

Furcation topography of the maxillary and mandibular first molars

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Abstract. The objective of the present study was to describe the topography of the furcation area of the maxillary and mandibular first molars. By using a photogrammetric method, the furcation areas of extracted teeth were plotted to obtain 3-dimensional contour maps. By comparing the individual 10 drawings of the maxillary and mandibular first molars, respectively, some morphological characteristics of the furcation areas could be described. Accordingly, the study showed the complexity of the furcation areas with presence of a number of small ridges, peaks and pits forming a mixture of convexities and concavities.

Key words: furcation; root morphology.

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The elimination of subgingival calculus and bacterial plaque is essential for the successful treatment of periodontal disease. To reach this goal with scaling and root planing procedures is a difficult task and the difficulties increase proportionally to increasing depth of the periodontal pockets (Waerhaug 1978, Caffesse et al. 1986). It is also obvious that periodontal pockets in the furcation area of multi-rooted teeth offer particular difficulties with respect to debridement (Waerhaug 1980). This is due to the limited accessibility through the furcation entrances as well as the complexity of the root anatomy (Everett et al. 1958, Bower 1979a, b and Gher & Vernino 1980).

The aim of the present study was to obtain a detailed topographical description of the furcation area of maxillary and mandibular first molars as a base for further studies regarding the clinical management of furcation involved teeth.

Material and Methods

20 randomly selected first molars were analyzed - 10 maxillary and 10 mandibular. The teeth, which had evidently been extracted due to caries, periodontitis, periradicularitis or orthodontic reasons had to be morphologically intact in an area covering 2 mm coronal to the cemento-enamel junction (CEJ)

and 6 mm apical to the fornix of the furcation.

A rubber impression was taken of the furcation areas and a plaster model was produced. The model was adapted to a Wild stereoaugraph A7 equipped with a Nite Micrall Stereomicroscope according to a method described by Torlegård (1966). By the use of this method a three-dimensional contour map of the furcation area was obtained. At the maxillary molars, a zero height plane was established by 3 points on the CEJ at the 3 furcation entrances. For the mandibular molars, 4 points, 2 at the furcation entrances and 2 at the most coronal part of the CEJ on the interproximal surfaces, were used to establish a zero height plane. The plane was fixed through the points of the furcation entrances parallel to the axis through the 2 proximal points.

The contour interval used in drawing the map was 0.5 mm in the predominantly vertical part of the roots. In areas with less inclination, the interval was reduced to 0.25 or 0.125 mm. Pits, peaks and ridges were marked (+) and their vertical distance to the zero height plane was measured. The scale of the contour maps obtained with the present method was 11.4:1. According to Bergström & Jonason (1974), the accuracy obtained by this method is 7 µm in the horizontal plane and 13 µm in the vertical direction.

Results and Discussion

As result of the study, 20 contour maps were obtained (Figs. 1, 2). Although the topography of the furcation areas seems to be rather individual, some major topographical characteristics can be described.

The maxillary first molar (Fig. 1)

According to the physiologically horizontal zero plane, the mesio-buccal root is standing in a mainly vertical position while the disto-buccal and the palatal roots are inclined to a varying degree. The disto-buccal root leans distally and the palatal root palatally as shown by the contour maps in Fig. 1. While the palatal and disto-buccal roots are mostly circular, the mesio-buccal root is compressed in mesio-distal direction and mostly concave both mesially and distally. The concavity facing the furcation area is the most pronounced, as shown also by Bower (1979b).

Within the furcation area, the surface of the fornix is mainly parallel to the zero height plane and rather rough. Distinct pits could be notable in the center of the furcation area (teeth U6 and U8; Fig. 1). These pits are bordered by the interradicular ridges at the furcation entrances. In addition to these ridges, there also could be ridges present in the center of the furcation area (teeth U4

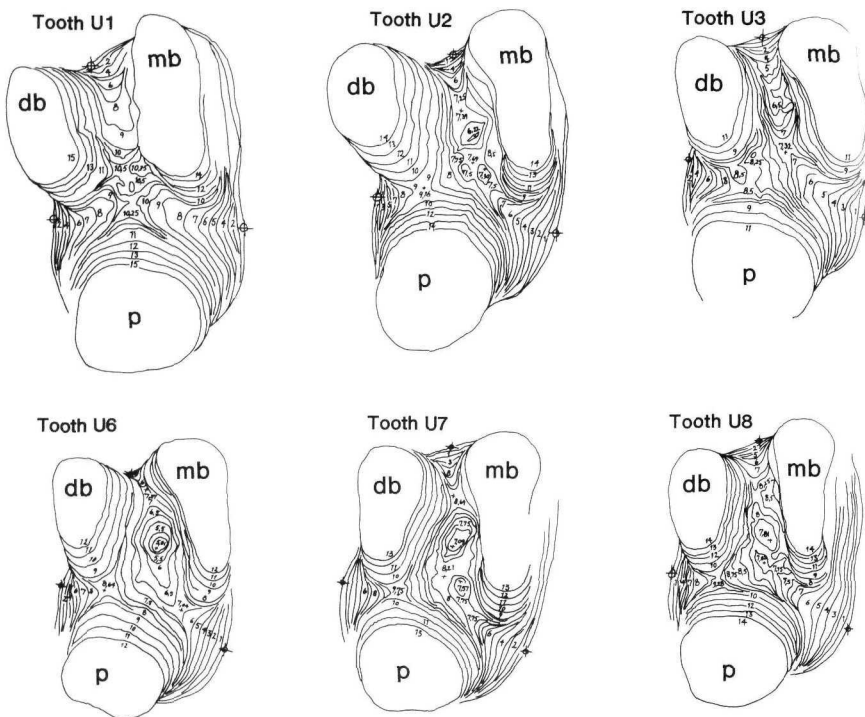


Fig. 1.

and U7), which in turn create several pits. Such central ridges are most frequently found in between the mesio-buccal and the disto-buccal roots, but there could also be a marked ridge in between the center of the furcation area and the palatal root (tooth U10). Furthermore, there is a tendency to a continuing of these interradicular ridges apically on the roots (teeth U2 and U10). These vertical ridges might correspond to the "developmental seams" described by Lester & Boyde (1970) from a study on rat molars.

The 3 furcation entrances of the maxillary first molar vary in width and are situated at different vertical distances from the CEJ. The distal entrance is the most apically positioned, as shown also by Abrams & Trachtenberg

(1974). Furthermore, the observations made in the present material correspond to the findings by Bower (1979a) showing that the buccal furcation entrance on the maxillary first molar is narrower than the mesial and distal ones.

Outside the furcation entrances, the root surfaces are more even than inside. In addition, the concavity formed by the furcation extends close to the CEJ. At the buccal and the distal entrances the inclination of the root surface is more vertical than at the mesial furcation (tooth U8). Accordingly, the buccal and the distal entrances are distinctly marked as the outline of the root surface in these areas turns over from a predominantly vertical to a mainly horizontal extension.

The mandibular first molar (Fig. 2)

The mesial root of the mandibular molar has in relation to the physiological zero plane an outline which is mainly vertical in comparison with the leaning distal root (Fig. 2). It is also apparent that the mesial root is wider in the bucco-lingual direction and has a larger cross-sectional area than that of the distal root. These observations correspond to findings reported by Dunlap & Gher (1985).

Although the distal surface of the distal root has not always been completely drawn due to the inclination of the root, it is obvious that there is a tendency to a compression of both the mesial and distal roots in their most interproximal part. That gives a cross-sectional area

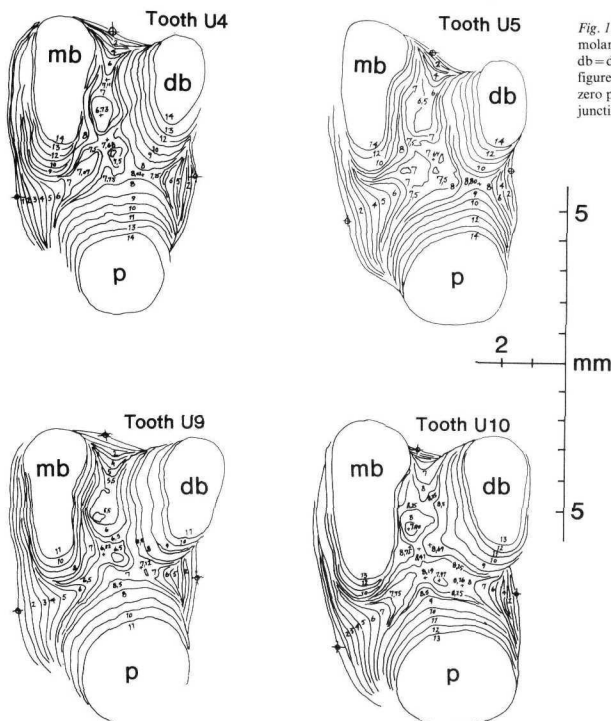


Fig. 1 (continued).

of the roots with a sand-glass shape which is most clearly seen on the mesial root. The mesial surface of this particular root is distinctly concave even close to the CEJ. Also, the root surfaces facing the furcation area are variably concave. In accordance with findings reported by Bower (1979b) the concavity on the mesial root is the most pronounced.

Inside the furcation entrances towards the center of the furcation, the surface of the fornix is mainly parallel to the zero height plane and rather rough. A more-or-less pronounced interradiaculal ridge is frequently found, dividing the furcation area into 2 parts. This ridge corresponds to the intermediate bifurcational ridge described by Everett et al. (1958). Together with the

interradiaculal ridges marking the furcation entrances, the central interradiaculal ridge often forms two distinct pits inside the furcation area (tooth L1; Fig. 2). The central and the lingual ridges may also be combined (tooth L2 and L6). In those cases, there is a lack of a horizontal ridge in connection with the buccal furcation entrance and, consequently, the furcation will be marked only by the vertical prominences of the mesial and distal root in combination with the leaning interradiaculal surface.

The furcation entrances of the lower first molar, like those of the maxillary first molar, are situated at different distances from the CEJ. The lingual entrance is frequently situated more apically than the buccal one, due to the occurrence of a marked lingual inter-

Fig. 1. Contour maps of the 10 maxillary first molars examined. mb=mesiobuccal root, db=disto-buccal root, p=palatal root. The figures describe the distance (mm) from the zero plane at the level of the cemento-enamel junction.

radiaculal ridge. In the present material, the width of the buccal and lingual entrances to the furcation area of the lower molar appears to be similar. However, Bower (1979a) reported a tendency for a wider lingual entrance.

Outside the furcation entrances the root surface of the mandibular first molar is more even than inside. In addition, even close to the CEJ, the surface is more or less concave.

To summarize, the study shows the complexity of the furcation topography of the first molars. For the clinical management of furcation involvements, it is evident that the difficulties with respect to proper debridement are increased considerably when the periodontal pocket reaches the furcation entrance and runs into the furcation area. In ad-

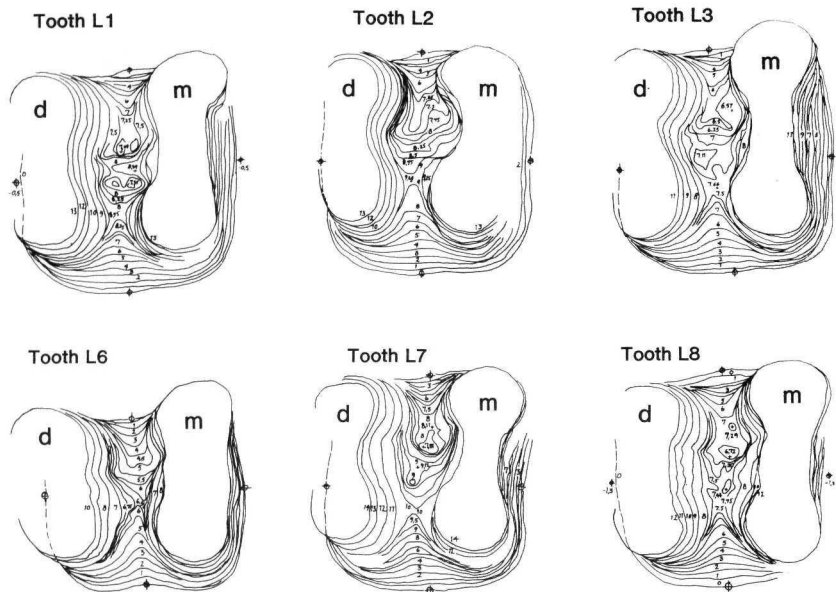


Fig. 2.

dition, a graded diagnosis system of furcation involvement ought to be specified according to the topographical characteristics. This topic will be addressed in a subsequent publication.

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Zusammenfassung

Die Topographie der "Wurzelteilungsstellen" der ersten Molaren des Ober- und Unterkiefers In der hier vorliegenden Studie sollte die Topographie der Furkationsregionen der 1. Molaren des Ober- und Unterkiefers beschrieben werden. Zur Erstellung 3-dimensionaler

Übersichtsbilder über die Konturen dieser Region wurden Furkationsregionen extrahierter Zähne vermessen. Durch Vergleiche zwischen 10 Zeichnungen der 1. Molaren des Ober- bzw. Unterkiefers konnten morphologische Charakteristika der Wurzelteilungsstellen beschrieben werden. Die Studie zeigte, dass die Wurzelteilungsstellen mit einer Vielfalt kleiner Leisten, Höhen und Grübchen versehen sind – wobei ein Durcheinander von Konvexitäten und Konkavitäten entsteht.

Résumé

Topographie interradiculaire des 1^{ères} molaires supérieures et inférieures

La présente étude avait pour but de décrire

la topographie de la région de la furcation des premières molaires supérieures et inférieures. On a, au moyen d'une méthode photogrammétrique, fait le tracé des régions de la furcation de dents extraites, afin d'obtenir une représentation des contours en 3 dimensions. En comparant les 10 tracés individuels de 1^{ères} molaires supérieures et ceux de 1^{ères} molaires inférieures, il a été possible de décrire quelques traits morphologiques caractéristiques des régions de la furcation. Cette étude a ainsi mis en évidence la complexité des régions de la furcation: elles présentent une quantité de petites crêtes, de petits pics et puits, formant un ensemble disparate de convexités et de concavités.

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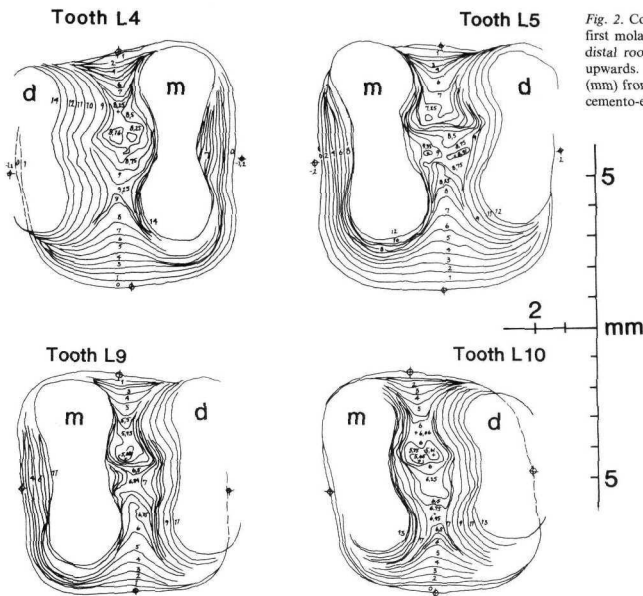


Fig. 2 (continued).

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