

Peyton's Approach in Teaching Access Cavity Creation and Root Canal Location: A Report from one Institution

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ABSTRACT

Objective: Access cavity preparation and location of the root canals are important stages in root canal therapy. The traditional see one-do one method of clinical instruction has been used in teaching these skills. However, newer methods of instruction in surgical skill acquisition have been advocated. The Peyton's four steps of instruction approach promotes active participation in the learning process by the learner. It represents a low-technology alternative to the traditional see one-do one approach for teaching surgical skills in a developing country like Nigeria. The study sought to compare access cavity preparation and root canal location among a group of junior residents using the traditional see-one-do-one approach; and the Peyton's four steps of instruction approach.

Methods: Ten consenting participants were randomly selected and divided into two groups A and B representing the see one-do one and Peyton's approach groups. The participants crossed over after a 6-week washout period. The participants created access cavities and located root canals in plaster mounted lower first molars. The time taken for the task and the angle of flare of the mesio-axial wall from the long axis of the mesio-buccal canal were recorded.

Results: The mean time for the traditional method was 547seconds \pm 204, while that for the Peyton's technique was 425 seconds \pm 138. The mean angulation for the traditional technique was $43^\circ \pm 14.9$, while the mean angulation for the Peyton's technique was $30^\circ \pm 13.3$. Paired t-tests showed that the mean angulation recorded with the Peyton's technique was significantly less than that recorded with the traditional technique ($p=0.04$), while the difference in times did not attain significance ($p=0.08$)

Conclusion: The outcomes with the Peyton's approach were significantly better than the outcomes with the traditional methods in this study

Keywords: Peyton's approach, access cavity, root canal location

INTRODUCTION

Root canal therapy is probably the most common endodontic treatment given to patients with pulpal and periapical inflammatory pathologies (Manfredi et al., 2016). This treatment while being responsible for salvaging many severely infected

teeth from extractions, may cause devastating amounts of tooth structure loss if carried out by technically inadequate hands (Ahmed et al., 2000).

Citation: Ikusika OF, Sotunde AO, Alalade O, Igweagu CE (2021). Peyton's approach in teaching access cavity creation and root canal location: A report from one institution. Nig J Med Dent Educ; 3(2):29-34.

This unnecessary loss of tooth structure may so weaken an otherwise salvaged tooth that restorative failure may ultimately lead to the loss of such teeth (Al-Nuami et al., 2017).

Access cavity preparation and location of the root canals to be treated have been described as probably the most important stage in root canal therapy (Adams & Tomson, 2014). The success of the treatment is said to be hinged on the successful completion of this stage of treatment (Patel & Rhodes, 2007). This stage of treatment has been reported to present difficulties with proper de-roofing of the pulp chamber and identification of the root canal orifices (Patel and Rhodes, 2007). This would lead to difficulties when returning to the treatment of teeth within and across appointments. Incidences of missed canals and (or) over preparation in an attempt to rectify this error, may be the cause of catastrophic treatment failure (Tabassum & Khan, 2016). In view of these challenges, there has been an emphasis by dental educators on ensuring a proper grasp of this stage of the treatment by their students.

The traditional method of teaching endodontics has involved the use of the see one, do one method using extracted teeth as an introduction to proper patient treatment (Suebnuakarn et al., 2011). However, the see one do one method of clinical instruction has come under increasing scrutiny (Naseri et al, 2016). There has been a clamor for the use of simulators in the teaching of clinical skills to reduce risks and improve outcomes (Roy, Bakr and George, 2017). The reality for most developing countries is that these simulators may be prohibitive as far as costs are concerned. This situation presents dental educators in such countries with a burden to improve skill acquisition by more cost effective low-technology methods as far as possible.

The acquisition of clinical skills in dental practice requires a cognitive understanding of the environment in which this skill will be employed, and proficiency in the manual dexterity required for the actualization of the desired end points (Schwibbe et al., 2016). The chances of this occurring will be significantly increased if the learner is emotionally invested in the process (Kumar, Rahman and Adds, 2018). The learner of such a skill will need to experience this skill in the three domains of learning for such skills to be clinically useful to them (Mettarg & Key, 2009). One of the techniques of achieving this is to make the learner an active participant during the teaching of such skills.

The teaching of surgical skills has been improved with several techniques (Preece et al., 2015; Rojas

et al., 2016; Campaign et al., 2018). These techniques usually require the use of technological innovations (Rojas et al., 2016; Campaign et al., 2018). However, some of these techniques involve modifications to the traditional see-one-do-one method (Preece et al., 2015). Such modifications are designed to increase the participation of the learner in the learning process. One validated example of such methods is the Peyton's four steps of instruction (Romero et al., 2018).

The Peyton's four step approach was developed by Rodney Peyton and documented in a 1998 textbook (Peyton, 1998; Krautter et al., 2011). The approach can be divided into four steps namely demonstration, deconstruction, comprehension and execution. The teacher **demonstrates** the skill without explanation, then he performs the skill again taking time to break the process into smaller parts with exhaustive explanations to the student, thus **deconstructing** the process into subparts in the mind of the student. The students' **comprehension** of the process is next tested by the student instructing the teacher and guiding the performance of the process. When these three stages have been satisfactorily completed, the student then **executes** the skill that has been taught without input from the teacher (Peyton, 1998; Krautter et al., 2011).

Randomized Controlled Trials provide level II evidence and are increasingly being recognized as a basic minimum to aim for when experiments are designed for testing causes and effects (Ahmad, et al., 2014; Bhide et al., 2018). The constraints of randomization in small groups can be bypassed by structuring trials in a cross over design (Bhide et al., 2018). This is especially true of small study populations like that presented by junior dental residents at an average Nigerian tertiary center. The elimination of confounding variables and the greater statistical efficiency associated with cross over designed trials recommend them to testing the effects of teaching models on such a population (Bhide et al., 2018). The issues of order and carry over effects are usually addressed by providing for a reasonable wash out period (Bhide et al., 2018). The study sought to compare the quality and efficiency of access cavity preparation and root canal location of plaster mounted lower first molars among a group of first year dental residents instructed with the traditional see-one do- one, and the Peyton's Technique. This was assessed by the degree of flare of the mesio-axial wall from a file placed vertically in the mesio-buccal canal, and by the duration of time in seconds till success for each participant's attempt.

MATERIALS AND METHODS

Ethical approval was sought and obtained from the Ethics Review Board of The Aminu Kano Teaching Hospital, Kano (NHREC/28/01/2020/AKTH/EC/2919). Ten consenting first-year junior residents were randomly selected and divided into two groups A and B. The residents consisted of 7 males and 3 females in keeping with the proportionality of available junior residents. Group A participants prepared access cavities on plaster mounted extracted lower first molars following the traditional see one do one method. They then subsequently identified the distal, mesio-lingual and mesio-buccal canals under the supervision of a senior resident. The successful identification of the canals was confirmed by the participants placing files within the canals. Participants in Group B performed the same task, but were instructed with the Peyton's technique by the same senior resident. The participants crossed over after a wash out period of six weeks. The times from when the bur first made contact with the tooth and when the participants successfully completed their tasks was recorded in minutes. The angulation between the mesio-axial wall and a file placed in the mesio-buccal canal was recorded with a protractor and compass by another senior resident.

The data generated was entered into a personal computer and analyzed with IBM SPSS Statistics for Windows version 23. The data was tested for normality with the Shapiro-Wilks normality test. Means, medians and interquartile ranges were determined. The means were compared with the paired t-test. Level of significance was set at $p < 0.05$.

RESULTS

The data generated is displayed in Table 1. The scores recorded for both duration of the task and the angulation between wall and file were normally distributed. The Shapiro-Wilks normality test was used for assessment ($p > 0.05$). Hence parametric analysis was conducted on the data set.

The duration of the task for the traditional method ranged from 300 to 1020 seconds, while that for the Peyton's technique ranged from 240 to 720 seconds. The mean time for the traditional method was 547 seconds \pm 204, while that for the Peyton's technique was 425 seconds \pm 138. While the average duration of achieving the task with Peyton's technique was less than that for the traditional technique, a paired t-test showed that this difference did not attain statistical significance ($p = 0.08$). Table 2 illustrates the relationships

between the duration of task achievement with both techniques. The quality of the results of the performed task was assessed by the angulation between a file in the mesio-buccal canal and the mesio-axial wall. The angulation recorded for both techniques ranged from 10° to 60°. The mean angulation for the traditional technique was 43° \pm 14.9, while the mean angulation for the Peyton's technique was 30° \pm 13.3. A paired t-test showed that the mean angulation recorded with the Peyton's technique was significantly less than that recorded with the traditional technique ($p = 0.04$). Table 3 illustrates the relationship of the angulations obtained with both techniques

DISCUSSION

The role of cognition in surgical skill acquisition has been highlighted by different investigators (Cooper and Tisdell, 2020; Szulewski et al., 2020). It has been said to have a facilitating effect on skill acquisition. The reduction in cognitive load that is a natural consequence of increased concentration on the performance of the skill is said to enhance performance of the skill (Szulewski et al., 2020). The Peyton's technique keys into this, focusing on the learner on the task to be learned. The learner becomes an active participant and not a passive consumer in the demonstration of the skill set being demonstrated.

The comprehension step in the Peyton's approach has been said to be the single most important step in successful execution of skills by the learner (Giacomino et al., 2020). This observation is in keeping with the role of cognition in refining surgical skills (Sewell et al., 2020). The deconstruction step, by breaking the procedure down to simple to understand parts, simplifies the task and aids comprehension. The teacher is then engaged in a conversation and is not giving a sermon. This would generate greater emotional investment in the process from the learner.

Many investigators have postulated that the technique works best when the teacher: student ratio is low (Giacomino et al., 2020). The proficiency of the teacher has also been shown to be a factor in the end points achieved with instructions using this technique (Giacomino et al., 2020). We have been guided by this in selecting a senior registrar as the instructor. The participants were less likely to be apprehensive during the sessions, as they would have been in front of their supervising consultant. The senior resident however was first calibrated by the consultant and certified fit to carry out the instructions.

Table 1: Data generated from the study

S/N	Duration of treatment (seconds)	Angle of inclination of mesio-axial wall from mesio-buccal canal
1	Traditional: 720 Peyton's: 480	Traditional: 60° Peyton's: 30°
2	Traditional: 480 Peyton's: 300	Traditional: 50° Peyton's: 30°
3	Traditional: 300 Peyton's: 240	Traditional: 60° Peyton's: 20°
4	Traditional: 1020 Peyton's: 480	Traditional: 40° Peyton's: 30°
5	Traditional: 720 Peyton's: 480	Traditional: 10° Peyton's: 10°
6	Traditional: 540 Peyton's: 420	Traditional: 40° Peyton's: 20°
7	Traditional: 660 Peyton's: 420	Traditional: 50° Peyton's: 30°
8	Traditional: 420 Peyton's: 300	Traditional: 50° Peyton's: 40°
9	Traditional: 480 Peyton's: 600	Traditional: 30° Peyton's: 30°
10	Traditional: 480 Peyton's: 720	Traditional: 40° Peyton's: 60°

Table 2. Comparison of treatment duration between the traditional see-one-do-one technique and the Peyton's four step approach

	Duration of treatment (seconds)				
	Min	Max	Mean	SD	Median (IQR)
Traditional	300	1020	582	204	510 (468 to 720)
Peyton	240	720	450	138	450 (348 to 510)

Min: Minimum, Max: Maximum, SD: Standard deviation, IQR: Interquartile range

Mean difference (\pm SD) = 132 (\pm 204) seconds, 95% CI of mean difference = -0.36 to 4.8, $t(9) = 1.94$, $P = 0.08$

Table 3. Comparing the degree of flare of mesio-axial wall from file placed in mesio-buccal canal preparation between the traditional see-one-do-one technique and the Peyton's four step approach

	Angle of inclination (degree)					
	Min	Max	Mean	SD	Median	(IQR)
Traditional	10	60	43	14.9	45	(37.5 to 52.5)
Peyton	10	60	30	13.3	30	(20 to 32.5)

Min: Minimum, Max: Maximum, SD: Standard deviation, IQR: Interquartile range

Mean difference (\pm SD) = 13° (\pm 17.0). 95% CI of mean difference = 0.82 to 25.2. $t(9) = 2.41$, $P = 0.04$

We have used a small sample size for this study due to logistical considerations. The study involved residents who were not necessarily in the conservative dentistry posting at the time of the study. The supervising consultants would not always be inclined to release their residents to participate in a study when they consider the work to be done in their respective units. We were also determined to use only one instructor for all the participants. The low instructor: student ratio

recommended for the success of this technique also guided us in our choice of sample. We used only one instructor to guide against variations in teaching quality.

The results we obtained are in keeping with results obtained by other investigators who have used the Peyton's technique to teach surgical skills (Gradl-Dietsch et al., 2016; Awad and Mohamed, 2019; Giacomino et al., 2020). The increased quality of the preparations as assessed by the degree of flare

of the mesio-axial walls did not prove surprising to us as we were aware of the reported improvements in outcomes with this technique. The normal distribution of the results we obtained was also a pointer to the fact that though our sample was small, it was statistically adequate.

There was no statistical difference in the times taken to perform the task. However, the average time for the task was shorter for the Peyton's technique than for the traditional technique. This may be due to the small size of the sample. However, it must be remembered that endodontic procedures must be meticulously carried out if they are not to be bungled. Excessive reduction in the time taken to carry out such procedures at the expense of quality would represent a grossly undesirable outcome.

CONCLUSION

The application of the Peyton's four steps of instruction model to the training of junior resident doctors in access cavity preparation and root canal location, in this study produced significantly better outcomes than the traditional see one-do one method. The Peyton's four steps of instruction model should be considered as an option for teaching this all-important skill. The Nigerian endodontic community should consider a large multi-center study to test the results of this pilot study.

Financial support and sponsorship

This work received no specific grant from any funding agency in the public, commercial or not-for-profit sectors

Conflicts of interest

The authors declare that they have no conflicts of interest.

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