SHORT COMMUNICATION

Simultaneous Dental Anomalies (Polyanomalodontia) in Medieval Japanese Skeletal Remains

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(Received on January 23, 1997; Accepted on March 12, 1997)

Key words: polyanomalodontia/taurodontism/persistence of deciduous tooth/microdontia/congenital absence of tooth

Introduction

Many dental anomalies, as separate conditions, have been reported extensively, but simultaneous occurrence of the four anomalies: microdontia, persistence of deciduous tooth, congenital absence of tooth and taurodontism have rarely been described especially in reference to archaeological skeletal materials. In modern clinical surgery, most dental anomalies are discussed in association with various hereditary disease and/or phylogenesis. Anthropologically, in contrast, these dental anomalies have been viewed with interest in connection with the “evolution of man”.

A skull was unearthed which simultaneously demonstrated several dental anomalies in the Zaimokuza skeletal series of medieval Kamakura (AD 1192-1333), and the present case has been termed Polyanomalodontia1-4). A description of the anthropological features of this unusual case is the subject of this paper.

Site and Material

The Zaimokuza site is a medieval cemetery, located in the eastern part of the seashore of Kamakura city, Kanagawa prefecture, Japan (Fig. 1). Kamakura city was the base of the Kamakura shogunate founded by MINAMOTO-no Yoritomo, (AD. 1147-1199). The Zaimokuza skeletal series consists of more than 900 individuals, excavated from in the 1950s. The excavation report was published5). These skeletal materials are thought to have been buried at this site as war dead at the fall of the Kamakura shogunate in 1333. Accordingly, skeletons have been found with sword wounds and damage probably caused by animals.

The material reported in the present paper concerns a skull of the Zaimokuza skeletal series. The skull is relatively complete, and is reasonably preserved, but the mandible and all of the post cranial skeleton corresponding to the skull are absent. The upper dental arch is preserved completely, and retains all of its teeth. Complete eruption of third molars, degree of dental attrition and cranial sutural closure suggest an age at death of between 25 and 40 years. The mastoid processes are not large, but the relatively developed external occipital protuberance and the whole size of this skull show that this material is probably male. The skull is normal in size and shape, and there is no evidence of pathology, exclusive of dental caries. The skull is now housed in the Department of Anthropology and Prehistory, the University Museum, University of Tokyo.
Findings

The upper bilateral incisors were diagnosed as microdontia, which are "cone" or "peg" shaped (Fig. 2). The incisors were buccolingually reduced in size at the rate of 65% in the upper right lateral incisor and 58% in the upper left lateral incisor, and were mesiodistally reduced in size at the rate of 50% in the upper right lateral incisor and 56% in the upper left lateral incisor, respectively, in comparison with those of average skeletons in the Zaimokuza skeletal series (Table 1). The incisors are worn showing exposure of dentine, marginal ridges were not apparent, and no evidence of a shovel-shaped character was evident, although the central incisors, considered to exhibit normal limits in size and shape, showed a somewhat shovel-shaped character. The position and erupted direction of all four incisors were normal.

The upper right canine is a primary tooth. A radiograph of this area reveals the absence of a permanent canine (Fig. 3). It can be assumed that the primary canine remained in consequence of the congenital absence of the secondary canine. This primary canine was quite worn, and absence of enamel on the labial surface was evident. However, there was no doubt that the tooth was a typical primary canine in shape. It was also recognized that the left canine was microdontia, with considerably little marginal ridge and lingual tubercle, and inapparent cusp (Fig. 4), both mesiodistally and buccolingually reduced in size at the rate of about 65% in comparison with that of the average skeleton of the Zaimokuza skeletal series. The root length of this canine was remarkably shorter than usual.

The radiographs of the bilateral molar regions show that the first and the second molars in both sides were taurodontia (Figs. 5 and 6). The teeth clearly showed the enlarged pulp chamber, compared with normal cynodontic teeth, and were meso- or hypertaurodont
Fig. 4 Photograph of the left permanent canine showing reduced in size compared with that of normal.

Fig. 5 Radiograph of the right molars. The first and second molars are taurodontism.

Fig. 6 Radiograph also showing taurodontism in the left first and second molars.

according to Shaw's classification. The cusp pattern of these teeth according to Dahlberg show class 4 (four well-developed cusps) in the upper first molars and class 4- (hypocone reduced in size) in the upper second molars, respectively. The upper third molars were also reduced in size and shape, especially, the right upper third molar was smaller than its opposite. The molar teeth decreased in size in the order $M_1 > M_2 > M_3$.

Discussion

In general, human teeth have been gradually reduced in both number and size through evolution. This effect has mainly been related to a lessening of selective pressures on tooth number and size, with the emergence of more efficient tools to aid feeding. Accordingly, microdontia should be discussed in association with both degeneration of the masticatory organs and signs of tooth absence (agenesia or hypodontia), not in a series of isolated units.

Microdontia is generally seen most commonly in upper lateral incisors and third molars, but criteria for describing microdontia differ among investigators. Thus, it is difficult to make a comparison. Regarding lateral incisors, the frequency in previous studies range from 0.5% to 3.4%. Meskin and Gorlin reported that microdontia appeared bilaterally in incisors and was present in 0.42% of 8,289 American Caucasian students. In Japan, Sumiya investigated 4,050 individuals with 7,938 permanent upper lateral incisors, 493 of which were microdontia (6.21%). In addition, there have been no reports of the frequency of microdontia regarding archaeological skeletal materials, however, according to Suzuki, who has investigated the Zaimokuza skeletal series,
Table 1  Dental crown diameters

<table>
<thead>
<tr>
<th></th>
<th>Right teeth</th>
<th>Left teeth</th>
<th>Average of the Zaimokuza skeletal series*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Mesiodistal diameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I1</td>
<td>8.62</td>
<td>8.15</td>
<td>77</td>
</tr>
<tr>
<td>I2</td>
<td>4.55</td>
<td>4.06</td>
<td>77</td>
</tr>
<tr>
<td>C</td>
<td>5.71</td>
<td>5.18</td>
<td>90</td>
</tr>
<tr>
<td>P1</td>
<td>5.70</td>
<td>5.56</td>
<td>95</td>
</tr>
<tr>
<td>P2</td>
<td>6.09</td>
<td>5.24</td>
<td>101</td>
</tr>
<tr>
<td>M1</td>
<td>11.19</td>
<td>11.73</td>
<td>9</td>
</tr>
<tr>
<td>M2</td>
<td>9.33</td>
<td>10.32</td>
<td>100</td>
</tr>
<tr>
<td>M3</td>
<td>7.02</td>
<td>9.41</td>
<td>—</td>
</tr>
<tr>
<td>Buccolingual diameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I1</td>
<td>6.38</td>
<td>6.79</td>
<td>80</td>
</tr>
<tr>
<td>I2</td>
<td>3.32</td>
<td>3.68</td>
<td>79</td>
</tr>
<tr>
<td>C</td>
<td>4.89</td>
<td>5.33</td>
<td>97</td>
</tr>
<tr>
<td>P1</td>
<td>7.40</td>
<td>7.44</td>
<td>95</td>
</tr>
<tr>
<td>P2</td>
<td>7.85</td>
<td>8.37</td>
<td>102</td>
</tr>
<tr>
<td>M1</td>
<td>10.83</td>
<td>11.05</td>
<td>97</td>
</tr>
<tr>
<td>M2</td>
<td>10.52</td>
<td>10.65</td>
<td>98</td>
</tr>
<tr>
<td>M3</td>
<td>8.21</td>
<td>9.93</td>
<td>—</td>
</tr>
</tbody>
</table>

* Male samples. Data were cited from Matsumura.37

peg-shaped lateral incisors appeared in this skeletal series at a frequency of 5.8%5).

As shown in Table 1, the mean dental crown diameters of the Zaimokuza skeletal series are relatively smaller compared with those of modern Japanese, particulary all the teeth comprising this material, exclusive of taurodontic first and second molars, are smaller than normal (Table 1). In addition, the canines, which are generally accepted as being the stablist in size and shape of all of human teeth, showed anomalies bilaterally, suggesting that this material shows a strong degenerative tendency.

Regarding taurodontism in the molar teeth, the molars of modern humans are so-called cynodontic, which displays a small pulp cavity, and small canals, taurodontism, on the other hand, first noted in Neanderthal man at the Krapina remains13,14), reveals the characteristics of large pulp chambers. While the etiology of taurodontism is not fully understood, it has been discussed as being a primitive pattern of tooth in early humans 15-17), and to be advantageous in the severe attritional enviroments which required heavy chewing18,19). Clinically, in contrast, taurodontism has often been considered to be a marker of underlying hereditary disease, such as Klinefelter's syndrome20-24), Down's syndrome25,26), Aarskog-Scott syndrome27), tricho-dento-osseous (TDO) syndrome28,29), Mohr syndrome or Orofacialdigital II syndrome30, Amelo-onychohypohidrotic syndrome31), and hypohidrotic ectodermal dysplasia32). Thus, it is possible that taurodontism and other anomalies in the present case may be symptoms of such diseases. Taurodontism is, however, also found in some modern human populations; 5.6% in young adult Israelis33), 11.3% in Saudi Arabian school children34). MacDonald-Jankowski and Li who investigated Chinese adults found values of 46.4% for individuals and 21.7% for teeth and suggest that taurodontism is not sufficiently sensitive to be a marker of genetic diseases in the Chinese population35). The present authors have also reported two cases of taurodontism found in the teeth of skeletal remains of the Jomon period (ca. BC 10,000 -300), and could not obtain evidence that taurodontism is positively linked with hereditary
It is rare that dental anomalies raise critical problems in clinical surgery, therefore very limited information is available. It is also rare that a single dental anomaly is generally reported in unearthed human skeletal remains. Ours is an unusual case in that the material showed degenerative tendencies in tooth morphology, such as small dental crown diameters, microdontia and congenital tooth absence, and also, simultaneously shows taurodontism. There are many difficulties in obtaining pathological and/or phylogenetic information from unearthed human skeletal remains, and many questions concerning the anthropological significance of these dental anomalies remain unanswered. However, we are convinced that the aggressive accumulation of information from many case studies of archaeological skeletal materials will be able to contribute to solving the questions of chronological change and etiology in these dental anomalies.

Acknowledgements

We thank Profs. T. Akazawa and G. Suwa of the Department of Anthropology and Prehistory, the University Museum, the University of Tokyo for their kind permission to study the material under their care. We wish to express our gratitude to Dr. Y. Mizoguchi of the Department of Anthropology, National Science Museum, Tokyo, for his valuable advice.

References


