

Technical Note: Occlusal Fingerprint Analysis: Quantification of Tooth Wear Pattern

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ABSTRACT Information about food ingestion and mastication behavior during the lifespan of an individual is encoded in the dental occlusal wear pattern. To decode this information, we describe a new method called occlusal fingerprint analysis (OFA). Structural parameters of wear facets on the occlusal surface of teeth are quantified from digitized casts for the interpretation of occlusal aspects. The OFA provides an individual three-dimensional dental occlusal compass that indicates the major pathways of interaction between antagonists, revealing information about development, spatial

position, and enlargement of wear facets. Humans develop a very similar overall pattern of crown contacts, although specific characteristics of wear facets reflect an individual's occlusal relationships and masticatory behavior. We hypothesize that the wear pattern is a unique character and therefore valuable for individual identification. Furthermore we suggest that OFA, when further developed, may be useful for identification of behavioral, biological, and chemical factors affecting crown morphology. *Am J Phys Anthropol* 139:600–605, 2009.

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The positional relationships of cusps provide access for the location of the primary contact areas during occlusion of upper and lower teeth (Fig. 1). The fissure pattern and cusp positions describe the major occlusal pathways for incursion and excursion movements of the antagonists. These major directions of possible movements, starting from the maximum intercuspation of the molars (centric position), are described as the occlusal compass (Kordaß and Velden, 1996; Douglass and DeVreugd, 1997; Schulz, 2003, 2008; Schulz and Winzen, 2004) (Fig. 1). Consequently, it is possible to attribute contact wear facet pairs, occurring on the occlusal surface of upper and lower teeth, to specific movements starting from the maximum intercuspation. A characteristic wear facet pattern occurs on cheek teeth in all modern great apes, *Homo sapiens* and ancestral hominoids (Maier and Schneck, 1981). Maier and Schneck (1981) described a maximum of 13 corresponding facet pairs in upper and lower molars possessing a dryopithecine cusp pattern (Fig. 1). The facets vary in number, size, and shape depending on the wear stage, absolute cusp number and morphology. The facet number increases from the beginning of the occlusal contacts until an advanced wear stage is reached, when facets start to fuse, because of the reduction in crown relief height. In heavily worn teeth there are no facets identifiable, because only a flat enamel rim, usually enclosing a large dentine basin, remains on the occlusal surface.

Following the facet labeling system of Maier and Schneck (1981) wear facet pairs 1, 4, 5, and 8 describe lateroretrusive movements of the lower jaw. Facets 2, 3, 6, and 7 are dominated by lateroprotrusion. Higher facet numbers correspond with the mediotrusion as the leading direction of the lower jaw. In facets 9, 10, and 12, the immediate side shift is of greater importance, and

facets 11 and 13 seem to be in contact during medioprotrusion (Ulhaas et al., 2007; Schulz, 2008).

The contact areas and the pattern of jaw movement are in close correlation, at least during the short phase of occlusion in the chewing cycle. It is obvious that, besides horizontal motion, upward (surtrusion) and downward (detrusion) lower jaw movements are of great importance for food breakdown. The mandibular surtrusion and detrusion, not recognized in the two-dimensional occlusal compass (Fig. 1), act during mastication in combination with a horizontal translation.

Lateroprotrusion describes lower jaw pathways between laterotrusion and protrusion, forming a distolingual pathway with the upper cusp tips in the lower tooth crown and a mesiobuccal direction with the lower cusp tips in the upper teeth (Fig. 1). Mediotrusion samples the movements between mediotrusion and protrusion towards mesio-palatal in the upper jaw and consequently distobuccal in the lower jaw cheek teeth.

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