INCIDENCE OF POST OBTURATION PAIN RELATED TO TWO ROOT CANAL HAND PREPARATION TECHNIQUES: A PROSPECTIVE CLINICAL STUDY

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ABSTRACT

This prospective study was undertaken to determine the incidence of post obturation pain related to root canal treatment of asymptomatic non-vital maxillary central incisor teeth that were prepared and filled in one visit using two different manual root canal preparation techniques: the step-back and the step-down and to determine the relationship, if any, between post obturation pain and root canal preparation technique.

The incidence of post obturation pain was recorded and evaluated over an observation period of one week in 120 patients.

Five patients were excluded from the analysis as they failed to attend for post obturation evaluation. Of the remaining 115 patients who returned for evaluation after 2 days following the obturation of the root canal system, 94 patients had no pain, 10 had slight pain, 9 patients had moderate pain and 2 patients had pain of severe nature for maxillary central incisor teeth instrumented and filled in one appointment. Clinical evaluation performed 7 days following the obturation of the root canal systems revealed that 3 patients had pain of moderate nature and were from the same group of patients who reported pain at the 2 days post obturation period. The incidence of post obturation pain of moderate and severe nature in a symptomatic endodontically treated non vital maxillary central incisor teeth was 9.5% after 2 days and 2.6% after 7 days following obturation.

The percentage of patients experiencing moderate to severe pain after 2 days following obturation was 10.6% for the step back patients group and 8.6% for the step down patients group. At the 7 days post obturation period 3.5% of patients experiencing moderate to severe pain in the step back group compared to 1.7% in the step down patients group.

No statistically significant difference in the incidence and degree of post obturation pain was found between patients who had teeth treated endodontically using the step-back or the step-down manual root canal preparation technique.

Key words: Postobturation pain, Incidence, step-back, step-down, technique.

INTRODUCTION

The objective of obturation is to create a complete seal along the length of the root canal from canal opening to the apical termination.

Unfortunately, canal preparation is adversely influenced by the highly variable root-canal anatomy and the relative inability of the operator to visualize this anatomy from radiographs. Hence, root canal preparation is not only important but also demanding for the clinician.

Techniques of root canal preparation include manual root canal preparation techniques, automated root canal preparation, sonic and ultrasonic preparation, and the use of laser systems and NITs. Manual root canal preparation techniques can be broadly divided into those techniques that adopt an apical to coronal prepa-
ration procedures and those that adopt a coronal to apical approach. Hybrid approaches have been also developed out of the two methods. A summary of some of these manual root canal preparation techniques\textsuperscript{1,5-23} which had been described in the literature is presented in Table 1.

The standardized technique was the first formal root canal preparation technique which was described by Ingle\textsuperscript{5} in 1961. Until recently the most widely used preparation technique has been the step back, telescopic technique or serial preparation technique which was first described in the 1960s\textsuperscript{6} and later modified by Mullaney.\textsuperscript{24} Step back techniques commence preparation at the apex with small instruments. Following apical enlargement instrumentation length may be reduced with increasing instrument size. After each step back the original working length file or one size smaller is reintroduced to the apex to ensure the canal patency a procedure known as recapitulation. This technique has some problems despite its popularity: firstly, the difficulty in obtaining the correct working length especially in calcified canals where interference's coronally could prevent apical movement of the file.

Secondly, irrigation solutions cannot reach the apex because of the narrowness of the canals.

Thirdly, attempting to negotiate and prepare the apex first pulpal debris and bacteria may be pushed apically and even extruded into the periapical tissues, beyond the apical foramen\textsuperscript{25,26} especially in non vital teeth, causing blockages and possibly post operative discomfort.

In an effort to reduce the incidence of these problems, step down techniques were developed. This technique, although not the term step down, was first suggested by Schilder in 1974\textsuperscript{1}, and the technique was

\begin{table}[h]
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\begin{tabular}{|l|l|l|}
\hline
\textbf{Approach} & \textbf{Authors} & \textbf{References} \\
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Standardized technique & Ingle 1961 & 5 \\
Step-back & Clem 1969 & 6 \\
Incremental technique & Wein et al 1970 & 7 \\
Anticurvature filing & Abou-rass et al 1980 & 8 \\
Step-down technique & Marshal & Papin 1980 & 9 \\
Step-down technique & Goerig et al 1982, Schilder 1974 & 10, 1 \\
Double flare technique & Fava 1983 & 11 \\
Pre flaring technique & Gerstein 1983 & 12 \\
Crown-down pressure less technique & Morgan & Montgomery 1984 & 13 \\
Balanced force technique & Roane et al 1985, 1984 & 14, 15 \\
Circumferential filing & Lim & Stock 1987 & 16 \\
Apical potency technique & Buchanan 1989 & 17 \\
Reverse flaring technique & Weine 1989 & 18 \\
Canal Master technique & Wildey & Senia 1989 & 19 \\
Apical box technique & Tronstad 1991 & 20 \\
Progressive enlargement technique & Backman et al 1992 & 21 \\
Modified double flare technique & Saunders & Saunders 1992 & 22 \\
Passive step back technique & Torabinjad 1994 & 23, 24 \\
Alternated rotary motions-technique (ARM) & Siqueira et al 2002 & 25 \\
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\end{tabular}
\caption{Summary of some of the manual root canal preparation techniques described in the literature}
\end{table}
described in detail by Goerig et al. Step-down techniques are now the most widely used technique for canal preparation. The principle of this technique is that the coronal aspect of the root canal is widened and cleaned before the apical part. Step-down techniques commence preparation using larger instrument from canal orifice and then work down the root canal with progressively smaller instruments. Broadly speaking the step-down technique divides the preparation into apical, mid root and coronal stages.

Studies have shown that step down techniques produce fewer canal blockages, less apically extruded debris, and a reduced incidence of apical transportation when compared to step-back techniques.

This technique permits straight access to the apical region of the root canal and enhanced tactile control. In addition it eliminates dentinal interferences found in the coronal two-thirds of the canal and allow apical instrumentation to be accomplished quickly and efficiently, thereby reducing the risk of compacting debris apical which may block the canal. However, problems can occur with step down techniques especially, if the coronal portion is over prepared and under irrigated which can result in ledges and blockages.

The occurrence of pain during or after root canal treatment is relatively common even when the treatment has followed the highest standards and should be expected by patients. This pain is thought to be related to a periapical inflammatory response secondary to one or more of the following factors: instrumentation, the introduction of medicaments and or debris into the periapical tissues, severing of vital neural and pulpal tissues.

Although postoperative pain associated with root canal therapy is a poor indicator of long-term success, the occurrence and the control of pain are of clinical interest in endodontics. In reviewing the literature, few studies were undertaken comparing between root canal preparation techniques and pain. Hence the ongoing study was undertaken to determine the incidence of postoperative pain in teeth with non vital pulps that were prepared and filled in one visit using two different manual root canal preparation techniques: the step back and the step-down techniques. The aim was to determine the relationship between post obturation pain and root canal preparation technique.

**MATERIALS AND METHODS**

The Ethical Committee of the Royal Medical Services-Jordan Armed Forces approved this study in which one hundred and twenty consecutive patients (66 females and 54 males) 16 to 45 years of age initially participated. All patients included in this study had non vital asymptomatic maxillary central incisor teeth and have root canal systems that were closed to the oral environment. Maxillary central incisors were selected for this study due to the fact that they maintain simple root morphology. All patients were referred to the endodontic clinic at al Hussien Hospital, King Husein Medical Centre during the period from August 2003 to October 2003. They willingly consented to the treatment following an explanation of the preparation procedures involved. Teeth which were tender to touch, or having extensive intracanal calcification or incompletely formed apices and retreatment cases were excluded from the study.

The diagnosis of non vital pulps was determined by routine diagnostic procedures: chief complaint, history given by patients, oral examination, lack of response to thermal and electrical pulp tests, cavity tests and the appearance on the preoperative radiographs.

All clinical procedures were undertaken by the first author in the endodontic clinic at al Hussien Hospital King Hussien Medical Centre and were based on the following criteria:

The patients accepted the criteria for post operative pain evaluation which were explained to them. The tooth had a non vital pulp with no symptoms. Only the non vital maxillary central incisors were selected because they had uncomplicated root morphology and only one tooth from each patient was used in this study. Patients were in good general health.

After the access to the root canal of the tooth was opened, patient teeth were consecutively assigned to one of two groups (of 60 patients in each group) according to the technique to be used for root canal preparation. All teeth were non vital upon access opening (no hemorrhage was observed). If present, carious lesions...
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and leaking restorations were removed. After initially accessing the floor of the pulp chamber, the tooth was isolated with rubber dam, and disinfected with 2.6% sodium hypochlorite. Subsequently, the access cavity was completed using a separate set of instruments. If present the coronal pulp tissue was removed with a 2.6% sodium hypochlorite solution and sterile round burs. The working length was determined radiographically from a coronal reference to a distance 1mm short of the radiographic apex. The root canals were instrumented in each technique under a thorough irrigation of 2.6% sodium hypochlorite solution. This procedure was performed during the biomechanical preparation of the root canal system. The apical portion of the root canals was prepared with the step back and the step down technique to an appropriate apical size to permit efficient penetration to the apical region of the canal.

After the cleaning, shaping procedures and final irrigation were completed all root canals were dried with paper points and obturated with laterally condensed gutta percha cones and calcium hydroxide based root canal sealer (Sealapex: Sybron Kerr, Romulus, MI, USA). The root canal preparation and obturation was completed for all patients' teeth at the first appointment. The access cavity of each root canal treated tooth was filled with a composite resin material at the same visit on which the canal was obturated.

The patients were asked to report all postoperative reactions after treatment. All patients were supplied with 20 (500mg) tablets of Acetaminophen. A written explanation of the treatment and instructions for post operative care in which warning or leading words were carefully avoided. The instructions stated that if patients were experiencing discomfort they were to take two of the paracetamol tablets and wait for 30 minutes. The dose could be repeated every 6 hours. If pain persisted they were instructed to return to the clinic in the following day.

The patients were asked to categories their pain experience according to the following criteria:

1. No pain: the treated tooth felt normal.
2. Slight postoperative pain: the patient did not require analgesics and reported mild or minimal discomfort that disappeared within 48 hour.
3. Moderate post operative pain: the patient reported tolerable discomfort with slight tenderness on biting or palpation of the periapical area that required an analgesic such as acetaminophen.
4. Severe postoperative pain: the patient reported continuous pain with extreme sensitivity on biting or palpation that required a strong analgesic.

The patients were asked to record any pain experienced at time intervals of 2 and 7 days after obturation.

The data were analyzed by means of the computerized Statistical Package for Social Sciences version 11 (SPSS©). Simple descriptive statistics were used together with chi square test. Frequency distributions were compared between the two groups using Chi-square analysis. The test was considered statistically significant when probability were less than 0.05.

RESULTS

Five patients failed to attend for post obturation evaluation (3 males, 2 females) and were excluded from the study. Of the remaining 115 patients who returned for evaluation (57 patients had been treated using step-back technique and 58 using step-down technique), 94 patients had no pain, 10 had slight pain, 9 patients had moderate pain and 2 patients had pain of severe nature after 2 days following obturation of the root canal systems of the non vital maxillary central incisor teeth instrumented and filled in one appointment. The percentage of patients experiencing moderate to severe pain at the 2 days post obturation period was 10.6, for the step back patients group and 8.6 for the step down patients group. Figure 1 shows the percentage of patients reporting different degrees of pain in the step-back and step-down patient groups. Statistical analysis of the incidence and degree of post obturation pain showed no significant difference between the two preparation techniques groups (chi square=0.918, p>0.05).

Clinical evaluation performed 7 days following the obturation of the root canal systems (Figure 2) revealed that there was no statistically significant difference between the two groups (chi square=0.507, p>0.05). The
percentage of patients experiencing moderate to severe pain at the 7 days post obturation period was 3.5 for the step back patients group and 1.7 in the step down patients group.

Three patients who had moderate pain were from the same group of patients who had reported pain in the initial 48 hours period, and who took mild analgesic to control their pain.

Examination of preoperative radiographs revealed that 42 patients were associated with periapical radiolucencies as compared to 73 patients with non vital teeth that had no periapical radiolucency. The percentage of patients who expressed different degrees of pain for both groups is given in figure 3.

There was a statistically significant difference in the incidence and degree of pain between patients who had teeth associated with periapical radiolucent lesions and those patients who had teeth with no periapical radiolucent lesions (chi square=0.012, p<0.05), Fig 3.

In the group of patients who had a preoperative periapical radiolucency, it was noticed that patients who reported pain of severe nature had non vital teeth associated with periapical radiolucency larger than 5 mm in size. Although female patients experienced more pain than male patients, the difference between them was not statistically significant at 2 days post obturation period (chi square=0.991, p>0.05). The percentage of male and female patients reporting pain after 2 days post obturation period is shown in figure(4).
DISCUSSION

Different scales and methods have been used for the assessment of pain after endodontic therapy. Among them, the visual analog scale (VAS) is considered to be a valid and reliable ratio scale for measurement of pain. However, it is well known that pain perception is a highly subjective and variable experience modulated by multiple physical and psychological factors. Pain reporting is influenced by many factors other than the experimental procedure. Apprehensive patients are more sensitive to pain in general and those who are dentally anxious are more sensitive to dental pain. Stressful situations unrelated to the treatment, together with anxiety, may reduce the patient’s tolerance to discomfort and result in an increase in the reported incidence of pain. In addition, the measurement of pain is fraught with hazards and opportunities for errors. Therefore, in this study the level of discomfort was rated in only 4 categories in order to simplify pain rating.

One limitation of this study is the relatively small number of teeth that were treated endodontically in this sample. Another factor which may have influenced the results is the assignment of patients which was performed by alternating the treatment, but since instrumentation of the canals was performed for all patients at the first visit this might have a little influence in the results. Only one tooth is root canal treated in the same patient in this study because if more than one tooth is treated, they cannot be assumed to behave independently from each other.

Although, relatively a higher percentage of post-obturation pain was experienced by the patients during the first two days after obturation. However, at seven days post-obturation period pain decreased significantly this was found in agreement with the findings of other studies. This should draw the attention of dentists not to overreact to early post-obturation symptoms by immediately initiating root canal retreatment or extraction the involved tooth.

Wide variations exists in the literature concerning the incidence of post-treatment pain reported and some conflicting conclusions were reached which may be due in part to great variation in the preoperative condition of teeth which sometimes included teeth with both vital and non-vital pulps, however, all teeth included in this study were non-vital, and to the small sample size in some studies relative to the number of covariables being examined. In addition it may be possibly due to variation in the the apical extension of root canal instrumentation and obturation which has been debated for decades and is a point of controversy between researchers. It is recommended in the light of current evidence that canals should be instrumented and filled to within 0.5mm of radiographic apex unless it is clinically determined that the canal exists of greater distance.

Although there is a difference in the incidence of postoperative pain between the two preparation techniques used in this study, the difference was not statistically significant. This may occurs due to extrusion of root contents beyond root canal system.
into radicular tissues which produce inflammatory and immunological reaction and subsequent postoperative pain. Healing process may be impaired when infected dentin derbies are carried out to the apical area and lie between the filling material and the periodontal area. The amount of debris pushed through the apical foramen was reported to be more in the step back root canal preparation technique than that in the crown down preparation techniques. This may contribute to the increased number of patients who reported postoperative pain in the step back preparation technique in the current study.

Careful examination of post obturation radiographs for those patients who reported postoperative pain at the first and second evaluation periods showed that these patients had periapical radiolucencies areas larger than 5 mm in diameter, this may possibly explain the occurrence of pain in this group of patients. The radiographic presence of a periapical lesion particularly larger ones serves as a risk factor for developing flare ups.

Although it was not statistically significant, females patients experienced more pain than male patients. A possible explanation is based on emerging evidence that biological differences between genders may explain increased pain prevalence in females. There are two possible explanations: One, differences in pelvic and reproductive organs may provide an additional portal of entry of infection in females leading to possible local and distant hyperalgesia. Two, fluctuating female hormonal levels may be associated with changing levels of serotonin and nor adrenaline leading to increased pain prevalence during the menstrual period and in women receiving hormonal replacement therapy or oral contraceptives.

**CONCLUSIONS**

Under the conditions of this prospective study the following conclusions can be drawn: The incidence of post obturation pain of moderate and severe nature in a symptomatic endodontically treated non vital maxillary central incisor teeth instrumented and filled in one appointment was 9.5% after 2 days following obturation of the root canal system and 2.6% at the 7 days post obturation period.

No significant difference in post operative pain incidence was found between patients who had teeth treated endodontically using the step-back or the step-down manual root canal preparation technique. The step down technique produce fewer incidence of pain of moderate to severe nature when compared with the step back technique. Patients who had a preoperative periapical radiolucency had a higher incidence of pain than patients who had teeth with no periapical radiolucency. Patients who reported pain of severe nature had a non vital teeth associated with periapical radiolucency larger than 5 mm in size.

Dentists should not over react to early post obturation symptoms by immediately initiating root canal re-treatment or extracting the involved teeth.

**REFERENCES**

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