Comparing populations by odontometric methods brings out new aspects of relevance.

—A.D.

**Odontometric Study of Medieval Danes**

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A study of tooth size was carried out on medieval skeletal material from Aebelholt and Naestved in Denmark. Measurements of all suitable permanent teeth were made in both mesiodistal and buccolingual dimensions with a sliding caliper with vernier reading to 0.1 mm. The material was divided according to sex and place of excavation; statistical preparation of the data provided mean values and standard deviations of tooth dimensions for each group separately. The significance of observed differences was assessed by the *t* test.

The aims of this investigation were to examine sex differences in the teeth of medieval Danes from Aebelholt and Naestved; to examine differences between these population groups; to compare the results obtained for medieval Danes with data previously published for other prehistoric, early historic, and modern populations.

**Sex Differences**

There are sex differences in the size of the tooth crowns in medieval Danes. The mean mesiodistal and labiolingual diameters of the teeth of the Aebelholt males and of the Naestved males are invariably larger than the corresponding tooth diameters of Aebelholt and Naestved females; most of these sex differences are statistically significant. When the data for the two groups are combined, almost all the sex differences can be shown to be highly significant (*P < 0.001*). The sex differences in size are most pronounced for the canines.

Statistically significant sex differences in both crown dimensions have previously been demonstrated in non-European races by Mijsberg,14 Thomsen,24 Moorrees,15 and Barrett et al.1,2 Only the mesiodistal dimensions of the teeth have been studied in modern European races, and significant sex differences in this dimension have been shown by Seipel20 Moorrees et al.,10 Stähle,22 and Garn et al.7 The only previous study of European races in which the labiolingual diameters of the teeth were examined and were found to exhibit significant sex differences, was that carried out on prehistoric Scottish skulls.12 In every instance, the teeth of males were larger than the teeth of females. In all previous investigations, the canines showed the greatest sex difference in crown size. Thus, the findings in the medieval Danes of statistically significant sex differences that are most pronounced in the canines conform to the general pattern that is gradually emerging.

There is a slight tendency in the Danish material for the labiolingual diameters of the teeth to show more highly significant sex differences than the mesiodistal diameters. There is no general agreement on this point in previous work. In two of the four studies in which this point was considered, the labiolingual diameters showed more highly significant sex differences whereas, in the other two reports, the differences in the mesiodistal diameters appeared to attain a higher degree of statistical significance. It seems probable that there is little if any real difference between mesiodistal and labiolingual diameters in the degree to which they exhibit sex difference.

No pronounced sex difference in the variability of tooth dimensions can be demonstrated in the medieval Danes. Such sex differences in variability have been reported by Selmer-Olsen21 and Barrett et al.,1,2 and, in both these studies, the males...

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showed greater variability in tooth size. On the other hand, Stein and Epstein,\textsuperscript{23} in their limited study of molar size, recorded higher coefficients of variation in the females. The mean coefficient of variation for all tooth dimensions of Danish males is only 0.2 percent greater than the mean coefficient of variation for all tooth dimensions of Danish females. It does not seem likely that this small discrepancy can represent any real sex difference in variability of tooth dimensions.

With regard to the rank order of size of the molars, there appears to be some sex variation in the frequency of patterns found in the mandible. Reduction of the second molar until it is smaller than the third molar is more frequently encountered in the females than in the males. The quantity of data is not sufficient to allow assessment of the significance of this difference to be made.

The crown indexes give little evidence of a distinct sex difference in crown proportions. On the whole, these indexes have slightly higher values in the males, which indicates that the male teeth are relatively broader in the labiolingual dimension. This can perhaps be correlated with the slightly greater significance of sex differences in the labiolingual dimensions than in the mesiodistal dimensions. The sex differences in crown index, however, are seldom sufficiently great to be statistically significant.

Thus, although there is a pronounced sex difference in tooth size in medieval Danes displayed by both mesiodistal and labiolingual diameters, there does not appear to be any significant sex difference in crown proportions, as represented mathematically by the crown index. This result supports the findings of other workers such as Selmer-Olsen,\textsuperscript{21} Thomsen,\textsuperscript{24} and Moorrees,\textsuperscript{15} all of whom reported that the crown indexes gave less evidence of sex difference than did the actual mesiodistal and labiolingual diameters of the crown.

**Local Group Differences**

A comparison of tooth dimensions in the Aebelholt group with the corresponding dimensions in the Naestved group shows that in general the Aebelholt teeth are slightly larger than those from Naestved. Most of the differences in tooth size between the two groups are small and are not statistically significant. An exception occurs for the mesiodistal diameters of the mandibular teeth. In a few of these diameters, the males of the two groups show significant differences, and an even greater number of significant differences is found in the females.

Thus, it is concluded that the medieval populations of Aebelholt and Naestved differ little in respect to tooth size, with the exception of the mandibular premolars and molars, which are smaller in the mesiodistal dimension in the Naestved group. A relatively greater mesiodistal shortening of the mandibular postcanine teeth seems to have occurred in the Naestved population.

In the mandible, therefore, a greater difference between the groups is shown by the mesiodistal than by the labiolingual diameters. In the maxilla, no such difference is obvious.

Variability of tooth dimensions is similar in the females of the two groups, and the mean coefficient of variation for Naestved males corresponds fairly closely to those of the females. The mean coefficient for Aebelholt males, however, is a little higher.

So few complete molar series are available that a study of differences in rank order of molar size between the Aebelholt and Naestved populations has not been attempted.

There are few significant differences in crown index between the Danes from Aebelholt and those from Naestved. In the maxilla, no significant differences can be shown in males or in females between the Aebelholt and Naestved groups. The mandibular teeth of males show two barely significant differences between the groups, but the canines and molars of the Naestved females show a significant difference in proportion from those of the Aebelholt females in that they are relatively shorter in the mesiodistal dimension and broader in the labiolingual dimension.

**Racial Differences**

Comparisons have been made between tooth size of medieval Danes and that of various other populations, both of earlier date and modern.

In comparing Danish teeth with those of three prehistoric Scottish populations, it is found that Scottish Bronze Age teeth appear to be larger than those of the Danes. The teeth of the Dark Age people of Scotland are similar in size to, or rather smaller than,
the medieval Danish teeth. There is so little Neolithic material from Scotland for which sex is identifiable that comparison is difficult. In the original study of the Scottish material,12 some skulls of indeterminable sex were used; when measurements of all Neolithic teeth were compared with those of all Bronze Age teeth, it was found that the Neolithic teeth tended to be slightly larger. In the present instance, only the maxillary teeth of Neolithic males could be compared with those of the Danes; these Neolithic teeth are much larger than the medieval Danish teeth. The present study seems to confirm a gradual decrease in tooth size from Neolithic and Bronze Age times to the Dark Ages and the medieval period. The smaller values of some tooth measurements recorded for the Scottish Dark Age material, as compared with those for medieval Danes, may be the result of the greater degree of attrition noted in the former population. Whether this decrease in tooth size is a function of time or whether it represents racial traits in successive populations has not been decided.

Comparison of the material studied by the author with that published by other workers shows a similar trend in continental European populations. Tooth measurements of several prehistoric groups3,5,6,18 are generally larger than those of the medieval Danes. Frankish teeth4,28 from a period beginning about two centuries earlier than the bulk of the Scottish long cists, seem to be very similar in size to those of medieval Danes, or slightly smaller. On the other hand, some small groups of Merovingian and medieval skulls4 and the Alamanni studied by Schwerz19 possess teeth that are generally larger than those of the medieval Danes.

Thus it appears that there is a general tendency in European populations to show a reduction in tooth size from the Mesolithic to the Dark Age or early medieval period.

The only early population group for which a statistical comparison of tooth size could be carried out was the group of medieval Swedish skulls from Västerhus.13 This material is a little earlier in date than the Danish skulls from Aebelholt and Naestved. The tooth measurements used in the comparison had been obtained from juvenile individuals and therefore should not have been affected by attrition more severely than those of the Danes. Nevertheless, the Västerhus teeth are smaller than those of the Danes, and some of the differences are statistically significant. The only factor that may have influenced this difference is the possible presence in this area of northern Sweden of a fairly large population of Lapps, who have been shown by Selmer-Olsen21 to have small teeth.

When comparisons are made between medieval Danes and modern Swedes,11,20 Swiss,23 and American Caucasians,16 there is a tendency for the Danes to show smaller tooth dimensions than the modern races. This difference is much more pronounced in the Swedes20 and the Swiss than it is with Lundström’s Swedes11 and the American Caucasians. This difference in size is most pronounced in the premolars. It is difficult to assess the role of attrition and of different technics of measurement in producing these results. But it seems unlikely that the largest differences can be entirely the result of attrition or variations in technic. If some of these differences are real, then the tendency to reduction in tooth size, which was noted from Mesolithic to early medieval times, has not been continued in the medieval to modern period. In view of these results, the figures obtained by Goose8 for 17th to 19th century English skulls were examined. The English teeth appear slightly smaller than those of medieval Danes, and thus are also smaller than the teeth of the four modern Caucasian groups. Thus, there seems to be some evidence of a slight increase in tooth size in recent centuries.

The Lapps21 have smaller teeth than the medieval Danes; the difference in size is more pronounced in the labiolingual than in the mesiodistal diameters.

Comparisons of tooth size have been made between the medieval Danes and several non-European peoples. There appears to be little difference in size between Chinese teeth10 and those of Danes although, in a few dimensions, the Chinese teeth are significantly larger. Aleut teeth15 tend to be larger than those of Danes, although not all the differences in tooth size are statistically significant. The teeth of Tristanites24 are generally larger than those of the Danes, and the differences are much greater in the labiolingual than in the mesiodistal diameters. Eskimo teeth17 are also larger than those of Danes, although the small quantity
of data available for the Eskimos reduces the significance of the differences. Tooth dimensions of Australian aborigines1,2 are considerably larger than those of medieval Danes, and the differences between the two groups are all statistically significant. Thus it can be shown that the teeth of some Mongoloid and Australoid populations are in general larger than those of the medieval Danes. No suitable data are available for a comparison to be carried out with any Negroid population.

On the whole, it appears that differences in tooth dimensions between populations are more pronounced in the labiolingual dimensions than in the mesiodistal dimensions.

No major differences are observed between coefficients of variation in Danes and in other populations. The ranges of coefficients of variation published by other workers are similar to the range for the Danes. Also, the teeth that show the greatest and least variability in size in the Danes are the same as the teeth that display these properties in other races.

The distribution of patterns of rank order of molar size in Danes is similar to those observed in Lapps and Finns.9 Fewer data are available for Aleuts, Tristanites, and East Greenland Eskimos, but these races appear to differ from the Danes in distribution of the patterns, and the results suggest that the second and third molars have undergone less reduction in size relative to the first molar than in Danes, Lapps, and Finns.

Crown indexes of the three prehistoric Scottish populations are similar to or higher than those of medieval Danes. This indicates a tendency for tooth crowns in the Scottish groups to be relatively shorter mesiodistally and broader labiolingually than those of the Danes. The difference may be largely attributable to the greater degree of attrition in the Scottish material, since attrition has a more serious effect on the mesiodistal diameters of the teeth.

Crown indexes published for Lapps, Tristanites, and Aleuts have been compared statistically with those calculated for the Danes. The crown indexes of Danish teeth are slightly higher than those in Lapps and Aleuts, and much lower than those of Tristanites. Thus, the teeth of medieval Danes are relatively shorter mesiodistally and broader labiolingually than those of Lapps or Aleuts. Tristanite teeth are much broader labiolingually than those of any other population.

Racial differences as well as sex differences are less pronounced in the crown indexes than in the individual mesiodistal and labiolingual dimensions of the crown.

The main results of this study are that there are statistically significant sex differences in crown size of the teeth, but not in crown proportions, in medieval Danes; that there are few significant differences, in either crown size or crown proportions, between the groups from Aebelholt and Naestved, and therefore the individuals from these localities may be regarded as forming a reasonably homogeneous population; that the medieval Danes have relatively small teeth when compared with various other racial groups. The Danish dentition, in general, shows smaller crown dimensions than are found in modern Australoid or Mongoloid races, in modern Caucasian races, and in most prehistoric European populations. Medieval Danish teeth are larger than those of a few population groups: the Scottish Dark Age people, the Dark Age Franks of Belgium, the medieval Swedes, the 17th to 19th century English, and the modern Lapps. In crown proportions, the medieval Danes differ considerably from only one group, the Tristanites.

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