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Challenges and Current Concepts in the Preparation of Root Canal System in Radix Entomolaris – Case Reports

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Abstract: *A success full endodontic therapy completely depends upon thorough biomechanical preparation of root canal system followed by three dimensional obturation. Complete knowledge about different variations associated with multirooted teeth is also very important for successfull endodontic treatment. A mandibular first molar Radix Entomolaris (Additional lingual root) and Radix Paramolaris (Additional Buccal root) with two distal roots is an interesting example of anatomic variation[1].These case reports describe management of two cases of Radix entomolaris with the help of two different rotary file system.*

Key words*: Biomechanical preparation, Radix entomolaris, Rotary files.*

I. Introduction

Radix entomolaris and other morphologic variations present definite challenges to endodontic therapy because of their orifice inclination and root canal curvature .the canal can be straight, have a coronal curvature or can have separate coronal and apical curvatures.[1]According to Barrett et all among all the phases of anatomic study in human system, one of the most complex is that of pulp cavity morphology. Radix entomolaris was first described by Carabelli in 1844 and was termed Radix entomolaris by Bolk in 1915.[1]

Mandibular molar usually have 2 roots .A variation in root morphology is the presence of an extra distolingual root .Usually this root has a type I canal configuration. It was found that two third of the first mandibular molars of a Chinese population possessed this variation. Similarly, this distolingual root occurred in 4% of mandibular first molars of Kuwait population. These results confirm the observation that East Asian populations have more three –rooted mandibular first molars than other racial groups.[1]

Another challenge for endodontist is to achieve proper working length and Selection of preparation sizes and overall geometries that allow adequate disinfection and subsequent obturation. File design was playing important role in preventing preparation errors. There have been significant advancements in the development of NiTi rotary instruments in recent years. The ProTaper NiTi files (Dentsply Maillefer; Ballaigues, Switzerland) represent a revolutionary generation of instruments for shaping root canal.[3]

1.1 Protaper Geometries

The following will describe the ProTaper geometries and specific features that make these Shaping and Finishing files remarkably unique.

1.1.1 The Shaping Files

Shaping File # 1 and Shaping File # 2, termed S1 and S2, have D0 diameters of 0.17 mm and 0.20 mm.The Auxiliary Shaping File, termed SX, with a shorter overall length of 19 mm, provides excellent access when space is restrictive. The SX file has a D0 diameter of 0.19 mm.[4]

1.1.2 The Finishing Files

Three Finishing files named F1, F2 and F3 have corresponding D0 diameters of 0.20 mm, 0.25 mm, and 0.30 mm, respectively. Additionally, F1, F2, and F3 have fixed tapers between D1 and D3 of .07, .08, and .09, respectively.[4]

Recently, the Protaper Next system (Dentsply/Maillefer) was launched into the dental market. There are five instruments in the system but most canals can be prepared by using only the first two instruments. The first instrument in the system is the Protaper Next X1, with a tip size of 0.17mm and a 4% taper. This instrument is used after creation of a reproducible glide path by means of hand instruments or rotary Pathfiles (Dentsply/Maillefer). [5]

The Protaper Next X1 is always followed by the second instrument: the Protaper Next X2 (0.25mm tip and 6% taper). The Protaper Next X2 can be regarded as the first finishing file in the system as it leaves the prepared root canal with adequate shape and taper for optimal irrigation and root canal obturation. The PTN X1

and X2 have an increasing and decreasing percentage tapered design over the active portion of the instruments. The last three finishing instruments are the Protaper Next X3 (0.30mm tip with 7% taper), Protaper Next X4 (0.40 mm tip with 6% taper) and the Protaper Next X5 (0.5mm tip with 6% taper). These instruments have a decreasing percentage taper from the tip to the shank. The Protaper Next X3, X4 and X5 can be used to either create more taper in a root canal or to prepare larger root canal systems.[5]

The advantages of the Protaper Next system include:

1. The instruments are manufactured from M-Wire that contributes towards more flexible instruments, increased safety and protection against instrument fracture (Gutmann, Gao, 2012)
2. The instruments have a bilateral symmetrical rectangular cross section with an offset from the central axis of rotation (except in the last 3mm of the instrument, D0-D3) creating an asymmetric rotary motion. The exception is the Protaper X1, which has a square cross section in the last 3mm to give the instruments a bit more core strength in the narrow apical part. The asymmetric rotary motion allows the instrument to experience a rotational phenomenon known as precession or swagger (Scianamblo, 2011).[5]

According to Van der Vyver and Scianamblo (2013) the benefits of this design characteristic include:

1. It further reduces (in addition to the progressive tapered design) the engagement between the instrument and the dentine walls because only two cutting points make contact with the canal wall at any time. This will contribute to a reduction in taper lock, screw-in effect and stress on the file.
2. It ensures debris removal in a coronal direction because the off-centre cross-section allows for more space around the flutes of the instrument. This will lead to improved cutting efficiency, as the blades will stay in contact with the surrounding dentine walls.
3. The swaggering (asymmetric) rotary motion of the instrument initiates activation of the irrigation solution during canal preparation, improving debris removal
4. Reduces the risk of instrument fracture because there is less stress on the file and more efficient debris removal.[5]

2. Case Report 1

A 34 year old Female patient was reported to the Department Of Conservative And Endodontics with a chief complaint of pain in the lower right back tooth region. On examination patient gave a history of intermittent pain for 5 months that increased in intensity for the past 4 days. On clinical examination there was distoproximal caries w.r.t 46.Two radiographs with different horizontal angulations were made which confirmed that the additional root was located distolingual to the mesial root (Fig1).After clinical examination diagnosis of Chronic irreversible pulpitis was made.

After anaesthetizing the tooth, access preparation was done with endo-access bur and canal orifices were located with DG 16 endodontic explorer. Initial negotiation of the root canals was conformed with K-file 10. The fourth disto-lingual canal orifice was present far from distal root canal orifices.

The canal lengths were determined radio graphically with K file ISO 15 size and electronically with Root ZX (Fig 2). They were cleaned with 2.5% sodium hypochlorite along with EDTA and shaped with protaper rotary system till a size of F-1 and patient was recalled after 3 days . At next appointment patient was asymptomatic. Master cone radiograph revealed proper fitting of cones (Fig 3) .Canals were dried with paper point and obturation done by using AH PLUS Sealer (Fig4).

3. Case Report 2

A 27 year old male patient was reported to the Department Of Conservative And Endodontics with a chief complaint of pain in the lower right back tooth region. On examination patient gave a history of intermittent pain for 3 months that increased intensity for the past 7 days. On clinical examination their was distoproximal caries w.r.t 46.Two radiographs with different horizontal angulations were made which confirmed that the additional root was located distolingual to the mesial root (Fig5).After clinical examination diagnosis of chronic irreversible pulpitis was made.

After anaesthetizing the tooth, access preparation was done with endo-access bur and canal orifices were located with DG 16 endodontic explorer. Initial negotiation of the root canals was conformed with K-file 10. The fourth disto-lingual canal orifice was present far from distal root canal orifices.

The canal lengths were determined radio graphically with K file ISO 15 size and electronically with Root ZX (Fig 6). They were cleaned with 2.5% sodium hypochlorite along with EDTA and shaped with protaper Next rotary system till a size of X2 and patient was recalled after 3 days . At next appointment patient was asymptomatic. Master cone radiograph revealed proper fitting of cones (Fig 7) .Canals were dried with paper point and obturation done by using AH PLUS sealer (Fig8).

4. Figures

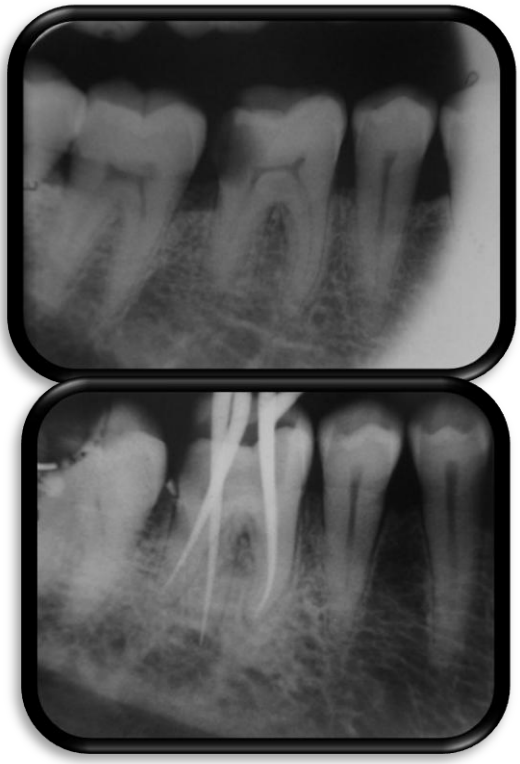

Fig. 3

Fig. 1

Fig. 4

Fig, 1, Preoperative IOPAR
Fig.2, Working Length IOPAR
Fig. 3, Master cone IOPAR
Fig. 4, Postobturation IOPAR

Fig.5

Fig.6

Fig.7

Fig.8

Fig.5, Preoperative IOPAR)
Fig.6, Working length IOPA
Fig.7, Master cone IOPAR
Fig.8 Postobturation IOPAR

II. Discussion

The etiology behind the formation of radix molar could be related to external factors during odontogenasis, or to penetrance of an atavistic gene or polygenetic system (atavism is the reappearance of a trait after several generations of absence)[6].The presence of a single radix entomolaris in the mandibular first molar has been associated with determined ethical groups. In Black populations, the maximum frequency found is 3% [7] , while in Caucasians and Indians, the occurrence is lower than 5%.[8] In Chinese, Eskimos, and American Indian population, studies have shown that radix entomolaris occurs in a constancy ranging from 5% to more than 30% [9]. Because of its high frequency in these populations, the o radix entomolaris is considered normal (eumorphic root morphology). In Caucasians, the radix entomolaris is not common with maximum occurrence from 3.4 to 4.2%.[10, 11]

Table 1: Incidence of two canals in distal root of mandibular first molar

Author/Year	Incidence (%)	Population group
Skidmore and Bjorndal (1971)	28.9	Caucasians
Vertucci and Williams(1974)	30	Caucasians
Yew and Chan (1993)	31.5	Chinese
Zaatar et al (1997)	29.9	Middle East
Gulabivala et al (2001)	20	Burmese
Gulabivala et al (2002)	33.4	Thai
Sen et al (2004)	46	Turkish

An RE can be found on the first, second and third mandibular molar, occurring least frequently on the second molar. Some studies report a bilateral occurrence of the RE from 50 to 67%. *Bolk* reported the occurrence of a buccally located additional root: the RP.

Table 2: Prevalence of three rooted mandibular first molars- survey of available studies

Author/year	Prevalence (%)	Population group
Taylor (1899)	3.4	United Kingdom
Tratman (1938)	5.8	Chinese
Tratman (1938)	0.2	Indians
Skidmore and Bjorndal (1972)	2.2	Caucasians
Yones et al (1990)	2.92	Saudi
Loh (1990)	7.9	Chinese (Singapore)
Yew and Chan (1993)	21.5	Chinese
Sperber and Moreau (1998)	3.0	Senegalese
Gulabivala et al (2001)	10.1	Burmese

The location of radix entomolaris is distolingually, with its coronal third completely or partially fixed to the distal root. The dimensions of the RE can vary with normal length and root canal. In most cases the pulpal extension is radiographically visible.

According to the classification of De Moor et al, based on the curvature of the separate RE variants in bucco-lingual orientation, three types can be identified.[6]

- Type I - refers to a straight root/root canal,
- Type II refers to an initially curved entrance which continues as a straight root/root canal.
- Type III - refers to an initial curve in the coronal third of the root canal and a second curve beginning in the middle and continuing to the apical third.

The presence of an RE or an RP has clinical implications in endodontic treatment. An accurate diagnosis of these supernumerary roots can avoid complications or a 'missed canal' during root canal treatment. To reveal the RE, a second radiograph should be taken from a more mesial or distal angle (30^0).

A severe root inclination or canal curvature, particularly in the apical third of the root (as in a type III RE), can cause shaping aberrations such as straightening of the root canal or a ledge, with root canal transportation and loss of working length resulting. The use of flexible nickel-titanium rotary files allows a more centered preparation shape with restricted enlargement of the coronal canal third and orifice relocation.[6]

III. Conclusion

Tooth anatomy is very complex.It is different for person to person. The dentist should be aware of this uncommon anatomy in the mandibular first molars in terms of root inclination and root canal curvature. A Skillfull diagnostic and radiographic interpretation is must for proper treatment of such abnormal anatomic variations. Preoperative Periapical radiographs exposed at two different horizontal angles are helpfull in such cases for diagnosis of additional root. The use of the operating microscope and the modification of the access cavity are also of fundamental importance for the location of the root canal orifice present in this extra root.

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