

Tooth use in Aboriginal Australia

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The study of dental casts taken from living people avoids the ethical problems of research into human remains, while providing valuable information about diet and life styles. This article describes a study of tooth wear in dental casts of three different groups of Australian Aborigines. The authors describe their methods of recording and report differential patterns of wear in the different groups. Preliminary interpretation relates the wear patterns both to diet and to the use of teeth as tools in a range of cultural activities, results which are potentially relevant to other groups of hunter-gatherers, past and present.

The unique appearance and lifestyle of the Australian Aborigine has long fascinated the rest of the world. Europeans first learned about their existence during the seventeenth and eighteenth centuries, through the encounters of explorers, such as Dampier, Cook and Flinders. Eye witness accounts described the hostility of the indigenous groups to these new travellers, which was often met with equal aggression. Although heavily influenced by their own beliefs, these accounts of early contact provide us with compelling observations of Australian Aborigines, describing their appearance, diets, customs and behaviour (Figs 1 and 2).

Much of the academic interest in Australian Aborigines, and all groups of recent hunter-gatherers, has been fuelled by the belief that they represent a way of life similar to that of our prehistoric ancestors. Their role in the study of human evolution and the distinctive nature of their skeletal remains has also attracted a great deal of interest from researchers over the past hundred years. During these early scientific investigations, little consideration was often given to the descendents of the skeletal material being studied. The tragic histories of many of these groups, especially the Tasmanian Aborigines, and the controversial collection of their human remains have led to a significant reduction in academic research in recent years. However, the study of dental casts taken from living groups of Australian Aborigines, such as those held at the University of Adelaide in Southern Australia, has the potential to provide valuable information about this hunter-gatherer group without using the more contentious skeletal collections.

Tooth use and tooth wear

Tooth wear results from the contact between teeth, or contact with foreign bodies in the mouth, such as food, materials, artefacts and grit. Some wear occurs during the chewing of meals, but this activity only occupies a small portion of every twenty-four hours and there are other ways in which teeth are brought

together. Some of these are involuntary, such as the grinding together of the teeth and some are deliberate, such as cutting

tape or thread, or holding an object to leave both hands free. Today such actions are relatively uncommon, as we have a large array of specialized tools to carry out these tasks. In the past teeth were used for a large variety of tasks, such as initial preparation of food, preparation of materials such as leather and fibres and woodworking. This was particularly true of hunter-gatherers and may well have had a considerably greater effect on tooth wear than eating itself. Consequently, most groups of hunter-gatherers, both ancient and recent, have been noted for their high rates of tooth wear.

Until recently Australian Aborigines lived entirely by hunting and gathering wild food, moving on foot over long



Figure 1 A group of Central Australian Aborigines

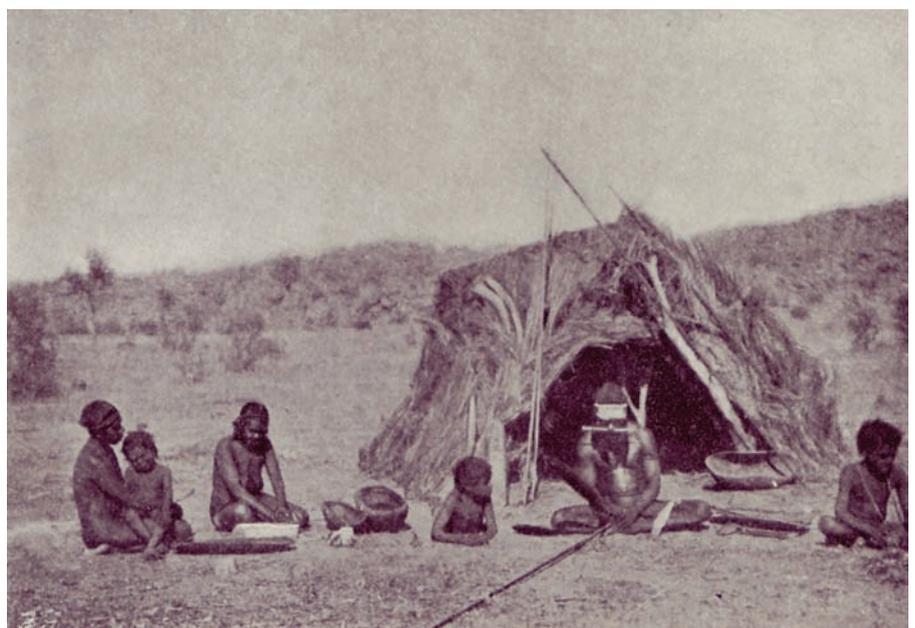


Figure 2 A family group of Australian Aborigines from the Arunta tribe

distances between water sources and sleeping behind windbreaks with fire for heat. Their traditional diet varied greatly by region, but included, milk, plant foods such as roots, tubers, bulbs, stems, leaves fruits and cereals, aquatic and sea foods, meat, honey, insects and eggs.² The nomadic nature of their existence meant their material culture needed to be highly portable and included stone axes, knives and spearheads, as well as wooden digging sticks, spear throwers, bowls, shields and spears (Figs 3 and 4).³ Art included personal decoration, bark paintings, wall paintings and carving. Men generally hunted large game, while the women collected smaller animals, plants and seeds. High rates of tooth wear have frequently been noted in both living groups of Australian Aborigines and their skeletal remains. This pattern of heavy tooth wear has been associated with the abrasiveness of their diet as well as the cultural use of their teeth in activities such as sharpening stone tools.⁴ By old age the teeth of Australian Aborigines were often worn down to the level of the gum.

Australian Aborigines and the University of Adelaide

The University of Adelaide in Southern Australia has a long history of anthropological study of living groups of Aborigines in Australia. From the 1920s to the 1970s large groups of researchers travelled to remote parts of Australia making detailed observations of these

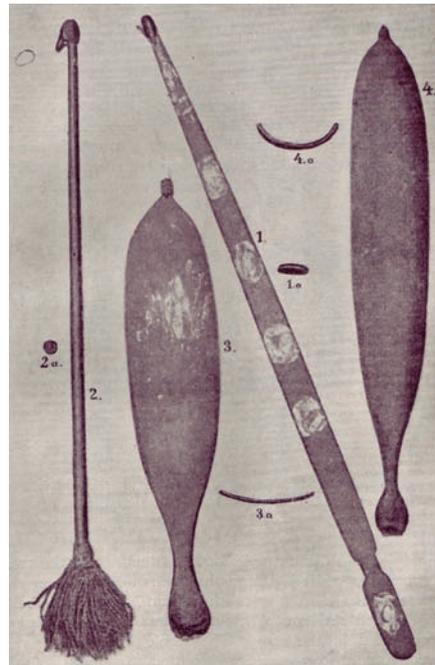


Figure 3 Spear-throwers

hunter-gatherers. During expeditions to the settlements of Yuendumu and Haast's Bluff in the Northern Territories, and Kalumburu in the Western Territories, dental impressions of many hundreds of individuals were taken. This collection of dental casts is still held at the University of Adelaide and was recently the subject of a scientific study by researchers from the Institute of Archaeology, UCL. This research focused on the examination,

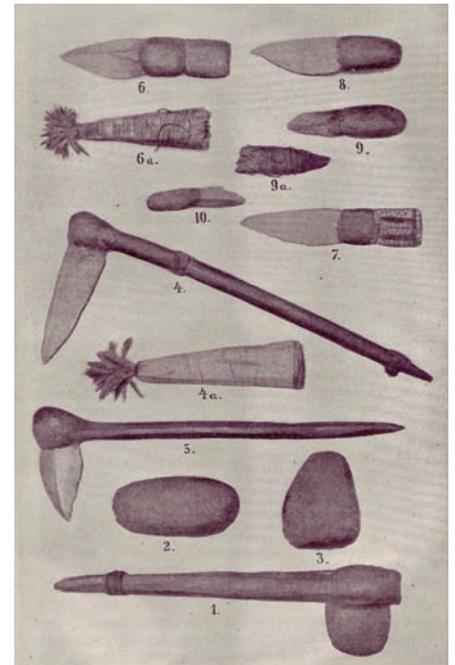


Figure 4 A selection of stone axes and knives

recording and evaluation of tooth wear patterns within and between these three different groups of Australian Aborigines.

The settlement of Yuendumu was established by the Australian government in 1946, representing one of many founded at this time in the Northern Territories as a result of the removal of Australian Aborigines from their ancestral lands, due to the expansion of the cattle industry. Yuendumu is situated about 285km west of Alice Springs and provided Australian Aborigines from this area, mostly from the Walbiri tribe, with clothing, food rations, medical care and schooling for their children.⁵ Regular field visits were made to Yuendumu by a research team from the University of Adelaide, led by Thomas Draper Campbell and Murray Barrett, between 1951 and 1971. A longitudinal growth study was carried out during this project that included the production of dental casts.

Haast's Bluff, another Australian Aborigine reserve near to Alice Springs and to Yuendumu, was also the subject of anthropological investigations by the University of Adelaide. An intensive study was undertaken of individuals mostly from the Pintubi or Aranda tribe, but also including the Ngalia, Kukatja and Pitjandjara.⁶ In the late 1950s a team from the anatomy department, led by Professor Abbie, examined 140 of the Haast's Bluff Aborigines, taking 115 dental impressions from a cross-section of the community.

In 1908, and with the encouragement from the government, Abbot Torres of the New Norcia Benedictine monastery and a small band of followers set up a mission at the site of Pago, in North-west Australia. To secure a reliable water

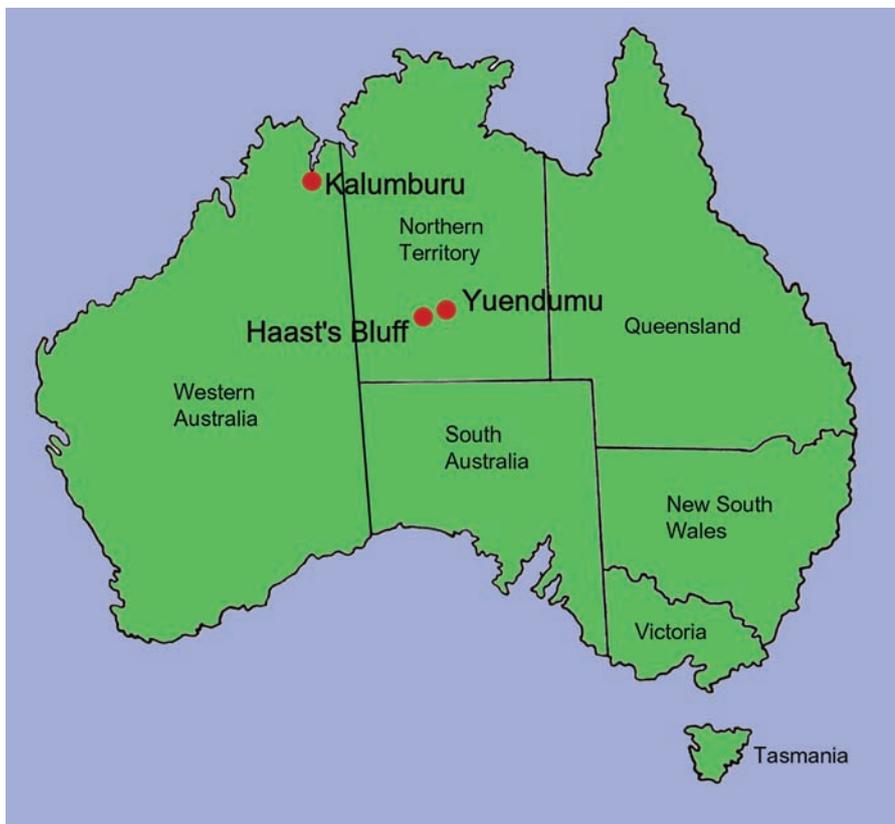


Figure 5 Map of Australia showing locations of Yuendumu and Haast's Bluff

supply the mission moved to the nearby site of Kalumburu situated on the mouth of the King Edward River about 300 miles southwest of Darwin. It was formed through concern for the welfare of the Aborigines from the Kimberley region, who had suffered greatly from death and disease since first encountering the Europeans. A community slowly built up at the mission, made up of individuals from the Kuini, Kulari, Walambi and Warmala tribes.⁷ This mission was visited by a team of researchers from the University of Adelaide during the 1950s, again led by Professor Abbie, and during this time dental casts were produced.

The geographic isolation of all three communities of Australian Aborigines during the anthropological study period limited the impact of European customs and food habits. In addition, although the groups had been de-tribalized they still retained a detailed knowledge of their surrounding environments and their natural history. This ensured that most inhabitants continued to practise a traditional way of life and is evidenced by the heavy pattern of tooth wear seen within the dentitions of these individuals.

Recording tooth wear

In the new study, tooth wear patterns were examined in a total of 90 adult dental casts from each of the three Aboriginal communities. Permanent tooth wear was measured from these high resolution dental casts using computer image analysis software and a graphics tablet (Fig. 6). The area of the occlusal (biting) surface and the area of exposed dentine (a hard yellow-coloured material lying below the enamel and exposed during the process of wear) were both measured, and a dentine proportion calculated by dividing the area of dentine by the area of the occlusal surface. Wear patterns were then compared between the three geographic groups independent of age. This is important when assessing wear patterns as the amount of tooth wear exhibited by an individual is strongly related to their age, i.e. the older an individual, the higher the amount of tooth wear, and this can often obscure the pattern of wear. The comparison was achieved by dividing the dentine proportion of each tooth by that of the permanent first molar. This tooth was selected as it is normally the first adult tooth to erupt (to emerge into the mouth through the gum from within the tooth socket). The first incisor is generally the next tooth to erupt, followed by the second incisor. The second group of teeth to erupt are the canine, premolars and second molar, and these teeth erupt approximately two to five years later than the incisors and first molar. The last



Figure 6 Occlusal view of teeth from the lower jaw

tooth to erupt is the third molar (wisdom tooth), which emerges substantially later than all of the other teeth, usually during early adulthood. If all the teeth are worn at a constant rate then it should follow that the most heavily worn of all the teeth would be the first molar, followed by the incisors, canine, premolars and second molar and finally the third molar. This is the pattern frequently observed in non-hunter-gatherer groups.⁸ In hunter-gatherer populations a constant rate of wear will not always be maintained throughout an individual's life and the wear ratio for different teeth will also vary. A good example of differential wearing of the teeth is the use of the anterior teeth as tools. Many modern hunter-gatherers, mostly notably the Inuit, have been observed using their front teeth as a "third hand" for gripping objects and in cultural activities such as softening raw seal hide. This contact with an external object meant that the anterior teeth (incisors and canines) wore at a much faster rate than the cheek teeth (premolars and molars). Thus the study of tooth wear patterns within groups of hunter-gatherers, such as the Australian Aborigines, can often provide us with information about the role of teeth within these communities.

The Australian Aborigine wear pattern

The results of this study showed strong differences in the wear patterns between the three groups of Australian Aborigines (Figs 7 and 8). In both the upper and lower dentitions all three groups exhibited a pattern of heavy anterior tooth wear, relative to the first molar and the other cheek teeth. The individuals from the settlements of Yuendumu and Haast's Bluff, however, both showed much higher wear values for their anterior teeth than those from Kalumburu.

For the upper anterior teeth the individuals from Kalumburu possessed median wear ratios of between 1.6 and 2.2, while those from Haast's Bluff and

Yuendumu varied between 2 and 8. They also displayed much larger inter-quartile ranges and overall ranges in wear ratios than the individuals from Kalumburu. A different pattern is shown by the upper cheek teeth, with the individuals from Kalumburu possessing the highest median wear ratios. In the Kalumburu group the median wear ratio of the upper third premolar is most notable out of the cheek teeth, being the same level as that of the upper first molar. In life the third premolar regularly erupts over three years later than the first molar. In the individuals from Yuendumu and Haast's Bluff all of the upper cheek teeth possessed median wear ratios less than that of the first molar, with only the upper inter-quartile ranges of the upper premolars being greater than 1 in the Haast's Bluff group. For the lower dentition a similar difference in wear patterns between the groups is shown. Again, the individuals from Kalumburu possessed much lower wear ratio values for their anterior teeth than those from Haast's Bluff and Yuendumu, but the highest wear ratios for their cheek teeth. Individuals from Haast's Bluff showed the highest wear ratios for their anterior teeth, with medians of over 10 and 6 for their first and second incisors, respectively. Only the individuals from Kalumburu possessed wear ratios for their cheek teeth which rose above the first molar line.

These results showed that all three groups of Australian Aborigines possessed high amounts of tooth wear on the occlusal surface of their anterior teeth compared to the cheek teeth. This is a different pattern than would be predicted from the eruption sequence of the teeth and the one often observed within the dentition of non hunter-gatherer groups. This heavy wear on the anterior teeth is indicative of the use of these teeth in cultural activities, such as those observed in the Inuit of Canada. It therefore seems reasonable to suggest that all three groups of Australian Aborigines were using their

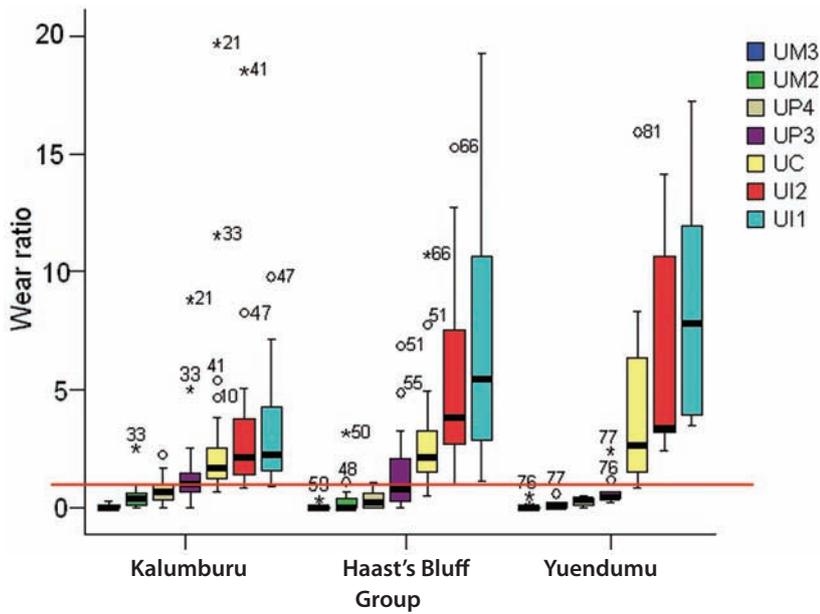


Figure 7 Graph showing the wear ratios for the upper dentition. Each box plot represents an individual tooth, starting with the third molar and following through to the first incisor; the first molar is not present as it is being used as the reference tooth. The y-axis represents the dentine proportion of each tooth, (as a ratio of the dentine proportion of the first molar), and the red line represents a wear ratio of 1:1 (i.e. the level of the first molar)

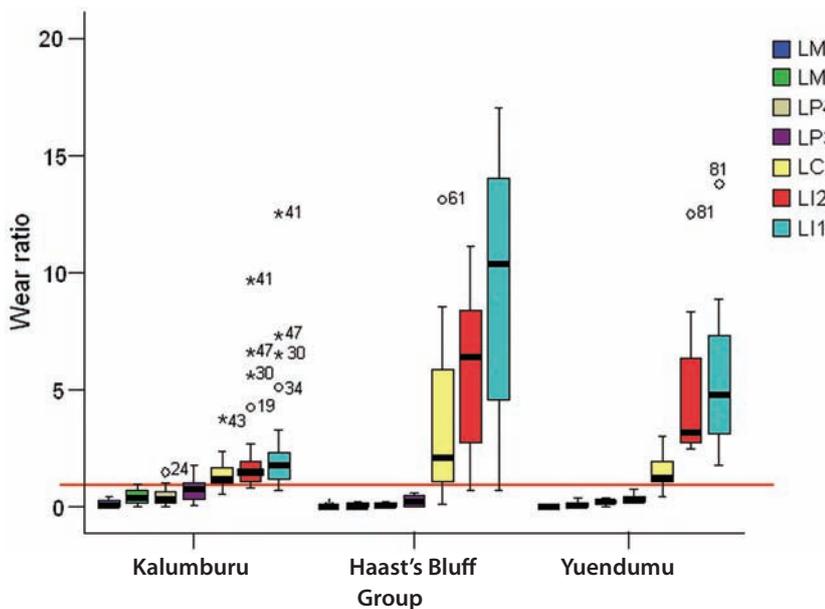


Figure 8 Graph showing the wear ratios for the lower dentition. Details as for Figure 7

anterior teeth for such purposes, although the individuals from the settlements of Haast's Bluff and Yuendumu were using their teeth to a greater extent than those from Kalumburu. Observations of the individuals from Kalumburu indicated their possession of an overall higher rate of tooth wear than the Aborigines from Yuendumu and Haast's Bluff, but this wear was more evenly spread across all the teeth, reflecting an abrasive diet that also wore the cheek teeth at a high rate.

Further research will investigate the relationship between these different wear

patterns and the lifestyle and material culture of these three different groups. The preliminary results seem to suggest that the individuals from the Northern Territories who inhabited a drier, harsher climate necessitating a more mobile lifestyle than those from northwest Australia, relied more heavily on their dentition as a useful tool. In addition, it seems logical that to the more mobile Australian Aborigines from the Northern Territories the dentition would have provided them with a highly portable, multi-functional tool that could easily be

accessed when travelling long distances, and that this might also be an important factor in determining the cause of different tooth wear patterns within and between groups of hunter-gatherers, both past and present.

Notes

- 1 Dental School, University of Adelaide, Australia.
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- 3 A. Abbie, *The original Australians* (Wellington: A.H. & A.W. Reed, 1969).
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