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WHY BUCCAL MICROWEAR?

ABSTRACT: Research in buccal microwear started in the late 1980s with a hypothesis relating striation length by orientation with the proportion of plant and meat foods in the diet. Such relationship has proven to be more complex than initially thought, with the density of striations being one of the most discriminating variables on the enamel surface. Significant differences in buccal microwear pattern have been observed both within populations, by age and sex, and between groups. Hunter-gatherer modern humans clearly differ in their buccal microwear, with strictly carnivorous populations showing a low density and short striations. The analyses of the buccal microwear of fossil humans have suggested that modern humans' microwear models may not be appropriate to infer diet in ancient populations. However, significant between-group differences have also been demonstrated in these populations, though the ecological, cultural and biological nature of such differences still needs to be ascertained. Buccal microwear has great potential to human evolutionary research. Informative, rather than large, samples need to be analysed. More than ever, the hypotheses to be tested are of major importance. Microwear research needs to thrive through a methodological revolution, so the years to come will be of special interest for human evolutionary research.

KEYWORDS: Buccal microwear – Diet – Ecology – Hominidae

Buccal microwear research focuses on the analysis of microscopic features on the vestibular enamel surfaces of teeth to infer diet and ecological adaptations of primate populations and species. Buccal microwear was first developed by the French odontologist Pierre-François Puech, who unwarily set the basis for an informative procedure on buccal microwear by pointing out that on the lateral surfaces of teeth the number, length and orientation of striations were the most informative variables for dietary interpretation (Puech *et al.* 1983, Puech, Albertini 1984, Puech 1986). Microwear research on the occlusal facets of teeth has long had a fruitful history of success (see Ungar *et al.* 2004), but has looked upon buccal microwear as a recent discipline. It is though true that buccal microwear needs to prove certain relationship between microwear patterns and ecological adaptations in primate species, as it is true as well that human adaptive radiation to diet is as much cultural as biological and little parallelism with other primates should be expected. The correlation between buccal and occlusal microwear researches on the same samples should provide a better understanding of the types of information yielded by each tooth surface.

In the late 1980s we chose the European way: the buccal surfaces. Our justification was diverse. The main reason for such selection was that no tooth-to-tooth contact occurs between buccal surfaces during mastication and, thus, occlusal wear does not affect buccal microwear, at least until the complete crown is worn down. A second draw back for occlusal surfaces was that two types of microscopic features could be observed on those occlusal facets: striations and pits, whereas on buccal enamel surfaces, striations were the only feature present, no pitting occurred. Pits are especially difficult to characterize since they greatly vary in shapes and sizes, especially if pit overlapping occurs. Our approach was thought to simplify the analysis, despite larger enamel surfaces needed to be measured on buccal surfaces because very few features can be seen at 500× magnification on them. Puech's 100× magnification standard was then adopted. We are proud of our origins and have not said the last word yet. However, today the debate occlusal *vs.* buccal, 500× *vs.*100×, or pits *vs.*

FIGURE 1. Collection of tooth moulds of *Hominidae* Primates curated at the University of Barcelona.

FIGURE 2. Occlusal view of tooth mould of Swartkrans 2306 – SKW5, lower, right P4 – *Paranthropus robustus*.

striations is irrelevant. The question is: do the measured variables discriminate dietary related behaviour in primate populations, either past or present?

Our experience on buccal microwear variability analysis is now beginning to show some promising results. We made an initial approximation to the study of fossil humans' dietary adaptations with the Neanderthal specimens of Gibraltar and Banyoles (Lalueza *et al.* 1993, Lalueza, Pérez-Pérez 1993) and tried to distinguish between *ante-mortem* and *post-mortem* wear types (Lalueza, Pérez-Pérez 1994), with great concern on the involvement of plant phytoliths in the formation of striations on the buccal surfaces (Lalueza *et al.* 1994). Our first population study involved the characterization of the within-population variability, with emphasis on age related variability (Pérez-Pérez *et al.* 1994), which might be informative on wearing patterns in infants. Buccal microwear variability in modern hunter-gatherer groups was also analysed (Lalueza *et al.* 1996), trying to make inferences on fossil humans diets. However, the microwear patterns of modern *Homo sapiens* populations did not seem to correlate to those of the fossil *H. heidelbergensis* from Sima de los Huesos (Atapuerca), which showed much more abrasive dietary habits, as suggested by its high density microwear pattern (Pérez-Pérez *et al.* 1999). Such deviation between the microwear patterns of modern humans and ancient hominin populations suggests that the buccal microwear pattern of fossils populations needs to be analysed in large samples, characterizing both the intra and inter-population variability. Our first approximation to this comparison indicates that ancient samples have more abraded enamel surfaces, probably due to technological differences in food processing techniques among groups, as well as to paleoclimatic fluctuations through time (Pérez-Pérez *et al.* 2003).

Future research in dental microwear should focus on the correlation of microwear patterns with morphological and ecological variables. The microwear pattern is expected to fluctuate with environmental conditions (overall temperature, type of habitat, available food resources, etc.), and as populations progressively adapt to the new requirements, such morphological adaptations would correlate with the environmental constrains. Buccal microwear patterns might thus be indicative not only of abrasiveness of the diet, but also of evolutionary patterns of adaptation through time. However, this type of analysis requires the study of large samples, including long-term periods of human adaptation and evolution. For this reason, we have almost finished now the gathering of a collection of hominid tooth moulds, and we have just edited a catalogue of this collection (Galbany *et al.* 2004). The collection includes several thousands of tooth moulds of *Hominidae* species, as well as some *Cercopithethidae* groups for comparisons. This is not the best *Cercopithecidae* tooth moulds collection, since other groups have dedicated greater efforts to the study of primate microwear than ourselves. On the other hand, our *Hominidae* collection of moulds includes tooth moulds of extant apes and Plio-Pleistocene fossil *Homininae*, from both Africa and Europe (*Figures 1, 2*). In this issue of *Anthropologie* you will find the preliminary analysis that we have obtained. The results do not intend to be conclusive yet. In the future we will continue the analyses with a more detailed presentation. However, the results shown in the papers of this *Anthropologie* issue try to point out that buccal microwear research will be of great interest in the near future and that collaborative research will be of major importance.

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We are thankful to all the institutions and researchers that granted permission for making the moulds. Many of these moulds are being studied in collaboration with the investigators in those institutions, and the buccal microwear analyses will be presented with them in a broad perspective, taking into account ecological, paleontological, archaeological, and biological information of each collection. We are also thankful to the *Serveis Cientificitècnics* of the University of Barcelona. This research was funded by the ACES1998-7/1, ACP1999-0021, BMC2000-0538, and BOS2002-10475E grants of the Spanish governments, and also by a L. S. B. Leakey Foundation Grant.

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