

Factors influencing post-obturation pain in single visit root canal treatment employing rotary endodontics

J.O. MAKANJUOLA¹, D.C. UMESI^{1,2}, O.H. ODERINU^{1,2}

1. Dpt of Restorative Dentistry, Faculty of Dental Sciences, College of Medicine, University of Lagos
2. Dpt of Restorative Dentistry, Lagos University Teaching Hospital, Idi Araba, Lagos State

Abstract

Objectives: To determine the prevalence of post-obturation pain following rotary endodontics in single-visit root canal treatment and to determine factors that may influence post-obturation pain.

Methods: A prospective, clinical study was conducted at a Nigerian Tertiary Hospital. Single visit root canal treatment was performed on seventy-five teeth. Biomechanical preparation of root canals was done employing ProTaper rotary system in a crown down technique. Pain was reviewed over a 1-month period employing Universal Pain Assessment Tool-Faces Scale and patients' use of analgesics. Factors evaluated for influence on pain were age, gender, tooth type and pre-operative diagnosis. Data was analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. Test for association between prevalence of pain and categorical variables were carried out using Pearson's Chi-square. Level of statistical significance was set at $p \leq 0.05$.

Results: At 1-day review, 38.7% of teeth had post-operative pain with central incisors (28%) followed by first molars (23.5%) having the highest prevalence. The prevalence of pain progressively decreased and by the 1-month review, total pain prevalence reduced to 5.3%. Factors significantly associated with post-obturation pain were being female ($p=0.050$) and posterior teeth ($p = 0.037$) at 1-week and 1-month review respectively.

Conclusion: Factors which affect post-obturation pain following single-visit root canal treatment employing ProTaper rotary instrumentation include gender and tooth type. Post-obturation pain which occurred within 24 hours following treatment steadily reduced over one-month review.

Résumé

Facteurs influençant la douleur post-obturation dans le traitement en consultation unique du canal radiculaire en utilisant des instruments endodontiques rotatifs

Objectifs : Etablir la prévalence de la douleur post-obturation à la suite d'une endodontie rotative dans le traitement canalaire en une consultation unique et établir les paramètres qui pourraient influencer la douleur post-obturation.

Méthodes : Une étude clinique prospective a été effectuée dans un hôpital tertiaire nigérian. Le traitement canalaire en une seule consultation a été mené sur soixante-quinze dents. La préparation biomécanique des canaux dentaires a été faite en exploitant le système rotatif "ProTaper" dans une technique de couronne descendante pour le traitement du canal radiculaire. La douleur a été évaluée pendant un mois en utilisant l'outil "Outil d'évaluation universelle de la douleur - échelle des visages" et l'utilisation d'antalgiques par les patients. Les facteurs évalués comme influençant la douleur étaient l'âge, le sexe, le type de dent et le diagnostic pré-opératoire. Les données ont été analysées avec le

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• Factors influencing... •

logiciel "Statistical Package for Social Sciences (SPSS) version 20.0". La prévalence de la douleur et les variables catégorielles a été évaluées en utilisant le Chi-carré de Pearson. Le niveau de signification statistique a été fixé à $p \leq 0,05$.

Résultats : A un jour post-opératoire, 38,7% des dents étaient douloureuses : incisives centrales (28%) et premières molaires (23,5%) ayant la plus grande prévalence. La prévalence de la douleur a progressivement diminué. A l'examen un mois après, la prévalence totale de la douleur était réduite jusqu'à 5,3%. Les facteurs nettement liés à la douleur post-obturation étaient liés au sexe féminin ($p = 0,050$) et aux dents postérieures ($p = 0,037$) respectivement à l'examen à 1 semaine et à 1 mois.

Conclusion : Les facteurs qui affectent la douleur post-obturation suite à un traitement canalaire en consultation unique en utilisant l'instrument rotatif ProTaper sont le sexe et le type de dent. La douleur post-obturation ressentie dans les 24 heures à la suite du traitement a diminué régulièrement sur un mois d'examen.

Introduction

Post-obturation pain following root canal treatment is a distressing experience for both patients and clinicians. It affects the patient's quality of life and ultimately the desired dentist-patient relationship (1, 2). Post-obturation pain following root canal treatment has been reported to range from about 3% to as high as approximately 70% (1-5).

In the past, root canal treatment was carried out in multiple visits mainly to ascertain a sterile root canal system before obturating the canals.⁶ Intracanal medicaments were used to ensure the total eradication of bacteria and their toxins since complete sterilization was not possible with copious irrigation and biomechanical preparation.

Also, agents such as phenolic compounds which were employed proved highly irritating to the tissues in the peri-radicular area (6). It has been reported that extreme use of these root canal medicaments led to complications after treatment that were wrongly identified as persistent peri-radicular infections.

This resulted in the improper and excessive use of antibiotics to treat the wrongly diagnosed infections (6). The harmful effects of these intracanal medicaments were eventually recognized and their routine use during treatment was discontinued. This led to the choice of one

of two courses of treatment, to either treat the root canal in a single visit or dress the canals with an intracanal medicament that does not injure the peri-radicular tissues (6). Single-visit root canal treatment is now widely considered to be an efficient endodontic practice, but there is still concern regarding the incidence of post-obturation pain (7). There is no consistency in the literature regarding the frequency of post-operative pain in single visit and multiple visit root canal treatment (1).

Some studies concerning post-operative pain (8, 9) as well as healing rates (10, 11) show the treatment outcome to be similar whether carried out in single or multiple visits. While some studies have shown that single visit root canal treatment have better treatment outcome than multiple visit, other studies have shown the contrary (1, 6, 12, 13).

The most important step for achieving a successful root canal treatment is the biomechanical preparation of the root canals (14-16). This step is very essential because it largely determines the sterility of the root canal system and the enlargement of the canal geometry for a satisfactory canal obturation (14).

Root canal preparation techniques have evolved over time and the introduction of Nickel-titanium (NiTi) rotary instrumentation with

steady improvement of these NiTi rotary systems in the endodontic market have assisted endodontists in performing root canal treatment (especially in molars) in a single visit (17, 18). The main advantage of engine-driven NiTi instruments is that they require less chair side time by facilitating a more uniform canal preparation with less transportation and less procedural errors e.g. ledging and zipping, as compared with stainless steel files.

This promotes a close to ideal obturation (19, 20). Studies have also revealed that NiTi rotary instruments are associated with less apical extrusion of canal contents compared to canal preparation using hand files which ultimately reduces the incidence of post-operative pain (15, 21-23).

Despite the various advances in contemporary endodontic techniques and equipment, studies have revealed that frequency and severity of post-obturation pain vary greatly (1, 2). As a result of this, there is no consistency in literature regarding the prevalence of post-obturation pain and several factors have been noted to influence this pain.

Thus, a prospective study was carried out to evaluate the prevalence of post-obturation pain and the relationship of certain factors that have an influence on pain following single-visit root canal treatment in a Nigerian population. The purpose of this study was to determine the prevalence of post-obturation pain following rotary endodontics in single-visit root canal therapy and to determine factors that may influence post-obturation pain.

Methodology

A clinical study was conducted at the Conservation Unit of Restorative Dental Clinics, Lagos University Teaching Hospital (LUTH), Idi Araba, Lagos State on patients who needed root canal treatment.

This study was part of a larger study of which ethical approval was obtained from the Health Research and Ethics Committee, LUTH.

The inclusion and exclusion criteria were strictly adhered to during subject selection in which single-visit root canal treatment was performed on seventy-five teeth by a single operator. The inclusion criteria for subjects were, no pain to moderate pain, irreversible pulpitis, apical periodontitis with not more than 2 x 2 mm periapical radiolucency, necrotic teeth, Ellis class III fracture while the exclusion criteria included unrestorable tooth, excessively curved roots, acute abscess.

A written informed consent was obtained from all the human adult participants/subjects following detailed explanation of the procedure they were to undergo. The procedure followed was in accordance with the ethical standards of the committee on human experimentation (institutional and national) and with the last update of Helsinki Declaration. The standard treatment protocol (7) included administration of local anaesthesia, rubber dam isolation, carries excavation and standard access cavity preparation. The pulp chamber and root canals were irrigated copiously with 2.5% sodium hypochlorite and lubricated with RC Prep (Stone Pharmaceuticals, Philadelphia, Pa) throughout treatment.

The working length for each canal was considered to be at the apical constriction as determined by radiographs (long cone paralleling technique). Biomechanical preparation of root canals was done employing NiTi ProTaper rotary system (Dentsply Maillefer Ballaigues, Switzerland) in a crown-down technique.

The canals were obturated with Zical sealer (PREVERST DenPro LTD. Jammu, India) and the selected ProTaper gutta percha using single cone technique where the master cone matched the exact canal space prepared with the last finishing file leaving no voids. In cases of very large patent canals, the gutta percha

cones of variable taper were added using the cold lateral compaction technique to completely obliterate the canal space. Obturation was then followed by core buildup (with/without a post) using light cured composite or reinforced Glass Ionomer Cement (GIC) for anterior teeth and amalgam, reinforced GIC or posterior composite for the posterior teeth and thereafter, an extracoronary restoration.

Pain was reviewed over a 1-month period employing Universal Pain Assessment Tool²⁵-Faces Scale and patients' use of analgesics. Factors that were evaluated for influence on pain are age, gender, tooth type and pre-operative diagnosis.

Data collected was analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. Test for association between the prevalence of pain and the categorical variables were carried out using Pearson's Chi-square Test. Data was represented using tables.

The level of statistical significance was set at $p \leq 0.05$.

Results

Seventy-five subjects were treated in this study, 60% were females. Each subject had one tooth treated. Majority (58.7%) belonged to 21-30 years age-group followed by the 31-40 years age-group (18.7%). There was a good spread of professions among the study subjects (Table I).

The central incisors (28%) followed by first molars (23.5%) were the most frequently treated teeth in this study.

The reasons for root canal treatment included apical periodontitis, irreversible pulpitis, pulp necrosis, tooth fracture with pulpal exposure. More than half of the subjects (56%) presented with apical periodontitis (Table I).

At 1-day review, 38.7% of the subjects had post-operative pain. The prevalence of pain progressively decreased to 5.3% by the 1-month review period (Table II).

There was no significant difference ($p > 0.05$) when comparing prevalence of pain between the various age groups, jaws and the different pre-operative diagnosis. Factors significantly associated with post-obturation pain were gender, more in females ($p = 0.050$) (Table II) and tooth type, more in posterior teeth ($p = 0.037$) (Table III) at 1-week and 1-month review periods respectively. The molar teeth especially in the maxilla accounted for most of the pain (Table III).

Table I: Socio-demographics, distribution of tooth types and pre-operative diagnosis among subjects

Variable		Frequency (%)
Gender	Male	30 (40.0)
	Female	45 (60.0)
Age group (years)	21-30	44 (58.7)
	31-40	14 (18.7)
	41-50	8 (10.7)
	51-60	9 (12.0)
	Mean \pm SD	32.5 \pm 13.1
Occupation	Professional	19 (25.3)
	Business	20 (26.7)
	Students	17 (22.7)
	Artisan	3 (4.0)
	Others	16 (21.3)
Tooth type	Central incisors	21 (28.0)
	Lateral incisors	11 (14.7)
	Canines	6 (8.0)
	1st Premolars	13 (17.3)
	2nd Premolars	5 (6.9)
	1st Molars	19 (23.5)
Pre-operative diagnosis	Ellis Class III fracture	6 (8.0)
	Irreversible pulpitis	20 (26.7)
	Pulp necrosis	7 (9.3)
	Apical periodontitis	42 (56.0)

Table II: Prevalence of pain at 1 day, 1 week and 1 month according to gender, age group and diagnosis

	Review Period		
	1-day n (%)	1-week n (%)	1-month n (%)
Gender			
Male (n = 30)	10 (33.3)	3 (10.0)	2 (6.7)
Female (n = 45)	19 (42.2)	13 (28.9)	2 (4.4)
Total (N = 75)	29 (38.7)	16 (21.3)	4 (5.3)
χ²	0.600	3.827	0.176
p-value	0.439	0.050*	0.675
Age group (years)			
21-30 (n = 44)	20 (45.5)	11 (25.0)	1 (2.3)
31-40 (n = 14)	3 (21.4)	4 (28.6)	2 (14.3)
41-50 (n = 8)	2 (25.0)	1 (12.5)	1 (12.5)
> 50 (n = 9)	4 (44.4)	0 (0.0)	0 (0.0)
χ²	4.360	3.602	3.366
p-value	0.339	0.308	0.225
Diagnosis			
Ellis class III (n = 6)	1 (16.7)	0 (0.0)	0 (0.0)
Irreversible pulpitis (n = 20)	8 (40.0)	7 (35.0)	3 (15.0)
Pulp necrosis (n = 7)	1 (14.3)	0 (0.0)	0 (0.0)
Apical periodontitis (n = 42)	19 (45.2)	9 (21.4)	1 (2.4)
χ²	3.759	5.752	5.159
p-value	0.289	0.124	0.161

*Significant

Table III: Prevalence of pain in relation to the different tooth categories at different review periods

Review Period	Tooth type - n (%)		Total n (%)	χ ²	p
	Anterior (n = 38)	Posterior (n = 37)			
1-day	11 (28.9)	18 (48.6)	29 (38.7)	3.068	0.080
1-week	6 (15.8)	10 (27.0)	16 (21.3)	1.411	0.235
1-month	0 (0.0)	4 (10.8)	4 (5.3)	4.340	0.037*
Jaw type					
	Maxilla	Mandible			
1-day	20 (40.0)	9 (36.0)	29 (38.7)	0.112	0.737
1-week	11 (22.0)	5 (20.0)	16 (21.3)	0.040	0.842
1-month	1 (2.0)	3 (12.0)	4 (5.3)	3.301	0.069
Multi-rooted teeth					
	Premolars	Molars			
1-day	7 (38.9)	11 (57.9)	18 (48.6)	1.337	0.248
1-week	3 (16.7)	7 (36.8)	10 (27.0)	1.908	0.167
1-month	1 (5.6)	3 (15.8)	4 (10.8)	1.004	0.315

Discussion

It is widely recognized that the perception of pain is highly subjective therefore, the way one individual assesses a pain intensity would vary from another. This variable experience of pain is regulated by several physical and psychological factors (7).

In order to eliminate this pain subjectivity, this study made use of the Universal Pain Assessment Tool (24) which categorizes pain as mild, moderate, severe and worst possible pain based on a scale 0-10. This scale was used after ensuring the patient understood how to rate the pain according to this objective scale that was used. The type of analgesics used was also taken into consideration to further reinforce the pain ratings.

The reported prevalence of pain at 1-day review in this study was 38.7% which steadily declined to 5.3% at final review period of one month. These findings agree with those of some other researchers (1, 3, 23, 25).

In this study, the variables- age, gender, different tooth types and pre-operative diagnosis were evaluated independently to determine their influence on the prevalence of post-obturation pain. Despite the marked prevalence of pain among subjects aged 21-30 years (45.5%) at 1-day review in comparison to pain prevalence of other age groups and also when comparing pain prevalence of teeth with apical periodontitis (45.2%) in relation to the teeth with other clinical presentations, the differences were not significant, $p > 0.05$.

Only gender and tooth type (anterior vs. posterior teeth) were significantly associated with post-obturation pain.

This present study revealed that a significantly higher number of females ($p = 0.05$) experienced post-obturation pain than males following treatment at 1-week review period. ALI et al. (2) reported a significant difference of post-obturation pain in relation to gender at 12 hours to 48 hours review period following a single visit root canal treatment. NG et al. and RYAN et al. also reported that gender ($p < 0.001$) significantly influenced the incidence of post-obturation pain (26, 27). Several hypotheses have been proffered in order to explain the high incidence of pain in women. A more legitimate explanation that is widely accepted is based on emerging evidence that the biological differences between the sexes may explain the increased occurrence of pain in women (26).

The two possible explanations are stated below: (26)

- Differences in pelvic and reproductive organs may provide an additional portal of entry of infection in females leading to possible local and distant hyperalgesia,
- Fluctuating female hormonal levels may be associated with changing levels of serotonin and noradrenaline leading to increased pain prevalence during the menstrual period and

in women receiving hormonal replacement therapy or oral contraceptives.

There is a need for researchers in this part of the globe to carry out studies among female subjects, taking their gynecological history into consideration when evaluating post-obturation pain following root canal treatment to further buttress the observations and explanations provided by other researchers.

This present study also revealed that a significantly higher number of posterior teeth ($p = 0.037$) were associated with pain post-obturation when compared to anterior teeth at 1-month review period. ALI et al. reported a significant difference of post-obturation pain in relation to tooth type at 12 hours to 48 hours review period following a single visit root canal treatment (2). NG et al. also reported that tooth type ($p = 0.007$) significantly influenced the incidence of post-obturation pain (26). ARIAS et al. also reported that the incidence of post-obturation pain was significantly higher in molars ($p = 0.003$) and mandibular teeth ($p = 0.045$) (28). Although there was a difference in post-obturation pain relating to age and gender in their study, it was not statistically significant ($p > 0.05$). The significant difference associated with tooth type might have been due to a higher likelihood of inadequate biomechanical preparation of the canals in the posterior teeth because of their complex morphology, poorer access and increased chances of missing extra canals (29).

Conclusion

Post-obturation pain which occurs within 24 hours steadily reduces over one-month review following single-visit root canal treatment employing ProTaper rotary instrumentation. Factors which affect post-obturation pain include tooth type and gender, pain being more prevalent in posterior teeth and female patients.

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