Anatomy of Mandibular Molar Furcation 
and its Clinical Implications

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Abstract:
A thorough understanding of molar root anatomy is essential for proper diagnostic and therapeutic decisions. Factors such as root trunk length, furcation entrance, root separation, and root surface area can affect diagnosis, and consequently, the choice of the appropriate therapy for furcally involved molars. Several morphological factors related to furcations and roots contribute to the etiology and compromised prognosis of furcation–involved teeth. In this review an attempt has been made to recollect the salient anatomical features of mandibular molar furcation with an emphasis on their clinical implications.

Introduction:
In 1884 Farrar reported on so called radical and heroic treatment of alveolar abscess by amputation of roots of teeth, “in order to enable nature to have a better chance for cure.” He absolutely correctly stated that, “if an entire tooth should be extracted from a diseased socket, the treatment might be termed highly radical”, and further “such a treatment might not only be unwise and unnecessary but absolutely wrong and unscientific.” Thus in those old days, far before the development of modern periodontics and endodontics, the author regarded, for scientific reason, the “heroic” furcation therapy (root amputation) as being more appropriate than tooth extraction. Unfortunately even today after a span of a century one of the most important and at present unsolved problems in clinical periodontology is the predictable successful treatment of periodontitis–affected furcations of multirooted teeth.1 A thorough understanding of molar root anatomy is essential for proper diagnostic and therapeutic decisions. Factors such as root trunk length, furcation entrance, root separation, and root surface area can affect diagnosis, and consequently, the choice of the appropriate therapy for furcally involved molars.2

The furcation area can be divided into 3 parts: (1) the root, (2) the surface immediately coronal to the root separation (flute) and (3) the area of root separation.3

Contributing Anatomical Factors:
Several morphological factors related to furcations and roots contribute to the etiology and compromised prognosis of furcation–involved teeth. These factors include: furcation entrance width, root trunk length, the presence of root concavities, cervical enamel projections, bifurcation ridges, enamel pearls and accessory pulp canals.2

Furcation Entrance Diameter:-
Bower et al (1979) examined furcation entrance diameter of 103 mandibular first molar teeth and found that in 81% of the furcations the entrance diameter was 1.0 mm or less, and in 50% the diameter of the mandibular teeth was 0.75 mm or less. Considering that the average width of a curette blade face ranges between 0.75 – 1.10 mm, the authors concluded that (1) the use of curettes alone might not be suitable for root preparation in the furcal area. (2) It is likely that a smaller furcation diameter carries a poorer prognostic indication because of difficulty of instrumentation when all other factors are constant. The authors also found a lack of correlation between furcation entrance diameter and mesiodistal width at the cemento enamel junction in the first molar teeth examined indicating that (3) large teeth do not necessarily have large furcation entrance diameters.4 Chiu et al (1991) studied 178 mandibular first molar entrance dimensions and encountered them to be equal to or less than 36% of buccal and 47% lingual furcation entrances and 49% of the overall furcation entrance was found to be less than 0.075 mm.

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One half of all furcation entrance dimension of first molars were less than the blade width of new Gracey Curretes.5

**Root Trunk Length:**
The root trunk is defined as the area of the tooth extending from the cemento enamel junction to the furcation, otherwise defined as root separation. Dunlap and Gher (1985) studied the root surface area of twenty mandibular first molars and found that the root surface area of the root trunk was 30.5% of the total surface area, which is approximately one-third of the total root surface area.6 Hou G.L and C.C. Tsai (1997) examined the types and dimensions of root trunks of 200 mandibular molar which consisted of 103 mandibular first and 97 mandibular second molar and summarized their findings about mandibular molars as follows.

1) Short – root trunks were most commonly found buccally, whereas long–root trunks were more commonly found lingually in both mandibular molars.

2) Long–root trunks were more commonly found on the second molars than on the first molars.

3) Long root trunks were associated with short root length.7

Mandelaris et al (1998) reported that the mean root trunk length was 3.14 mm on the buccal aspect, and 4.17 mm on the lingual aspect.8 Roussa (1998) studied 14 mandibular first molars and 16 mandibular second molars and observed that root concavities were present coronal to the furcation roof, deep concavities were measured at both the buccal and lingual aspect of mandibular molar teeth. In first molars the mean depth of these concavities was 3.28 mm and 3.71 mm for buccal and lingual concavities. Second molars had deeper buccal concavities of 3.6±1.32 mm but narrower lingual concavities of 3.10±1.17 mm.9

**Cervical Enamel Projections:-**
The cervical enamel projection is defined as a dipping of enamel from the cemento enamel junction towards and often into the furcation area. Cervical enamel projections have been implicated as etiologic factors in furcation defects due to the lack of connective tissue attachment on enamel surface. Masters and Hoskins (1964) were the first to name these structures and document their presumed relation to furcation invasion. They found a cemento enamel projection incidence of 28.6% for mandibular molars and classified cemento enamel projection into 3 grades, based on their proximity to the furcation entrance. Grade I cemento enamel projection shows a definite change in cemento enamel junction level, with enamel projecting toward the furcation. Grade II cemento enamel projection approaches the furcation but does not make contact with it. Grade III cemento enamel projection extends into the furcation.10

Bissada & Abdel Malik (1973) reported a cemento enamel projection incidence rate of 8.6% in a study of 1138 molars, with mandibular molars having cemento enamel projections twice as frequently as maxillary molars. The association between cemento enamel projection and furcation involvement was noticed to be 50%. They reported the highest incidence of cemento enamel projections in the mandibular 2nd molar (14.8%) followed by the maxillary 2nd molar (99.1%), mandibular 1st molar (7.8%) and maxillary 1st molar (3.3%).

Müller, et al (1979) studied 14 mandibular first molars and 16 mandibular second molars and observed cervical enamel projections in three mandibular molars and nine mandibular second molars, representing a prevalence of 30%. Interestingly Roussa (1998) also found that teeth exhibiting cervical enamel projections significantly showed deeper concavities at both mesial and distal roots, than without cervical enamel projections.

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**Bifurcation Ridges:**

Two types of bifurcation ridges have been described; Intermediate and buccal / lingual ridges. Intermediate bifurcation ridges connect the mesial and distal roots, and are composed primarily of cementum. Buccal and lingual ridges are composed primarily of dentine with overlying thin layers of cementum.

**Enamel Pearls:**

The prevalence of enamel pearls is less than that of cervical enamel projections. Moskow & Canut (1990) reported an incidence of 2.6%. Like cemento enamel projections, enamel pearls contribute to the etiology of furcation involvement by preventing connective tissue attachment.

**References:**

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