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The effects of dental wear on third molar eruption and on the curve of Spee in human archaeological dentitions

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Abstract

The abrasiveness of food is a key determinant in the rate of physiological attrition (dental wear) in humans. With increasing food processing through time, the rate of physiological dental wear in human teeth has decreased markedly. Many consider such wear to be beneficial to oral health and that insufficient wear may result in impaction of the third molars. If enhanced extraoral food processing provides an evolutionary advantage, then it is possible that agenesis of the redundant third molar may follow. One of the aims here was to examine impaction and agenesis of the third molars in four populations of varying antiquity and hence varying dental-wear rates. Paradoxically, whilst there is a decrease in the rate of dental wear with modernity, there is also an increasing prevalence of advanced dental wear due to prolongation of the lifespan of the human dentition. As the effect of dental wear on the curve of Spee was unknown, a second aim was to examine it in an archaeological population with a high rate of dental wear. The results showed an increase in non-eruption and impaction of the third molars with modernity, but did not demonstrate a significant increase in the rate of agenesis. The time period over which impaction and agenesis could be discerned was of the order of 600 years and this may not be sufficient to observe adaptive changes at the genetic level in humans. In molar teeth there was no clear indication of maintenance of the curve of Spee with dental wear. This has potential implications on the design of prostheses for the worn dentition.

Keywords: Physiological attrition; Dental wear; Non-eruption; agenesis; Impaction; Third molars; Curve of Spee; Gerodontology

1. Introduction

In most mammals, dental wear is a physiological and regular occurrence. Indeed the teeth of many herbivorous species are not well adapted to mastication until attrition has removed the smooth, enamel-covered cusps (Dubrul, 1988). Physiological attrition (wear) is defined as the gradual and regular loss of tooth substance as a result of natural mastication (Pindborg, 1970). More extensive attrition than would normally be expected is called intensified attrition and pathological attrition may result from abnormal occlusion. The abrasive property of food is paramount in determining the rate of physiological attrition (Davies and Pederson, 1955; Lavelle, 1970; Molnar, 1971; Smith, 1972; Walker, 1978; Turner and Machado, 1983). In

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the past, the role of attrition of teeth was much more marked than it is today. However, with increased food processing, use of hands and of tools (Dubrul, 1988) and the general rejection of the teeth as weapons (Every, 1965) the whole of the masticatory apparatus in humans has somewhat atrophied.

Nevertheless, many workers are of the opinion that a certain degree of attrition is beneficial for dental health. Beyron (1951), Begg (1954), Orban (1959), Murphy (1968) and Berry and Poole (1976) have demonstrated the advantages of dental wear in eliminating cuspal interferences to excursive movements; Ainamo (1972) and Newman (1974) have shown the benefits of removal of stagnation areas in reducing caries and periodontal disease. Lack of occlusal and approximal attrition may lead to crowding, rotation and overlapping of anterior teeth, with the second premolars and third molars being excluded from the dental arcade and consequently remaining impacted (Murphy, 1964; Berry and Poole, 1976). Björk et al. (1956) demonstrated that failure of third molars to erupt completely was due to lack of space in the alveolar arch between the second molar and the ascending ramus. They attributed this, in contemporary human mandibles, to the growth rate and orientation of the mandible and condyle and to the direction of eruption of the other teeth. However, with some occlusal and interstitial dental wear, the pre-eruptive dimensions of teeth would be reduced, thus increasing the available space. All of this evidence led Murphy (1968) to suggest that prophylactic cuspal grinding should be as commonplace as routine caries inspection in the dental surgery.

Wear on the occlusal surface of teeth will have an effect on the orientation of the occlusal planes. In human dentitions they do not lie in a perfectly flat, horizontal plane. In lateral view the occlusal plane of the maxillary arch runs in a downwardly convex curve from canine to last molar, whilst the occlusal plane of the mandible has a matching downwardly concave curve from canine to last molar. This is known as the curve of Spee (Ferrario et al., 1992). It is not clear as to whether the curve of Spee is a description of the occlusal surface of each arch separately, or in maximal intercuspation. On occasion it has been defined as the curvature of the occlusal surfaces described by an imaginary line joining the lower buccal and canine cusps in the sagittal plane (Posselt, 1962). At other times it has been described as the curved movement of the mandible when incisal guidance is less than condylar guidance (Thomson, 1975). Ferrario et al. (1992) measure the curve of Spee as a single entity related to an imaginary plane touching the incisal edges of the lower incisors and the distobuccal cusps of the lower second molars — called the plane of orientation. Tobias (1980), on the other hand, accounts for the curve of Spee as a succession of changing mesiodistal slopes from anterior to posterior.

In frontal view the occlusal surfaces of upper posterior teeth of each side lie in a downward-curved transverse plane, whilst those of the mandible in an upwardly curved transverse plane. These curves are the curves of Wilson or Monson (Berkovitz et al., 1992). Following the pioneering measurements of occlusion carried out by Count von Spee in 1890, Monson (1932) proposed the spherical theory of occlusion, postulating that the "centre of a sphere with a radius of approximately 4 ″ is equidistant from the occlusal surfaces of the posterior teeth and from the centres of the condyles". He further claimed that the long axes of the posterior teeth form extensions of radii from the centre of this sphere. These theories have largely been rejected (Brown et al., 1977) and the continuous curvatures are now thought simply to reflect the long axes of individual teeth. It is unclear as to whether the curvatures apply to the worn or unworn dentition, but dentures have been set up along the curve of Monson in the transverse plane and the curve of Spee in the anteroposterior plane ever since the publication of this theory, to allow for movement along the sphere.

Many workers have studied the change in the curve of Monson with wear. They found that the brunt of the wear occurred on the buccal cusp of the lower teeth and the palatal cusp of the upper teeth (Osborn, 1982). This would reverse the curve of Monson into the so-called Avery curve (Pleasure and Friedman, 1938; Van Reenen, 1964). An intermediate condition exists called the helicoidal occlusal plane, in which the transverse occlusal plane between the first molars is reversed, that between the second molars is flat, and finally that between the third molars fits the classic Monson pattern. The helicoid is described by many workers whose findings are reviewed by Tobias (1980). There was no knowledge available as to how the curve of Spee might be affected by dental wear.

Our aim now was to examine two aspects of dental anatomy that may be affected by dental wear. The first was exclusion of the third molar from the dental arcade with modernity and hence lack of dental wear; the second was the direct affect of wear on the curve of Spee.

2. Materials and methods

2.1. Studies on third molar eruption

Studies on the eruption status of third molars were carried out on 100 crania from excavations of the burials at St Peter's Church, Barton-on-Humber (medieval sample), and from the Spitalfields "Victorian" sample, median date 1830 (Molleson et al., 1993). Most of the

Barton-on-Humber remains were dated by standard stratigraphic techniques, and we used those from the medieval phases, that is the tenth and fifteenth centuries (Rodwell and Rodwell, 1981). The exhumation of the burials from Christchurch, Spitalfields, came about as a result of the need to clear the crypt for a change in its use, and also for the restoration of the church to Nicholas Hawkesmoor's design. The date of death was present on the coffin plates. One hundred photographs of crania and dentitions in Bröste's 'prehistoric man in Denmark' (Bröste, 1956), median date approx. 2000BC; and 100 orthopantomograms of a modern population from the Bristol Dental Hospital, median date 1994, were also used. An orthopantomogram is a panoramic radiographic survey of the jaws and teeth. The "prehistoric" collection was mostly composed of interred remains found in dolmens, passage graves and cists. Using artefacts and grave types, the finds were classified into six dating periods from Mesolithic to Bronze Age. Most of the samples used in this study were from the Neolithic period. Subsequent carbon-14 dating of these Neolithic artefacts gave the median date, although this had not been corrected for European dendrochronology (Klindt-Jensen, 1957; Whittle, 1985). No attempt was made to establish sex or provenance, as this would introduce more variability and error.

When skulls were used, skeletal markers other than dental chronology were employed to establish that crania were aged over 25 years and any root development and eruption of the third molars had been completed. As the dentitions were often incomplete, all quadrants with intact molar tables (established from the extent of alveolar bone) were treated as separate specimens. When the molar segment consisted of only one or two members with no indication in the alveolar bone of pre-mortem loss, rigorous attempts at identification of the erupted molars were made to ensure that the third molars had not erupted and migrated medially. In these cases the retromolar regions of alveolar bone were thoroughly examined, by transillumination, gentle shaking, probing, minor bone removal or radiographic investigation to differentiate between impaction and agenesis. This examination could not be conducted on the photographs in the prehistoric sample, but all of the other precautions were applied as above.

Using patients from the Bristol Dental Hospital had already compromised the random sampling process, as these individuals were actively seeking dental treatment and were not simply being screened. However, the patient records were recovered and any patients attending with a history of third molar complaints, third molar extractions or referrals for dental pathology in number or eruption of teeth were excluded from the sample. Absent third molars were assigned the status of agenesis (complete failure to form) or impaction (no clear route for eruption), but the impaction was not further classified.

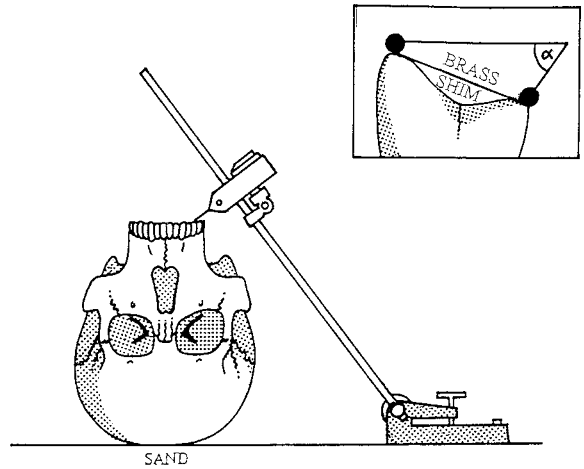

Fig. 1. Use of engineer's microclock and stand to measure the mesiodistal height difference of a maxillary molar tooth. Inset shows a closer view of measurement of mesiodistal height differential. α = angle of deflection of ball of spring arm of microclock with change in height whilst traversing the brass shim.

A bar chart showing the percentage of dental quadrants with unerupted third molars in each population and a cluster bar chart showing the percentage of dental quadrants with impacted third molars or agenesis of third molars in the medieval, Victorian and modern populations were constructed. To show that the populations were independent in terms of the third molar, ANOVA tests were performed on the percentage of unerupted third molars, the impacted third molars and agenesis of the third molars in each population. The statistical software package Systat for Windows™ and the graphics package Microsoft Excel '97™ were used throughout.

2.2. Studies on the curve of Spee

The relation of the curve of Spee to dental wear was investigated in 34 dentitions from the Barton-upon-Humber sample (described above). This sample was chosen as the dental wear rate was such that estimation of an individual's age could be readily made from it. Only complete mandibles were used for this study and for each dentition an average value of gradient of mesiodistal slope and occlusal wear were assigned to each molar. In healthy occlusion there is frequent exchange of working- and balancing-side roles with no evidence of a preferred side (Lunt, 1978), and similarly the effects of wear on the occlusion should be considered to be the sum of effects on both sides.

The wear of each tooth was quantified by the scor-

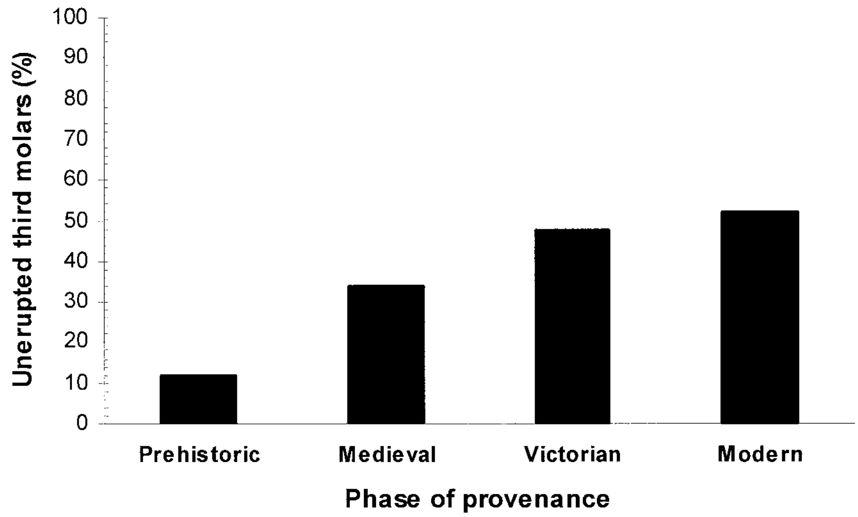

Fig. 2. Bar chart showing percentage unerupted third molars in prehistoric, medieval, Victorian and modern populations.

ing system of Scott (1979), as the 4–40 system allowed accuracy on a tooth-quadrant level. This is an ordinal scoring system based upon the amount of enamel present on the occlusal surface of the tooth. Molar teeth were visibly divided into four quadrants and each scored on a 1–10 scale, the score for the whole tooth being the sum of the quadrant scores and ranging from 4 to 40. Different parts of the tooth wear at different rates, depending on the part played by mastication, and an average value for each tooth quadrant accounts for this. A mean value of wear for each tooth in the molar segment of the mandible was calculated and related to the mesiodistal slope of each tooth.

This slope was measured relative to a flat occlusal plane. This was achieved by placing the mandible in a tray of sand, with a spirit level balanced on a square of ultra-flat brass shim on the occlusal surface of the dentition. The position of the mandible within the sand was adjusted with the help of the spirit level. A sensitive engineer's microclock on a stand was used to measure the height difference between the highest points on the mesial and distal cusps (Fig. 1, showing measurement on a maxilla rather than mandible). The points were connected by a short piece of ultra-flat brass shim, along which the ball of the spring arm of the microclock traversed. If the height difference was more than the maximum deflection on the lever, then the clamp of the lever arm was adjusted level to the higher cusp, then moved to lie directly level with the lower cusp and the perpendicular drop measured with Vernier callipers. The mesiodistal length of the occlusal surface was measured with Vernier callipers and the calculated gradient was assigned positive if the slope rose distally. Any dentitions in which molar teeth had been lost ante or postmortem were discarded from the study as there was potential for tipping into the space or incorrect replacement following post-mortem loss. Intraobserver reliability was tested on this technique by taking 10 measurements from randomly chosen skulls from the Barton-upon-Humber collection, calculating the gradients and repeating these 1 week later. Matched paired t-tests were employed to note any significant differences. Once again no attempt was made to establish sex or provenance, as this would introduce more variability and error.

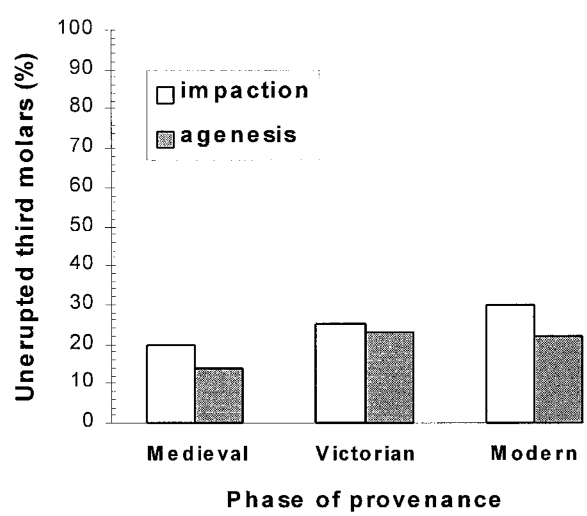

Fig. 3. Cluster bar chart showing percentage impaction and agenesis of third molars in medieval, Victorian and modern populations.

Table 1
ANOVA matrices of pairwise comparisons of (a) non-eruption; (b) impaction; (c) agenesis in third molar teeth in prehistoric (P), medieval (Me), Victorian (V) and modern (M) sample populations

	P	Me	V	M
(a) *Unerupted*				
P	1.000			
Me	0.003	1.000		
V	0.002	0.048	1.000	
M	0.001	0.048	0.080	1.000
(b)*Impaction*				
Me		1.000		
V		0.048	1.000	
M		0.036	0.095	1.000
(c) *Agenesis*				
Me		1.000		
V		0.095	1.000	
M		0.095	0.120	1.000

Table 2
Repeated measures of mesiodistal gradient on 10 teeth from the Barton-on-Humber sample.[a]

Mesiodistal gradient (week 1)	Mesiodistal gradient (week 2)
0.02	0.04
−0.19	−0.15
0.76	0.70
0.47	0.45
0.16	0.20
−0.43	−0.44
0.15	0.16
0.65	0.60
0.05	0.06
−0.54	−0.48
Paired samples *t*-test:	week 1 vs week 2 at 9df
$T = -0.323$	$p = 0.754$
No significant difference	

[a] Measurements were made by the same observer and repeated after one week. Analytical data from a matched paired *t*-test.

Scatterplots of the gradients of mesiodistal slopes of the first, second and third molars were plotted (dependent variable) against the wear score of each tooth (independent variable). Where appropriate regression lines were calculated by the method of least squares. The statistical software package Systat for Windows™ and the graphics package Microsoft Excel '97™ were once again used throughout.

3. Results

3.1. Studies on third molar eruption

Fig. 2 is a bar chart showing the percentage of dentitions with unerupted third molars in each population. This provides a broad view of any change in eruption pattern with modernity. Similarly Fig. 3 is a cluster bar chart showing the percentage of those unerupted third molars which have failed to develop completely (agenesis) or are impacted in the medieval, Victorian and modern populations.

Although the populations were selected from discrete geographical locations, they may still have been samples from the same population with respect to third molar eruption. To show that these populations were indeed independent, ANOVA tests were performed on the percentage of unerupted third molars, the impacted third molars and agenesis of the third molars in each population. Post-hoc pairwise comparison of probability matrices are shown in Table 1. Probability values of less than 0.05 indicate a significant difference at the 5% level.

The results show that in each case the prehistoric sample differed significantly at the 1% and hence 5% level ($p < 0.01$) from any of the more recent populations, in non-eruption. There was a significant difference at the 5% level between the medieval population and the Victorian and modern populations when considering non-eruption and impaction of third molars, but not agenesis. There was no significant difference between the non-eruption, agenesis or impaction between the Victorian and modern samples.

The Victorian and modern samples had very little wear faceting on their surfaces and this associates well with similarities in diet. Consequently there was no real difference in impaction or agenesis of the third molars. Thus these two groups can be considered to be from the same population. There were, however, significant differences between this single, post-1800 population and the medieval and prehistoric groups.

3.2. Studies on the curve of Spee

Table 2 shows the results from the intraobserver reliability test performed on 10 specimens from the Barton-upon-Humber sample. Matched paired *t*-tests showed no significant differences when measurements of the mesiodistal gradient were repeated by the same observer 1 week later.

Table 3 displays the mesiodistal gradients of the first, second and third mandibular molars with respect to dental wear score. In 11 of the dentitions the third molars were absent from the fully erupted dental arch. When comparing the wear scores (Table 3) of each molar in a particular sample, one finds that the mandibular first molars were worn to a greater degree than the second molars, which were themselves worn to a

Table 3
Wear score (Scott system) and mesiodistal gradient of each mandibular molar tooth in 34 human dentitions from the Barton-upon-Humber sample

Sample no.	Wear score 1st molar	M-D[a] gradient 1st molar	Wear score 2nd molar	M-D gradient 2nd molar	Wear score 3rd molar	M-D gradient 3rd molar
1	30	0.02	28.5	−0.15	23	0.01
2	28	−0.19	19	0.17	14	0.01
3	25	0.76	17	0.08		
4	19.5	0.22	14	0.05	8.5	−0.01
5	34	−0.23	26	0.03	13	0.21
6	4	0.23	2.5	0.25		
7	11	0.17	9	0.00		
8	33.5	0.47	31	−0.05	28	−0.30
9	22.5	0.53	18.5	0.23	13	−0.33
10	16	0.30	13	0.32		
11	30	0.40	25.5	0.30		
12	26.5	0.30	11.5	−0.21	4	−0.21
13	16	0.05	13	−0.33	4	0.53
14	12.5	0.30	6.5	−0.14		
15	19	−0.29	14	0.38	10.5	−0.26
16	11	0.44	8	−0.01		
17	30	0.45	11	0.60	8	−0.24
18	31	0.29	20	0.78	8	0.16
19	27	0.16	12	−0.34		
20	24	0.36	20.5	0.80	9.5	0.61
21	11	0.34	8	0.58	4	0.53
22	33	−0.04	32	0.38	15	−0.37
23	12.5	0.42	8	0.36	4	0.61
24	20	0.01	10	0.11	6	−0.46
25	15	0.27	11.5	0.27	8	1.09
26	12	0.34	8	0.67	4	−0.29
27	22	0.16	14.5	0.52	12	−0.35
28	34	0.13	27	−0.32		
29	11	0.71	6	0.07	4	−0.42
30	16	0.41	12	−0.01	8	0
31	16	0.36	13	0.06	13.5	0.22
32	23	0.52	16	0.32		
33	16	0.25	12	0.18		
34	16	0.71	12.5	0.35	9	0.29

[a] M-D, mesiodistal.

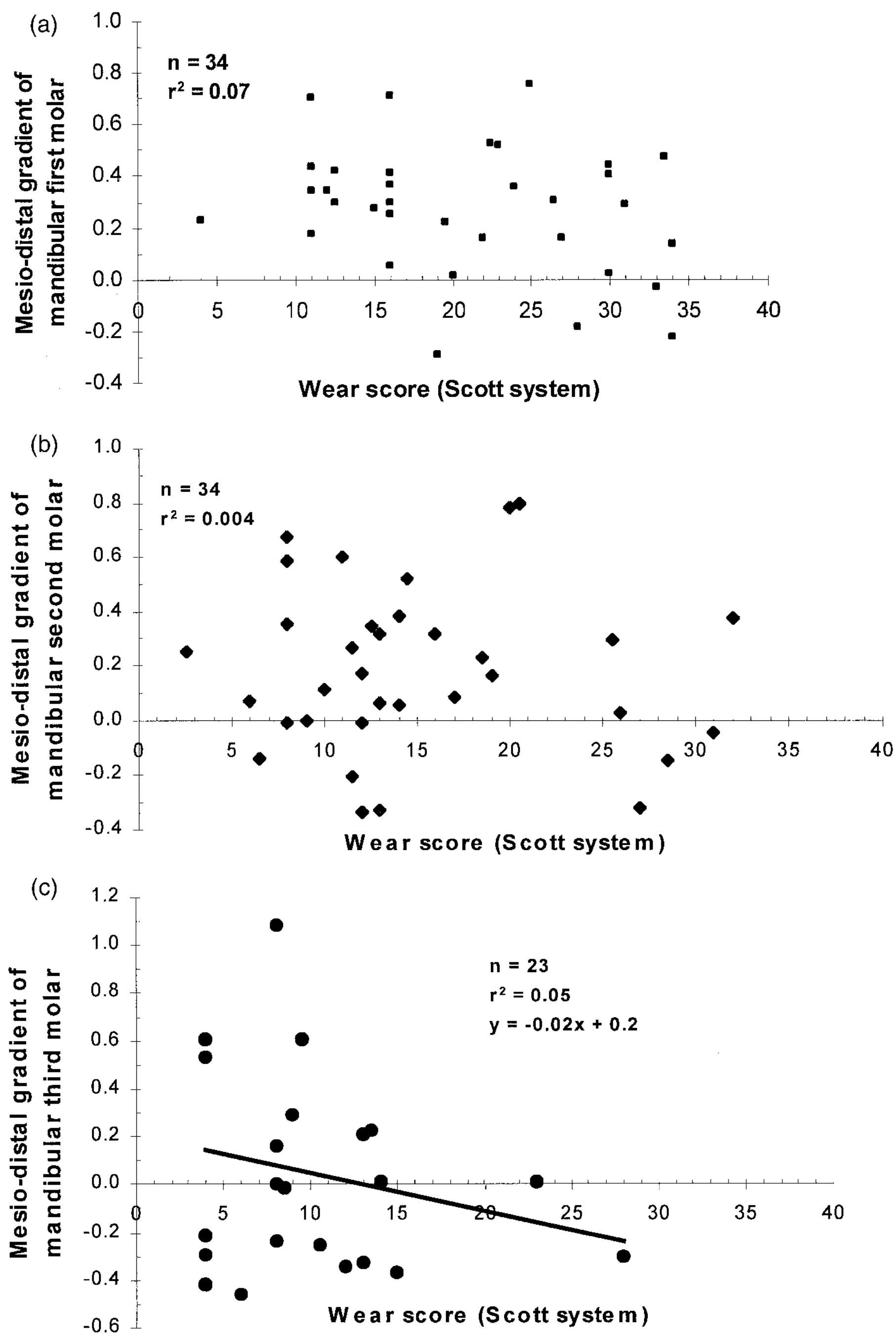

Fig. 4. Scattergrams showing mesiodistal gradient against wear score (Scott system) in (a) mandibular first molar, (b) mandibular second molar, (c) mandibular third molar. Where appropriate, regression lines have been superimposed. n = number of data-points; r^2 = coefficient of determination.

greater degree than the third molars. This concurs with the eruption sequence. Similarly the mesiodistal gradients were steeper the more anterior the molar.

The wear scores were normally distributed and, although they are not strictly continuous data, scatterplots of their association with mesiodistal slopes in the first, second and third molars are shown in Figs. 4. The coefficients of determination were very low and a regression line was calculated only for the third molars. In the first and the second molar studies, there appeared to be no association between mesiodistal gradient and dental wear. Furthermore, when the coefficient of determination showed a glimpse of association in the third molars, the equation of the regression line demonstrated a negative slope. This is the opposite direction to the curve of Spee and suggests that with increasing wear the curve actually reverses. The coefficient is, however, very low and therefore the position of the majority of the data-points is determined by other, unknown factors. Nevertheless, if the curve of Spee is the sum of these individual slopes, then there appears to be no tendency towards maintaining it.

4. Discussion

Homo sapiens sapiens is the most recently evolved subspecies in the genus *Homo* and fossil evidence would suggest that they outnumbered and replaced the Neanderthals about 35,000 years ago (Dorit et al., 1991). However, we, like all other organisms, are still subject to evolutionary forces such as random mutation, natural selection, genetic drift and isolation. Furthermore, we are biologically capable of constant adaptation to new, hostile and man-made environments, a process reflected in our histological and topographical morphology.

There have been many craniofacial and dentoalveolar changes caused by disuse atrophy of the masticatory apparatus, which is the result of change in diet and greater extraoral processing of food. The posterior arch widths and alveolar processes have reduced in size (Tobias, 1980). This has led to a decrease in alveolar prognathism and an increasing tendency for crowding resulting in an exclusion from the dental arch of the third molar tooth (Scott and Symons, 1974). The transition towards exclusion of this tooth was here investigated using samples from different archaeological phases.

The prehistoric population differed significantly from any other in terms of non-eruption of the third molar. In this population, far more members had functioning third molars. Our value of 12% uneruption in this prehistoric population compared favourably with the 11% mean value for the prehistoric Canary islanders (1st Century BC to 14th Century AD) examined by Bermúdez de Castro (1989). With increasing modernity it was also apparent that more third molars were being excluded from the dental arch because of lack of space to erupt into. Thus non-eruption of the third molars increases with modernity. This concurs with the views of Murphy (1968), Scott and Symons (1974) and Berry and Poole (1976). Although impaction could not be discerned in the prehistoric population, there was a significant difference in impaction of the third molars between the medieval population and the Victorian and modern ones. The medieval population had fewer impacted third molars and a greater degree of dental wear. The Victorian and modern populations could not be distinguished from each other in uneruption, agenesis or impaction of the third molars and this concurs with the widely held view that the Spitalfields (Victorian) population has a modern rate of dental wear (Molleson et al., 1993, pp. 49–50). The results also suggested that the prevalence of agenesis was the same in the medieval, Victorian and modern populations. Whilst the phase difference between these populations allowed sufficient time for humans to adapt to diet with a greater incidence of impacted third molars, there was insufficient time to adapt with complete agenesis. If it had been possible to radiograph the prehistoric skulls there would have been a greater adaptive time period to study changes in impaction and agenesis in the third molar and in the other teeth. As Garn et al. (1963) postulated from their modern data that agenesis of third molars was not independent of polymorphisms in the development of the other teeth, a panoral radiographic study would be useful in increasing our understanding of human dental adaptation.

The changes in inclination of the occlusal surface of the tooth with wear have been described by Molnar (1971) as natural form, oblique (buccolingual), oblique (lingual–buccal), oblique (mesiodistal), oblique (distomesial), horizontal, rounded (buccolingual) or rounded (mesiodistal). No indication was given as to whether these were consistent with the curve of Spee or the curve of Monson. Doubt was cast on the curve of Monson by Brown et al. (1977) when they measured the worn and unworn dentition and found no conclusive evidence to demonstrate the existence of that curve. The presence of the helicoid caused by dental wear in the buccolingual direction has been demonstrated by many workers (Tobias, 1980) and can be explained by the force and direction of occlusal loads.

The downwardly concave, anteroposterior occlusal plane of the mandible, or the curve of Spee (Dubrul, 1988), had not been as extensively studied. It can be perceived on a daily basis in the modern dental surgery in orthopantomograms and bitewing radiographs and is used to orientate these views (Beeching, 1981). The relation between masticatory movements and the curve of Spee is not clear. Protrusive and retrusive forces are restricted to the incising phase of mastication, which in early man and the non-human primates was also used for tearing meat from bones, reflected in the specialized spade shape of their incisors (Scott and Symons, 1974; Osborn, 1982). It is not known whether this movement leads to wear of the molar cusps. If there is an increased overjet, the molar teeth may be in contact during the forward movement of the mandible. However, if there is an increased overbite, the anterior guidance from the palatal surface of the maxillary incisors will take the posterior teeth out of occlusion. On the other hand, if there was an edge-to-edge or incomplete overbite, then forward movement could take place without posterior disclusion (Levers and Darling, 1983). This may have an effect on the curve of Spee and if the protrusive force were enough to maintain the M1: M2: M3 — 6:6.5:7 ratio of wear described by Murphy (1959), then the curve of Spee would become steeper. This, however, would result in a more contained area for the upper teeth making occlusion more restrictive (Andrews, 1972).

In the current studies the wear scores revealed that the mandibular first molars were worn to a greater extent than the second molars, which are worn to a greater degree than the third. This concurs with the findings of Murphy (1959) and Akpata (1975), and is used in the charts of wear patterns used in age determination generated by Miles (1961), Molnar (1971), Brothwell (1981) and Lovejoy (1985). Our findings also revealed that the steepness of the mesiodistal gradients also followed this sequence and so any curves that existed before wear would be either accentuated or reversed. The increased wear of the first molars may be due to their earlier eruption (and therefore earlier exposure of soft dentine), or their playing a disproportionately large role in the occlusal table, imparting the bulk of the comminution of the food. It has been assumed thus far that, following incision, food is passed back on to the occlusal table of molars and premolars for grinding, and that all surfaces are equally employed. It, however, seems unlikely that a large enough amount of food is taken in to cover the entire occlusal table, and that the most anterior parts of the occlusal table are probably reached and employed first.

If the curve of Spee can be represented by a series of mesiodistal slopes of the occlusal surfaces of the teeth, then our findings do not demonstrate maintenance of the curve of Spee with increasing wear. The scatter was so great in the first and second molars that no particular orientation of mesiodistal wear plane could be determined and in the third molars a tentative regression line suggested that the plane was in the opposite direction to the curve of Spee. These tentative findings should be repeated with larger numbers and on a co-ordinate analysis machine capable of measuring the x, y and z planes. Nonetheless, the findings suggest that there is no straightforward relation between the curve of Spee and occlusal wear. In orthodontic treatment a flat plane of occlusion is a treatment goal and occasionally a reverse curve of Spee is desirable to allow more space for the maxillary posterior teeth (Andrews, 1979). Orthodontic evidence would suggest that this treatment does not cause a marked disturbance to occlusion.

When teeth erupt into occlusion, each tooth lines up in a direction that ensures maximal resistance to the direction of forces applied to the occlusal surface in chewing (Dubrul, 1988). In physiological wear this damage-limitation system should be maintained and this will be reflected in the pattern of wear and the orientation of the occlusal wear planes.

As elderly people are retaining their teeth for longer, the worn dentition becomes increasingly relevant to dentists. If the curve of Spee is not maintained in the worn dentition, then prosthetic teeth should not be aligned along it. It is essential in all aspects of restorative dentistry to maintain occlusal harmony and comfort, and it is therefore imperative to accrue as much data as possible on occlusal wear planes.

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