



ASSESSMENT OF THE OBTURATION QUALITY OF THREE DIFFERENT ENDODONTIC ROTARY FILES USING CBCT

Swathi.S¹, Dr. S. Delphine Priscilla Antony²

Article History: Received: 12.12.2022

Revised: 29.01.2023

Accepted: 15.03.2023

Abstract:

Aim: To assess the quality of obturation using three different rotary endodontic files using CBCT

Materials and Methods: 30 extracted single rooted mandibular premolars were collected. Access cavity preparation was done and working length determined. Biomechanical preparation was done using three different rotary files. Samples were divided into 3 groups and the quality of obturation was analyzed using cone beam computed tomography.

Results: Profit S3 showed better obturation quality comparatively to other two file systems. Assessment of quality of obturation was statistically done using chi square test and there was a statistical significant difference between all the groups in length of obturation, quality of the obturation and density of the obturation ($p=0.01$).

Conclusion: Among three different rotary endodontic files profit S3 has perfect obturation quality in length, density and taper next comes the Neo Endo predominantly has acceptable quality of obturation compared to protaper Gold in density, taper and length.

Keywords: C.B.C.T, Quality, Permanent teeth, Obturation.

¹Postgraduate, Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-77

²Reader, Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-77

DOI: 10.31838/ecb/2023.12.s2.002

1. Introduction:

To prevent or treat apical periodontitis, endodontic treatment aims to eradicate pathogenic microbes from the root canal (Zhang et al. 2021). Three-dimensional obturation of the root canal(s) is necessary for endodontic treatment to be successful over the long term because it stops bacteria and their toxins from entering the periapical tissues (Naseri et al. 2013). In order to limit microleakage after the sealer has finished setting, the goal of canal filling procedures is to increase the use of gutta-percha and decrease the sealer's thickness (Zand et al. 2022). In this case, radiography is the imaging technique that is most widely acknowledged. Root canal treatment outcomes have long been assessed using intraoral periapical radiography (Cakici et al. 2016). Periapical radiographs, on the other hand, only produce two-dimensional pictures, hence they are insufficient for determining the root canal architecture (Nur et al. 2014). A specific tooth or teeth can be seen in any perspective using the 3D imaging technique known as CBCT. Oral surgery, endodontics, and orthodontics all utilise CBCT more prevalently in dentistry (Song et al. 2017). In particular for endodontic situations, CBCT imaging is a more sensitive and precise diagnostic tool than traditional imaging methods (Celikten et al. 2017). The ProTaper Gold (PTG) system has a convex triangle cross-section, variable progressive taper, and rotational action in addition to a constantly tapered form for a more effective, adaptable, and safe cutting action. (Yılmaz Çırakoglu and Özbay 2021). Neo Endo files have a triangular cross-section, regulated memory, sharp cutting edges, and remarkable flexibility. They are gold-treated NiTi rotary files. (Verma et al. 2017). Profit S3 (PS3), a new heat-treated rotary mechanism with titanium oxide coating, was unveiled in 2019 and is based on Blue Technology. It has a variable taper design with a rectangular cross-section. (Antony et al. 2020). There aren't many research comparing the various rotary file systems used in permanent teeth for evaluating obturation quality. The quality of obturation employing different cross sections of rotary files from Profit S3, Neo Endo, and ProTaper Gold in permanent teeth has not been compared in vitro investigations. Our team has extensive knowledge and research experience that has translate into high quality publications (Sathish and Karthick 2020; Krishna, Nivesh Krishna, and Yuvaraj Babu 2016; Sriram, Thenmozhi, and Yuvaraj 2015; Subashri and Thenmozhi 2016; Mootha et al. 2016; Marofi et al. 2021; Mohanavel et al. 2020; Vigneshwaran et al. 2020; Suresh et al. 2014; Robert et al. 2010). In order to assess the quality of obturation between three different rotary ni ti files in permanent teeth, this present study was carried out.

2. Materials and Methods:

The present in vitro study was conducted in the Department of Conservative dentistry and endodontics, Saveetha dental college, Chennai, India. Sample size was determined using G*power software version 3.1.0. The study protocol was approved by Institutional Ethical Committee. Thirty extracted single-rooted permanent teeth having full root length were collected, any teeth with signs of root canal obstruction, grossly decayed or fracture were excluded. Collected teeth were cleaned and stored in saline until use. The length of the tooth was standardized to 16mm using diamond disk by flattening the occlusal surface of the tooth. Teeth with two canals, calcification, dentinal cracks, pulp stones, and resorption were not included in the study. Access was gained with carbide bur, working length were established using a 15 K file and working length was kept 1mm short of the radiographic apex and biomechanical preparation was performed by a single trained operator. Thirty Human mandibular incisors were categorized into 3 groups (n=10) based on three different rotary file systems.

Experimental Setup:

The experimental design was similar to how Myers and Montgomery described (Myers & Montgomery. 1991). A Pre-weighed Eppendorf tube was attached to the rubber stopper as seen in (figure 1) glass bottle was used to hold the device to avoid contacting the vial during instrumentation (Bürklein and Schäfer 2012), 15 gauge needle was placed inside the rubber stopper to equalize the internal and external pressure within the tube. Each tooth was placed in the rubber stopper attached to the Eppendorf tube, where each tube were fitted in to the glass vial, simulating identical environment as in vivo conditions. Later, 30 teeth were randomly selected with 10 teeth in each three different rotary files group. The prepared root canals were colated with AH plus sealer and obturation was done 1 mm short of radiographic apex.

Group 1: Protaper Gold

Coronal enlargement is done using SX rotary file and apical enlargement was done with Protaper Gold rotary file till size F2 and 6% taper was used according to manufactures instruction till the working length with the coronal portion as a stable reference point.

Group 2: Neo Endo

Coronal enlargement is done using SX rotary file and apical enlargement was done with Neo Endo rotary file till size F2 and 6% taper was used according to manufactures instruction till the working length with the coronal portion as a stable reference point.

Group 3: Profit S3

Coronal enlargement is done using SX rotary file and apical enlargement was done with Profit S3 rotary file till size PF2 and 6% taper was used according to manufactures instruction till the working length with the coronal portion as a stable reference point.

The canals' instrumentation time was recorded in seconds by an assistant using a stopwatch. Distilled water irrigation was done and then dried using sterile paper points. AH plus sealer was coated on the walls using the finger plugger and obturated using the single cone technique. A post-obturation CBCT was taken to evaluate the obturation quality. It was then analyzed by another endodontist who was blinded to the type of instrumentation employed.

Evaluation of Quality of Obturation:

Quality of obturation like optimal filling, underfilling, overfilling, and voids (presence and location) was evaluated with C.B.C.T according to coll and sadrian criteria.

Under-filling: >2 mm short of the apex in all the canals.

Optimal filling: at the radiographic apex or up to 2 mm short of the apex in one or more of the root canals.

Over-filling: outside the root in any canal.

Statistical Analysis:

SPSS software version 17.0 (Chicago, SPSS Inc.) was used for statistical analysis. Shapiro wilk test was done for normality and Pearson's Chi-square test was utilized for comparison of obturation quality of between the groups. In this study, $p < 0.05$ was considered to be the level of significance. Here (table 1) gives the significant difference between quality of obturation between three different rotary files.

3. Results

After obtaining the values, the mean and standard deviation was calculated in all three groups. There were statistically significant results obtained in all three groups. Table 2,3,4 evaluates length, density and taper of the obturation between three rotary files.

Table 1: Significant difference in multiple comparisons between groups on quality of obturation

			Shapiro-Wilk test
	GROUPS	N	Sig
Length of the obturation	Ptotaper Gold	10	0.002
	Neo endo	10	0.036
	Profit S3	10	0
Density of the obturation	Ptotaper Gold	10	0.012
	Neo endo	10	0.004
	Profit S3	10	0.015
Taper of the obturation	Ptotaper Gold	10	0.015
	Neo endo	10	0.012

	Profit S3	10	0
--	-----------	----	---

Table 2: Evaluating length of the obturation between three rotary files

		Length of the obturation			Total
		Unacceptable	acceptable	perfect	
Groups	PROTAPER GOLD	1	3	6	10
	NEO ENDO	2	5	3	10
	PROFIT S3	0	2	8	10
Total		3	10	17	30

Table 3: Evaluating Density of the obturation between three rotary files

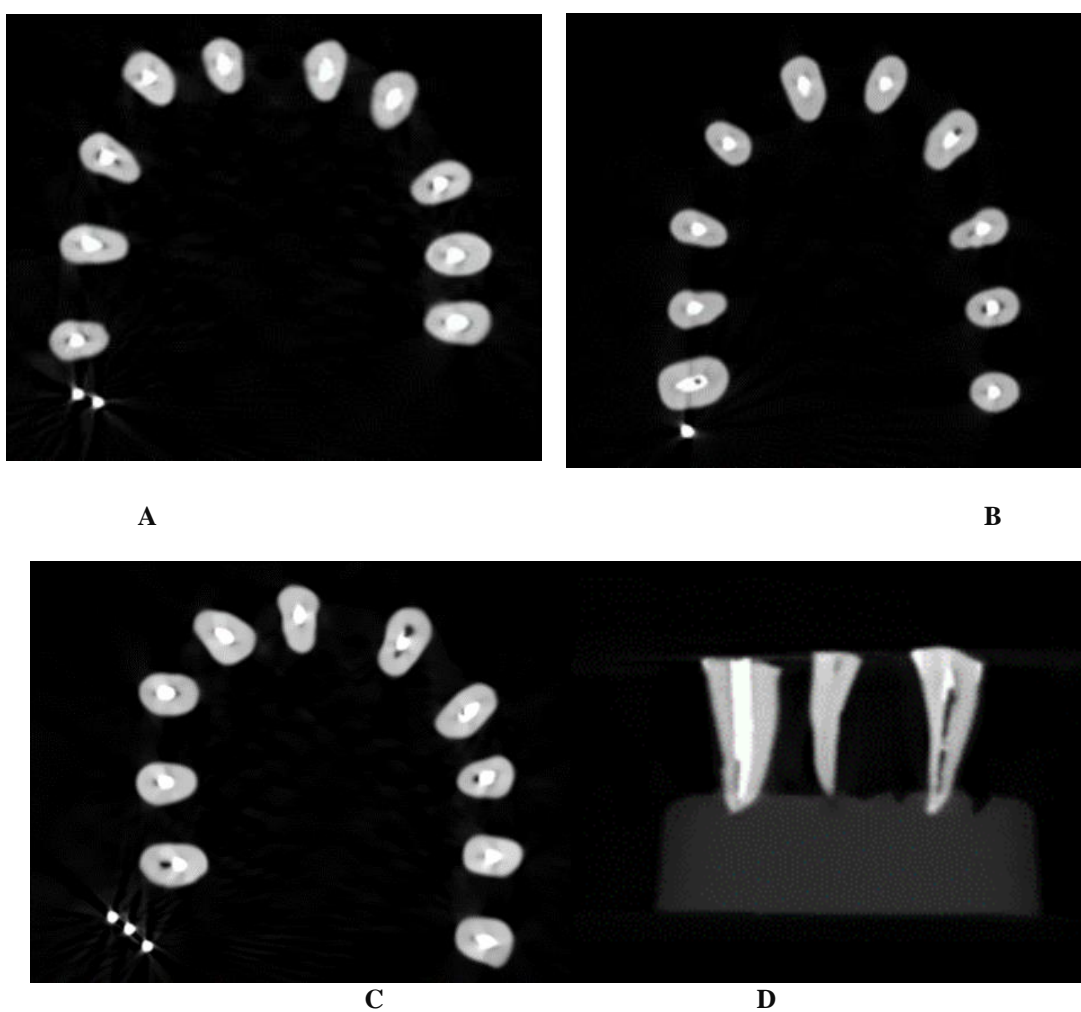
		Density of the obturation			Total
		unacceptable	acceptable	perfect	
Groups	PROTAPER GOLD	1	6	3	10
	NEO ENDO	1	7	2	10
	PROFIT S3	1	5	4	10
Total		3	18	9	30

Table 4: Evaluating taper of the obturation between three rotary files

		Taper of the obturation			Total
		unacceptable	acceptable	perfect	

Groups	PROTAPER GOLD	1	5	4	10
	NEO ENDO	1	6	3	10
	PROFIT S3	0	2	8	10
Total		2	13	15	30

Figure: (A-C) Cross section of all three samples, (D) sagittal section of the sample, having voids and incomplete taper (E-F) Incomplete taper and quality of obturation seen in sagittal section



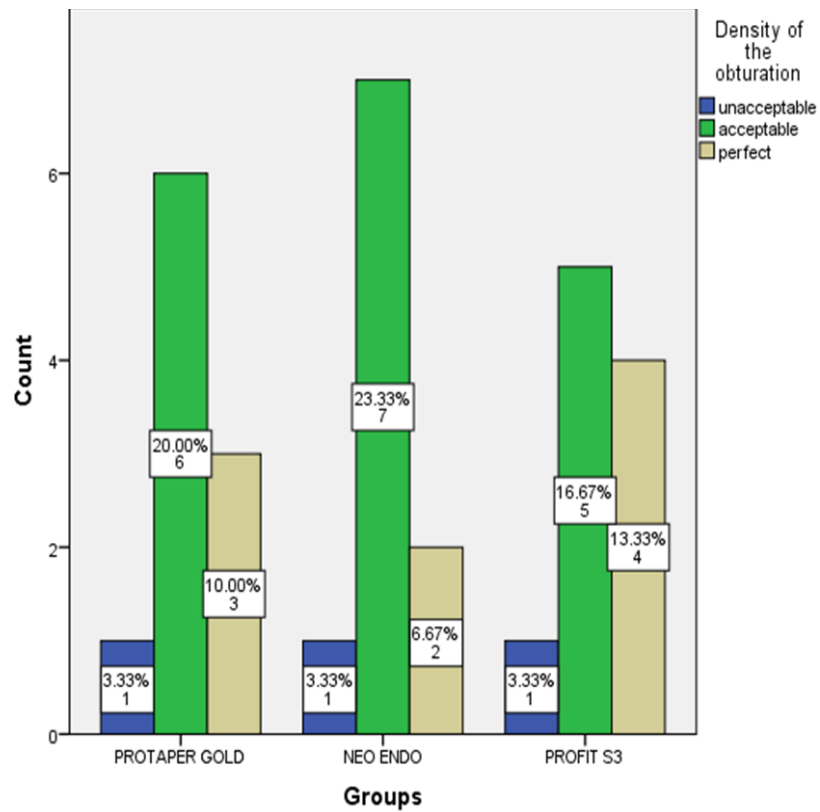
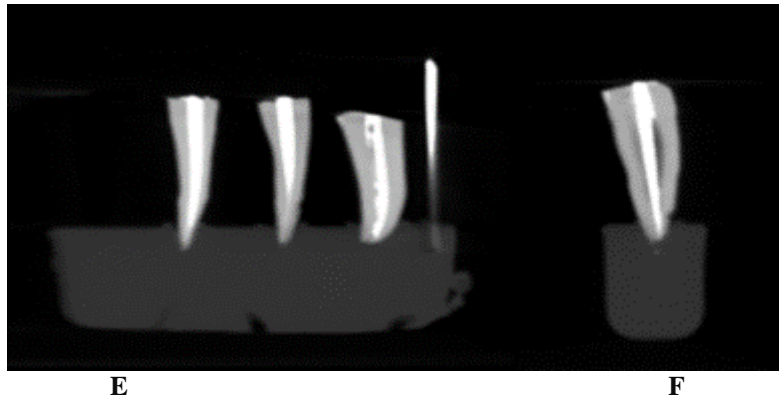


Figure 2: Mean Density of the obturation scores between three different rotary files

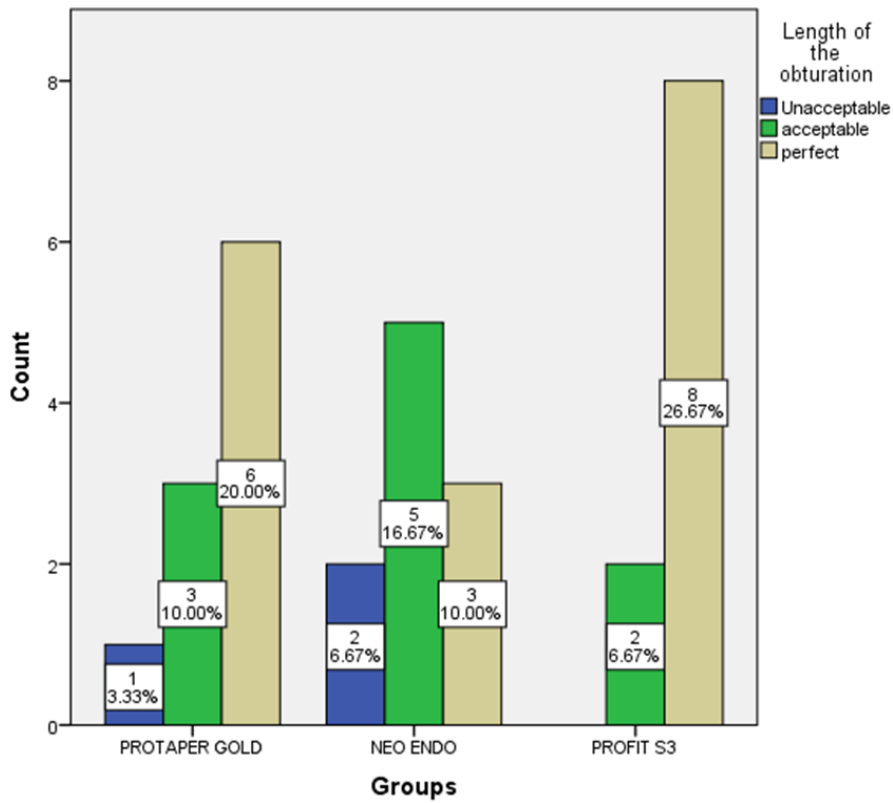


Figure 3: Mean length of the obturation scores between three different rotary files

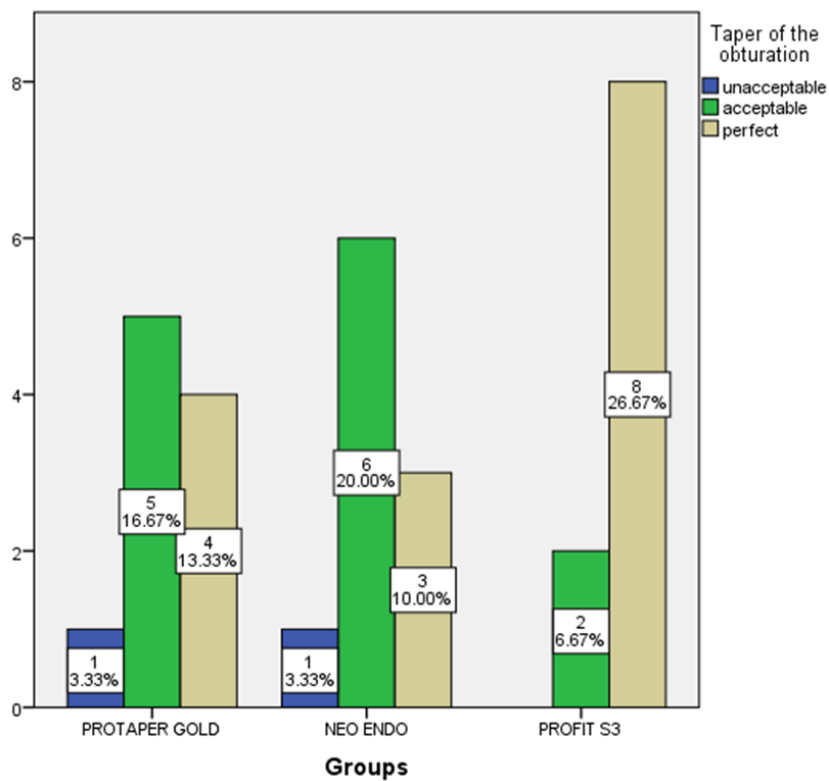


Figure 4: Mean taper of the obturation scores between three different rotary files

4. Discussion

The single-cone technique uses a single gutta-percha point at room temperature with varying cement thickness based on how well the tip conforms to the

root canal walls and in comparison to the lateral condensation technique, the single cone technique demonstrated a superior sealing however, the root canals on the teeth were straight and quite large.(Pereira, Nishiyama, and Lidiane de Castro Pinto 2013). A single gutta-percha point combined with the ProTaper and Mtwo rotary devices may be able to seal canals as well as any obturation technique(Taşdemir et al. 2009).Lateral condensation took longer than the single-cone method. (Ozawa, Taha, and Messer 2009). ProTaper Next files that were matched produced the highest PGFA and the least PSFA of all the groups (Capar et al. 2014). The apical level of the root canal filling had an impact on the effectiveness of treatment in teeth with preoperative periapical lesions because extruded filler material markedly decreased the success rate from 94% to 76% (Haupt et al. 2018). EndoSequence cones were the least accurate because of their substantially higher diameter variability. The best agreement between file and cone diameter measurements was found using EndoSequence, though (Chesler et al. 2013). Previous research looked into the files' taper, and they discovered that the majority of the files had taper measurements that were smaller than the nominal taper (Mirmohammadi, Sitarz, and Shemesh 2018). Matching gutta-percha cones depend on the canal's original shape and the ability to make a tapered circular preparation (Capar et al. 2014). In order to fit matching single cones to root canals that are oval-shaped and have bigger diameters, extensive preparation with thicker, more tapered instruments is necessary (Gordon, Love, and Chandler 2005).

Due to its exceptional flexibility, form memory, and taper, the PS3 has The rectangular cross shape and off-centered design may contribute to less canal transportation.(Antony et al. 2020). Nonlanded convex triangular cross-section and a modified guiding tip with a roughly 39° variable taper design are features of the protaper gold file design.(Singla, Kumar, and Satija 2021)and Neo endo has a triangle cross-section, controlled memory, sharp edges, and exceptional flexibility.It could lead to abnormally shaped canals if the instrument failed to stay centered in the curved canal. (Nagaraja and Sreenivasa Murthy 2010)

The type of material utilised, the teeth used, the sample size, the needle thickness, or the technique used, as well as the operator's skills, knowledge, and experience, may be the cause of the discrepancies in the results between the current study and earlier investigations. Even across in vivo and in vitro investigations, it can differ. The sample size of the current in vitro study is restricted to incisors. Therefore, additional research is needed to assess the obturation quality using various methodologies. By decorating the coronal surface of the tooth with the usual length of 16mm, we were able to

compensate for the WL loss and provide a stable coronal reference point (Vyavahare, Raghavendra, and Desai 2016) . According to the study's findings, Profit S3 had a density, length, and taper ratio of 23.37%, 26.67%, and 20%, respectively, of perfect obturation quality. Neo Endo had a density, length, and taper ratio of 16.67%, 20%, and 26.67%, respectively, of acceptable obturation quality, followed by Protaper Gold.

CONCLUSION:

Profit S3, one of three rotary endodontic files, has the perfect obturation quality in terms of length, density, and taper, followed by Neo Endo, which had acceptable obturation quality when compared to Protaper Gold in terms of density, taper, and length.

5. References:

- Antony, S. Delphine Priscilla, Aravind Kumar Subramanian, M. S. Nivedhitha, and Pradeep Solete. 2020. "Comparative Evaluation of Canal Transportation, Centering Ability, and Dentin Removal between ProTaper Gold, One Curve, and Profit S3: An in Vitro Study." *Journal of Conservative Dentistry: JCD* 23 (6): 632–36.
- Bürklein, Sebastian, and Edgar Schäfer. 2012. "Apically Extruded Debris with Reciprocating Single-File and Full-Sequence Rotary Instrumentation Systems." *Journal of Endodontia* 38 (6): 850–52.
- Cakici, E. B., E. Yildirim, F. Cakici, and A. S. Erdogan. 2016. "Assessment of Periapical Health, Quality of Root Canal Filling, and Coronal Restoration by Using Cone-beam Computed Tomography." *Nigerian Journal of Clinical Practice*. <https://www.ajol.info/index.php/njcp/article/view/142759>.
- Capar, Ismail Davut, Hüseyin Ertas, Evren Ok, and Hakan Arslan. 2014. "Comparison of Single Cone Obturation Performance of Different Novel Nickel-Titanium Rotary Systems." *Acta Odontologica Scandinavica* 72 (7): 537–42.
- Celikten, Berkan, Reinhilde Jacobs, Karla deFaria Vasconcelos, Yan Huang, Laura Ferreira Pinheiro Nicolielo, and Kaan Orhan. 2017. "Assessment of Volumetric Distortion Artifact in Filled Root Canals Using Different Cone-Beam Computed Tomographic Devices." *Journal of Endodontics* 43 (9): 1517–21.
- Chesler, Matthew B., Patricia A. Tordik, Glen M. Imamura, and Gary G. Goodell. 2013. "Intramanager Diameter and Taper Variability of Rotary Instruments and Their Corresponding Gutta-Percha Cones." *Journal of Endodontia* 39 (4): 538–41.

- Gordon, M. P. J., R. M. Love, and N. P. Chandler. 2005. "An Evaluation of .06 Tapered Gutta-Percha Cones for Filling of .06 Taper Prepared Curved Root Canals." *International Endodontic Journal* 38 (2): 87–96.
- Haupt, Franziska, Miriam Seidel, Marta Rizk, Hans-Georg Sydow, Annette Wiegand, and Tina Rödig. 2018. "Diameter and Taper Variability of Single-File Instrumentation Systems and Their Corresponding Gutta-Percha Cones." *Journal of Endodontia* 44 (9): 1436–41.
- Krishna, R. Nivesh, R. Nivesh Krishna, and K. Yuvaraj Babu. 2016. "Estimation of Stature from Physiognomic Facial Length and Morphological Facial Length." *Research Journal of Pharmacy and Technology*. <https://doi.org/10.5958/0974-360x.2016.00423.6>.
- Marofi, Farooq, Roza Motavalli, Vladimir A. Safonov, Lakshmi Thangavelu, Alexei Valerievich Yumashev, Markov Alexander, Navid Shomali, et al. 2021. "CAR T Cells in Solid Tumors: Challenges and Opportunities." *Stem Cell Research & Therapy* 12 (1): 81.
- Mirmohammadi, Hesam, Monika Sitarz, and Hagay Shemesh. 2018. "Intra-Manufacture Diameter Variability of Rotary Files and Their Corresponding Gutta-Percha Cones Using Laser Scan Micrometre." *Iranian Endodontic Journal* 13 (2): 159–62.
- Mohanavel, V., K. S. Ashraff Ali, S. Prasath, T. Sathish, and M. Ravichandran. 2020. "Microstructural and Tribological Characteristics of AA6351/Si3N4 Composites Manufactured by Stir Casting." *Journal of Materials Research and Technology* 9 (6): 14662–72.
- Mootha, Archana, Sankari Malaiappan, N. D. Jayakumar, Sheeja S. Varghese, and Julie Toby Thomas. 2016. "The Effect of Periodontitis on Expression of Interleukin-21: A Systematic Review." *International Journal of Inflammation* 2016 (February): 3507503.
- Nagaraja, Shruthi, and B. V. Sreenivasa Murthy. 2010. "CT Evaluation of Canal Preparation Using Rotary and Hand NI-TI Instruments: An in Vitro Study." *Journal of Conservative Dentistry: JCD* 13 (1): 16–22.
- Naseri, Mandana, Ali Kangarlou, Atefeh Khavid, and Mostafa Goodini. 2013. "Evaluation of the Quality of Four Root Canal Obturation Techniques Using Micro-Computed Tomography." *Iranian Endodontic Journal* 8 (3): 89–93.
- Nur, Bilge Gülsüm, Evren Ok, Mustafa Altunsoy, Osman Sami Ağlarci, Mehmet Çolak, and Enes Güngör. 2014. "Evaluation of Technical Quality and Periapical Health of Root-Filled Teeth by Using Cone-Beam CT." *Journal of Applied Oral Science: Revista FOB* 22 (6): 502–8.
- Ozawa, Toshiko, Nessrin Taha, and Harold H. Messer. 2009. "A Comparison of Techniques for Obturating Oval-Shaped Root Canals." *Dental Materials Journal* 28 (3): 290–94.
- Pereira, Andréa Cardoso, Celso Kenji Nishiyama, and Lidiane de Castro Pinto. 2013. "Single-Cone Obturation Technique: A Literature Review." *RSBO* 9 (4): 442–47.
- Robert, R., C. Justin Raj, S. Krishnan, and S. Jerome Das. 2010. "Growth, Theoretical and Optical Studies on Potassium Dihydrogen Phosphate (KDP) Single Crystals by Modified Sankaranarayanan–Ramasamy (mSR) Method." *Physica. B, Condensed Matter* 405 (1): 20–24.
- Sathish, T., and S. Karthick. 2020. "Wear Behaviour Analysis on Aluminium Alloy 7050 with Reinforced SiC through Taguchi Approach." *Journal of Materials Research and Technology* 9 (3): 3481–87.
- Singla, Meenu G., Hemanshi Kumar, and Ritika Satija. 2021. "Shaping Ability of ProTaper Gold, One Curve, and Self-Adjusting File Systems in Severely Curved Canals: A Cone-Beam Computed Tomography Study." *Journal of Conservative Dentistry: JCD* 24 (3): 271–77.
- Song, D., L. Zhang, W. Zhou, and Q. Zheng. 2017. "Comparing Cone-Beam Computed Tomography with Periapical Radiography for Assessing Root Canal Obturation in Vivo Using Microsurgical Findings as Validation." *Dentomaxillofacial*. <https://www.birpublications.org/doi/abs/10.1259/dmfr.20160463>.
- Sriram, Nirisha, Thenmozhi, and Samrithi Yuvaraj. 2015. "Effects of Mobile Phone Radiation on Brain: A Questionnaire Based Study." *Journal of Advanced Pharmaceutical Technology & Research* 8 (7): 867.
- Subashri, A., and M. S. Thenmozhi. 2016. "Occipital Emissary Foramina in Human Adult Skull and Their Clinical Implications." *Research Journal of Pharmacy and Technology*. <https://doi.org/10.5958/0974-360x.2016.00135.9>.
- Suresh, P., K. Marimuthu, S. Ranganathan, and T. Rajmohan. 2014. "Optimization of Machining Parameters in Turning of Al-SiC-Gr Hybrid Metal Matrix Composites Using Grey-Fuzzy Algorithm." *Transactions of the Nonferrous Metals Society of China* 24 (9): 2805–14.
- Taşdemir, Tamer, Kürşat Er, Tahsin Yildirim, Kurtulus Buruk, Davut Celik, Sabri Cora, Erhan Tahan, Behram Tuncel, and Ahmet

- Serper. 2009. "Comparison of the Sealing Ability of Three Filling Techniques in Canals Shaped with Two Different Rotary Systems: A Bacterial Leakage Study." *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics* 108 (3): e129–34.
- Verma, Mudita, N. Meena, R. Anitha Kumari, Sudhanva Mallandur, R. Vikram, and Vishwas Gowda. 2017. "Comparison of Apical Debris Extrusion during Root Canal Preparation Using Instrumentation Techniques with Two Operating Principles: An in Vitro Study." *Journal of Conservative Dentistry: JCD* 20 (2): 96–99.
- Vigneshwaran, S., R. Sundarakannan, K. M. John, R. Deepak Joel Johnson, K. Arun Prasath, S. Ajith, V. Arumugaprabu, and M. Uthayakumar. 2020. "Recent Advancement in the Natural Fiber Polymer Composites: A Comprehensive Review." *Journal of Cleaner Production* 277 (December): 124109.
- Vyavahare, Nishant K., Srinidhi Surya Raghavendra, and Niranjana N. Desai. 2016. "Comparative Evaluation of Apically Extruded Debris with V-Taper, ProTaper Next, and the Self-Adjusting File Systems." *Journal of Conservative Dentistry: JCD* 19 (3): 235–38.
- Yılmaz Çırakoglu, Neslihan, and Yağız Özbay. 2021. "Apically Extruded Debris Associated with ProTaper Next, ProTaper Gold and TruNatomy Systems: An in Vitro Study." *Journal of Dental Research, Dental Clinics, Dental Prospects* 15 (1): 30–34.
- Zand, Vahid, Amin Salem Milani, Pardis Tehranchi, Sabete Bagheri Sabzevar, and Omid Goudarzi. 2022. "Comparative CBCT Assessment of Obturation Quality in Different Obturation Techniques." *Journal of Dental Materials and Techniques* 11 (2): 84–92.
- Zhang, Pengfei, Keyong Yuan, Qiaoqiao Jin, Fen Zhao, and Zhengwei Huang. 2021. "Presence of Voids after Three Obturation Techniques in Band-shaped Isthmuses: A Micro-computed Tomography Study." *BMC Oral Health* 21 (1): 227.