REVIEW ARTICLE

Rotary Endodontics in Pediatric Dentistry: Embracing the New Alternative

Ananya Chauhan[1], Sheeba Saini[2], Parminder Dua[3], Ritu Mangla[4]

Abstract

Pulpectomy is one of the most important procedures in maintaining the necrotic primary teeth until physiologic exfoliation. In clinical practice, time efficacy is invaluable, especially in pediatric endodontics, where unpredictability and difficulty of root canal morphology adds to a clinician's challenge. The success of a pulpectomy procedure mainly depends upon the biomechanical preparation of the root canal systems. With the advent of NiTi rotary files, adult endodontic procedures have been rendered easy, but its popularity in pedodontic practice is limited. Therefore, the purpose of this article is to review the use of NiTi rotary files for root canal instrumentation in primary teeth.

Keywords: Deciduous teeth, Pulpectomy, Rotary endodontics, Rotary files.

International Journal of Clinical Pediatric Dentistry (2019): 10.5005/jp-journals-10005-1679

Introduction

In pediatric dentistry, premature loss of necrotic primary molars has been a matter of great concern over the years.[1–3] In modern pedodontic practice, pulpectomy of such teeth is regarded as a treatment of choice over extraction.[4,5] Success of a pulpectomy procedure mainly depends upon the biomechanical preparation of the root canal systems.[6] Although manual instrumentation for root canal preparation is widely used in primary teeth, there are limitations regarding patient cooperation and time consumption.[6,7] Therefore, more and more practitioners are exploring the benefits of rotary endodontics in modern-day practice.[8] However, its use has been fairly limited to permanent teeth.[6] With changing trends, much attention has been directed towards making pulpectomy a less time-consuming and a more-efficient procedure.

Rotary instrumentation has made a quantum leap in the field of endodontics.[9] These changes lead to the introduction of rotary endodontics in pediatric dentistry. However, the bizarre root canal morphology and thinner root dentin limited the use of rotary endodontics in primary teeth.[3,4,10] To overcome such barriers, various modified protocols have been introduced to prevent any undesirable complications.[11–13]

Barr et al.[4] was first to demonstrate the use of NiTi rotary files in primary molars advocating the same principles of biomechanical preparation as described for permanent teeth. Many authors have reported the clinical success of Profile, ProTaper, Mtwo, FlexMaster, Light Speed LSX, Hero 642, K3, and WaveOne rotary files in primary teeth.[1,2] Most recently, Kedo-S (the first rotary Paedodontic file) has made a major breakthrough in the field of pediatric endodontics.[14]

Review

ProFile 0.04 (Dentsply Maillefer)

It has a triple U-shaped cross-sectional design with flat radial lands, a non-cutting tip, and constant taper with a 20° helical angle and constant pitch.[15] According to Barr et al.[4] and Crespo et al.[16] the pulpectomy procedure began with a standard access and removal of coronal tissue. A NiTi ProFile 0.04 was chosen that approximates the canal size. It was inserted into the canal while rotating at a slow speed of 150–300 rpm till the calculated working length, as determined by pretreatment radiography. The canals were cleansed and shaped with sequentially larger files until the last file. It was suggested that frequent inspection of each file for flute unwinding or distortion was important, and the file may be discarded after use on 5 primary teeth. Copious irrigation was must to keep the canals moist. The crown down instrumentation technique was not necessary as the primary root dentin cuts more easily than permanent teeth. Maintaining the original path of the root canal was essential to ensure the integrity of permanent successor. It was concluded that the use of Ni-Ti rotary files for root canal preparation in primary teeth was cost-effective, less time-consuming, and resulted in consistently uniform and predictable fillings. However, it reported the results of only two clinical cases without any followup results. Silva et al.[7] and Canoglu et al.[17] instrumented the root canals with rotary Profile 0.04 system up to a 35 size file. Then the files were stepped back with 40, 45, and 50 size rotary files. Nagaratna et al.[11] used ProFile 0.04 taper 29 series starting from size 2 to 7 in a reduction-gear handpiece. Files were advanced slowly toward the apex, which were withdrawn when working length was reached. Copious irrigation with saline was done after each filing.

ProTaper (Dentsply Maillefer, Ballaigues, Switzerland)

It has a convex triangular-shaped cross-sectional design with sharp cutting edges and no radial lands, noncutting tip, and variable

[1–4]Department of Paedodontics and Preventive Dentistry, Himachal Institute of Dental Sciences, Sirmour, Himachal Pradesh, India

Corresponding Author: Ananya Chauhan, Department of Paedodontics and Preventive Dentistry, Himachal Institute of Dental Sciences, Sirmour, Himachal Pradesh, India, Phone: +91 8894575739, e-mail: chauhan.ananya77@gmail.com

How to cite this article: Chauhan A, Saini S, Dua P, *et al.* Rotary Endodontics in Pediatric Dentistry: Embracing the New Alternative. Int J Clin Pediatr Dent 2019;12(5):460–463.

Source of support: Nil

Conflict of interest: None

taper with balanced helical angle and pitch to prevent "screwing in" effect.[18,19] Kuo et al.[6] used Sx file of ProTaper NiTi rotary system for instrumentation to about 3 mm beyond the root canal orifice with a slight buccolingual brushing motion to gain a straight line access. The S2 file was then inserted into the canal while rotating till the calculated working length. If a point of resistance was encountered, no attempt was made to go beyond, so as to avoid the risk of instrument separation. It was concluded that lateral perforation can be avoided by using only SX and S2 files. As the gradual taper of SX files can selectively remove the dentin in a safe way. S1 and F series were not used as the increased taper and tip size resulted in excessive apical dentin removal. Azar et al.[12] modified the sequence of the three ProTaper instruments slightly to prepare the canals. Root canals were cleaned in a crown down method with three instruments in the sequence from S1 in the coronal third of the root canal, S2 in the middle third, and F1 till the working length. Pinheiro et al.[13] prepared the root canal with ProTaper using a handpiece with an electric motor X-Smart. At a speed of 300 rpm and torque of 3 N/cm, S1 and S2 ProTaper files were used for shaping the primary molar root canals. For F1 and F2, 2 N/cm torque with a speed of 300 rpm was used with an anticurvature filing method for finishing the canals.

Hybrid Technique

Pinheiro et al.[20] used a hybrid technique for instrumentation of primary molar root canals with ProTaper system and hand K-files. Root canals were initially prepared by manual instrumentation using a size 15 K-file followed by S1 and S2 rotary file; then again manual instrumentation was performed with size 15 and 20 K-files followed by F1 rotary file. Finally manual instrumentation was done with size 25 K-file and F2 rotary file.

Flex-Master (VDW, Munich, Germany)

These NiTi rotary files have a convex triangular-shaped cross-sectional design with sharp cutting edges and no radial lands, noncutting tip, fixed taper, and individual helical angles to prevent "screwing in" effect.[21] Bahrololoomi et al.[22] used 25 mm-long Flexmaster rotary files with a modified crown down technique with 35/0.06, 35/0.04, 30/0.06 and 40/0.02 tapers for instrumentation. Shaping was completed with a gentle advance and withdrawal motion. Instruments were removed when resistance was felt and changed for the next instrument. Makarem et al.[23] conducted a randomized controlled clinical trial in the pulpectomy of primary second molar teeth and achieved superior radiographic findings and less chair time with Flex-Master system. Moghaddam et al.[3] enlarged the root canal orifices with the orifice shaper "Introfile" of Flex-Master file system until the root canal middle third was reached. Crown down preparation was performed with a 64:1 speed gear reduction handpiece. At first, 25/0.04 rotary file was used until resistance was felt followed by 25/0.02 rotary file till working length.

Hero (Micro-Mega, Besancon, France)

These instruments are an example of second-generation rotary system. HERO stands for high elasticity in rotation. Recently a new root canal preparation instrument—HERO shapers—was designed with the same triple-helix cross-section. The key modification in this instrument is the introduction of the adapted pitch concept.[24] Kummer et al.[25] prepared the root canals with Hero 642 system and a reducing 50:1 handpiece. Preparation was performed with 21 mm NiTi instruments with 2% and 4% taper using the crown down technique. The protocol established for instrumentation comprised a kit with 3 instruments: (1) Hero 642 taper 0.04, size 30, 2 mm short of the working length; (2) Hero 642 taper 0.02, size 35, up to the working length; (3) Hero 642 taper 0.02, size 40, up to the working length. Each Hero instrument was introduced into the canal with a gentle push-and-pull motion. Ozen et al.[26] used Protaper and Hero 642 for instrumentation of the canals. The protocol followed was SX, S1, and S2 in a crown down manner with the ProTaper system. This was followed by F1, F2, and F3 till the working length. For Hero 642, 2% and 4% taper files were used in the crown down technique for preparation of canal.

Mtwo (VDW, Munich, Germany)

It is a new generation of NiTi rotary instruments with an "italic S" cross-section with two cutting blades, noncutting tip, fixed taper, and variable pitch.[27] Azar et al.[28] used four 21-mm Mtwo instruments (10/0.04, 15/0.05, 20/0.06, and 25/0.06) in a crown down technique with a maximum speed of 280 rpm till the working length in primary teeth.

K3 (SybronEndo, Orange, California)

It has an asymmetrical design with a slightly positive rake angle for optimum cutting, three radial lands with peripheral blade relief, fixed taper, a noncutting tip, and variable pitch.[29,30] Romero et al.[5] performed instrumentation with K3 rotary system; the working length was established by placing the first adjusting file to radiographic working length; instrumentation started with the 0.06 taper file. The canals were cleansed and shaped with three progressively larger tapered files, using the "crown down" technique; each instrument was changed according to the manufacturer's recommendation. After use of each file, the root canals were irrigated with 1 mL of 1% NaOCl. The rotary files were used with an X-Smart motor at 350 rpm and slow torque. Rosa et al.[31] also instrumented the root canals with K3 rotary files using crown drown technique in the sequences No. 25/0.8, 30/0.6, 25/0.4, 25/0.2 at a speed of 250 rpm.

Light Speed (SybronEndo)

It has a triple U-shaped cross-sectional geometry with radial lands, a short cutting head and a long, noncutting, taperless shaft.[32] Vieyra et al.[33] instrumented the root canals with rotary Light Speed LSX instruments and ProTaper. The rotary Light Speed LSX instruments were used in the canal preparation to a size 50 for anteriors and to a size 40 for molars. For Protaper, the root canals were instrumented with SX orifice opener rotary file for widening the orifice and then with S1–F2 till the full working length.

Musale et al.[34] used ProFile, ProTaper, Hero Shaper, and K-Files for instrumentation of primary molars as per the manufacturer's recommendations. It was concluded that not only more conical canals were prepared with rotary files but also reduced preparation time with rotary files enhanced patient cooperation. However, Madan et al.[35] reported that the time taken during the cleaning of the root canals appeared to be statistically shorter with K-files than ProFile.

Katge et al.[36] reported that Wave One and Pro Taper showed better cleaning efficiency when compared to manual instrumentation especially in the coronal and middle one third of root. Ozen et al.[26] reported that 22% perforations were made by Hero 642 rotary system. Hence, care must be taken with each rotary file, for overpreparation can lead to unexpected lateral perforation, especially in severely curved canals. Elmsallati et al.[37] also reported that K3 rotary system produces minimum wear of root canal walls of

primary teeth. Yoshimine et al.[38] reported that K3 and RaCe should be used in the apical preparation of canals with a complicated curvature, since the relative rigidity of ProTaper system resulted in reduced canal curvature, increased apical transportation, and apical irregularities.

Recent Advances

Twisted Files[39]

In recent times, a completely different manufacturing process has evolved to introduce the third generation of NiTi rotary instruments: the twisted file (TF) with R-phase technology with three innovative methods of manufacturing viz. R-phase heat treatment, metal twisting, and special surface conditioning (deoxidation). These processes have shown to increase the instrument resistance, provide greater flexibility, and maintain the sharpness of the flutes. Prabhakar et al.[40] reported better cutting efficiency of twisted files over ProTaper rotary system. Hence these files can be efficiently incorporated into the contemporary pedodontic armamentarium.

Kedo-S[14] *(Reeganz Dental Care)*

Kids Endodontic Shaper is the world's first rotary file exclusively for shaping primary teeth. It is invented by Dr Ganesh Jeevanandan and came into existence in November 2016. It is a three-file system 16 mm in length—D1, E1, U1. D1 is specifically designed for molars with narrower canals. E1 is designed for molars with wider canals and U1 is designed for incisors. They are made functional at a speed of ≤250 rpm. This system claims to provide a safe and simple technique for shaping of primary root canals in the shortest time available. However, studies are yet to confirm its efficacy.

Conclusion

The research in the field of rotary endodontics is an ongoing process. With every passing day, newer systems with better efficiencies are introduced. NiTi rotary system in pediatric dentistry is like a double-edged sword. The design and flexibility of NiTi rotary instruments not only preserves the original anatomy of curved canals but also reduces procedural errors. It allows faster procedures, thereby enhancing patient cooperation, which is of paramount importance in paediatric dentistry. However, previous training of the operator is important to control the working length because there is reduction in tactile sensitivity. The high cost of armamentarium and need for learning the technique are other limitations of NiTi rotary systems.

References

1. Farhin K, Devendra P, et al. Application of Rotary Instrumentation in Paediatric Endodontics – A Review. Int J Prev Clin Dent Res 2014;1(3):48–52.
2. George S, Anandaraj S, et al. Rotary endodontics in primary teeth – A review. Saudi Dent J 2016;28:12–17. DOI: 10.1016/j.sdentj.2015.08.004.
3. Moghaddam KN, Mehran M, et al. Root canal cleaning efficacy of rotary and hand files instrumentation in primary molars. Iran Endod J 2009;4(2):53–57.
4. Barr ES, Kleier DJ, et al. Use of nickel titanium rotary files for root canal preparation in primary teeth. Pediatr Dent 2000;22:77–78.
5. Ochoa-Romero T, Mendez-Gonzalez V, et al. Comparison between rotary and manual techniques on duration of instrumentation and obturation times in primary teeth. J Clin Pediatr Dent 2011;35(4): 359–363. DOI: 10.17796/jcpd.35.4.8k013k21t39245n8.
6. Kuo CI, Wang YL, et al. Application of Ni-Ti rotary files for pulpectomy in primary molars. J Dent Sci 2006;1:10–15.
7. Silva LA, Leonardo MR, et al. Comparison of rotary and manual instrumentation techniques on cleaning capacity and instrumentation time indeciduous molars. J Dent Child 2004;71:45–47.
8. Dey B, Jana S, et al. A Comparison of Ni-Ti Rotary and Hand Files Instrumentation in Primary Teeth – A Review Article. Int J Oral Health Med Res 2016;3(2):59–62.
9. Walsch H. The hybrid concept of nickel–titanium rotary instrumentation. Dent Clin N Am 2004;48:183–202. DOI: 10.1016/j.cden.2003.11.003.
10. Finn SB. Morphology of primary teeth, 4th ed.; 1973. pp. 59–70.
11. Nagaratna PJ, Shashikiran ND, et al. *In vitro* comparison of NiTi rotary instruments and stainless steel hand instruments in root canal preparations of primary and permanent molar. J Indian Soc Pedod Prev Dent 2006;24:186–191. DOI: 10.4103/0970-4388.28075.
12. Azar MR, Safi L, et al. Comparison of the cleaning capacity of Mtwo and ProTaper rotary systems and manual instruments in primary teeth. Dent Res J 2012;9(2):146–151. DOI: 10.4103/1735-3327.95227.
13. Pinheiro SL, Neves LS, et al. Analysis of the instrumentation time and cleaning between manual and rotary techniques in deciduous molars. RSBO 2012;9(3):238–244.
14. https://www.youtube.com/watch?v=eoXwbV4iRQY.
15. Hsu Y-Y. The ProFile system. Dent Clin N Am 2004;48:69–85.
16. Crespo S, Cortes O, et al. Comparison between rotary and manual instrumentation in primary teeth. J Clin Pediatr Dent 2008;32: 295–298. DOI: 10.17796/jcpd.32.4.l57l36355u606576.
17. Canoglu C, Tekcicek MU, et al. Comparison of Conventional, Rotary, and Ultrasonic Preparation, Different Final Irrigation Regimens, and 2 Sealers in Primary. Molar Root Canal Therapy 2006;28(6):518–523.
18. Ruddle CJ. The ProTaper technique. Endodontic Topics 2005;10: 187–190. DOI: 10.1111/j.1601-1546.2005.00115.x.
19. Clauder T, Baumann MA. ProTaper NT system. Dent Clin N Am 2004;48:87–111. DOI: 10.1016/j.cden.2003.10.006.
20. Pinheiro SL, Araujo G, et al. Evaluation of cleaning capacity and instrumentation time of manual, hybrid and rotary instrumentation techniques in primary molars. Int Endod J 2012;45(4):379–385. DOI: 10.1111/j.1365-2591.2011.01987.x.
21. Sonntag D. FlexMaster: A universal system. Endodontic Topics 2005;10:183–186. DOI: 10.1111/j.1601-1546.2005.00120.x.
22. Bahrololoomi Z, Tabrizizadeh M, et al. *In Vitro* Comparison of Instrumentation Time and Cleaning Capacity between Rotary and Manual Preparation Techniques in Primary Anterior Teeth. J Dent Tehran Univ Med Sci 2007;4(2):59–62.
23. Makarem A, Ravandeh N, et al. Radiographic assessment and chair time of rotary instruments in the pulpectomy of primary second molar teeth: a randomised controlled clinical trial. J Dent Res Clin Dent Prospect 2014;8:84–89.
24. Calas P. HERO Shapers: The adapted pitch Concept. Endodontic Topics 2005;10:155–162. DOI: 10.1111/j.1601-1546.2005.00118.x.
25. Kummer TR, Calvo MC, et al. *Ex vivo* study of manual and rotary instrumentation techniques in human primary teeth. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:84–92. DOI: 10.1016/j.tripleo.2007.12.008.
26. Ozen B, Akgun OM. A Comparison of Ni-Ti Rotary and Hand Files Instrumentation in Primary Molars. J Int Dent. Med Res 2013;6(1): 6–8.
27. Malagino VA, Grande NM, et al. The Mtwo NiTi rotary system for root canal preparation. Roots 2006;3:67–70.
28. Azar MR, Mokhtare M. Rotary Mtwo system versus manual K-file instruments: Efficacy in preparing primary and permanent molar root canals. Indian J Dent Res 2011;22(2):363. DOI: 10.4103/0970-9290.84283.
29. Mounce RE. The K3 rotary nickel–titanium file system. Dent Clin N Am 2004;48:137–157. DOI: 10.1016/j.cden.2003.11.002.
30. Gambarini G. The K3 rotary nickel titanium instrument system. Endodontic Topics 2005;10:179–182. DOI: 10.1111/j.1601-1546.2005.00119.x.
31. Rosa FM, Modesto A, et al. Manual and rotary instrumentation techniques for root canal preparation in primary molars. 2014;2:1–5.

32. Barbakow F. The LightSpeed System. Dent Clin N Am 2004;48:113–135. DOI: 10.1016/j.cden.2003.10.003.
33. Vieyra JP, Enriquez FJ. Instrumentation Time Efficiency of Rotary and Hand Instrumentation Performed on Vital and Necrotic Human Primary Teeth: A Randomized Clinical Trial. Dentistry 2014;4:214.
34. Musale PK, Mujawar SA. Evaluation of the efficacy of rotary versus hand files in root canal preparation of primary teeth *in vitro* using CBCT. Eur Arch Paediatr Dent 2014;15:113–120. DOI: 10.1007/s40368-013-0072-1.
35. Madan N, Rathnam A, et al. K-file vs ProFiles in cleaning capacity and instrumentation time in primary molar root canals: An *in vitro* study. J Indian Soc Pedod Prev Dent 2011;29:2–6. DOI: 10.4103/0970-4388.79907.
36. Katge F, Patil D, et al. Comparison of instrumentation time and cleaning efficacy of manual instrumentation, rotary systems and reciprocating systems in primary teeth: *an vitro* study. J Indian Soc Pedod Prev Dent 2014;32:311–316. DOI: 10.4103/0970-4388.140957.
37. Elmsallati EA, Wadachi R, et al. Debris retention and wear in three different nickel-titanium rotary instruments. Aust Endod J 2006;32:107–111. DOI: 10.1111/j.1747-4477.2006.00029.x.
38. Yoshimine Y, Ono M, et al. The shaping effects of three nickel-titanium rotary instruments in simulated S-shaped canals. J Endod 2005;31:373–375. DOI: 10.1097/01.don.0000140568.40462.43.
39. Fayyad DM, Elgendy AAE. Cutting efficiency of twisted *vs* machined nickel-titanium endodontic files. J Endod 2011;37(8):1143–1146. DOI: 10.1016/j.joen.2011.03.036.
40. Prabhakar AR, Yavagal C, et al. Twisted *vs* Protaper Files in Contemporary Pediatric Endodontics. Int J Clin Pediatr Dent 2014;7(2):93–96. DOI: 10.5005/jp-journals-10005-1244.