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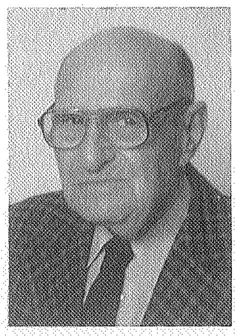

# Dental attrition in a South Indian skull

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ABSTRACT: The skull of a twentieth-century man presented by chance and was recognised as an example of attritional occlusion. It was photographed and x-rayed and seemed to be a worthy supplement to Begg's classic work. It demonstrates severe loss of tooth structure from attrition, both occlusally and interproximally, resulting in reduction of tooth width and height. Interproximal loss of tooth substance results in a mesial inclination of the posterior teeth. 'X-occlusion' is found to be functional in origin, rather than hereditary, and caused by the reverse bucco-lingual obliquity of the occlusal plane. The arches accommodate all the teeth, including the third molars, without crowding or protrusion. A study of this case sheds additional light on the causes of Modern Man's anomalous occlusion. Relevance to orthodontic analysis and treatment is noted.

Reference: Aust.Orthod.J.11(4):241-246

MeSH words: dental enamel; dental occlusion; tooth attrition
Key words: attrition, 'chevron effect', 'X-occlusion'

## INTRODUCTION

This study originated as a chance discovery. The object of this study was resting on a shelf in the office of a dental practitioner I was visiting. Out of idle curiosity, I picked it up, turning it round and round. I recognised it immediately as a case of dental attrition. In addition to attrition, superficial inspection showed the presence of all four third molars and severe periodontal disease of all the upper molars. Having an intuitive feeling that this skull might be important as a contribution to the theory of dental attrition (Begg & Kesling 1977), I obtained permission to borrow it for photographic purposes.

## MATERIALS AND METHODS

35mm colour slides were made with a Honeywell Pentax Exacta H1 camera using Kodachrome KM135 film. The slides were projected on to a 4-foot screen for enlargement for ease of viewing. Final views selected were those that seemed best for demonstration purposes. Some pictures were taken indoors with artificial light using a Strobe ring-attachment. Others were taken outdoors in the shade on sunny days for even light distribution. In some cases, the camera was held by hand, in others by tripod.

A lateral cephalogram and tracing were made. Bitewing x-rays of the posterior teeth were taken and angulations of the roots were made therefrom onto tracing paper.

Since it was felt that a better understanding of the dynamics of attrition could be obtained from some understanding of the life and lifestyle of the individual to whom this skull belonged, these will be considered under 'Discussion.'

Regarding method, Giard (in Moore 1961), a noted French zoologist, wrote in 1881: 'Detailed and conscientious observation of facts that may seem unimportant in their extreme minutiae, can awaken in an alert mind theories of the highest scientific import.' In this study I have tried to adopt Giard's modus operandi and urge the assiduous reader to follow the text closely.

## RESULTS

*Figure 1.* Most of the anterior teeth are missing. Their loss is the result of post-mortem evulsion, the sockets not having been filled in. Missing are: the upper right central and lateral incisors, the upper left cuspid, the lower right central and lateral incisors and cuspid, and left central incisor and second molar (*see Figure 3 for the latter*). The upper left central incisor has a mesial periodontal pocket. The teeth fall into Broca's (Begg 1977) third stage of occlusal and incisal attrition. The labial surface of the upper right cuspid is two-thirds attrited, the mesial surface being all cementum. Centric relation, as commonly understood, is absent since there are no cusps to guide the lower teeth into apposition with the upper teeth. Centric

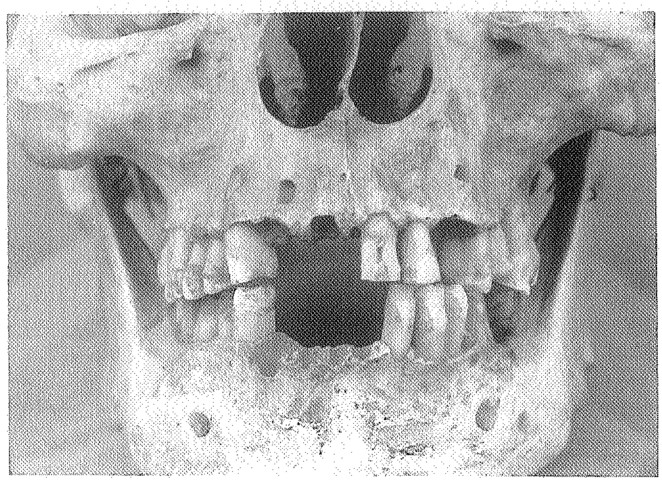

Figure 1. Anterior view of skull

*In private practice, New York

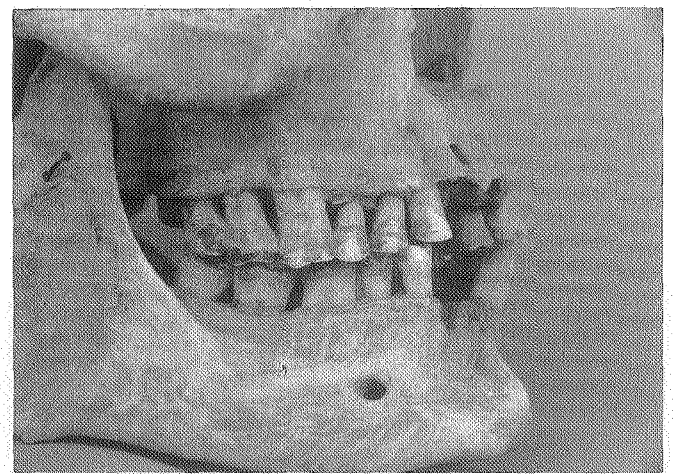

Figure 2. Right side

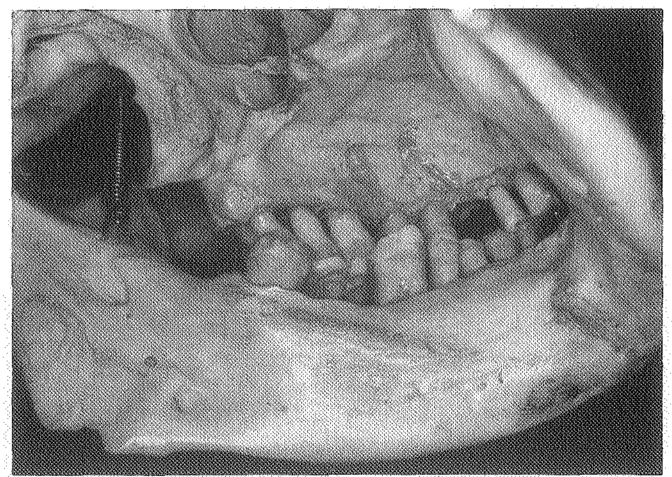

Figure 4. Oblique view, lingual aspect of the occluded dentition, left side

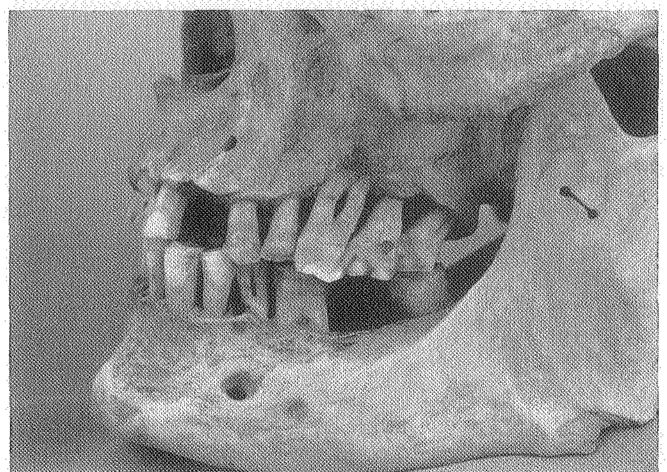

Figure 3. Left side

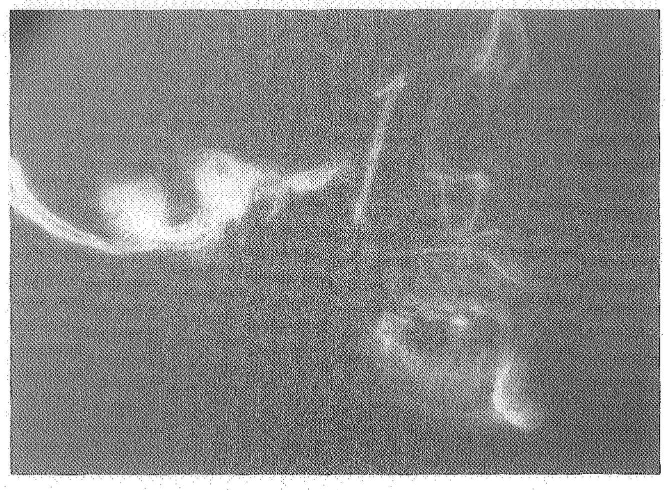

Figure 5. Lateral cephalogram

occlusion is here determined by the pull of steel springs anchored into the medial surfaces of the rami and into the floor of the cranium which seat the condyles into their respective sockets without soft tissue intervention. Measuring from the buccal surfaces of the upper first molars to the buccal surfaces of the lower first molars, there is a 5mm overjet of the upper right first molar and a 9mm overjet of the upper left first molar. The bucco-lingual edge of the lower left first molar (seen in this view immediately behind the lower first premolar [the buccal surface of the lower left second premolar has been fractured off and is not visible]) barely engages the linguo-occlusal edge of the upper left first molar. The labial surface of the upper left central incisor has been fractured off into the pulp, as has been that of the lower left second premolar. They are both post-mortem fractures (intraoral x-rays [not shown] reveal no root-end rarefactions). A view of the root-end of the lower second premolar is shown in Figure *3*. The buccal cusp of the upper left second premolar has been fractured off in vitae without pulp exposure. The reasoning for saying 'in vitae' will be given in the discussion of *Figure 3*. The remaining anterior teeth are not crowded and the sockets of those that were evulsed are in regular alignment indicating that they too, were not crowded. There is a zero overbite. Comparing the levels of the cemento-enamel junctions of the teeth with the alveolar crests it is seen that there is an approximately 5mm difference – an amount approximately equivalent to that lost by occlusal attrition. The upper molars are obviously periodontally involved. The teeth are caries free.

*Figure 2*. Pogonion is prominent. The anterior teeth are set well back on the ridges (*Figure 7 and Table 1*). There is one gonial tubercle in view and prominent zygomatic tubercles suggesting strong muscle pull. The overjet is 2mm after mentally replacing 1mm of labial enamel fractured off the lower left lateral incisor. This overjet, being less than the labio-lingual incisal width of the upper left lateral incisor, maintains the zero overbite. The first molars appear to be properly positioned mesio-distally with respect to each other, the second molars less so, and the distal surface of the upper third molar is mesial to that of the lower third molar, indicating greater interproximal attrition of the upper molars, probably due to the greater mobility of the upper periodontally involved teeth. A mesial inclination of the posterior teeth forms a chevron-like effect when the long axes of these teeth meet the occlusal plane *(Figure 13)*. A 'chevron' (Webster's Third New International Dictionary) is defined as a V-shaped stripe, a series of which is commonly seen on the sleeves of soldiers' uniforms. The mesial surfaces of the upper second and third molars ride successively higher up on the distal surfaces of the preceding teeth, the occlusal surfaces forming a step-like effect. This effect is shown more clearly in *Figure 3*. The upper third molar is actually riding on the root surface of the upper second molar in such a manner as to be possibly thought of as being impacted.

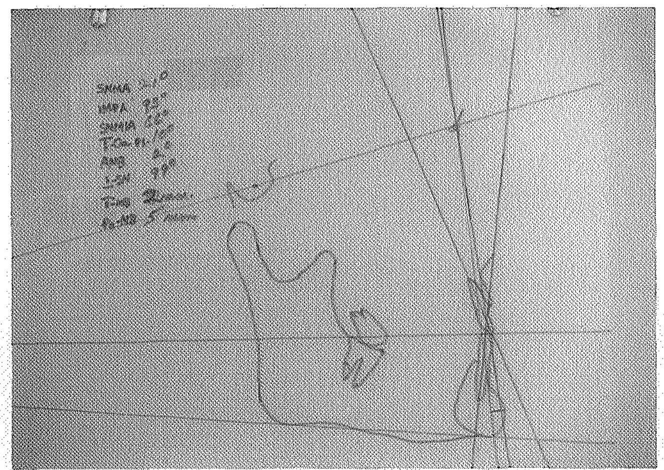

Figure 6. Tracing of cephalogram

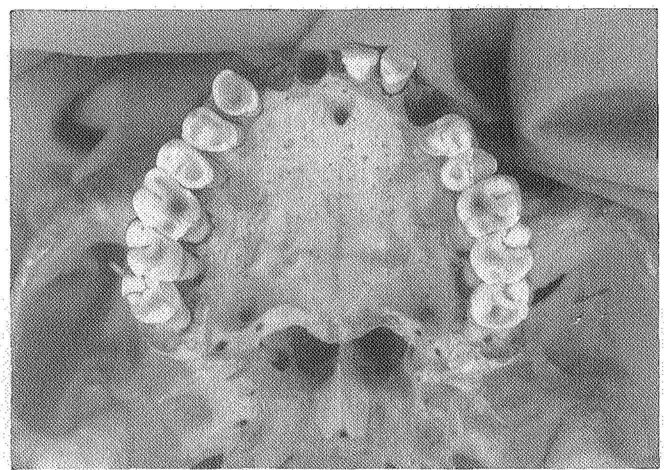

Figure 8. Occlusal view of the maxilla

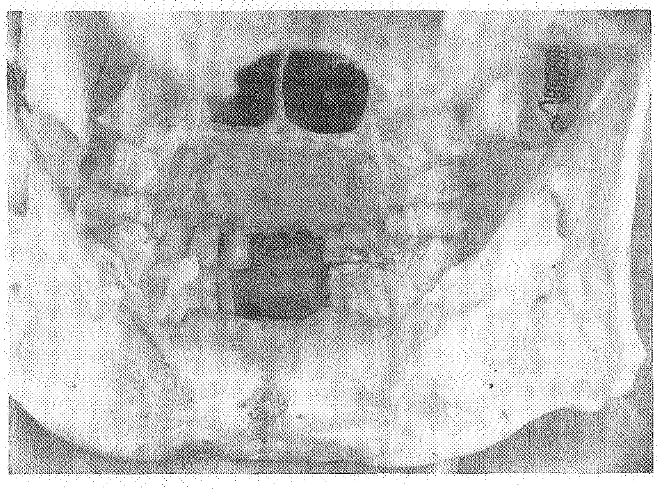

Figure 7. Posterior view

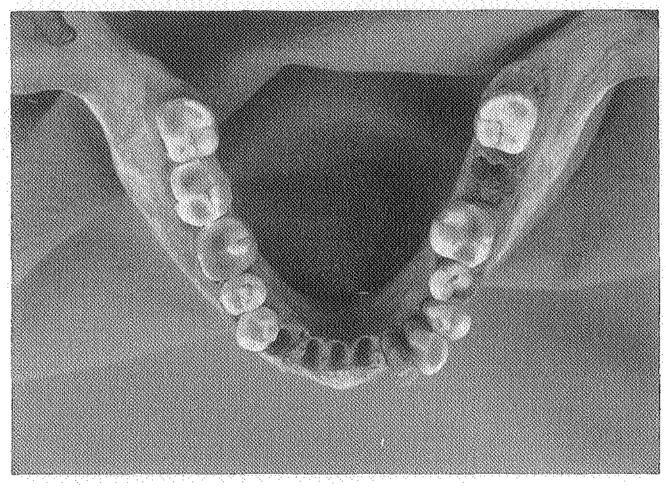

Figure 9. Occlusal view of the mandible

*Figure 3.* This left side is similar to the right except that the mesial inclination of the posterior teeth is greater. The lower third molar occludes on the distal surface of the upper third molar, appearing to force it mesially. The rectangular shape of the buccal surface of the originally unworn crown has been changed to an almost unrecognisable triangular shape by attrition. The second premolars show an interesting contrast. The upper second premolar has had its buccal cusp fractured off without pulp exposure. The fracture extends occlusally short of the central fissure. The narrow mesio-distal diameter of this tooth has permitted the adjoining teeth to converge over the occlusal surface of the second premolar 'locking it in' to prevent further eruption, producing an open bite of 1mm. Whether the cause of the fracture was accident or the shearing effect of the force of mastication is conjecture. This fracture was in vitae since the narrowing of the mesio-distal diameter of this tooth has resulted in space closure. The lower second premolar fracture was post-mortem as shown not only by the x-rays but also by the failure of the distal space to close. Another view of prominent zygomatic tubercles presents.

*Figure 4.* This oblique view of the lingual aspect of the occluded dentition, left side, gives some idea of the force of mastication of the lower third molar against the upper third molar. The unworn mesiolingual cusp of the lower left first molar stands up high occlusally.

*Figure 5.* Shows the lateral cephalogram of the skull.

*Figure 6.* Tracing of the cephalogram. The analysis of the tracing is found in *Table 1.*

*Figure 7.* A posterior view of the skull shows an expanded upper arch with buccal tilting of the upper molars and a

**Table 1.**
Cephalometric measurements - comparison with standards

| | Skull | Standards | | | Estimate |
|---|---|---|---|---|---|
| | | Strong | Weak | Average | |
| SNMA | 21$^{\circ}$ | 24$^{\circ}$ | 35$^{\circ}$ | 28.9$^{\circ}$+ | Strong |
| IMPA | +3$^{\circ}$ | -8.5$^{\circ}$ | +7$^{\circ}$ | +1.4$^{\circ}$* | Weaker than average |
| SNMIA | 66$^{\circ}$ | - | - | 51$^{\circ}$# | Strong |
| 1-Oc. Pl. | 10$^{\circ}$ | 3.5$^{\circ}$ | 20$^{\circ}$ | 14.5$^{\circ}$* | Stronger than average |
| ANB | 2$^{\circ}$ | 0$^{\circ}$ | 4$^{\circ}$ | 2$^{\circ}$# | Average |
| 1-SN | 99$^{\circ}$ | 95$^{\circ}$ | 110$^{\circ}$ | 103$^{\circ}$# | Stronger than average |
| 1-NB | 2mm | 2mm | 4mm | 3mm# | Strong |
| Po-NB | 5mm | 4mm | 2mm | 3mm# | Strong |
| 1-1 | 150$^{\circ}$ | 150.5$^{\circ}$ | 130$^{\circ}$ | 135.4$^{\circ}$* | Strong |

*Downs
+Derived from Downs by adding 7$^{\circ}$=SN-FH
#Author's own standards

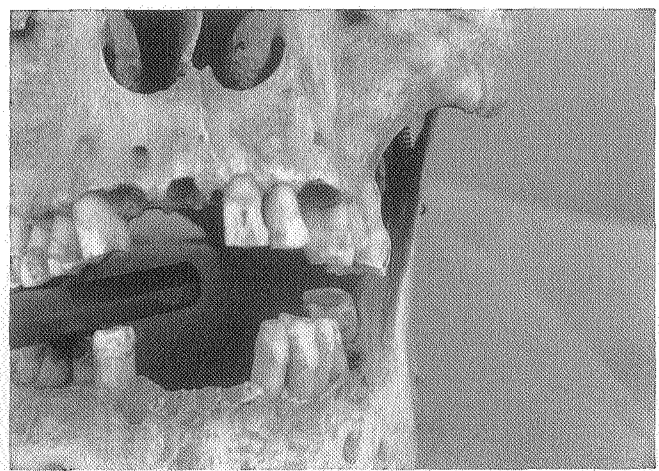

Figure 10. Reverse bucco-lingual obliquity of the occlusal plane of the posterior teeth, left side

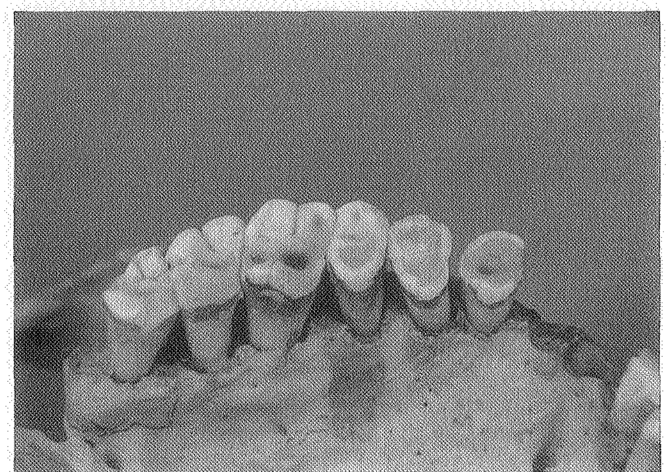

Figure 11. Enlargement of the upper right side

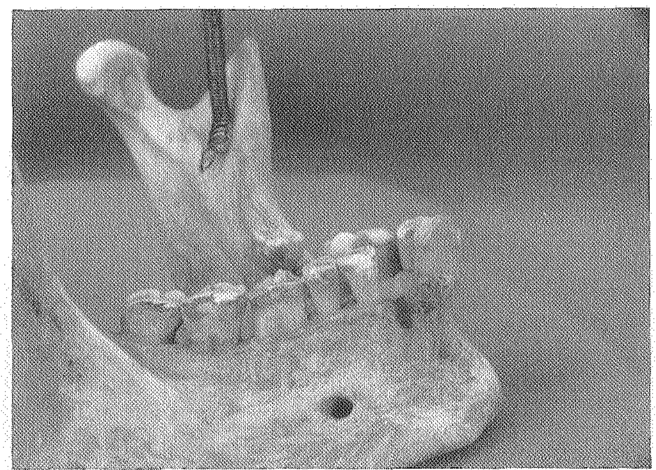

Figure 12. A view of the lower dentition

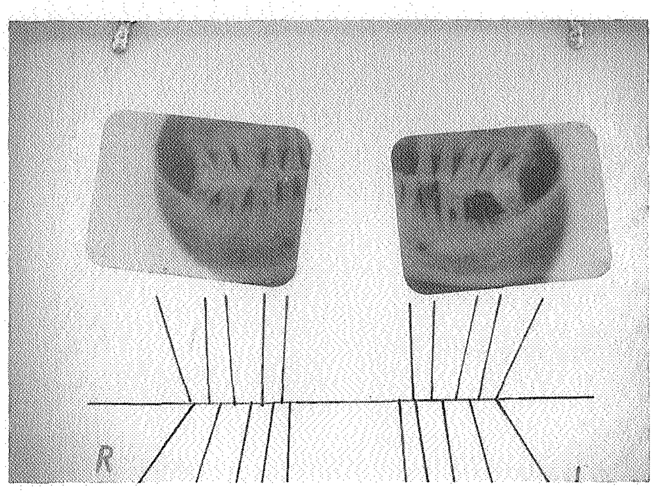


Figure 13. Posterior bitewing x-rays with tracing of the long axes of the teeth

constricted lower arch with lingual tilting of the molars, particularly the lower left first molar. The occlusal plane of this latter tooth slants downward bucco-lingually, with the lingual cusps being so far lingual that they are out of occlusion. Right gonion has three tubercles enlarged by peripheral lens distortion.

*Figure 8.* An occlusal view of the maxilla shows an expanded palate with flaring posterior teeth, the molars in particular. The lingual root surfaces show prominently. Abrasion of the occlusal surfaces, especially the linguo-occlusal, through the enamel into dentine and secondary dentine may be noted. Abrasion of interproximal surfaces is extreme. The interproximal surfaces of the molars and the distal surfaces of the second premolars are worn flat, and even, in the case of the adjoining surfaces of the right first molar and second premolar, worn concave in spots. The contact points have been worn flat in general, with surface areas of up to 7.5mm in width. The buccal cusps of the molars and the upper right second premolar are relatively untouched by attrition. There is another view of the tubercles on the inferior surface of the zygomas.

*Figure 9.* An occlusal view of the mandible shows a constricted arch, most pronounced in the left first molar area. There is marked attrition through the enamel into dentine and secondary dentine. The greatest wear is on the first molars, especially the right first molar. The wear is invariably on the buccal cusps, while the lingual cusps are relatively free of attrition. The degree of occlusal attrition increases from first to second to third molar, and from first to second premolar, in accordance with the functional life of the teeth. Interproximal attrition is similarly affected, resulting in a tendency towards equalisation of the widths of those teeth. The lower first molars are actually 1mm narrower than the others. The mesial surfaces of the left molars are concave.

*Figure 10.* There is a reverse obliquity of the bucco-lingual occlusal plane of the posterior teeth, left side. The right side shows a similar condition, so this photo has been omitted. The jaws were propped open to better show the obliquity of the bucco-lingual plane of occlusion of both upper and lower teeth. The angle of the prop on the right side illustrates this phenomenon graphically. The obliquity is diametrically opposed to that of unworn teeth.

*Figure 11.* The upper right side, enlarged, shows the facets of wear of the occlusal portions of the lingual surfaces and the lingual portions of the occlusal surfaces. The buccal cusps are relatively unworn since the teeth have been forced so far out buccally by the obliquity of the bucco-lingual plane of occlusion.

*Figure 12.* A view of the lower dentition shows extreme wear of the lower right first molar to below the level of the contact points, the adjoining teeth leaning over it, 'locking it in.' The height of the lower molars has been reduced by

attrition, the height varying according to the functional life of the teeth. The missing lower left second molar provides a good view of the clean, flat (from this view) mesial surface of the lower left third molar.

*Figure 13.* Posterior bitewing x-rays with tracings of the long axes of the teeth meet in at an angle at the occlusal plane, making a 'chevron effect' where the angles formed by the long axes of the teeth are closer together than the apices of the roots. This geometric pattern is caused by attrition of the proximal surfaces of the teeth. The occlusal surfaces of the molars form a step-like effect with the mesial surfaces tucked in under the distals of the preceding teeth. A slight modification of the 'chevron effect' is caused by the convergence of the lower right second premolar and molar over the occlusal surface of the lower right first molar, which surface has been considerably reduced by wear. This wear is in accordance with the greater functional life of this tooth. This convergence 'locks in' the lower right first molar and tends to prevent its further eruption. This also shortens the dental arch further. A similar condition exists with respect to the upper left second premolar because of its fractured buccal cusp. The teeth opposing the intruded teeth extrude into the space provided. The two unexpected findings were pulp stones in all first and second molars, and the distal root of the lower left third molar is almost entirely resorbed.

## DISCUSSION

Modern civilised man, Homo sapiens sapiens (Kornberg 1938), stands on top of the evolutionary ladder. On the bottom stands earliest man, Homo habilis (Kornberg 1938). The time span of 3.5 million years (Leakey 1981), during which attritional occlusion has been a distinguishing feature of man's dentition, has etched its pattern of forces and dynamics into his genes. This pattern tends to emerge in modern civilised man in his non-attritional occlusion in the anomalies of crowding and protrusion of anterior teeth and impaction of third molars. The skull of the present study, a Homo sapiens sapiens who is also at the top of the evolutionary ladder, is that of a modern uncivilised man, a member of a primitive culture group or tribe, of which there are still over 300 extant throughout the world today (Montagu 1969), which have attritional occlusion.

The source of this skull was traced from my dental acquaintance to the University of Buffalo School of Dentistry and to the Professor of Anatomy at the University of Buffalo School of Medicine and thence to H.Barbeau, President of Ward's Sciences Establishment, Rochester, New York, who, from photographs of the skull, identified it, in all probability, to be from Southern India.

The attrition of the teeth falls into Broca's Stage III of occlusal and incisal attrition. This is severe compared to Modern Man's.

An educated guess of the skull's age at decease is approximately 42 years. This was determined by comparing the degree of attrition with Miles' chart of attrition made up from a study of 157 Anglo-Saxon skulls. Miles' chart provides, in itself, only a rough estimate of age, especially in older specimens where fewer skulls are available. Undoubtedly a better estimate could be obtained from a similar chart of Indian skulls, but I am unaware of such a chart.

Three evenly spaced lines of enamel hypoplasia (Cohen and Armelagos 1984) on the cuspids (*see Figures 1,2 and 3*) indicate seasonal periods of malnutrition which indicate a relatively isolated primitive semi-agrarian society.

Brown stains on the teeth may be assigned to betel or betel nut chewing as a masticatory stimulant. This habit is prevalent among southeastern Asians.

The bony framework has been found to be strong (*Table 1*).

From the above a picture presents of a Southern Indian male living in a rural society, subsisting on agriculture, fishing, hunting, foraging, using his teeth vigorously on a coarse, fibrous diet of grains, and chewing almost constantly, causing severe attrition of the teeth. His diet did not include refined grains and cereals.

Fundamentally, this modern Primitive man has an attritional occlusion very similar to that of the Australian aborigine (Begg and Kesling 1977) the main difference being the periodontal involvement of the upper molars. Although I had not expected to find anything original, several new observations did arise:

1. Attrition of the teeth, mainly interproximally and partly occlusally to below the level of the contact points, causes a mesial tilting of the posterior teeth. The more posterior the teeth the greater the inclination resulting in a 'chevron effect' *(Figure 13)*. No gross mesial movement of the root-ends is observable, although it is conceivable that there might be some, since the greater force of mastication exerted on the disto-occlusal than on the mesio-occlusal could cause mesial shifting of the roots. The elevation of the distal margins and depression of the mesial creates a step-like effect of the occlusal surfaces with greater attrition of the disto-occlusal area and relatively little of the mesio-occlusal areas. Mesial tilting of the teeth differs from mesial movement. The latter implies bodily movement, such as one generally obtains in the strictly edgewise technique, whereas mesial tilting of the teeth is in harmony with the tipping action of the Begg technique. The greater the wear, the greater the mesial tilting. The less the wear, the less the mesial tilting. The amount of wear depends on diet, age, and the severity of mastication.

2. Begg (1977) claims that the position of the mental foramen between the roots of the second premolar and first molar often found in the Australian aborigine is proof of the mesial movement of the teeth, but this allegation may not be correct. For example, perhaps the mental foramen is not as fixed a landmark as supposed; the position of the mental foramen relative to the roots may be influenced by the procumbency or uprightness of the anterior teeth; note Begg's Figures 7, 18 and 43 for the former presumption, and his Figures 4 and 53 for the latter. In our skull, on the right side *(Figure 2)*, the mental foramen is between the roots of the second premolar and first molar; on the left side *(Figure 3)*, it is between the roots of the premolars. Regardless of the reliability of the mental foramen as a dependable landmark, the evidence of this article indicates that the concept of mesial migration of the posterior teeth ought to be replaced by the concept of mesial inclination, which latter forms in one's mind a 'chevron effect'. Further research on the position of the mental foramen is indicated. Further research on skulls generally should also be done, preferably on older skulls, since older skulls show the greatest wear, but skulls of all ages and from many countries could well be studied. These studies should also include, if possible, panoramic x-rays to show the axial inclinations of all the teeth, anteriors as well as posteriors, and electron micrography to show patterns of wear on the occlusal surfaces to give clues as to diet.

3. *Figure 8*, the expanded maxilla, and *Figure 9*, the contracted mandible, are an example of 'X-occlusion' (Begg and Kesling 1977). If one were to place the teeth on one side into masticatory position, the lower posterior teeth on the opposite side would be mostly so far lingual to the upper teeth that they would be out of occlusion. And if one were to put the teeth on the other side into masticatory position, the opposite side would then be out of occlusion. The lower jaw must have had, in vitae, a

wide range of lateral movement, similar to the 'nanny-goat.' Barrett (in Begg) found that one third of Australian aborigines had 'x-occlusion,' and attributed this to heredity. The evidence of the present article is that the cause is functional and due to the reverse bucco-lingual obliquity of the occlusal plane. The chewing mechanism may be viewed in toto as an efficient triturator, similar to a mortar and pestle, upside-down, the upper dentition being the mortar, the lower dentition the pestle, the motor being the muscles of mastication. Other studies similar to this one are indicated. Also indicated is the intra-oral inspection of large populations in primitive cultures to correlate age with 'X-occlusion.'

Attrition of the anterior teeth provides room for proper alignment of those teeth and proper placement on the ridges. An examination of a better preserved specimen could serve to better elucidate this observation. Attrition of the teeth shortens the arch sufficiently to permit full eruption of the third molars. In Modern Man with his non-attritional occlusion, in addition to crowding and protrusion of anterior teeth, there is an approximately 85 per cent incidence of third molar impaction due to crowding. In orthodontic analysis and treatment planning, allowance should be made for this concept of a lifelong dynamically changing occlusion and a place kept in analysis for future arch reduction. This is best done, in the Begg technique, except in cases of naturally small teeth, by the removal of all four first premolars. It is usually found, in cases of mild crowding and protrusion treated in this manner, that the third molars erupt normally.

Because of the above considerations, the common practice of extra-oral anchorage to distal-drive the upper molars to relieve crowding and protrusion of the anterior teeth is contraindicated. Distal-driving of molars goes counter to Nature's desire for mesial tilting of the molars. The result of this form of therapy is generally difficult to accomplish and disappointing in results, and often, to be successful, requires removal of a molar on each side.

The common belief that third molars are not good teeth and are destined for eventual extraction stems from Darwin's theory of evolution. Moore (1961b), popular science writer, commenting on Darwin, said : 'Wisdom teeth, the appendix and man's rudimentary tail were further and telling evidence of man's long jungle past'. This was an inaccurate inference to make from Darwin's theory of evolution. It implied that, as evolution proceeds, all three are destined to disappear, and hence third molars are unimportant. This is solely Moore's interpretation of Darwin's theory. As far as this author could ascertain from a perusal of Darwin's 'The origin of species' and his other books, Darwin never commented on the human dentition. He would not write on anything he had not studied and researched thoroughly. The study of the teeth and their development belongs to the field of dental anthropology. Darwin was a naturalist, not an anthropologist. Modern anthropologists generally understand that attrition of the teeth is prevalent among primitive peoples. In fact, one anthropologist (Goose 1963) said 'The lack of harmony between jaws and teeth seems to be one of the main factors determining the increased number of irregularities of teeth at the present time, and it may be supposed that as there is more and more miscegenation, so there will be more and more disharmonies occurring. The absence of attrition in modern teeth is also important since there is effectively more tooth material to be accommodated than in earlier populations'.

## CONCLUSIONS

Features of attritional occlusion are: strong forces of mastication on tough, abrasive food; constantly changing tooth anatomy and occlusion; severe attrition occlusally and interproximally; constant extrusion of the teeth with mesial inclination of the posterior teeth; fully erupted third molars; broad, flat contact areas; an anterior edge-to-edge bite; constant eruption of the teeth; rapid formation of secondary dentine with receding pulps; occasional pulp stones and root resorption; generalised freedom from caries and periodontal disease (the loss of bone around the upper molars is due to the reverse bucco-lingual obliquity of the occlusal plane and the extreme forces of mastication which force those teeth out buccally into areas of stagnation which augments the periodontal disease process.)

Features of non-attritional occlusion are: teeth generally too large for the jaws; crowding, protrusion, impaction of third molars and increasing overbite. Lack of wear of the teeth contributes to gingival recession, periodontal disease and caries.

New findings are: the shortening of the dental arch from attrition is enhanced by the mesial inclination of the posterior teeth which can be visualised as a 'chevron effect' 'X-occlusion' is a phenomenon of function rather than heredity and due to the reverse bucco-lingual obliquity of the posterior teeth.

Further studies are needed on skulls of older individuals which show advanced attrition to verify the results of this study. Research should also be done on young adults and children. Intra-oral examination of extant primitive populations to check the incidence of 'X-occlusion' and its frequency in different age groups should also be done.

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