

Clinical Efficiency (Reliability) of Using a Barbed Broach for the Purpose of Pulp Extirpation among Undergraduate Dental Students

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ABSTRACT

Introduction: A barbed broach is considered to be a primitive hand instrument (root canal) and considered by many as outdated, especially in the modern world of rotary instruments. However, its efficiency in terms of pulp removal is unmatched and therefore is considered necessary to teach its use at the level of undergraduate dental curriculum. This study aims to evaluate the clinical reliability and efficiency of barbed broach as pulp removal instrument, and indirectly determine the need of modifying undergraduate students' curriculum. **Materials and methods:** Patients suffering from pain due to pulpal/periapical involvement, which was referred from diagnostic department to ongoing fifth year clinical courses and recommended for root canal treatment were included in the study. Reliability was measured by determining the procedure each student used to remove the pulp (barbed broach versus other instruments), while efficiency was determined by determining the pain score (visual analog scale with a score of 1 to 10) for three consecutive days after pulp extirpation. A questionnaire was distributed among all students who had to enter all details of the treatment in the questionnaire. **Results:** The average preoperative pain score for females (n=35) was 9.09 ± 1.22 which decreased significantly to 4.49 ± 2.88 after pulpectomy only with bb in the 1st day then to 3.00 ± 2.8 in the 3rd day. After working length determination and initial instrumentation, the mean pain scores decreased to 0.94 ± 1.9 . In the males (n=25), the average preoperative pain score was 6.56 ± 1.4 which decreased significantly to 3.60 ± 2.67 after pulpectomy only with bb in the 1st day then to 2.60 ± 2.06 in the 3rd day. After working length determination and initial instrumentation, the mean pain scores decreased to 1.16 ± 1.67 . Patients whose pulp were removed using files (n=11 students), revealed an increase in pain (n=2), same level (n=5) and little decrease (n=4). No statistical tests were employed since the number of cases in the groups was not equal. **Conclusion:** Within the limitations of this study, it was observed that the method of pulp extirpation done by using a barbed broach was more effective in reducing pulpal pain clinically as compared to other instrument among the studied sample.

Keywords (barbed broach, nerve broach, pulp extirpation, endodontic file)

Introduction

Endodontic clinical teaching is multi-staged, interdependent process that requires sound biomedical and dental knowledge integrated with sufficient preclinical and clinical training [1], [2]. Most undergraduate dental students who usually start endodontic clinical training first time, are apprehensive and fearful, for making errors or bringing any harm to their patients. This demands their close hand supervision of respective clinical supervisors [3]. At the same time, when such students are prone to make mistakes, it becomes important to build up a good communication between the student and patient to avoid patient dissatisfaction or withdrawal [4]. Constant imposition of patient education and motivation along with assurance and an assertion is key to patient management in academic setups [5]. However, in Endodontics, achieving such objectives are challenging because of the presence of pain. Patients with pulpal/ periapical problems expect their pain to subside after the intervention has been done by an endodontist. Control of pain during and after treatment is one of the most important aspects to have patients'

confidence. Postoperative pain of root canal treatment of both vital and non-vital teeth is a one of the most common complications with an incidence in the range of 3%-58% [6].

Postoperative pain of root canal treatments is dependent on multiple factors, namely, presence of inflamed or necrotic pulp tissues (left over), high temporary dressing, over instrumentation, extrusion of debris beyond the apex and or presence of missing extra-canal [7]. It has also been widely reported that postoperative pain is more common in non-vital teeth [8], [9], [10]. Meanwhile, a large number of studies have mentioned that that vital tooth is more liable to cause postoperative pain [11], [12]. However, one of the most significant factors associated with the cause of the postoperative pain, is the presence of preoperative pain at the time of diagnosis and treatment planning [13], [14]. Consequently, removal of inflamed pulpal tissues and any irritant byproducts from the root canal is the main emergency treatment to relieve the preoperative pain and minimize the postoperative pain in vital teeth. Removal of the main bulk of the pulp tissues by pulpotomy and or pulpectomy represents an acceptable emergency procedure to achieve such goals. However, removal of all inflamed and necrotic pulp tissues will be assured only after the working length determination and cleaning and shaping [15], [16].

Partial pulpectomy without working length and initial cleaning and shaping should be avoided. The remaining pulp tissues may cause; sensory nerve sprouting from “random” peripheral axotomy and postoperative pain [17]. Moreover, the remaining pulp tissues may also contain necrotic irritants and also may adversely affect the proper measurement of the apex locators [18]. To free the root canal from so much pain causing adversaries, it is important that an instrument is used that is efficient in the removal of various forms of pulp tissue. In academic set up it is also important to understand that undergraduate students with limited clinical skills have to finish their cases within a time frame, which makes specific instrumentation for pulp removal more significant. Barbed broach (BB) is considered as one of the primitive root canal hand instruments. Since long time it has been used for removal of pulp tissues and other materials such as paper points or cotton pellets from the root canals [19]. In spite of considerable progress in the production of new instruments, no hand instrument is thought to efficiently remove the vital pulp tissues from the root canal as efficiently as a BB. Even though, it has some disadvantages like a liability to fracture, incomplete removal of pulp. All undergraduate students must pursue its use in their clinical practice. It has been stated that students tend to forget the application of clinical findings in their clinical cases [20]. This has significance since improper removal of the pulp can continue painful stimulus in the patient and may divert a clinician from the actual cause of pain.

This In vivo study was therefore aimed to evaluate the reliability of the use of BB among undergraduate students by determining the frequency of its use among independent working students (interns) in an academic institute. The study also aims to determine the efficiency of pulp removal using various instruments selected by independent dental students as determined by monitoring the pain before and after treatment. Incidence of fracture of the BB was also determined to complete evaluation of ability to use of that instrument by undergraduate students.

Methodology

This cross sectional descriptive study was undertaken between the academic year 2019 – 20, in Jazan a dental college of the kingdom of Saudi Arabia, as part of student research program. The study was approved and conducted under the ethical committee of the college and the university, which conducts all research on human and animal subjects in accordance with the ethical principles and standards of the Helsinki declaration. All the participants (patients, students and supervisors) were briefed about the study and a written informed consent was procured from the patients. The inclusion criteria of patients were that, they should be having current pulpal pain

(acute), patients were undergoing their restorative treatment under supervision (prosthodontic or restorative dentist) and finally the pulpal condition was irreversible so that the procedure of pulpectomy was indicated. Teeth with completely necrotic pulp, badly destroyed, having advanced periodontitis, with immature apex and without preoperative pain were all excluded from the study. All patients were assigned to root canal treatment among respective students. The diagnosis was confirmed by the student supervisor using thermal and electric pulp vitality tests.

Standard procedures of root canal treatment were followed with special care to infection control protocol without telling the students to use a particular type of instrument for pulp tissue removal. Standard use of local anesthesia (2% Lidocaine with 1: 100 000 epinephrine), rubber dam isolation, removal of caries /defective restorations, coronal cavity preparations, straight line access, canal irrigation (2.5% sodium hypochlorite), pulp tissue removal with sharp spoon excavators were performed with little of no variation depending upon individual case. After detection of root canal orifices, the removal of radicular pulp was decided by student and done using either BB or by K file (Dentsply Sirona Endodontics). Working length was determined with the aid of apex locators and radiographs. Cleaning and shaping was performed according to respective patients working length using hand K files, at least up to the size no 25-30. Pulp chamber was closed with a sterile dry cotton pellet followed by a temporary dressing (Cavit, Minnesota, USA) that was applied in increments. This was the standard procedure done for all patients to rule out the effect of confounding variables upon the postoperative pain. All patients were followed up by the students and patients' response in terms of postoperative pain was determined on a Visual analog numerical scale with a score from 0 to 10, with zero indicating no pain while the score of 10 indicating severe or exaggerated pain after pulp removal [21]. All students were asked to enter patient relevant data that was actually an extension of the case history questionnaire. Postoperative pain by every student was noted at day of treatment, 24 hours and 48 hours after pulp extirpation. The questionnaire also included information concerning any incidence of fracture of the instrument during manipulation inside the root canals. The questionnaires were collected from the students after completion of endodontic treatment and all data was entered in a microsoft excel sheet. After refining, coding and data correction relevant data was entered in SPSS V25 (IBM, Armonk, NY, USA) for determining absolute and relative frequency (percentage) and respective means for each parameter. Parameters included gender, type of tooth, employed clinical procedure and time period. Independent 't' test was used to determine the statistical significance of the differences in the mean values for pain at different intervals (before treatment, after one day, after 2 days and after 3 days). Differences in the p value were considered to be statistically significant at the value of $p \leq 0.05$.

Results

A total of 71 questionnaires, were found eligible in terms of correct data entered by the students, while the remaining were rejected due to incomplete data. Demographic data in terms of the distribution of cases among the teeth and the age group of the patients are shown in table 1 and 2 respectively. Out of a total number of cases, 84.5% of students had used BB to remove pulp tissue while 15.5% had used the file. Most of the cases, were posterior teeth out of which the molars contributed 46.5%. Female cases (40) represented around 56%, while male cases (31) represented around (43.6%) of all cases. Most of the cases in this study were found to be adults in the age group of 31 to 40 years (35%) while the least percentage was that of the age group of 41 to 50 %. Distribution of the type of involved tooth as per each age distribution is shown in table 2. The results of the pain intensity (as represented in pain scores) of barbed broach group (table

3) revealed that the average preoperative pain score (base line) for females (n=35) was 9.09 ± 1.22 before the start of treatment which decreased to 4.49 ± 2.88 (50.6%) (1st day), 4.06 ± 2.73 (4.73%) (2nd day) and 3.00 ± 2.8 (11.66%) (3rd day).

After working length determination + cleaning and shaping, the mean pain scores again significantly decreased to 0.94 ± 1.9 (22.66%) in the 1st day then 0.40 ± 1.03 (5.94%) in the 2nd day and 0.20 ± 0.76 (2.2%) in the 3rd day. For the gender of males (n=25), the average preoperative pain score was 6.56 ± 1.4 (before treatment) which decreased to 3.60 ± 2.67 (45.12%) (1st day), 3.00 ± 2.25 (9.14%) (2nd day) and 2.60 ± 2.06 (6.09%) (3rd day). After working length determination and cleaning and shaping, the mean pain scores substantially decreased to 1.16 ± 1.67 (23.47%) (1st day), 0.44 ± 0.9 (10.97%) (2nd day) and 0.08 ± 2.77 (5.48%) in the 3rd day. The differences in pain scores between the males and females, were found to be statistically significant for the base line group (pain before treatment) (Table 3, Figure 1), where females showed higher pain intensity before treatment than males ($P < 0.05$). Table 4, presents the total mean pain scores associated with removal of pulp using a barbed broach before and after pulpectomy. Significant statistical differences of p value were observed at the base line pain score before treatment (P1) and after pulpectomy (P2-1) at 1st day, and between that in 3rd day of pulpectomy (P2-3) and that of the 1st day of working length determination + cleaning and shaping (P3-1). No significant differences were found when statistical analysis was performed on the type of tooth (anterior, posterior). In the file group (Table 4), the basal mean pain score was 8.00 ± 1.844 , which decreased into 6.45 ± 1.572 after pulpectomy in the 1st day, and to 6.18 ± 1.537 in the 2nd day then 5.09 ± 1.973 in the 3rd day. The pain scores after working length for that group were not registered in the questionnaires except for one patient which was neglected to avoid misinterpretation. Statistical test employed to evaluate the differences between the mean pain scores of patients treated with use of barbed broach and file shows a significant difference in the pain reduction after pulpectomy in the 1st day ($P \leq 0.001$), in the 2nd day ($P \leq 0.002$) and in the 2nd day ($P \leq 0.004$). No significant difference was found in the pain intensity as expressed in the pain score before treatment between the two groups (Table 5, Figure 2). Concerning the incidence of fracture, no fracture was reported with any of the used instruments along with 71 students, all over the treatment of all patients (71).

Table 1: Distribution of tooth type according to the gender in barbed broach (BB) and file groups

Tooth Type	Anterior			Premolar			Molar			Grand total
Gender	F	M	Total	F	M	Total	F	M	Total	
BB Group	5	8	13	12	8	20	18	9	27	60 (84.5%)
File Group	2	2	4	1	-	1	2	4	6	11 (15.5%)
Grand Total	7 (9.8%)	10 (14%)	17 (24%)	13 (18%)	8 (11.3%)	21 (29.6%)	20 (28%)	13 (18.3%)	33 (46.5%)	71 (100%)

BB – Barbed broach

Table 2: Distribution of teeth within BB and File groups according to the age and gender

Age group (years)		12-20			21-30			31-40			41-50			51-60			Total no of teeth
Tooth type		A	P	M	A	P	M	A	P	M	A	P	M	A	P	M	
BB group	Female	3	-	4	1	2	5	-	7	6	1	2	1	-	1	2	35 (49.3%)

	Male	-	1	3	-	3	2	8	2	1	-	-	3	1	1	-	25 (35.2%)
File group	Female	-	1	1	-	-	-	-	-	-	-	-	-	2	-	1	5 (7%)
	Male	-	-	-	1	-	3	1	-	-	-	-	-	-	-	1	6 (8.4%)
Total		3	2	8	2	5	10	9	9	7	1	2	4	3	2	4	71 (100%)
Total in each age group		13 (18.3%)			17 (23.94%)			25 (35.21%)			7 (9.85%)			9 (12.67%)			
BB, barbed broach; A, anterior teeth; P, premolar teeth; M, Molar																	

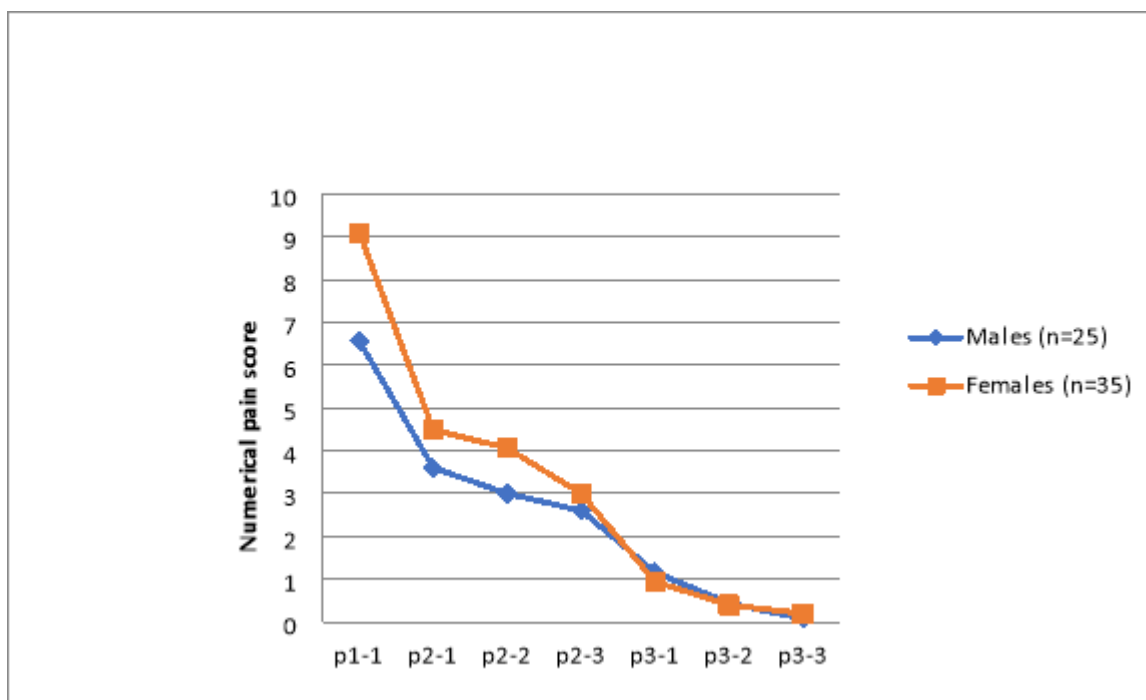


Figure 1: Numerical pain scores of male and female patients of barbed broach group (BB) before and after pulpectomy and after working length determination and cleaning and shaping [P1- pain before pulpectomy, P2-1 (1 day), P2-2 (2 days), P2-3 (3 days), P3-1 (1 day of P2+WL+CL and SH), P3-2 (2days of P2+WL+CL and SH), P3-3 (3 days of P2+WL+CL and S)]

Table 3: Numerical mean pain scores before and after pulpectomy in male and female patients of barbed broach group

Variable	Males (n=25)	Females (n=35)	P value
P1 Pain before treatment (base line)	6.56 ± 1.42	9.09 ± 1.22	0

P2-1 Pain after 1 st day of pulpectomy	3.60 ± 2.67 (45.12%)	4.49 ± 2.88 (50.6%)	0.232
P2-2 Pain after 2 nd day pulpectomy	3.00 ± 2.25 (9.14%)	4.06 ± 2.73 (4.73%)	0.118
P2-3 Pain after 3 rd day of pulpectomy	2.60 ± 2.06 (6.09%)	3.00 ± 2.82 (11.66%)	0.55
P3-1 Pain after P2+WL 1 st day	1.16 ± 1.67 (23.47%)	0.94 ± 1.92 (22.66%)	0.651
P3-2 Pain after P2+WL 2 nd day	0.44 ± 0.9 (10.97%)	0.40 ± 1.03 (5.94%)	0.878
P3-3 Pain after P2+WL 3 rd day	0.08 ± 2.77 (5.48%)	0.20 ± 0.76 (2.20%)	0.454

Table 4: Comparison of mean pain scores and their statistical significance using independence t test between subjects of barbed broach group and those of file group (before and after pulpectomy)

BB Group	P1	8.03 ± 1.8	P=0.000					
	P2-1	4.12 ± 2.81		P=0.000				
	P2-2	3.62 ± 2.58			P=0.001			
	P2-3	2.83 ± 2.53				P=0.000		
	P3-1	1.03 ± 1.81					P=0.002	
	P3-2	0.42 ± 0.98						P=0.015
	P3-3	0.42 ± 0.98						
File group	P1	8.00 ± 1.843	P=0.036					
	P2-1	6.454 ± 1.572		P=0.341				
	P2-2	6.181 ± 1.537			P=0.089			
	P2-3	5.09 ± 1.972				P=0.077		
	P3-1	5.0 ± 1.772					P=0.037	

	P3-2	Not applicable						
BB: Barbed broach								

Table 5: Comparison of mean pain scores of barbed broach and file groups before and after pulpectomy			
Variable	BB group (n=60)	File group (n=11)	P value
P1 (base line mean pain score)	8.08 ± 1.804	8.00 ± 1.844	0.957
P2-1 (mean pain score after 1 st day of pulpectomy)	4.12 ± 2.811	6.45 ± 1.572	0.001
P2-2 (mean pain score after 2 nd day of pulpectomy)	3.62 ± 2.578	6.18 ± 1.537	0.002
P2-3 (mean pain score after 3 rd day of pulpectomy)	2.83 ± 2.526	5.09 ± 1.973	0.004

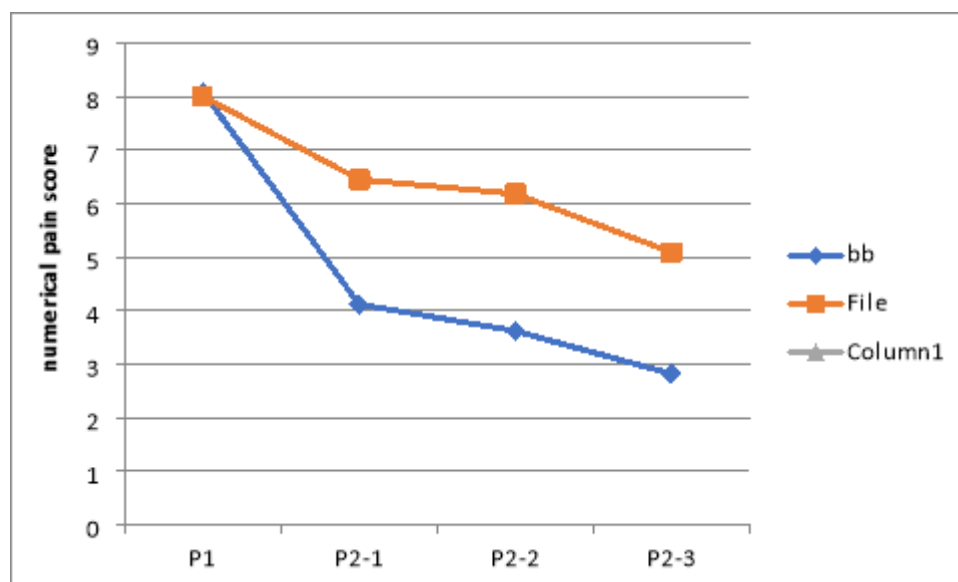


Figure 2: Numerical pain scores of male and female patients of barbed broach group (BB) before and after pulpectomy and after working length determination and cleaning and shaping

Discussions

This study clarified the clinical efficiency of hand instruments for pulp tissues removal by undergraduate students, utilizing the subjective threshold of experiencing pain at various time interval of pulpectomy. The main findings of the study show that majority of the students prefer to use BB for removal of pulp and when using BB to remove pulp, there was less pain experienced than when a file was used. Demographic data shows female patients seeking the treatment more readily than males which have been attributed to their natural ability of complaining and seeking remedy, whenever severe pain exists [22]. The baseline pain intensity in this study was found to be much higher in females than males, which was in agreement with

results obtained by Minhinick [15] and Dao and LeResche [23]. For the incidence of pain and intensity after pulpectomy and after working length and cleaning and shaping, no significant difference was found between males and females and that is in accordance with results reported by Marshal and Liesinger [24], and Sequra et al [25]. We did not find any significant differences between the pain intensity and age which has also been reported by the same researchers [24], [25]. Postoperative pain after pulpectomy is affected by various factors which including temporary fillings (high), presence of infected pulp tissue in the canal, extruding canal contents through the apex, over instrumentation of the apex and perforation of the canal wall [8]. In a systemic review of postoperative pain of vital teeth, differences in the pulp conditions and difference in the used technique and procedure have been stated as significant contributing factors in the incidence of postoperative pain [10]. Gotler et al [12] reported higher incidence of postoperative pain when the tooth is vital. They also indicated that presence of preoperative pain is the most significant factor in prevalence of postoperative pain after pulpectomy in vital teeth with symptomatic irreversible pulpitis.

In this study, all patients who were selected were having preoperative pain before endodontic treatment so that monitoring of the change in pain intensity after pulpectomy would be an acceptable measure for the clinical efficiency of the procedure. Visual analogue scale (VAS) was used for assessment of pain before and after treatment [26] as it was valid and reliable method widely used in the endodontic literature [27], [28]. The results of the present study showed 45-50 % reduction in the intensity of pain before and after pulp extirpation by barbed broach in both males and female patients, regardless of the type of the tooth which indicates the efficiency of the instrument and procedure. Even though 40-50 % of pain was still there, it could be attributed to remaining inflamed pulp tissues at the apical part of the root canal. Working length determination plus cleaning and shaping significantly reduced the great part of remaining postoperative pain (22-23%) where most of the remaining inflamed pulp tissues were removed. Even though, around 8-16% of the pain was still present, other causes like manipulation of the instruments and injury and inflammation of adjacent apical tissues can be associated with such pain cause. These results agree with those reported in the literature [13], [15], [16]. Consequently Pulpectomy with working length determination plus cleaning and shaping or at least initial instrumentation would be the standard treatment of choice if the time permits to avoid leaving of inflamed and damaged pulp tissues. At times there is no time available during a clinical session for the student to complete the procedure, in such cases a simple pulpotomy is preferred as emergency treatment [17].

For students who chose to use a file (K file) to remove the pulp tissues, around 50% of the patients were found to have no improvement or even the pain was intensified. Comparison of the mean pain score reduction after pulpectomy between barbed broach and file group showed significant difference for all 3 consequent days of treatment, which indicates the clinical unsuitability of the file for using of pulp extirpation. The results also showed that there is no incidence of any fracture of the barbed broach or file during manipulation inside the root canal by undergraduate students (71 students). This may be attributed to proper selection of the size and proper manipulation of both file and barbed broach by the students, besides the improved physical and mechanical properties of the newly produced instruments. Students who are aptly trained to use such instruments in preclinical have been reported to be more clinically efficient with use of instruments and procedures [29], [30]. Absence of BB fractures has also been reported previously [31], [32]. Very low instrument fracture incidence of 0.3% and 0.6% has

been associated with undergraduate students in two universities. This is also true for other endodontic instrument used by students, which have been reported to have 0.3% to 0.5-0.9 % fracture incidence during root canal instrumentation [33], [34].

Conclusion

The evidence obtained from this study suggests that the barbed broach still considered as safe and effective instrument for pulp extirpation as used by the undergraduate students. The study also suggests that most of the undergraduate students do follow their textbooks while doing clinical cases.

Limitations and Future Studies

Since the design of the study restricted uniform sample distribution, the present study is limited by issues related to sample design and distribution. Further study with large/equal number of cases is encouraged for the future. Till the production of alternative hand instrument or use of rotaries for the level of under graduate students is done, we feel that use of the barbed broach for pulp extirpation accompanied with working length determination and initial cleaning and shaping in the same visit is the best method to minimize the postoperative pain of endodontic treatment. However, such decisions are clinically case based and individual in nature depending upon the circumstances.

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