Larsen, C. S., Ruff, C. B. and Kelly, R. L. (1995) "Structural analysis of the Stillwater postcranial human remains: Behavioural implications of articular joint pathology and long bone diaphyseal morphology" In *Bioarchaeology of the Stillwater Marsh,* (Ed: Larsen, C. S. and Kelly, R. L.): American Museum of Natural History, New York, pp. 107-133.

Law, A. (2004) "A Simple Method for Calculating the Prevalence of Disease in a Past Human Population" *International Journal of Osteoarchaeology*??

Lawrence, J. S. (1955) "Rheumatism in coal miners. III. Occupational factors" *British Journal of Industrial Medicine,* **12**:249-261.

Lawrence, J. S. (1961) "Rheumatism in cotton operatives" *British Journal of Industrial Medicine,* **18**:270-276.

Lawrence, J. S., Bremner, J. M. and Bier, F. (1966) "Osteoarthrosis. Prevalence in the Population and Relationship Between Symptoms and X-Ray Changes" *Annals of the Rheumatic Diseases.,* **25**:1-24.

Lazenby, R. (1995) "Brief Communication: Non-Circular Geometry and Radiogrammetry of the Second Metacarpal" *American Journal of Physical Anthropology,* **97**:323-327.

Leahy, K. (1998a) "Discussion and Interpretation: Summary" In *The Anglo-Saxon Cemetery at Castledyke South, Barton-on-Humber,* (Ed: Drinkall, G. and Foreman, M.): Sheffield Academic Press, Sheffield, pp. 358-364.

Leahy, K. (1998b) "The Early Saxon Context" In *The Anglo-Saxon Cemetery at Castledyke South, Barton-on-Humber*, (Ed: Drinkall, G. and Foreman, M.): Sheffield Academic Press, Sheffield, pp. 6-13.

Lee, T. C., Staines, A. and Taylor, D. (2002) "Bone Adaptation to Load: Microdamage as a Stimulus for Bone Remodelling." *Journal of Anatomy*, **201**:437-446.

Lethbridge, T. C. (1931) *Recent Investigations in Anglo-Saxon Cemeteries in Cambridgeshire and Suffolk*, Cambridge Antiquarian Society, Cambridge.

Lewis, M. (2000) "Non-Adult Palaeopathology: Current Status and Future Potential" In *Human Osteology in Archaeology and Forensic Science*, (Ed: Cox, M. and Mays, S.): Greenwich Medical Media, London, pp. 39-59.

Lieberman, D. E., Devlin, M. J. and Pearson, O. M. (2001) "Articular Area Responses to Mechanical Loading: Effects of Exercise, Age, and Skeletal Location" *American Journal of Physical Anthropology*, **116**:266-277.

Lieberson, F. (1937) "Os acromiale- a contested anomaly" *Journal of Bone and Joint Surgery*, **19**:683-689.

Lillios, K. T. (1999) "Objects of Memory: The Ethnography and Archaeology of Heirlooms" *Journal of Archaeological Method and Theory*, **6**:**3**: 235-262.

Loth, S. R. and Iscan, M. Y. (1989) "Morphological assessment of age in the adult: The thoracic region" In *Age Markers in the Human Skeleton*, (Ed:Iscan, M. Y.): Charles Thomas, Illinois, pp. 105-135.

Lovejoy, C. O., Meindl, R. S., Mensforth, R. P. and Barton, T. J. (1985) "Multifactorial determination of skeletal age at death; a method and blind tests of its accuracy" *American Journal of Physical Anthropology*, **68**:1-14.

Lovell, N. C. (1997) "Trauma Analysis in Paleopathology" *Yearbook of Physical Anthropology*, **40**:139-170.

Lovell, N. C. and Dublenko, A. A. (1999) "Further Aspects of Fur Trade Life Depicted in the Skeleton" *International Journal of Osteoarchaeology*, **9**:248-256.

Lucy, S. (2000) *The Anglo-Saxon Way of Death*, Stroud, London.

Lucy, S. (2002a) "Burial Practice in Early Medieval Eastern Britain: Constructing Local Identities, Deconstructing Ethnicity" In *Burial in Early Medieval England and Wales*, (Ed: Lucy, S. and Reynolds, A.): The Society for Medieval Archaeology, London, pp. 72-87.

Lucy, S. (2002b) "From Pots to People: Two Hundred Years of Anglo-Saxon Archaeology" In *'Lastworda Betst': Essays in Memory of Christine E. Fell, With her Unpublished Writings*, (Ed: Hough, C. and Lowe, K. A.): Shaun Tyas, Donington, pp. 144-169.

Lucy, S. and Reynolds, A. (Eds.) (2002a) *Burial in Early Medieval England and Wales*, Society for Medieval Archaeology Monograph 17, The Society for Medieval Archaeology, London.

Lucy, S. and Reynolds, A. (2002b) "Burial in Early Medieval England and Wales: Past, Present and Future" In *Burial in Early Medieval England and Wales*, (Ed: Lucy, S. and Reynolds, A.): The Society for Medieval Archaeology, London, pp. 1-23.

Lucy, S. J. (1998) *The Early Anglo-Saxon Cemeteries of East Yorkshire: An Analysis and Re-interpretation,* BAR British Series 272, BAR, Oxford.

Maat, G. J. R. and Mastwijk, R. W. (2000) "Avulsion Injuries of Vertebral Endplates" *International Journal of Osteoarchaeology,* **10:**142-152.

Maat, G. J. R., Mastwijk, R. W. and Van Der Velde, E. A. (1995) "Skeletal Distribution of Degenerative Changes in Vertebral Osteophytosis, Vertebral Osteoarthritis and DISH" *International Journal of Osteoarchaeology,* **5:**289-298.

Mackie, W. S. (Ed.) (1934) *Exeter Book - Part II: Poems IX - XXXII,* Early English Text Society: Original Series, Oxford University Press, London.

Madrigal, L. (1998) *Statistics for Anthropology,* Cambridge University Press, Cambridge.

Maillefert, J. F., Gueguen, A., Monreal, M., Nguyen, M., Berdah, L., Lequesne, M., Mazieres, B., Vignon, E. and Dougados, M. (2003) "Sex Differences in Hop Osteoarthritis: Results of a Longitudinal Study in 508 Patients" *Annals of the Rheumatic Diseases.,* **62:**931-934.

Malmivaara, A., Videman, T., Kuosma, E. and Troup, J. D. (1987) "Plain Radiographic, Discographic, and Direct Observations of Schmorl's Nodes in the Thoracolumbar Junctional Region of the Cadaveric Spine" *Spine,* **12:5:** 453-457.

Mankin, H. J., Brandt, K. D. and Shulman, L. E. (1986) "Workshop on Etiopathogenesis of Osteoarthritis. Proceedings and Recommendations" *Journal of Rheumatology,* **13:**1130-1160.

Mankin, H. J. and Radin, E. (1989) "Structure and Function of Joints" In *Arthritis and Allied Conditions* 11th Edition, (Ed: McCarty, D. J.): Lea and Febinger, Philadelphia, pp. 189-206.

Marks, R. and Allegrante, J. P. (2002) "Body Mass Indices in Patients with Disabling Hip Osteoarthritis" *Arthritis Research,* **4:**112-116.

Marlow, M. (1992) "The Human Remains" In *An Anglo-Saxon Cemetery at Norton, Cleveland,* (Ed: Sherlock, S. J. and Welch, M.): **CBA Research Report 82** Council for British Archaeology, London, pp. 107-120.

Marras, W. S., Davis, K. G. and Jorgensen, M. (2003) "Gender Influences on Spine Loads During Complex Lifting" *The Spine Journal,* **3:**93-99.

Martin, E. A. (Ed.) (1998) *Oxford Concise Medical Dictionary,* Fifth Edition, Oxford University Press, Oxford.

Matsui, H., Terahata, N., Tsuji, H., Hirano, N. and Naruse, Y. (1992) "Familial Predisposition and Clustering for Juvenile Lumbar Disc Herniation" *Spine,* **17:**1223-1228.

Mays, S. (1998) *The Archaeology of Human Bones,* Routledge, London.

Mays, S. (1999) "A Biomechanical Study of Activity Patterns in a Medieval Human Skeletal Assemblage" *International Journal of Osteoarchaeology,* **9:**68-73.

Mays, S. (2000) "Age-Dependent Cortical Bone Loss in Women From 18th and Early 19th Century London" *American Journal of Physical Anthropology,* **112:**349-361.

Mays, S. (2001) "Effects of Age and Occupation on Cortical Bone in a Group of 18th-19th Century British Men" *American Journal of Physical Anthropology,* **116:**34-44.

Mays, S. (2002) "Osteological and Biomolecular Study of Two Possible Cases of Hypertrophic Osteoarthropathy from Mediaeval England" *Journal of Archaeological Science,* **29:**1267-1276.

Mays, S. and Cox, M. (2000) "Sex Determination in Skeletal Remains" In *Human Osteology in Archaeology and Forensic Science,* (Ed: Cox, M. a. M. S.): Greenwich Medical Media Ltd, London, pp. 117-130.

Mays, S., Steele, J. and Ford, M. (1999) "Directional Asymmetry in the Human Clavicle" *International Journal of Osteoarchaeology,* **9:**18-28.

Mays, S. A. (2005) "Supra-acetabular Cysts in a Medieval Skeletal Population" *International Journal of Osteoarchaeology,* **15:**233-246.

Mazieres, B. and Rovensky, J. (2000) "Non-inflammatory Enthesopathies of the Spine: a Diagnostic Approach" *Baillieres Clinical Rheumatology: International Practice and Research,* **14:2:** 201-217.

McCarthy, E. F. and Frassica, F. J. (1998) *Pathology of Bone and Joint Disorders: with clinical and radiographic correlation,* W.B. Saunders Company, Philadelphia.

McFadden, K. D. and Taylor, J. R. (1989) "End-Plate Lesions of the Lumbar Spine" *Spine,* **14:8:** 867-869.

McGaughey, I. and Sullivan, P. (2003) "The Epidemiology of Knee and Ankle Injuries on Macquarie Island" *Injury: International Journal of the Care of the Injured,* **34:**842-846.

McKinley, T. O. and Bay, B. K. (2003) "Trabecular bone strain changes associated with subchondral stiffening of the proximal tibia" *Journal of Biomechanics,* **36:**155-163.

McLorg, P. A. (2000) "Variability in Humeral Dimensions in a Sample of Modern Human Females: Implications for Measuring Cortical Bone Loss" *American Journal of Human Biology,* **12:**118-127.

Meaney, A. (1964) *A Gazetteer of Early Anglo-Saxon Burial Sites,* George Allen & Unwin Ltd, London.

Meaney, A. (1998) "Girdle Groups: reconstruction and comparative study" In *The Anglo-Saxon Cemetery at Edix Hill (Barrington A), Cambridgeshire,* (Ed: Malim, T. and Hines, J.): **CBA Research Report 112** Council for British Archaeology, York, pp. 268-274.

Merbs, C. F. (1983) "Patterns of Activity-Induced Pathology in a Canadian Inuit Population." *Archaeological Survey of Canada, Mercury Series Paper.,* **119.**

Merbs, C. F. (1989) "Spondylolysis; its nature and anthropological significance" *International Journal of Anthropology,* **4:**163-169.

Merbs, C. F. (1996a) "Spondylolysis and Spondylolisthesis: a Cost of Being an Erect Biped or a Clever Adaptation" *Yearbook of Physical Anthropology,* **39:**201-228.

Merbs, C. F. (1996b) "Spondylolysis of the Sacrum in Alaskan and Canadian Inuit Skeletons" *American Journal of Physical Anthropology,* **101:**357-367.

Merbs, C. F. (2001) "Degenerative Spondylolisthesis in Ancient and Historic Skeletons From New Mexico Pueblo Sites" *American Journal of Physical Anthropology,* **116:**285-295.

Michael, R. H. and Holder, L. E. (1985) "The Soleus Syndrome: a Cause of Medial Tibial Stress (Shin Splints)" *American Journal of Sports Medicine,* **13**:87-94.

Micheli, L. J. and Klein, J. D. (1991) "Sports injuries in children and adolescents" *British Journal of Sports Medicine,* **25**:6-9.

Miles, A. E. W. (1998) "New Light on the Acromial Attachment of the Human Coraco-Acromial Ligament" *International Journal of Osteoarchaeology,* **8**:274-279.

Miles, A. E. W. (1999) "Observations on the Undersurface of the Skeletalized Human Acromion in Two Populations" *International Journal of Osteoarchaeology,* **9**:131-145.

Milne, B. J., Belsky, J., Poulton, R., Murray Thompson, W., Caspi, A. and Kieser, J. (2003) "Fluctuating Asymmetry and Physical Health Among Young Adults" *Evolution and Human Behaviour,* **24**:53-63.

Mirtz, T. A. and Greene, L. (2005) "Is Obesity a Risk Factor for Low Back Pain? An Example of Using the Evidence to Answer a Clinical Question" *Chiropractic & Osteopathy,* **13:2**. http://www.chiroandosteo.com/content/13/1/2

Molleson, T. (1989) "Seed preparation in the Mesolithic: The osteological evidence" *Antiquity,* **63**:356-362.

Molleson, T. and Cox, M. (1993) *The Spitalfields Project Volume 2: The Anthropology. The Middling Sort,* CBA Research Report 86, Council for British Archaeology, York.

Montgomery, J., Evans, J. A., Powesland, D. and Roberts, C. (2005) "Continuity or Colonization in Anglo-Saxon England? Isotope Evidence for Mobility, Subsistence Practice and Status at West Heslerton" *American Journal of Physical Anthropology,* **126:2**: 123-138.

Moriggl, B., Jax, P., Milz, A., Buttner, A. and Benjamin, M. (2001) "Fibrocartilage at the Entheses of the Suprascapular (Superior Transverse Scapular) Ligament of Man- A Ligament Spanning Two Regions of a Single Bone" *Journal of Anatomy,* **199**:539-545.

Moskowitz, R. W. and Holderbaum, D. (2001) "Clinical and Laboratory Findings in Osteoarthritis" In *Arthritis and Allied Conditions* 14th Edition, (Ed: Koopman, W. J.): **Volume 2** Lippincott Williams and Wilkins, Philadelphia, pp. 2216-2245.

Munson Chapman, N. E. (1997) "Evidence for Spanish Influence on Activity Induced Musculoskeletal Stress Markers at Pecos Pueblo" *International Journal of Osteoarchaeology,* **7**:497-506.

Murray, R. O. (1965) "The Aetiology of Primary OA of the Hip" *British Journal of Radiology,* **38**:810-824.

Murrell, G. A. (2002) "Understanding Tendinopathies" *British Journal of Sports Medicine,* **36**:392-393.

Nakama, L. H., King, K. B., Abrahamsson, S. and Rempel, D. M. (2005) "Evidence of Tendon Microtears due to Cyclical Loading in an In Vivo Tendinopathy Model" *Journal of Orthopaedic Research,* **in press.**

Neri, R. and Lancellotti, L. (2004) "Fractures of the Lower Limbs and their Secondary Skeletal Adaptations: a 20th Century Example of Pre-modern Healing" *International Journal of Osteoarchaeology,* **14**:60-66.

NIAMS (2000) *Handout on Health Osteoarthritis,* National Institute of Arthritis and Musculoskeletal and Skin Diseases Information Clearinghouse, Bethesda. http://www.niams.nih.gov/hi/index.htm

Niepel, G. A. and Sit' Aj, S. (1979) "Enthesopathy" *Clinics in Rheumatic Diseases,* 5:857-872.

Nystrom, K. C. and Buikstra, J. E. (2005 (in Press)) "Trauma-Induced Changed in Dyaphyseal Cross-Sectional Geometry in Two Eltes from Copan, Honduras" *American Journal of Physical Anthropology,* **127**:in press.

O'Brien, C. (2002) "The Early Medieval Shires of Yeavering, Bamburgh and Breamish" *Archaeologia Aeliana,* **5th Series:30**: 53-73.

O'Brien, E. (1999) *Post Roman Britain to Anglo-Saxon England: Burial Practices Reviewed,* **BAR British Series 289**, BAR, Oxford.

Ondrouch, A. S. (1963) "Cyst Formation in Osteoarthritis" *Journal of Bone and Joint Surgery,* **45B:British series**: 755-760.

Ortner, D. J. (1968) "Description and Classification of Degenerative Bone Changes in the Distal Joint Surfaces of the Humerus" *American Journal of Physical Anthropology,* **28**:139-156.

O'Shea, J. M. (1984) *Mortuary Variability: An Archaeological Investigation,* Academic Press, London.

Owen-Crocker, G. R. (1986) *Dress in Anglo-Saxon England,* Manchester University Press, Manchester.

Owsley, D. W., Gill, G. W. and Owsley, S. D. (1994) "Biological Effects of European Contact on Easter Island" In *In the Wake of Contact. Biological Responses to Conquest,* (Ed: Larsen, C. S. and Milner, G. R.): Wiley-Liss, New York, pp. 161-177.

Pader, E.-J. (1982) *Symbolism, Social Relations and the Interpretation of Mortuary Remains,* **130**, BAR, International Series, British Archaeological Reports, Oxford.

Pande, B. S. and Singh, I. (1971) "One-sided dominance in the upper limbs of human fetuses as evidenced by asymmetry in muscle and bone weight" *Journal of Anatomy,* **109**:457-459.

Pawlowski, B., Dunbar, R. I. M. and Lipowicz, A. (2000) "Evolutionary Fitness: Tall Men Have More Reproductive Success" *Nature,* **403:6766**: 156.

Pearson, O. M. and Lieberman, D. E. (2004) "The Ageing of Wolff's "Law": Ontogeny and Responses to Mechanical Loading" *Yearbook of Physical Anthropology,* **47**:63-99.

Peebles, C. S. and Kus, S. M. (1977) "Some Archaeological Correlates of Ranked Societies" *American Antiquity,* **42:3**: 421-448.

Peng, B., Wu, W., Hou, S., Shang, W., Wang, X. and Yang, Y. (2003) "The pathogenesis of Schmorl's nodes" *Journal of Bone and Joint Surgery,* **85-B**:879-882.

Peters, M. (1991) "Laterality and Motor Control" In *Biological Asymmetry and Handedness,*Wiley, Chichester, pp. 300-311.

Peterson, J. (1998) "The Natufian Hunting Conundrum: Spears, Atlatls, or Bows? Musculoskeletal and Armature Evidence" *International Journal of Osteoarchaeology,* **8**:378-389.

Peterson, J. D. (2000) "Labour Patterns in the Southern Levant in the Early Bronze Age" In *Reading the Body: representations and remains in the archaeological record,* (Ed: Rautman, A. E.): University of Pennsylvania Press, Philadelphia, pp. 38-54.

Petersson, I. F., Boegard, T., Saxne, T., Silman, A. J. and Svensson, B. (1997a) "Radiographic Osteoarthritis of the Knee Classified by the Ahlback and Kellgren & Lawrence Systems for the Tibiofemoral Joint in People Aged 35-54 Years with Chronic Knee Pain" *Annals of the Rheumatic Diseases.,* **56:**493-496.

Petersson, I. F., Boegard, T., Svensson, B., Heinegard, D. and Saxne, T. (1998) "Changes in Cartilage and Bone Metabolism Identified by Serum Markers in Early Osteoarthritis of the Knee Joint" *British Journal of Rheumatology,* **37:**46-50.

Petersson, I. F., Sandqvist, L., Svensson, B. and Saxne, T. (1997b) "Cartilage Markers in synovial Fluid in Symptomatic Knee Osteoarthritis" *Annals of the Rheumatic Diseases,* **56:** 64-67.

Pfeiffer, S. (1980) "Age Changes in the Eternal Dimensions of Adult Bone" *American Journal of Physical Anthropology,* **52:**529-532.

Pfirrmann, C. W. and Resnick, D. (2001) "Schmorl's Nodes of the Thoracic and Lumbar Spine: Radiographic-Pathologic Study of Prevalence, Characterization, and Correlation with Degenerative Changes of 1,650 Spinal Levels in 1000 Cadavers" *Radiology,* **219:2:** 368-374.

Phenice, T. W. (1969) "A Newly Developed Visual Method of Sexing in the Os Pubis" *American Journal of Physical Anthropology,* **30:**297-301.

Pinals, R. S. (1989) "Traumatic Arthritis and Allied Conditions" In *Arthritis and Allied Conditions* 11th, (Ed: McCarty, D. J.): Lea and Febinger, Philadelphia, pp. 1371-1389.

Pitsavos, C., Panagiotakos, D. B., Lentzas, Y. and Stefanadis, C. (2005 (in press)) "Epidemiology of Leisure-Time Physical Activity in Socio-Demographic, Lifestyle and Psychological Characteristics of Men and Women in Greece: The ATTICA Study" *BMC Public Health,* **5:37.**

Porter, A. M. W. (1999) "Modern Human, Early Modern Human and Neanderthal Limb Proportions" *International Journal of Osteoarchaeology,* **9:**54-67.

Porter, J. (1995) *Anglo-Saxon Riddles,* Anglo-Saxon Books, Hockwold-cum-Wilton.

Powesland, D. (1997) "Early Anglo-Saxon Settlements, Structures, Form and Function" In *The Anglo-Saxons from the Migration Period to the Eighth Century: an Ethnographic Perspective,* (Ed: Hines, J.): The Boydell Press, Woodbridge, pp. 101-124.

Puranen, J., Ala-Ketola, L., Peltokallio, P. and al, e. (1975) "Running and Primary Osteoarthritis of the Hip" *British Medical Journal,* **2:**424-425.

Rackham, J. (Ed.) (1994) *Environment and Economy in Anglo-Saxon England,* CBA Research Report 89, Council for British Archaeology, York.

Radin, E. L., Paul, I. L. and Rose, R. M. (1972) "Role of Mechanical Factors in Pathogenesis of Primary Osteoarthritis" *The Lancet,* **March 4th:**519-522.

Rahtz, P., Dickinson, T. and Watts, L. (Eds.) (1980) *Anglo-Saxon Cemeteries 1979: The Fourth Anglo-Saxon Symposium at Oxford,* B.A.R British Series 82, British Archaeological Reports, Oxford.

Rannou, F., Corvol, M., Revel, M. and Poiraudeau, S. (2001) "Disk Degeneration and Disk Herniation: The Contribution of Mechanical Stress" *Joint Bone Spine,* **68**:543-546.

Rannou, F., Revel, M. and Poiraudeau, S. (2003) "Editorial: Is Degenerative Disc Disease Genetically Determined?" *Joint Bone Spine,* **70**:3-5.

Reeves, W. (1857) *Life of St Columba,* Irish Archaeological Society.

Renfrew, C. and Bahn, P. (1996) *Archaeology: Theories, Methods and Practice,* Thames and Hudson, London.

Resnick, D. and Niwayama, G. (1978) "Intravertebral Herniation: Cartilagenous (Schmorl's) Nodes" *Radiology,* **126**:57-65.

Resnick, D. and Niwayama, G. (1983) "Entheses and Enthesopathy: Anatomical, pathological and radiological correlation." *Radiology,* **146**:1-9.

Resnick, D., Shaul, S. R. and Robins, J. M. (1975) "Diffuse idiopathic skeletal hyperostosis (DISH): Forestier's disease with extraspinal manifestations" *Radiology,* **115**:513-524.

Reynolds, A. (2005) "Review Article: On Farmers, Traders and Kings: Archaeological Reflections of Social Complexity in Early Medieval North-Western Europe" *Early Medieval Europe,* **13:1**: 97-118.

Rhodes, J. A. and Knüsel, C. (2005) "Activity-Related Skeletal Change in Medieval Humeri: Cross-Sectional and Architectural Alterations" *American Journal of Physical Anthropology,* **Early View.**

Richards, J. D. (1992) "Anglo-Saxon Symbolism" In *The Age of Sutton Hoo: The Seventh Century in North-Western Europe,* (Ed: Carver, M. O. H.): The Boydell Press,, pp. 132-147.

Robb, J. (1994) "Skeletal signs of activity in the Italian Metal Ages: Methodological and interpretive notes" *Human Evolution,* **9**:215-229.

Robb, J. E. (1998) "The Interpretation of Skeletal Muscle Sites: A Statistical Approach" *International Journal of Osteoarchaeology,* **8**:363–377.

Robb, J. E., Bigazzi, R., Lazzarini, L., Scarsini, C. and Sonego, F. (2001) "Social "Status" and Biological "Status": A Comparison of Grave Goods and Skeletal Indicators from Pontecagnano" *American Journal of Physical Anthropology,* **115**:213-222.

Roberts, C. and Cox, M. (2003) *Health and Disease in Britain: From Prehistory to the Present Day,* Sutton Publishing Ltd, Stroud.

Roberts, C. and Manchester, K. (1995) *The Archaeology of Disease,* Second Edition, Sutton Publishing Ltd., Stroud.

Rogers, J. and Dieppe, P. (1981) "Arthritis in Saxon and Medieval Skeletons" *British Medical Journal,* **283**:1668-1671.

Rogers, J., Shepstone, L. and Dieppe, P. (1997) "Bone Formers: osteophyte and enthesophyte formation are positively associated." *Annals of the Rheumatic Diseases.,* **56**:85-90.

Rogers, J. and Waldron, H. A. (1989) "The Palaeopathology of Enthesopathy" In *Advances in Palaeopathology: Proceedings of the VII European Meeting of the Palaeopathology Association*, PPA, Lyon, pp. 169-172.

Rogers, J. and Waldron, T. (1995) *A Field Guide to Joint Diseases in Archaeology,* John Wiley, New York.

Rogers, J. and Waldron, T. (2001) "DISH and the Monastic Way of Life" *International Journal of Osteoarchaeology,* **11**:357-365.

Rogers, J., Waldron, T., Dieppe, P. and Watt, I. (1987) "Arthropathies in Palaeopathology: The Basis of Classification according to Most Probable Cause" *Journal of Archaeological Science,* **14**:179-193.

Rogers, J., Watt, I. and Dieppe, P. (1990) "Comparison of Visual and Radiographic Detection of Bony Changes at the Knee Joint" *British Medical Journal,* **300**:367-368.

Rollason, D. (2003) *Northumbria, 500-1100,* Cambridge University Press, Cambridge.

Ronchese, F. (1948) *Occupational Marks and Other Physical Signs: A Guide to Personal Identification,* Grune and Stratton, New York.

Rothschild, B. M. (1997) "Porosity: A Curiosity Without Diagnostic Significance" *American Journal of Physical Anthropology,* **104**:529-533.

Rowe, P. (2000) *Anglo-Saxon Teeside,* **Archaeological Booklet No.1,** Tees Archaeology, Hartlepool.

Roy, T. A., Ruff, C. B. and Plato, C. C. (1994) "Hand Dominance and Bilateral Asymmetry in the Structure of the Second Metacarpal" *American Journal of Physical Anthropology,* **94**:203-211.

Ruff, C. B. (2000a) "Biomechanical Analyses of Archaeological Human Skeletons" In *Biological Anthropology of the Human Skeleton,* (Ed: Katzenberg, M. A. and Saunders, S. R.): Wiley-Liss, New York, pp. 71-102.

Ruff, C. B. (2000b) "Body Size, Body Shape, and Long Bone Strength in Modern Humans" *Journal of Human Evolution,* **38**:269-290.

Ruff, C. B. and Jones, H. H. (1981) "Bilateral asymmetry in cortical bone of the humerus and tibia- sex and age factors" *Human Biology,* **53:1**: 69-86.

Ruff, C. B. and Larsen, C. S. (1990) "Postcranial biomechanical adaptations to subsistence strategy changes on the Georgia Coast" In *The Archaeology of Mission Santa Catalina De Guale: 2. Biocultural Interpretations of a Population in Transition,* (Ed: Larsen, C. S.): The American Museum of Natural History, New York, pp. 94-120.

Ruff, C. B., Larsen, C. S. and Hayes, W. C. (1984) "Structural Changes in the Femur with the Transition to Agriculture on the Georgia Coast" *American Journal of Physical Anthropology,* **64**:125-136.

Ruff, C. B., Scott, W. W. and Liu, A. Y.-C. (1991) "Articular and Diaphyseal Remodeling of the Proximal Femur With Changes in Body Mass in Adults" *American Journal of Physical Anthropology,* **86**:397-413.

Ruff, C. B., Walker, A. and Trinkaus, E. (1994) "Postcranial Robusticity in Homo. III: Ontogeny" *American Journal of Physical Anthropology,* **93**:35-54.

Rugg, G. and Mullane, M. (2001) "Inferring Handedness from Lithic Evidence" *Laterality,* **6 (3)**:247-259.

Runestad, J. A., Ruff, C. B., Neih, J. C., Thorington, R. W. and Teaford, M. F. (1993) "Radiographic Estimation of Long Bone Cross-Sectional Geometric Properties" *American Journal of Physical Anthropology,* **90**:207-213.

Sakaue, K. (1998) "Bilateral Asymmetry of the Humerus in Jomon People and Modern Japanese" *Anthropological Science,* **105 (4)**:231-246.

Saluja, G., Fitzpatrick, K., Bruce, M. and Cross, J. (1986) "Schmorl's nodes (intravertebral herniations of intervertebral disc tissue) in two historic British populations" *Journal of Anatomy,* **145**:187-196.

Sarringhaus, L. A., Stock, J. T., Marchant, L. F. and McGrew, W. C. (2005) "Bilateral Asymmetry in the Limb Bones of the Chimpanzee (Pan troglodytes)" *American Journal of Physical Anthropology,* **127**:In Press.

Saunders, S. R. and Herring, A. (Eds.) (1995) *Grave Reflections: Portraying the Past through Cemetery Studies,* Canadian Scholars Press, Toronto.

Schell, L. M., Johnston, F. E., Smith, D. R. and Paolone, A. M. (1985) "Directional asymmetry of body dimensions among white adolescents" *American Journal of Physical Anthropology,* **67**:317-322.

Scheuer, L. and Black, S. (2000) *Developmental Juvenile Osteology,* Academic Press, London.

Schmitt, D., Churchill, S. E. and Hylander, W. L. (2003) "Experimental Evidence Concerning Spear Use in Neandertals and Early Modern Humans" *Journal of Archaeological Science,* **30**:103-114.

Schmorl, G. and Junghanns, H. (1971) *The Spine in Health and Disease,* Second edition, Grune and Stratton, New York.

Schulting, R. J. (1996) "Antlers, bone pins and flint blades: the Mesolithic cemeteries of Teviec and Hoedic, Brittany" *Antiquity,* **70**:335-350.

Scull, c. (1993) "Archaeology, Early Anglo-Saxon Society and the Origins of the Anglo-Saxon Kingdoms" *Anglo-Saxon Studies in Archaeology and History,* **6**:65-82.

Segal, R., Avrahami, E., Lebdinski, E., Habut, B., Leibovitz, A., Gil, I., Yaron, M. and Caspi, D. (1998) "The Impact of Hemiparalysis on the Expression of Osteoarthritis" *Arthritis and Rheumatism,* **41**:**12**: 2249-2256.

Shaibani, A., Workman, R. and Rothschild, B. M. (1993) "The Significance of Enthesopathy as a Skeletal Phenomenon" *Clinical and Experimental Rheumatology,* **11**:399-403.

Sherlock, S. J. and Welch, M. G. (1992) *An Anglo-Saxon cemetery at Norton, Cleveland,* CBA Research Report 82, Council for British Archaeology, London.

Shrier, I. (2004) "Muscle Dysfunction Versus Wear and Tear as a Cause of Exercise Related Osteoarthritis: an Epidemiological Update" *British Journal of Sports Medicine,* **38**:526-535.

Sofaer Derevenski, J. R. (2000) "Sex Differences in Activity-Related Osseous Change in the Spine and the Gendered Division of Labour at Ensay and Wharram Percy, UK" *American Journal of Physical Anthropology,* **111**:333-354.

Sokoloff, L. (1969) *The Biology of Degenerative Joint Disease,* University of Chicago Press, London.

Solomon, L. (1976) "Patterns of Osteoarthritis of the Hip" *Journal of Bone and Joint Surgery,* **58B**:176-183.

Southworth, E. (Ed.) (1986) *Anglo-Saxon Cemeteries: A Reappraisal,* Alan Sutton, Stroud, Gloucestershire.

Spector, T. D., Nandra, D., Hart, D. J. and al, e. (1997) "Is Hormone Replacement Protective for Hand and Knee Osteoarthritis in Women? The Chingford Study" *Annals of the Rheumatic Diseases.,* **56**:432-434.

Stabler, A., Bellan, M., Weiss, M. and al, e. (1997) "MR Imaging of Enhancing Interosseous Disk Herniation (Schmorl's Nodes)" *American Journal of Roentgenology,* **168**:933-938.

Steckel, R. H. (1995) "Stature and the Standard of Living" *Journal of Economic Literature,* **33:4:** 1903-1940.

Steckel, R. H. (2004) "New Light on the "Dark ages": The Remarkably Tall Stature of Northern European Men during the Medieval Era" *Social Science History,* **28:2:** 211-229.

Steele, J. (2000) "Skeletal Indicators of Handedness" In *Human Osteology in Archaeology and Forensic Science,* (Ed: Cox, M. and Mays, S.): Greenwich Medical Media, London, pp. 307-324.

Steele, J. and Mays, S. (1995) "New Findings on the Frequency of Left- and Right-Handedness in Mediaeval Britain" *http://www.soton.ac.uk/tjms/handed.html.*

Steen, S. L. and Lane, R. W. (1998) "Evaluation of Habitual Activities among Two Alaskan Eskimo Populations Based on Musculoskeletal Stress Markers" *International Journal of Osteoarchaeology,* **8**:341-353.

Stenlund, B. (1993) "Shoulder tendinitis and osteoarthritis of the acromioclavicular joint and their relation to sports" *British Journal of Sports Medicine,* **27**:125-130.

Stenton, F. M. (1971) *Anglo-Saxon England,* Third Edition, Clarendon Press, Oxford.

Stephenson, I. P. (2002) *The Anglo-Saxon Shield,* Tempus, Stoud.

Steuer, H. (1989) "Archaeology and History: Proposals on the Social Structure of the Merovingian Kingdom" In *The Birth of Europe: Archaeology and Social Development in the First Milennium AD,* (Ed:Randsborg, K.): L'Erma di Bretschneider, Rome, pp. 100-122.

Stini, W. A. (1982) "Sexual Dimorphism and Nutrient Reserves" In *Sexual Dimorphism in Homo Sapiens,* (Ed: Hall, R. L.): Praeger, New York, pp. 391-419.

Stirland, A. J. (1993) "Asymmetry and Activity-related Change in the Male Humerus" *International Journal of Osteoarchaeology,* **3**:105-113.

Stirland, A. J. (1996) "Patterns of trauma in a unique Medieval parish cemetery" *International Journal of Osteoarchaeology,* **6**:92-100.

Stirland, A. J. (1998) "Musculoskeletal Evidence for Activity: Problems of Evaluation" *International Journal of Osteoarchaeology,* **8**:354-362.

Stirland, A. J. (2000) *Raising the Dead: The Skeleton Crew of King Henry VIII's Great Ship, The Mary Rose,* John Wiley and Sons, Ltd, Chichester.

Stirland, A. J. and Waldron, T. (1997) "Evidence for Activity Related Markers in the Vertebrae of the Crew of the Mary Rose" *Journal of Archaeological Science,* **24**:329-335.

Stock, J. and Pfeiffer, S. (2001) "Linking Structural Variability in Long Bone Diaphyses to Habitual Behaviours: Foragers From the Southern African Later Stone Age and the Andaman Islands" *American Journal of Physical Anthropology,* **115**:337-348.

Stone, R. J. and Stone, J. A. (2000) *Atlas of Skeletal Muscles,* 3rd edition, McGraw-Hill, London.

Stoodley, N. (1999) *The Spindle and the Spear: A Critical Enquiry into the Construction and Meaning of Gender in the Early Anglo-Saxon Burial Rite,* B.A.R British Series 288, British Archaeological Reports, Oxford.

Stoodley, N. (2000) "From the Cradle to the Grave: Age Organization and the Early Anglo-Saxon Burial Rite" *World Archaeology,* **31:3:** 456-472.

Suffolk-County-Council (2001) *Archaeological Service Annual Report 2000-2001,* Suffolk County Council Pamphlet.

Sullivan, A. (2004) "Reconstructing Relationships Among Mortality, Status and Gender at the Medieval Gilbertine Priory of St. Andrew, Fishergate, York" *American Journal of Physical Anthropology,* **124**:330-345.

Sumner, D. R. and Andriacchi, T. P. (1996) "Adaptation to Differential Loading: Comparison of Growth Related Changes in Cross-Sectional Properties of the Human Femur and Humerus" *Bone,* **19, 2**:121-126.

Swinscow, T. D. V. and Campbell, M. J. (1997) *Statistics at Square One,* 9th Edition, BMJ Publishing Group.

Swischuk, L. E., John, S. D. and Allbery, S. (1998) "Disk Degenerative Disease in Childhood: Scheuermann's Disease, Schmorl's Nodes, and the Limbus Vertebra: MRI Findings in 12 Patients" *Pediatric Radiology,* **28**:334-338.

Synek, E. M. (2000) "'Ex utroque sexu fidelium tres ordines' - The Status of Women in Early Medieval Canon Law" *Gender and History,* **12:3:** 595-621.

Tainter, J. A. (1977) "Modeling Change in Prehistoric Social Systems" In *For Theory Building in Archaeology,* (Ed: Binford, L. R.): Academic Press, New York, pp. 327-351.

Takahashi, K., Miyazaki, T., Ohnari, H., Takino, T. and Tomita, K. (1995) "Schmorl's Nodes and Low-Back Pain: Analysis of Magnetic Resonance Imaging Findings in Symptomatic and Asymptomatic Individuals" *European Spine Journal,* **4**:56-59.

Tanaka, N., An, H. S., Lim, T.-H., Fujiwara, A., Jeon, C.-H. and Haughton, V. M. (2001) "The Relationship Between Disc Degeneration and Flexibility of the Lumbar Spine" *The Spine Journal,* **1**:47-56.

Taylor, A. (2001) *Burial Practice in Early England,* Tempus, Stroud.

Thompson, V. (2002) "Constructing Salvation: A Homiletic and Penitential Context for Late Anglo-Saxon Burial Practice" In *Burial in Early Medieval England and Wales,* (Ed: Lucy, S. and Reynolds, A.): The Society for Medieval Archaeology, London, pp. 229-240.

Thompson, V. (2004) *Dying and Death in Later Anglo-Saxon England,* Anglo-Saxon Studies, The Boydell Press, Woodbridge.

Toth, N. (1985) "Archaeological Evidence for Preferential Right-Handedness in the Lower and Middle Pleistocene, and its Possible Implications" *Journal of Human Evolution,* **14:**607-614.

Trinkaus, E. and Churchill, S. E. (1999) "Diaphyseal Cross-sectional Geometry of Near Eastern Middle Palaeolithic Humans: The Humerus" *Journal of Archaeological Science,* **26:**173-184.

Trinkaus, E., Churchill, S. E. and Ruff, C. B. (1994) "Postcranial Robusticity in Homo. II: Humeral Bilateral Asymmetry and Bone Plasticity" *American Journal of Physical Anthropology,* **93:**1-34.

Trotter, M. (1970) "Estimation of stature from intact long bones" In *Personal investigation in mass disasters,* (Ed: Stewart, T. D.): National Museum of Natural History, Smithsonion Institution, Washington DC, pp. 71-83.

Tyrrell, A. (2000) "Skeletal Non-Metric Traits and the Assessment of Inter- and Intra-Population Diversity: Past Problems and Future Potential" In *Human Osteology in Archaeology and Forensic Science,* (Ed: Cox, M. and Mays, S.): Greenwich Medical Media, London, pp. 289-306.

Ucko, P. J. (1969) "Ethnography and Archaeological Interpretation of Funerary Remains" *World Archaeology,* **1:2:** 262-280.

Urban, J. P. G. and Roberts, S. (2003) "Degeneration of the Intervertebral Disc" *Arthritis Research and Therapy,* **5:3:** 120-130.

Urwin, M., Symmons, D., Allison, T., Brammah, T., Busby, H., Roxby, M., Simmons, A. and Williams, G. (1998) "Estimating the burden of musculoskeletal disorders in the community: the comparative prevalence of symptoms at different anatomical sites, and the relation to social deprivation" *Annals of the Rheumatic Diseases.,* **57:**649-655.

van der Meulen, M. C. H. and Huiskes, R. (2002) "Why Mechanobiology? A Survey Article" *Journal of Biomechanics,* **35:**401-414.

van Deursen, L. L., van Deurse, D. L., Snijders, C. J. and Wilke, H. J. (2005) "Relationship Between Everyday Activities and Spinal Shrinkage" *Clinical Biomechanics,* **20:**547-550.

van Dijk, C. N. (2002) "Management of the Sprained Ankle" *British Journal of Sports Medicine,* **36:**83-84.

Vingard, E., Alfredsson, L. and Malchau, H. (1997) "Lifestyle Factors and Hip Arthrosis: A Case Referent Study of Body Mass Index, Smoking and Hormone Therapy" *Acta Orthopaedia Scandinavia,* **68:**216-220.

Virtama, P. and Helela, T. (1969) "Radiographic Measurements of Cortical Bone: Variations in a Normal Population Between 1 and 90 Years of Age" *Acta Radiologica Supplementum,* **293.**

Wada, Y. (1998) "Morphological Assessment of Ethnic, Sex and Side Differences in the Human Radius Based on Intra-Regional and Side Ratios" *Anthropological Science,* **105(4):**193-210.

Waldron, H. A. (1993) "The health of the adults" In *The Spitalfields Project Volume 2: The Anthropology. The Middling Sort*, (Ed: Molleson, T. and Cox, M.): Council for British Archaeology, York, pp. 67-87.

Waldron, H. A. (1996) "Osteoarthritis of the hands in early populations" *British Journal of Rheumatology*, **35**:1292-1298.

Waldron, H. A. and Cox, M. (1989) "Occupational arthropathy. Evidence from the past" *British Journal of Industrial Medicine*, **46**:420-422.

Waldron, T. (1994) *Counting the Dead: The Epidemiology of Skeletal Populations*, John Wiley and Sons, Chichester.

Waldron, T. (1997) "Population Studies" *Paleopathology Newsletter*, **100**:22.

Walker, P. L. (1995) "Problems of Preservation and Sexism in Sexing: Some Lessons from Historical Collections for Palaeodemographers" In *Grave Reflections: Portraying the Past Through Cemetery Studies*, (Ed: Saunders, S. R. and Herring, A.): Canadian Scholars, Toronto, pp. 31-46.

Walker, P. L. and Cook, D. C. (1998) "Brief Communication: Gender and Sex: Vive la Difference" *American Journal of Physical Anthropology*, **106**:255-259.

Walker, P. L. and Holliman, S. E. (1989) "Changes in Osteoarthritis Associated with the Development of a Maritime Economy Among Southern California Indians" *International Journal of Anthropology*, **4:3:** 171-183.

Walton, P. (1992) "Textile Remains" In *An Anglo-Saxon Cemetery at Norton, Cleveland*, (Ed: Sherlock, S. J. and Welch, M. G.): Council for British Archaeology, London, pp. 57-61.

Wareham, A. (2001) "The Transformation of Kinship and the Family in Late Anglo-Saxon England" *Early Medieval Europe*, **10:3:** 375-399.

Weale, M. E., Weiss, D. A., Jager, R. F., Bradman, N. and Thomas, M. G. (2002) "Y Chromosome Evidence for Anglo-Saxon Mass Migration" *Molecular Biology and Evolution*, **19:7:** 1008-1021.

Weiss, E. (2003) "Understanding Muscle Markers: Aggregation and Construct Validity" *American Journal of Physical Anthropology*, **121**:230-240.

Weiss, E. (2004) "Understanding Muscle Markers: Lower Limbs" *American Journal of Physical Anthropology*, **125**:232-238.

Weiss, E. (2005) "Humeral Cross-Sectional Morphology From 18th Century Quebec Prisoners of War: Limits to Activity Reconstruction" *American Journal of Physical Anthropology*, **126**:311-317.

Welch, M. (1992) *Anglo-Saxon England*, Batsford Ltd/English Heritage, London.

Wells, C. (1974) "Osteochondritis Dissecans in Ancient British Skeletal Material" *Medical History*, **18**:365-369.

Wells, C. (1975) "Ancient Obstetric Hazards and Female Mortality" *Bulletin for the New York Academy of Medicine*, **51:11:** 1235-1249.

West, S. (1985) *West Stow: The Anglo-Saxon Village*, East Anglian Archaeology 24, Bury St Edmunds.

White, T. D. (2000) *Human Osteology*, Academic Press, London.

Wienker, C. W. and Wood, J. F. (1987) "Osteological individuality indicative of migrant citrus laboring." *Journal of Forensic Sciences,* **33:2:** 562-567.

Wilczak, C. A. (1998) "Consideration of Sexual Dimorphism, Age and Asymmetry in Quantative Measurements of Muscle Insertion Sites" *International Journal of Osteoarchaeology,* **8:**311-325.

Wilczak, C. A. and Kennedy, K. A. R. (1998) "Mostly MOS: Technical Aspects of Identification of Skeletal Markers of Occupational Stress" In *Forensic Osteology: Advances in the Identification of Human Remains* Second, (Ed: Reichs, K. J.): Charles C Thomas Ltd, Springfield, pp. 461-490.

Willey, P. and Hofman, J. L. (1994) "Interproximal grooves, toothaches, and purple coneflowers." In *Skeletal Biology in the Great Plains: Migration, Warfare, Health and Subsistence,* (Ed: Owsley, D. W. and Lantz, R. L.): Smithsonian Institution Press, Washington D.C., pp. 147-157.

Williams, H. (2003) "Material culture as memory: combs and cremation in early medieval Britian" *Early Medieval Europe,* **12:2:** 89-128.

Williams, H. (2005) "Review Article: Rethinking Early Medieval Mortuary Archaeology" *Early Medieval Europe,* **13:2:** 195-217.

Wolff, J. (1892) *The Law of Bone Remodelling,* Springer-Verlag, Berlin.

Wollheim, F. A. (2003) "Early stages of osteoarthritis: the search for sensitive predictors" *Annals of the Rheumatic Diseases.,* **62:**1031-1032.

Woo, S. L.-Y., Kuei, S. C., Amiel, D., Gomez, M. A., Hayes, W. C., White, F. C. and Akeson, W. H. (1981) "The Effect of Prolonged Physical Training on the Properties of Long Bone: A Study of Wolff's Law" *Journal of Bone and Joint Surgery,* **63-A:**780-786.

Wood, I. (1997) "Before and After the Migration to Britain" In *The Anglo-Saxons from the Migration Period to the Eighth Century: an Ethnographic Perspective,* (Ed: Hines, J.): The Boydell Press, Woodbridge, pp. 41-64.

Wood, J. W., Milner, G. R., Harpending, H. C. and Weiss, K. M. (1992) "The Osteological Paradox: Problems of Inferring Prehistoric Health from Skeletal Samples" *Current Anthropology,* **33:4:** 343-370.

Wood, P. N. (2003) *Excavation in the Bowl Hole Graveyard, Bamburgh: Summary of 2003 Results,* Bamburgh Research Project, Unpublished interim report.

Wormald, P. (1999) *The Making of English Law: King Alfred to the twelfth century,* Blackwell, Oxford.

Young, G. (2003) *Bamburgh Castle: The Archaeology of the Fortress of Bamburgh AD 500 to AD 1500,* The Bamburgh Research Project.