OUTCOME EVALUATION OF ENDODONTIC TREATMENT WITH PROTAPER ROTARY INSTRUMENT SYSTEM ON MAXILLARY INCISORS

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I. BACKGROUND

In recent years, thanks to the rapid advancement of science and technology and a better understanding of the anatomy of the root canal system, many new endodontic instruments and materials have been introduced with the desire to minimize complications in the process of preparing the root canal, help the cleaning and shaping process to complete well. It is noteworthy that the emergence of new endodontic files made of Nickel-Titanium alloy (NiTi files), which, according to the recommendations of manufacturers, make the preparation of root canals faster and more efficient, with a much simpler shaping technique than previous stainless-steel files. This is the topic that attracts great interest from clinicians. Therefore, it is necessary to conduct studies to evaluate these types of instruments. Over the years, there has been a lot of research on NiTi instrument systems carried out in the world, which mainly focused on the current types of rotary NiTi files. In Vietnam, although the NiTi instrument system appears a lot on the market and is increasingly employed by many dentists and endodontic experts, the amount of research on them is limited.

Therefore, in order to contribute to more understanding and improve the effectiveness of endodontic treatment with niti rotary instrument systems we carry out the research: "Outcome Evaluation of endodontic treatment with Protaper rotary instrument system on maxillary incisors" with two aims:

1. To evaluate root canal sealing results with cone beam computed tomography (CBCT)

2. To evaluate the outcomes of maxillary incisor root canal treatment with the Protaper rotary instrument system.

II. MATERIALS AND METHODS

2.1. Patient selection

2.1.1. Patient selection

Patients presented at Oral and Maxillofacial Medicine clinic at Can Tho University of Medicine and Pharmacy in 2019 - 2021 with primary endodontic infection

2.1.2. Inclusion criteria included the following:

- Patients whose permanent maxillary central incisors diagnosed with pulp infection according to American association of endodontists criterias [1] and have indications of root canal treatments
- Patient who agreed to participate in the study.

2.1.3. Exclusion criteria were as follows:

- Teeth with previous endodontic treatment, immature apices
- Patients who are pregnant.
- Patient who are incapable of communicating.

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- Patients who have apical periodontitis with large periapical lesion that may required apicoectomy.

2.2. Methods

2.2.1. Research methods

- Descriptive research methods cross-sectional.
- Sample size: 65 maxillary central incisors.

2.2.2. Sampling method

Convenient sampling

2.2.3. Materials and methods

Evaluations during root canal treatments

- Working length: acquired by using apex locator and radiograph.
- Filling cones: F1, F2, F3, F4.
- Preparation time: time spent cleaning and shaping root canals using Protaper rotary instrument system.
- Complications during root canal treatments: Occurred during the treatments, there were three [6]: loss of working length, ledge formation and instrument separation.

Root canal treatment outcomes evaluation using CT cone beam

- Void of sealer in 3 horizontal cross-sections at apical, middle and cervical one thirds were collected based on CBCT images, including 2 values: no and yes.
- Position of the void of the sealing materials at coronal one-third, middle one-third, apical one-third, including 5 values: no, lingual, labial, mesial, distal.
- Sealing length: qualitative variable, collected based on Cone beam CT film imagery, has 3 values:

+ Adequate obturation: filling materials being 0-1mm away from radiographic apex.

+ Short obturation: filling materials being 2mm away from radiographic apex.

+ Over obturation: filling materials goes beyond anatomical apex.

- Complications after root canal treatments: data collected based on CBCT images, with 5 values: No complication, Missed canals, apical transportations, root fractures, blocked canals (due to debris, fractured instruments).

Evaluation of treatment outcomes after 1 week:

- Clinical evaluation after 1 week of treatment: evaluation based on measures proposed by Ha Hoang Manh [3], including 3 levels: Good, acceptable, poor.

Evaluation of treatment outcomes after 3 months, 6 months:

- Evaluation of treatment outcome after 3 months, 6 months: Evaluation based on the measures proposed by Ha Hoang Manh [3], including 3 levels: Success, uncertainty, failure. The patient will have root canal treatments of maxillary central incisor with a Protaper rotary instrument system. After treatment, the patient will have 1 CBCT image for evaluation and be re-evaluated after 1 week, 3 months and 6 months. The same treatment procedure for all cases includes:

Step 1: *Anesthesisa*

- This step is for irreversible pulpitis, with other diseases dentists do not need to take this step.
- Local anesthesia: use a dental syringe with short needle, insert the needle into the oral vestibule related to treated tooth, the axis of the syringe is parallel to the tooth axis, the needle creates an angle of 45 degree to the gingival, slowly inject 1ml of anesthetic (lidocaine HCl 2% and Epinephrine 1/100000).

Step 2: Open the pulp chamber to remove all the pulp tissue and smooth the chamber's walls with Endo Z bur. For pulp necrosis, open the pulp chamber, rinse with antiseptic solutions, Remove all necrotic pulp tissues.

Find the root canal orifices with a probe or initial file

- Identify the root canals and remove remaining pulp tissues with a barbed broach.
- Irrigating with 2.5% NaOCl

Step 3: Shaping root canal system with the Protaper rotary instrument system (Protaper Universal of Dentsply) with Crown-down technique:

- For irreversible pulpitis teeth, we perform obturation on the first appointment.
- For teeth with necrotic pulp tissue, we dress the root canal with calcium hydroxide paste during appointment intervals, each appointment is 1 week apart from others.
- For symptomatic apical periodontitis, acute apical abscess, per-acute abscess, after opening and rinsing pulp chamber with sterile water to relieve pain for 1-2 days, we then dress the root canals with calcium hydroxide paste during appointment intervals, each appointment is 1 week apart from others.

Step 4: *Obturation method*

When the treated teeth meet the standards for canal sealing, we will carry out the obturation procedure. Standards for root canal obturation: [4]

- Teeth are asymptomatic, painless when touched or examined around the apical area, and in stable condition.
- The canals are dry, clean, with no discharge of fluid.
- No appearances of sinus tract, or if there is, the tract has healed.
- No smell.
- Temporary filling is intact.

Using lateral condensation technique with gutta percha cone and cortisomol (Pierre Rolland, France) sealer to seal the root canal system.

- Permanent filling with composite and combine with GIC as liner.

Upon completion of obturation procedure, the patients will undergo a CBCT scan:

- The maxillary central incisors that have been treated will be evaluated for the outcome of the root canal treatment.
- Normal incisors will be analyzed for root canal system.
- The patient will then be scheduled for follow-up visits after 1 week, 3 months and 6 months to evaluate the clinical and radiological results of the treatment.

2.3. Statitis analysis

All collected data are analyzed using Statistical Package for Social Sciences (SPSS software, IBM 2020; SPSS Institute Inc., Cary, NC, USA)

III. RESULTS

3.1. Root canal preparation complications

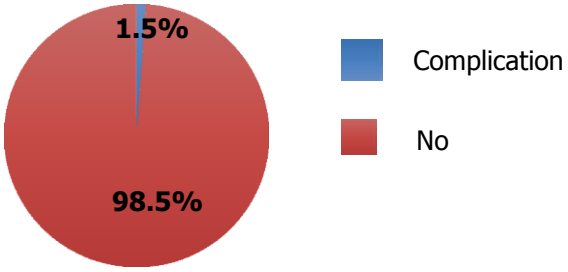

Chart 3.1. Percentage (%) of complication when shaping

During the preparation of the root canals, only 1 tooth had complication, accounting for 1.5%. The complication encountered during preparation was a instrument separation.

3.2. Evaluation of obturation result using cone beam CT

3.2.1.Void characteristics of sealer at coronal one-third

Table 3.1. Void characteristics of sealer at coronal one-third

			Void at coronal one-third				Total
			None	Labial	Lingual	Mesial	
Teeth	Maxillary central incisor	Amount	22	6	3	1	32
		Percentage	68.8%	18.8%	9.3%	3.1%	100.0%
	Maxillary lateral incisor	Amount	23	7	3	0	33
		Percentage	69.7%	21.3%	9.0%	0.0%	100.0%
Total		Amount	45	13	6	1	65
		Percentage	69.2%	20%	9.3%	1.5%	100.0%

Using CBCT to examine coronal one-third of the root canal after sealing, it was found that there were 45 teeth without void, accounting for 69.2%, 13 teeth had void in the labial area of the root canal, accounted for 20.0%; 6 teeth with void in the lingual area, accounted for 9.3% and 1 tooth with void in the mesial area, accounted for 1.5%.

3.2.2.Void characteristics of sealer at middle one-third

Table 3.2. Void characteristics of sealer at middle one-third

			Void at middle one-third				Total
			None	Labial	Lingual	Mesial	
Teeth	Maxillary central incisor	Amount	27	4	1	0	32
		Percentage	84.4%	12.5%	3.1%	0%	100.0%
	Maxillary lateral incisor	Amount	29	3	1	0	33
		Percentage	87.9%	9.1%	3.0%	0%	100.0%
Total		Amount	56	7	2	0	65
		Percentage	86.2%	10.8%	3.0%	0%	100.0%

Using CBCT to examine middle one-third of the root canal after filling, it was found that there were 56 teeth without void accounting for 86.2%, 7 teeth with void in labial area of canal, accounted for 10.8%; 2 teeth have void in the lingual area, accounted for 3.0%.

3.2.3. Void characteristics of sealer at apical one-third

Table 3.3. Void characteristics of sealer at apical one-third

			Void at apical one-third			Total
			None	Labial	Lingual	
Teeth	Maxillary central incisor	Amount	30	1	1	32
		Percentage	93.8%	3.1%	3.1%	100.0%
	Maxillary lateral incisor	Amount	32	1	0	33
		Percentage	97.0%	3.0%	0.0%	100.0%
Total		Amount	62	2	1	65
		Percentage	95.3%	3.1%	1.6%	100.0%

Using CBCT to examine apical one-third of the root canal after sealing, it was found that there were 62 teeth without void accounting for 95.3%, 2 teeth with void in the labial area accounted for 3.1%; 1 tooth with void in the lingual area accounted for 1.6%.

3.2.4. Obturation length

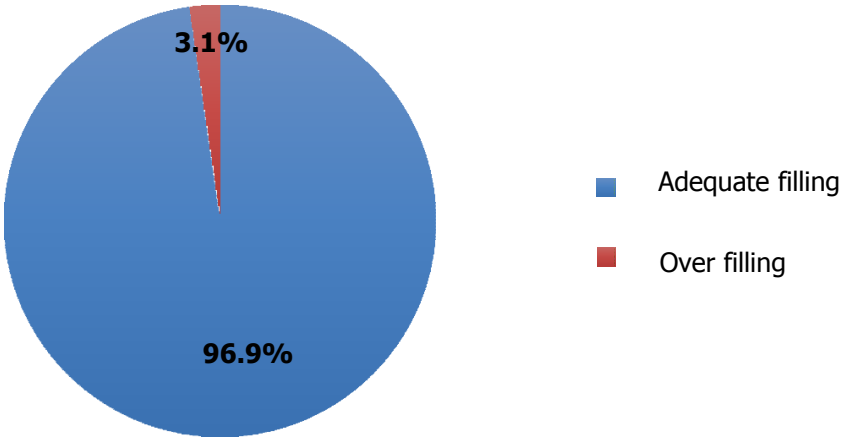

Figure 3.2. Percentage (%) of adequate obturation

Using CBCT to examine the root canal after sealing, it was found that there were 63 cases of adequate filling with accurate working length, accounting for 96.9% and 2 cases of overfilling accounting for 3.1%

3.3. Evaluation of results after 1 week, 3 months and 6 months

3.3.1. Evaluation of results after 1 week

Table 3.4. Evaluation of results after 1 week

	Amounts	**Percentage**
Good	54	83.1%
Average	10	15.4%
Poor	1	1.5%
Total	**89**	**100.0%**

Evaluating the results of root canal treatment after 1 week, we found that there were 54 good cases, accounting for 83.1%; 10 cases The average accounted for 15.4%; 1 poor case accounted for 1.5%.

3.3.2. Evaluation of results after 3 months

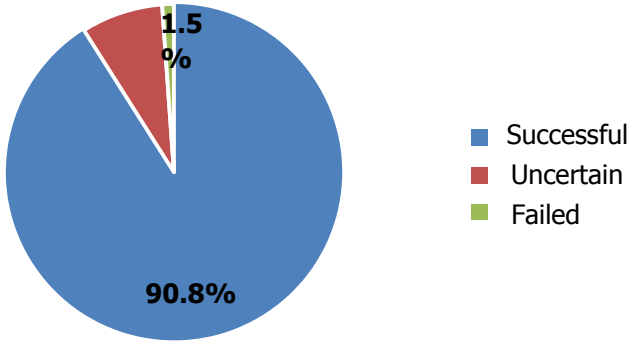

Chart 3.2. Evaluation of result after 3 months

Evaluating the outcomes of root canal treatment after 3 months, we found that there were 59 successful cases, accounting for 90.8%; 5 uncertain cases accounted for 7.7%; 1 failed case accounted for 1.5%.

3.3.3. Evaluation of results after 6 months

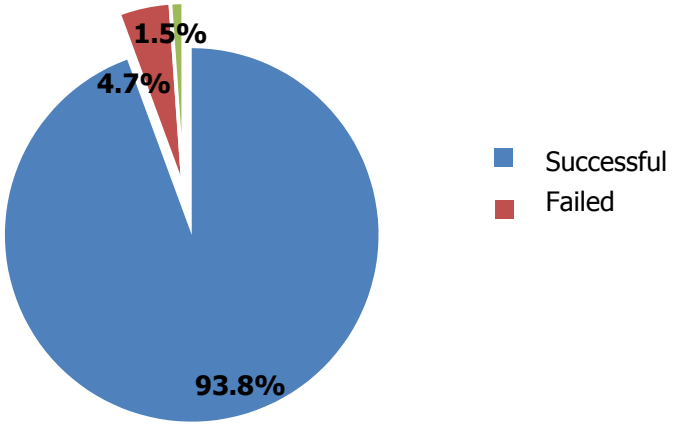

Chart 3.3. Evaluation of result after 6 months

Evaluating the results of root canal treatment after 6 months, we found that there were 61 successful cases, accounting for 93.8%; 3 uncertain cases accounted for 4.7%; 1 failed case accounted for 1.5%.

IV. DISCUSSION

4.1. Root canal preparation complicaions

During the preparation of the root canal, only 1 tooth had complication, accounting for 1.5%. The complication encountered during preparation was a separation of instrument. In this case, we handled the incident by using a smaller instrument that can pass through the broken piece, then take X-rayed radiograph and continued on preparing the root canal and filled it normally. The broken instrument in this case was a F2 Protaper file. However, according to a research conducted by Ha Trinh Thi Thai (2013)[4] on the causes of treatment failure, instrument fracture accounts for a very low rate of only 2%. This suggests that a broken piece of endodontic file seldom leads to the failure of this treatment.

In endodontic treatment we can make some mistakes such as pulp chamber floor perforation or root perforation of the tooth when searching for the root canal orifice, ledge formation or apical transportation, fractured instruments. All these complications are the causes of failure during endodontic treatment. To avoid these accidents, dentists do not only need to respect the principles as well as perform correct techniques throughout the working process but also having specialized instruments with features suitable for the indications. Before usage, instruments must be carefully inspected, when preparing the root canal, dentists should always cleaning root canals with chelating agents or irrigating solutions, The root canal access must be straight as well as they must be flared appropriately. When using the instrument, dentists must be very gentle. Ha Hoang Manh 's study reported a 2.0% incidence of

complication in root canal treatments. The incident is a case of instrument fracture in the root canal. However, the fractured instrument is a K file, not a Protaper hand-use file. According to Alemam AAH[1], ledges is formed in 30% of the root canals prepared by ProTaper Universal, while there were no ledge was formed with Protaper Next ($P < 0.001$). Middle contraction, a form of root aberration, is produced by both systems although it occurs significantly ($P = 0.006$) more often with ProTaper Next. According to Plotino Gianluca [8] the temperature inside the root canal affects the cyclic fatigue resistance of instruments manufactured in traditional nickel-titanium, while it does not affect the cyclic fatigue resisistance of those manufactured in gold heat treated gold. Heat treated gold enhances the cyclic fatigue resistance of ProTaper instruments.

4.2. Evaluation of the results of myelosuppression with Cone beam CT

Using CBCT to examine coronal one-third of the root canal after filling, it was found that there were 45 teeth without void accounting for 69.2%, 13 teeth with void in the labial area of the root canal accounting for 20.0%; 6 teeth with void in the lingual area accounting for 9.3% and 1 tooth with void in the mesial area accounting for 1.5%.

Using CBCT to examine middle one-third of the root canal after filling, it was found that there were 56 teeth without voids accounting for 86.2%, 7 teeth with voids in the labial area of the pulp canal accounted for 10.8%; 2 teeth have voids in the lingual area accounting for 3.0%.

Using CBCT to examine apical one-third of the root canal after filling, it was found that there were 62 teeth without void accounting for 95.3%, 2 teeth with void in the labial area of the medullary canal accounting for 3.1%; 1 tooth with a void in the lingual area accounting for 1.6%.

Our research results are similar to those of Lan Ngo Thi Huong (2017) [6], Ha Trinh Thi Thai (2013)[4] which concluded that the position where the most void appear was coronal one-third, followed by middle one-third and the densest was apical one-third.

Using CBCT to examine the root canal after sealing, it was found that there were 63 cases of good cuffs of sufficient length, accounting for 96.9% and 2 cases of bad seals accounting for 3.1%.

According to Patel S [7], additional information provided by CBCT can increase and/or improve diagnostic accuracy and confidence in decision-making as well as have an impact on treatment planning. More clinical studies are needed to assess the long-term impact of CBCT on endodontic treatment outcomes. However, CBCT scanning comes at the cost of increasing the radiation dose; therefore, CBCT should only be resorted for cases where three-dimensional assessment will yield valuable information. It is essential that the patient's radiation exposure is kept to the lowest level reasonably practicable. The benefits of investigating CBCT must outweigh any potential risks. Therefore, each scan must be optimized to reduce patient exposure by adjusting CBCT settings, allowing each examination to be personalized to each patient and diagnostic needs, rather than just using the manufacturer's default settings.

4.3. Evaluation of results after 1 week, 3 months and 6 months

Evaluating the results of root canal treatment after 1 week, we found that there were 54 successful cases, accounting for 83.1%; 10 uncertain cases, accounting for 15.4%; 1 failed case, accounting for 1.5%.

Evaluating the results of root canal treatment after 3 months, we found that there were 59 successful cases, accounting for 90.8%; 5 uncertain cases, accounting for 7.7%; 1 failed case, accounting for 1.5%.

Evaluating the results of root canal treatment after 6 months, we found that there were 61 successful cases, accounting for 93.8%; 3 uncertain cases, accounting for 4.7%; 1 failed case, accounting for 1.5%.

The results of our study are similar to Ha Hoang Manh (2013) [3]. According to Daline IH progression of persistent pain following endodontic treatment occurs in 19% of patients. The majority (56%) of patients improved without further intervention [2]. Both the group that improved and the group that continued to have pain had a mix of dental and non-dental causes. According to Karataş Ertuğrul [5] under the study conditions and within the limits of the study it can be concluded that the ProTaper Universal, ProTaper Next, WaveOne and TF Adaptive instruments can lead to dentin cracking so that the incidence of post-treatment accidents may be high.

V. CONCLUSION

- The protaper rotary instrument system had the most void at coronal one third, followed by middle one third and finally apical one third.

- In evaluation of endodontic treatment outcomes after 1 week, good obturation rate accounted for 83.1%.

- In evaluation of endodontic treatment results after 3 months, successfull obturation accounted for 90.8%.

- In evaluation of endodontic treatment results after 6 months, successful obturation accounted for 93.8%.

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