

Generation and Evaluation for the Effectiveness of ACCU DIRECT SCALE Developed for Access Cavity Preparation using CBCT Analysis for Guided Endodontic Procedure in Calcified Canals and in Comparison with Conventional Method.

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Abstract:

BACKGROUND: The Guided Endodontics is a novel virtual planning advancement towards localizing and negotiating obliterated root canals. This guided endodontic access technique for obliterated canals help to maintain the anatomy and subsequently enhancing the success of tooth and this procedure helps in to avoid iatrogenic damage such as deviations, perforations,fracture of root can be a risk,separation of instruments during chemo-mechanical debridement.

OBJECTIVES:

PHASE 1(In Vitro)

- 1) To evaluate Access cavity preparation in vitro using conventional method.
- 2) To evaluate Access cavity preparation in vitro using template and CBCT (Guided Endodontics).
- 3) To compare conventional versus Guided Endodontics and to generate the scale.

PHASE 2 (INVIVO)

To evaluate the accuracy of access cavity preparation of conventional and guided endodontics with the help of ACCU DIRECT SCALE.

Methodology:

The study will be conducted in two Phases.

PHASE 1 – INVITRO

- Onextracted teeth (No. Of sample) – 22
- Group A- Conventional Endodontics with RVG (conventional access cavity preparation using round bur No. 2 in calcified anterior teeth and deviation will be recorded postoperatively by RVG).
- Group B- Guided Endodontics with CBCT

PHASE 2 – INVIVO (Evaluating effectiveness of scale)

- Group A- Conventional Endodontics =11, guided endodontics in vitro = 11
- Group B- Guided Endodontics in vivo = 11

Expected Results: The standardization of the depth and the direction of penetration of the bur, play a significant role in minimizing the errors during access cavity preparation in severely calcified teeth. This study will help in minimizing the errors by generating ACCU DIRECT SCALE.

Conclusion: The Accu direct scale can be used in day to day practice with precision, predictability of an endodontist leading to success for root canal therapy

Keywords- Guided endodontics, calcified canals, CBCT

INTRODUCTION

The other name for Calcific Metamorphosis is Dystrophic Calcification, and Diffuse Calcification. Definite mechanism for calcification is unidentified but investigated it involves deposition of mineralized tissue due to breakdown of pyrophosphatase enzyme, decrease in capillary permeability and neurovascular supply.¹Nearly 3.8% to 24% of traumatized teeth progress to varying levels of dystrophic calcification as a result of trauma.²

Etiology for pulp canal obliteration/Calcification –

- 1) It is a sequelae after traumatic injuries most often with concussion and subluxation types and affecting maxillary anterior commonly, in numerous cases obliteration was advanced enough at 9 to 12 months subsequent the trauma and results in total pulp canal obliteration in 1 to 2 years.³
- 2) There is a growing number of elderly patients who require endodontic therapy. These patients may have teeth with partial or total obliteration of the pulp chambers & obstructed root canals caused by dentin deposition throughout their lifetime.
- 3) Tertiary dentin formation or external injuries such as-Attrition, Abfraction,Abrasion, Caries, occlusal derangement and Prior operative therapy like pulpotomy and step wise excavation of pulp cause partially or completely obliterated root canals.
- 4) Root canal obliteration can occur when excessive orthodontic forces are used, causing damage to the neurovascular pulpal blood supply.

Complications / problems associated with calcified teeth

- 1) Difficult to locate root canal orifice because dentin of the calcified tooth is typically greyish in hue compare to adjoining teeth, with semi transparency results in iatrogenic mishaps such as perforation.
- 2) Difficulty in negotiating full working length leads to incomplete chemo-mechanical debridement and sometimes can cause separation of instruments.
- 3) Massive loss of tooth structure in cervical area in order to locate the canal and subsequently that is related with fracture of root and results in high technical failure rate.

Preparing endodontic access cavity in a calcified root canal is a difficult task. Conventional RCT is associated with high risk of technical failures like over preparation of the thin roots, alterations of root canal geometry, substantial loss of dental hard tissue, which may weaken a tooth considerably or result in high risk of perforation, surgical intervention or extraction and replantation are alternative approaches for teeth with calcified root canal systems.

In non-surgical root canal treatment, with the advent of “Minimally invasive endodontics” access cavity should be kept as conventional as possible. Access cavity preparation that involves both mesial and distal marginal ridges can decrease cuspal stiffness by up to 63%.⁴

On the contrary of conservative access cavity preparation “ultraconservative ninja endodontic cavity” have been promoted. Nevertheless, therefore to locate the calcified canal, increasing amount of tooth tissue need to be removed, compromising structural integrity and risking perforation. The American Association of Endodontists Case evaluation standards put these cases into the highest difficulty league because of the fact that a predictable outcome of the treatment may be challenging the qualified practitioner so.⁵

A case report by T. Connert demonstrates that minimally invasive and apically extended access cavities are feasible in mandibular incisors with this technique.⁶ The ‘Micro guided Endodontics’ technique is a safe and minimally invasive method for root canal location and prevention of technical failures in anterior teeth with pulp canal calcification.

C byunet al did a case of guided endodontics and concluded that the method is highly reliable and allow root canal disinfection efficiently, without removing excess of tooth structure in the incisal area.⁷

- Therefore, to get the best possible results for these teeth, technical complications must be avoided and the results will be similar to any other anterior tooth with necrotic pulp. This study showed a new procedure to negotiate and treat partial obliteration of the canal in the teeth using guided preparation of the access cavity.

AIM

- 1) To generate ACCU DIRECT SCALE.
- 2) To evaluate the effectiveness of ACCU DIRECT SCALE for precise access cavity preparation in calcified teeth using CBCT under guided endodontic procedure.
- 3) To evaluate the effectiveness of ACCU DIRECT SCALE for precise access cavity preparation in calcified teeth using CBCT under guided endodontic procedure in comparison with conventional method.

OBJECTIVES OF THE STUDY

PHASE 1 (In Vitro for Generation of ACCU DIRECT SCALE)

- To evaluate access cavity preparation in vitro using conventional method.
- To evaluate access cavity preparation in vitro using template and CBCT (Guided Endodontics).
- To compare conventional versus Guided Endodontics and to generate the scale.

PHASE 2 (In VIVO for Evaluating the effectiveness of scale)

- To evaluate the accuracy using the ACCU DIRECT SCALE in locating root canal orifice.

HYPOTHESES

The ACCU DIRECT SCALE is effective therefore it is useful in the precise access cavity preparation in the calcified teeth as compared to the conventional method.

METHODOLOGY

PHASE 1 – INVITRO (For generation of scale)

- On extracted teeth (No. of sample) – 22
- Inclusion criteria
- Severely attrited maxillary and mandibular calcified incisor teeth
- Exclusion criteria
- Teeth with Hypo plastic defects & fractured teeth will be excluded from the study
- Group A- Conventional Endodontics with RVG (conventional access cavity preparation using round bur No. 2 in calcified anterior teeth and deviation will be recorded postoperatively by RVG).
- Group B- Guided Endodontics with CBCT

PHASE 2 – INVIVO (Evaluating effectiveness of scale)

- **Participants & recruitment**
- The subjects will be recruited from the outpatient Endodontics dentistry department, SPDC, wardha, based on the following criteria:
- **Inclusion criteria**
- Age: above 45years
- Gender: all included
- Habits: betel nut chewing
- Subjects providing consent for the study will only be recruited
- Severely attrited maxillary and mandibular incisors teeth

Radiographic Classification(Abbott PV et al 2007)

- 1) Partial pulp canal calcification (coronal part of the tooth is only obliterated)
- 2) Complete pulp canal calcification (Total root canal space is obliterated i.e. coronal and radicular both)

Exclusion criteria

Teeth with Hypo plastic defects & fractured teeth will be excluded from the study

Sample size–

by using purposive sampling will select all the patients which will come for treatment at our department during the study period.

Group A- Conventional Endodontics =11, guided endodontics in vitro = 11

Group B- Guided Endodontics in vivo = 11

Methodology: for guided endodontics using CBCT

- Age group – above 45 years
- Patients will be informed regarding the purpose of the study and patients volunteering to participate will be recruited for the study.

- The obliteration of pulp canal space will be checked using RVG. Will select Patients who don't respond to thermal (Pulper G; C Corporation, Tokyo, Japan) and electrical sensitivity tests. Before treatment cone-beam computed tomography (CBCT) scan will be taken and stored in DICOM format.
- A Dental 3D Scanner will be obtained to get a stereo lithography file of the teeth and software will be used to design the splints and a printer will be used to fabricate the guides. Both types of data will be uploaded to software. Simulated images of the bur and the sleeve for access cavity preparation will be developed and implemented in the software. Access to the root canal will be calculated by the position of the simulated bur.
- The guides will be made using resin. The position will be assessed 3 dimensionally and simulated sleeve will be placed for the guidance of the bur. The STL data will be uploaded and the template will be designed, fabricated with a 3D printer. Consequently, a guide rail including the metal sleeves will be incorporated into the template.
- The template will be set over the sleeves to signify the exact coronal position to gain access to the root canal. After preparing access cavity, a postop CBCT image with the same variables will be carried out to verify the deviation. Depending on the stored data, the length of bur penetration & the deviation (mesio-distal/ Apical-coronal) difference measured between the planned and prepared access will be correlated using the ACCU DIRECT SCALE accordingly for future references.

STATISTICAL ANALYSIS

All the Data thus obtained will be tabulated and subjected to statistical interpretation. Descriptive and analytical statistics will be performed. The normality of data will be carried out using Shapiro-Wilk test. Independent sample t-test will be applied if data followed parametric tests and if does not non-parametric test which is a Mann-Whitney U test will be applicable.

Data calculated using: SPSS Version 20.1 (IBM Corporation, Chicago, USA) software.

EXPECTED RESULTS

- Newly generated ACCU DIRECT SCALE may prove useful for correct determination of extent of calcification of tooth before access cavity preparation.
- Thus the co-relation of the deviation as per radiograph (CBCT) and the level of depth of penetration may be useful in marking the bur so as to avoid the endodontic errors.

Expected outcome :

Designing of ACCU DIRECT SCALE

DISCUSSION:

Conventional methods and their limitations

Drawback of using long neck burs and drills to locate root canal orifice is that they cause defects in dentin in particular like micro craze lines and dentinal cracks, can propagate and cause vertical root fracture, which commonly result in tooth loss.⁸

Studies Partly to overcome the limitations of conventional method

- 1) Modified access cavity preparations by Lovdahl & Gutmann, they suggested to change the angle of bur in bucco-palatal direction in order to make the bur following the axis of the

tooth. In the majority of cases, bur is oriented labially not followed the long axis, causing labial perforation i.e. the most common mistake.⁹

2) use of operating microscope by da Cunha et al (Even when using magnification concept of blind drilling is a reality, it is related with a significant risk of mishaps, especially over preparation of the thin roots like mandibular incisors).¹⁰

3) use of ultrasonic tips simultaneously with regular radiographs between preparing the access to locate obliterated root canal orifice.

Why guided endodontics- maybe able to overcome

The minimally guided virtually planned access cavity in teeth with calcified canals could help to conserve tooth structure and avoid mishaps and improve long-term success rate. Despite the fact guided access is virtually planned, regular examination and radiographs are a compulsory add on procedure to check the path of drill.¹¹

So the determination of correlation of calcification and depth of penetration of bur has not been mentioned in the literature till date and to overcome the shortcoming of conventional method and to standardize the deviation penetration of bur to avoid the endodontic mishaps, this study will be carried out. This will help in generation and evaluation of the scale for precise access cavity preparation using CBCT analysis. This way one will be able to achieve the guided endodontic procedure in calcified teeth. Furthermore, using a printed guide designed by CBCT is a more precise technique for access cavity preparation compared with a “freehand” CBCT- approximated technique.¹²

The routine root canal access in calcified teeth can cause iatrogenic damage to the anatomical structure, consequently resulting in an additional treatment time. The time required to plan, design, and manufacture the guide was long enough. On the other hand, lowering the chair side treatment time.¹³ The probability of iatrogenic mishap to the sound tooth structure was also reduced. M. S. Zehnder et al found that ‘Guided Endodontics’ enabled a accurate preparation till the end of the root using guided templates.¹⁴

Kiefner et al stated that endodontic therapy in calcified teeth if done by an endodontist under dental operating microscope is a feasible option but didn’t mentioned the amount of tooth substance loss during conventional access cavity preparation. This needs more investigations for the treatment approaches for both guided endodontics as well as for convention endodontic therapy.¹⁵

Gabriel Krastlet al is the first person to introduce guided technique in endodontics and he concluded that guided endodontic procedures are apparently safe, clinically achievable method to identify root canal orifices and more importantly minimise the risk of root perforation in calcified metamorphosed teeth.¹⁶ Afzal Ali and Hakanarslan found Stereo lithographed guided splints permit to prepare a minimal invasive access cavity in teeth affected by tooth anomalies such as type V dens evaginatus.¹⁷ Authors found guided endodontic technique is a quick, safe, and predictable procedure and can be considered a great option for the location of calcified root canals, avoiding failures in complex cases.^{18,19} Even guided designed surgical template using CAD-CAM is helpful in micro endodontic apicoectomy for challenging cases.²⁰ Few of the related studies on endodontic treatment procedures were reviewed²¹⁻²⁵.

CONCLUSION:

- 1) A new minimally invasive approach for root canal location that leads to precise cavity preparation using ACCU DIRECT SCALE.
- 2) This procedure can be used in day to day practice with precision, predictability of an endodontist leading to success for root canal therapy.

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