ROOT CANAL MORPHOLOGY OF MANDIBULAR FIRST PERMANENT MOLARS — KARACHI SAMPLE

SYED ABDUL FARAZ
AMYNAH TARIQ
ASMAT JAMEEL

ABSTRACT

Asian populations show many variations in root canal morphology of permanent mandibular first molar. This in vitro study was done at Dr Ishrat ul Ibad Khan Institute of Oral Health Sciences and NED University Karachi, Pakistan to explore the number of roots and root canals, their configurations, occurrence of isthmi and apical deltas in mandibular permanent first molar teeth in Pakistani population. One hundred and twenty three mandibular first permanent molars were collected and exposed to clearing technique. The teeth were then viewed in a stereomicroscope under 7.5 x magnifications. The canal configurations were characterized using Vertucci’s categorization of canal configuration. Although two roots were found in all teeth under study, 65.8% exhibited three root canals, 34.2% had four root canals. The most prevalent canal arrangements found in mesial roots were Vertucci’s type (IV) 70.7% and in distal roots Vertucci’s type (I) 65.8% respectively.

Key Words: Mandibular first molar, root canal morphology, canal configuration, mandibular first molar morphology.

INTRODUCTION

The goal of endodontic treatment is thorough mechanical and chemical debridement of the entire pulp cavity in addition to the attainment of hermetic seal along the entire root canal system. Therefore it is essential for the clinician to have adequate knowledge of root canal anatomy and morphologic variations in order to reduce the probability of treatment failure.

It is now well accepted that mandibular first molar exhibits a number of anatomical variations not only in number of roots but also in canal morphology. Anatomically permanent mandibular first molar typically displays a mesial and a distal root with two mesial and one distal canal. Other studies describe high prevalence of two canals in distal root in different population.

Variations in morphology of canals and number of roots appear to have a genetic predisposition in addition to environmental influence. Hence a clinician should also be well aware of racially prevalent morphology.

The significant variant in mandibular first permanent molar is the existence of supernumerary root that can be found distolingually. This structure was first discovered by Carabelli then named as Radix Entomolaris, and is generally smaller than the distobuccal and mesial root. Moreover, it may be partially fused with other roots or separated.

The morphology of mesial root allows inter- canal communications and isthmi - a narrow connection between two root canals that contain pulp tissues.

Studies to explore root canal anatomy on first permanent mandibular molars have been performed on several populations including Pakistani population. The purpose of this study was to perform a detailed investigation examination to explore the number of roots and root canals, their configurations, occurrence of isthmi and apical deltas in mandibular permanent first molar teeth in Karachi sample by utilizing clearing technique.

METHODOLOGY

One hundred and twenty three mandibular first molars were collected from Department of Oral and Maxillofacial Surgery of Dr Ishrat ul Ibad Khan Institute of Oral Health Sciences, Karachi, Pakistan making sure that teeth belonged to native Pakistani population. Teeth with intact external morphology were selected. The teeth were washed under running tap water after extraction and then kept in 10% formalin. The attached soft tissue, and calculus remaining after
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Type I. A single canal extends from the pulp chamber to the apex.

Type II. Two separate canals leave the pulp chamber and join short of the apex to form one canal.

Type III. One canal leaves the pulp chamber, divides into two within the root, and then merges to exit as one canal.

Type IV. Two separate and distinct canals extend from the pulp chamber to the apex.

Type V. One canal leaves the pulp chamber and divides short of the apex into two separate and distinct canals with separate apical foramina.

Type VI. Two separate canals leave the pulp chamber, merge in the body of the root, and re divide short of the apex to exit as two distinct canals.

Type VII. One canal leaves the pulp chamber, divides and then rejoins within the body of the root, and finally redivides into two distinct canals short of the apex.

Type VIII. Three separate and distinct canals extend from the pulp chamber to the apex.

The specimens were photographed to provide permanent visual demonstration of their root canal system as shown in Fig 1-4. They were vertically sectioned in buccolingual direction through the furcation. Mesial and distal roots were separated for viewing under stereomicroscope.

RESULTS

Of 123 teeth that were observed 100% had two roots. None of them exhibited extra distal root (radix entomolaris). 65.8% of specimens displayed three root canals (mesiobuccal, mesiolingual, distal) whereas 34.2% displayed four root canals two in mesial root (mesiobuccal, mesiolingual) two in distal roots (distobuccal and distolingual). (Table 1)

These mesial and distal roots displayed differences in canal configuration. Mesial roots dominated by type IV configuration (70.7%) followed by type II (26.8%)

TABLE 1: NUMBER OF ROOTS AND CANALS IN MANDIBULAR FIRST MOLARS

<table>
<thead>
<tr>
<th>No. teeth</th>
<th>No. Roots</th>
<th>No. of Canals per tooth</th>
</tr>
</thead>
<tbody>
<tr>
<td>123</td>
<td>123</td>
<td>—</td>
</tr>
<tr>
<td>100%</td>
<td>—</td>
<td>65.8% 34% —</td>
</tr>
</tbody>
</table>

TABLE 2: CANAL CONFIGURATION AND THE TYPE OF ROOT CANAL IN MANDIBULAR FIRST MOLARS

<table>
<thead>
<tr>
<th>Group (No. root)</th>
<th>Canal Configuration (Type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesial root (123)</td>
<td>I  II  III  IV  VI  VII  VIII</td>
</tr>
<tr>
<td></td>
<td>—  33  —  87  3  —  —</td>
</tr>
<tr>
<td></td>
<td>26.8% 70.7% 2.4% — — —</td>
</tr>
<tr>
<td>Distal root (123)</td>
<td>81  18  —  24  —  —  —</td>
</tr>
<tr>
<td></td>
<td>65.8% 14.6% 19.5% — — —</td>
</tr>
</tbody>
</table>

Canal configurations were categorized using Vertucci’s classification (1984).
Root canal morphology

and type VI (2.4). (Table 2). Distal roots dominated by type I (65.8%) and then type IV (19.5%) and type II (14.6%). Isthmi were found in (10%) of cases in mesial roots. Apical deltas were found in (5%) of cases in distal roots. (Table 3)

DISCUSSION

Over the years the method used to study root canal anatomy are replication technique, use of radiopaque dyes and radiographs, sectioning of teeth, clearing technique and recently, spiral computed tomography (SCT), and cone beam computed tomography (CBCT). The decalcification and clearing technique provides a clearer picture of canal morphology providing a three dimensional view of the root canal system without gaining access into specimen with instruments. This helps to maintain the external shape and internal morphology of canals with their isthmi and interconnections. Hence, clearing technique was used in present study. The clearing technique is simple but there are some limitations. First of these limitations is the formation of opaque areas owing to incomplete dehydration. This is taken care of by additional dehydration in 100% ethyl.
alcohol. Secondly there could be development of opacity after air drying; however this is readily reversible by immersion in methyl salicylate solution.

In the present study none of the teeth exhibited third root (radix entomolaris). The prevalence of three roots in mandibular first permanent molars was 1.44% as observed by Shahi S et al by clearing technique in Iranian population. According to Vertucci’s study the prevalence of radix entomolaris was reported to be 2.02%. In contrast, Gulabivala et al observed that 13% of mandibular first molars in Thai population had three roots. Ethnic variations are probably responsible for the difference in number of roots observed.

In the present study it was established that 42 teeth (34.2%) of mandibular first molar had four canals. These results are close to those of Hartwell and Chaurasia, who found four canals in 35.1% and 36% of teeth respectively. In a study of Pakistani population in Peshawar by Hussain et al reported 40% of the teeth had four canals and 60% had three canals.

Some studies have shown higher prevalence of fourth canal like Wang Y, Al-Nazhan and Al-Qudah who reported 51.4%, 57.6% and 46% respectively. Similarly, Wasti and coworkers observed that in Pakistani population 47% had four canals and 53% had three canals.

On the other hand, Skidmore and Bjorndal, Zaatar et al, Sperber and Moreau, Shahi S et al reported 28.9%, 29%, 25%, 31.57% of teeth had four canals respectively which has a lower value than the current study.

In the current study, type IV configuration was most prevalent (70.7%) for mesial roots followed by type II (62.8%) configuration. Other authors have also reported high prevalence of type IV canal configuration in mesial root including Wang Y, Al-Qudah, H A Ahmad et al who reported 93.9%, 73%, 53% respectively. Furthermore Skidmore and Chaurasia found out that type IV 54% was more prevalent followed by type II 36.6%, and type VI 8%. Shahi S et al reported type IV 53.69% followed by type II 41.87%.

These results differ from Zaatar et al and Al Nazhan who reported type II being most prevalent followed by type IV. The most prevalent configuration in distal root was type I (65.8%) followed by type IV (19.5%) and type II (14.6%). Similar prevalence of type I configuration has been reported by Chaurasia HR et al (65.3%), Wang Y (62%), Al-Qudah (54%) and Shahi S et al (68%). Type II canal configuration (14.6%) seen in the current study is similar to Shahi S et al who reported type II (11%) prevalence, but lower than H A Ahmad et al who reported type II (28%), Skidmore and Bjorndal type II (61.5%).

Type IV canal configuration in distal root of present study (19.5%), is similar to Shahi S et al (17.22%) and H A Ahmad et al (22%). Whereas it is higher than Chaurasia et al who reported type IV (9.3%), and lower than reported by Skidmore and Bjorndal type IV (38.5%). In the present study isthmuses (anastomosis) were observed in 10% of cases in mesial root and which is lower than Chaurasia et al 30%.

Apical delta was observed in 5% of cases in distal roots which is higher than reported by Chaurasia et al. The presence of isthmi and apical deltas may be of clinical significance, because it may be difficult to debride and fill these ramifications adequately. The use of sodium hypochlorite preferably agitated by ultrasonics may help to reach the uninstrumented parts of the root canal system. Furthermore, these ramifications can be more satisfactorily obturated by using some thermoplasticized gutta-percha technique.

**CONCLUSION**

Within the limitation of present study it was concluded that there is a high prevalence (34%) of four canals, two mesial and two distal in mandibular first molars. Access preparation for canals should therefore be rectangular. As isthmi are observed in mesial roots and apical deltas in distal roots, efficient delivery and activation of irrigants are more essential.

**REFERENCES**

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