REPRINTED FROM: PROSIMIAN BIOLOGY
(R.D. Martin, G.A. Doyle, and A.C. Walker, eds.)
Duckworth, London, 1974

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Dental function in the Palaeocene primate Plesiadapis

Introduction

The main function of mammalian teeth is to reduce food matter to a size and consistency that can be swallowed and digested. The wide range of dental types seen in living mammals is the result of successive evolutionary radiations of animals adapted to masticating specific diets. In each radiation the dental morphology and adaptation are modified from those of an ancestral species to produce descendant species with a range of dental adaptations. Thus within any radiation it is usually possible to identify a number of dental types, each derived from the ancestral morphology and retaining features of it. For example, the Palaeocene primates *Plesiadapis*, *Phenacolemur*, *Carpolestes*, and *Palaechthon* exhibit four rather different adaptive modifications of the ancestral primate molar morphology. They also share many features which presumably were inherited from a common ancestor. The adaptive significance of the morphological differences seen in the teeth of these early primates can only be determined by a detailed consideration of how the teeth function.

Functional occlusion produces matching striated wear facets on upper and lower teeth. Much of the chewing behaviour of an animal can be reconstructed by studying these striated wear facets. Butler and Mills were the first systematically to map wear facets and classify them according to the direction of their striations.[1, 2] Mills distinguished two sets of wear facets on primate molars. One set is the result of an upward, medial, and slightly forward movement of the lower jaw into centric occlusion on the active side. This phase of occlusion Mills referred to as the 'buccal' phase. From centric occlusion the mandible moves forward, medially, and slightly downward on the active side, producing the second set of wear facets. This phase of occlusion Mills termed the 'lingual' phase.

Recent important cineradiographic studies of mastication in the opossum by Crompton and Hiiemae,[3] and in *Galago crassicaudatus* by Kay and Hiiemae,[4] have clarified several aspects of mandibular movement during molar occlusion. Fortunately, striated wear facets are as well preserved on the teeth of fossil mammals as on those of living animals. Thus it has been possible to identify both buccal and lingual phase facets on molars of the Eocene primate *Adapis*, as well as a third 'orthal retraction' set of facets indicating an upward and backward movement of the mandible during one stage of chewing.[5]

In this paper the wear facets on the molars and incisors of specimens of *Plesiadapis rex* (Gidley)[6] from the early Late Palaeocene Cedar Point quarry in northwestern Wyoming are described. This description will form the basis for a later comprehensive study of the evolution of dental function in the Plesiadapidae.

Molar morphology and function

Upper and lower molars of species of *Plesiadapis* have been illustrated and described in detail by Matthew,[7] Jepsen,[8] Simpson,[9] and Russell,[10] among others. The terminology used here in describing *Plesiadapis* molars is illustrated in Fig. 1. The lower molars are roughly rectangular; the protoconid and metaconid are joined by a strongly developed protocristid; the metaconid and paraconid are connate (as Matthew suggested, possibly what is here called the paraconid is really the metaconid, and what is here called the metaconid should really be considered a metastyle);[7] the paracristid runs forward to join the postcristid of the preceding molar; the cristid obliqua forms a strong shearing crest connected with the postcristid at the hypoconid; lingually the postcristid is supported by a well developed entoconid; a buccal cingulum is well developed on all molars, and a very weak lingual cingulum is suggested on some.

The upper molars are roughly triangular; the metacone and paracone support a continuous series of shearing crests: the paracrista, centrocrista, and metacrista; the paraconule and metaconule are joined to the protocone by the preprotocrista and postprotocrista respectively; the '*Nannopithex* fold'[11] is invariably a well developed crest running posteriorly from the protocone and turning abruptly buccally at the posterior margin of the tooth to form a post-cingulum; a cingulum borders the molars buccally, and a lingual cingulum is developed along the anteromedial border of the molars. Both upper and lower molars are low in profile and bear bulbous cusps.

Fig. 2 illustrates upper and lower second molars of *Plesiadapis rex* and indicates the wear facets formed during function. Each of the major crests connecting the cusps on the lower molars supports a buccal phase wear facet on its buccal surface. For descriptive