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Analgesic intake after pulpotomy and root canal treatment of permanent molars with carious exposure: A randomized clinical trial

Aya Alaa

Resident at Pediatric Dentistry Department, Faculty of Dentistry, Cairo University, Egypt

*Corresponding author email: aya.alaa@dentistry.cu.edu.eg

Shaimaa Sabry

Lecturer at Pediatric Dentistry Department, Faculty of Dentistry, Cairo University, Egypt

Email: shaimaa.sabry@dentistry.cu.edu.eg

Hany Mohamed Saber

Associate professor at Pediatric Dentistry Department, Faculty of Dentistry, Cairo University, Egypt

Email: drhanysaber@yahoo.com

Abstract---To compare the patients' analgesic intake after pulpotomy and root canal treatment and to compare the time span of both endodontic procedures. A total of thirty-four permanent mandibular molars with signs and symptoms of irreversible pulpitis were randomly assigned to a pulpotomy group (n=17) and root canal treatment (RCT) group (n=17). Endodontic procedure duration was recorded for both groups. Analgesic intake for each patient was recorded up to the fourth day post treatment. In management of mature permanent teeth with carious exposure, pulpotomy may be preferred because it is a simple technique requiring less time and patients requires significantly less analgesics postoperatively.

Keywords---pulpotomy, root canal treatment, pulpitis, pain, analgesics, time.

Introduction

Emergency treatment for irreversible pulpitis should ideally include root canal treatment, which can be completed in a single or multiple visits. In recent years, there has also been a trend toward providing endodontic treatment in a single

visit, particularly in simple cases where the pulp is vital. The majority of studies have found that single-visit root canal treatment had a similar or reduced postoperative pain^{1,2}. Endodontic emergencies caused by irreversible pulpitis necessitate unexpected patient visits, which are inconvenient and interrupt usual schedules. In such instances, the amount of time needed to intervene is frequently a concern. Given the inherent time limits and unavoidable disparities in clinician skill levels, full canal cleaning may not be possible during the initial emergency visit. Furthermore, emergency endodontic therapies, like other dental treatments, might be disrupted by unfavorable 'procedural mistakes³.' In situations with irreversible pulpitis, many of these issues can be avoided by using accepted, simple therapeutic approaches that relieve symptoms fast and efficiently⁴. Moreover, Pain management during the intraoperative and postoperative stages is an important element of endodontic treatment. Despite recent advances in endodontics, up to 58 percent of patients report postoperative pain. Endodontic postoperative pain is a complex multifactorial condition that affects patient's quality of life⁵.

Gotler et al evaluated postoperative discomfort in patients who had endodontic therapy in teeth with various initial pulpal diagnoses, such as vital, necrotic pulp tissues, or previously endodontically treated teeth that needed retreatment. The results demonstrated that vital teeth induced a significantly higher incidence and severity of postoperative pain (64%) compared with necrotic pulps (38%) or retreated teeth (49%). The authors thought the pain was higher in vital teeth because of endodontic treatment causing inflammation periapically⁶. That's why endontology has recently shifted to more conservative and less invasive options such as vital pulp therapy (VPT) that was recommended as a successful treatment option in management of irreversible pulpitis. VPT was defined as techniques that aim to conserve the vitality and function of the tooth pulp following harm caused by trauma, caries, or restorative operations. VPT includes indirect or direct pulp capping, as well as partial or total pulpotomy^{7,8}. Pulpotomy is a technique that focuses on preserving the pulp and its functions such as proprioception, innervation, and vascularization. It takes less time and is theoretically easier to execute than RCT. Clinical signs such as pain types and severity are not reliable markers of the pulp's condition, the extent of its involvement, or whether the pulp can initiate healing. Histological investigations have also shown that pulp inflammation in irreversible pulpitis is generally localized to the exposure site rather than affecting deeper tissues. It is currently being argued that, rather than RCT, removal of a superficially damaged layer of pulp may be sufficient to promote healing in teeth with symptoms of irreversible pulpitis⁹⁻¹¹. Hence, the aim of the study was to compare the analgesic intake after pulpotomy and root canal treatment and to evaluate the time span of both treatments.

Materials and Methods

Ethics approval

The study was reviewed and accepted by Ethics Committee of Cairo University in 2019.

Study Design

This study is a parallel group, two tail and equivalence frame with 1:1 allocation ratio.

Recruitment

Exposed permanent mandibular molars with signs of symptomatic irreversible pulpitis with no symptomatic apical periodontitis were recruited from dentistry clinic. Clinical examination included visual assessment of the tooth and surrounding tissues, periodontal probing, palpation and percussion tests. Vital pulp status was confirmed before treatment if the tooth responded to cold stimulus exhibited hemorrhage on opening the pulp chamber. In each case, radiographic evaluation involved examining and recording findings from a periapical radiograph of the tooth taken.

Sample size was calculated based on Eren et al¹² and Using G power statistical power Analysis program (version 3.1.9.4) for sample size determination¹³, A total sample size (n=34; subdivided to 17 in each group) will be sufficient to detect a large effect size (W) = 0.48, with an actual power (1- β error) of 0.8 (80%) and a significance level (α error) 0.05 (5%) for two-sided hypothesis test.

Randomization

The 66 participants were then randomly divided and allocated into 2 groups (n=17) by choosing a folded paper containing the number of their assigned group.

Grouping

- Group 1 (Intervention):
Pulpotomy was done in each molar under rubber dam isolation and the tooth was restored by composite restoration in the same visit.
 - Group 2 (Control):
Root canal treatment was done under rubber dam isolation and the tooth was restored by composite restoration in the same visit.
- In both groups, the total time per procedure was recorded for each tooth, with timing initiated once access cavity preparation was complete till the end of the endodontic procedure. Participants, without being excluded from the study, were permitted to take effective analgesics if needed post-operatively and was recorded till the fourth day. Ibuprofen was prescribed and the dose was determined according to the age and weight of the patient.

Outcome measured

The primary outcome was the analgesic intake after the endodontic procedure up to the fourth day and the secondary outcome was the total time of the treatment in minute in each group.

Statistical Analysis

Numerical data was described as mean and standard deviation or as median and range as appropriate according to the normality of the data. Data was compared using Mann Whitney U test or independent t test depending on normality. The level of significance will be set at $P \leq 0.05$. All tests will be two tailed.

Results

Analgesic intake

Results of analgesic intake are summarized in Table (1) and (Fig.1)

- Comparison between groups:
 - At day 0, 82.4% of patients in control (RCT) group required analgesic intake, in comparison to 29.4% of test group (pulpotomy). The difference between groups was statistically significant ($p=.002$)
 - At day 1, 64.7% of patients in control (RCT) group required analgesic intake, in comparison to 11.8% of test group (pulpotomy). The difference between groups was statistically significant ($p=.001$)
 - At day 2, 47.1% of patients in control (RCT) group required analgesic intake, in comparison to 5.9% of test group (pulpotomy). The difference between groups was statistically significant ($p=.007$)
 - At day 3, 17.6% of patients in control (RCT) group required analgesic intake, in comparison to none in test group (pulpotomy). The difference between groups was not statistically significant ($p=.07$)
 - At day 4, 11.8% of patients in control (RCT) group required analgesic intake, in comparison to none in test group (pulpotomy). The difference between groups was not statistically significant ($p=.145$)
- Comparison within the same group (effect of time)
 - In test group, the percentage of patients requiring analgesic intake gradually decreased from 29.4% at Day0 to 0% at Day3& 4. The difference by time was statistically significant ($p=.018$)
 - In control group, the percentage of patients requiring analgesic intake gradually decreased from 82.4% at Day0 to 11.8% at Day4. The difference by time was statistically significant ($p=.000$)

Table 1
Analgesic intake in test and control group (Chi square test)

				Groups		P value between group
				Test group (Pulpotomy)	Control group (RCT)	
Day0	No	Count % within Group		12 70.6%	3 17.6%	.002*
	Yes	Count % within Group		5 29.4%	14 82.4%	

		Group				
Day1	No	Count % Group	within	15 88.2%	6 35.3%	.001*
	Yes	Count % Group	within	2 11.8%	11 64.7%	
Day2	No	Count % Group	within	16 94.1%	9 52.9%	.007*
	Yes	Count % Group	within	1 5.9%	8 47.1%	
Day3	No	Count % Group	within	17 100.0%	14 82.4%	.07 ns
	Yes	Count % Group	within	0 .0%	3 17.6%	
Day4	No	Count % Group	within	17 100.0%	15 88.2%	.145 ns
	Yes	Count % Group	within	0 .0%	2 11.8%	
P value within the same group (effect of time)				.018*	.000*	

Significance level $p \leq 0.05$, *significant, ns=non-significant

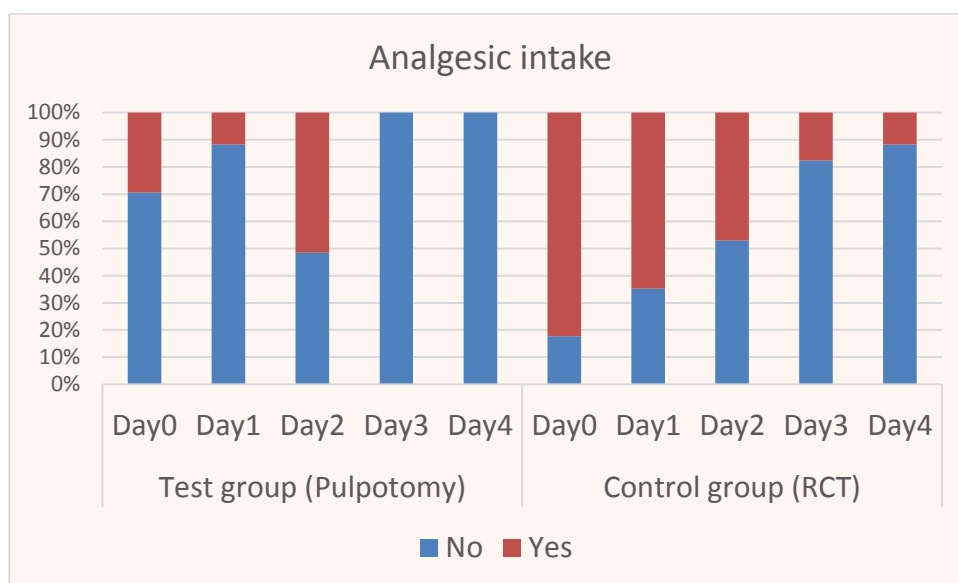


Fig 1. Bar chart illustrating analgesic intake at different observations in both groups

Time span of treatment

Control group (RCT) recorded a significantly higher ($p=0.000$) mean value (23.24 ± 4.41), in comparison to Test group (Pulpotomy) ($4.88\pm.93$). the difference between groups was (18.35 ± 1.09), (Table 2, Fig.2)

Table 2
Descriptive statistics and comparison of time span in test and control group
(independent t test)

Groups	Mean	Std. Dev	Difference				t	P
			Mean	Std. error	C.I. lower	C.I. upper		
Test group (Pulpotomy)	4.88	.93	-18.35	1.09	-20.65	-16.05	16.97	.000*
Control group (RCT)	23.24	4.41						

Significance level $p\leq 0.05$, *significant

C.I.=95% confidence interval of the difference

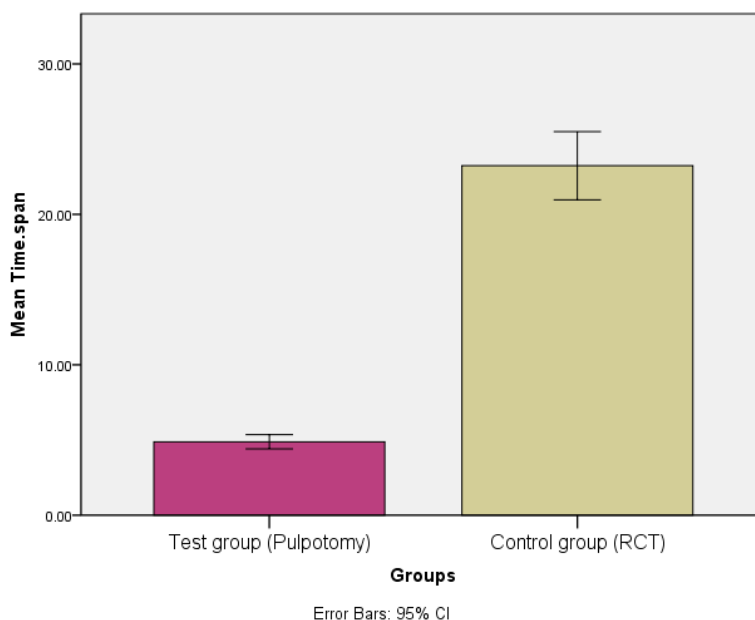


Fig 2. Bar chart illustrating mean time span of treatment in both groups

Correlation between time span and analgesic intake

- The whole sample
Patients requiring analgesic intake were those with significantly higher time span of treatment. This difference was statistically significant at day 0 ($p=0.003$), Day 1 ($p=0.003$), Day 2 ($p=0.014$) and Day 3 ($p=0.027$), but didn't reach the level of statistical significance at day 4 ($p=0.106$), Table (3)

- Between groups:
 - Among patients who didn't require analgesics, Control group (RCT) recorded a significantly higher mean time span, in comparison to Test group (Pulpotomy) ($p = .03$ at Day 0; $P = .000$ at the following dates) (Table 4)
 - Among patients who required analgesics, Control group (RCT) recorded a significantly higher mean time span, in comparison to Test group (Pulpotomy) ($p = .000$ at Day 0 & Day 1; $P = .012$ at Day 2) (Table 4)

Table 3
Descriptive statistics and comparison of time span according to analgesic intake in the whole study sample (independent t test)

Time	Analgesic	Mean	Std. Dev	Difference				t	P
				Mean	Std. error	C.I. lower	C.I. upper		
Day0	No	8.60	7.98	-9.77	2.98	-15.85	-3.69	3.27	.003*
	Yes	18.37	9.12						
Day1	No	10.33	8.94	-9.74	3.07	-16.00	-3.49	3.17	.003*
	Yes	20.08	8.30						
Day2	No	11.64	9.40	-9.14	3.53	-16.32	-1.95	2.59	.014*
	Yes	20.78	8.03						
Day3	No	13.00	9.56	-12.00	3.36	-21.71	-2.29	3.57	.027*
	Yes	25.00	5.00						
Day4	No	13.38	9.64	-11.63	6.98	-25.84	2.59	1.66	.106 ns
	Yes	25.00	7.07						

Significance level $p \leq 0.05$, *significant, ns=non-significant

C.I.=95% confidence interval of the difference

Table 4
Descriptive statistics and comparison of time span according to analgesic intake between groups (independent t test)

Time	Analgesic	Groups	Mean	Std. Dev	Difference				t	P
					Mean	Std. error	C.I. lower	C.I. upper		
Day0	No	Test	4.92	1.00	-18.42	3.35	-	-4.22	5.5	.03*
		Control	23.33	5.77			32.61			
	Yes	Test	4.80	.84	-18.41	1.22	-	-	15.12	.000*
		Control	23.21	4.34			21.01	15.82		
Day1	No	Test	5.00	.93	-18.67	1.78	-	-	10.49	.000*
		Control	23.67	4.32			23.19	14.14		
	Yes	Test	4.00	.00	-19.00	1.40	-	-	13.56	.000*
		Control	23.00	4.65			22.12	15.88		
Day2	No	Test	4.94	.93	-18.62	1.26	-	-	14.79	.000*

	Control	Yes	4.00#	.						
	Test	No	23.56	3.71	.68	2.25	-4.22	5.58	.302	.768
		Yes	22.88	5.33						ns
Day3	Control	No	4.88	.93	Not computed					
	Test	Yes	.	.						
		No	22.86	4.38	-2.14	3.12	-	8.42	.688	.546
	Control	Yes	25.00	5.00			12.71			ns
Day4	Test	No	4.88	.93	Not computed					
		Yes	.	.						
		No	23.00	4.26	-2.00	5.12	-	50.72	.391	.758
	Control	Yes	25.00	7.07			54.72			ns

Significance level $p \leq 0.05$, *significant, ns=non-significant

C.I.=95% confidence interval of the difference

#only one case (one value)

Discussion

Root canal treatment and complete pulpotomy is now being proposed as possible treatment modality in teeth with signs indicative of irreversible pulpitis¹⁴. Whilst both have shown successful outcomes, the benefits and drawbacks of the individual techniques create confusion in the clinician's mind whilst choosing one over the other. The present study attempted to compare the patients' analgesic intake after pulpotomy and root canal treatment and to compare the time span of both endodontic procedures. Pulpal pain is usually due to pulpal inflammation which is due to bacterial invasion. Therefore, pain should be eliminated by removal of the irritating factor and the inflamed pulp. Previous studies have shown that pulpotomy effectively relived postoperative pain in cases with irreversible pulpitis¹⁵⁻¹⁷. The need for analgesics indicates how effective a therapy technique is in controlling pain. The pulpotomy group had considerably reduced analgesic consumption, showing that the short-term goal of pain management was better attained with pulpotomy. This might be because pulpotomy ensures better clearance of infected and inflamed pulp, resulting in a faster recovery from pain¹⁸. In order to standardize the data and link analgesic usage to postoperative discomfort or pain change, just one type of painkiller was administered.

Our study results were in accordance with Eghbal et al⁴ who showed that the number of people who used analgesics, mean number of taken tablets/persons, and selected drugs were comparable in the study arms, where analgesic intake (tablets/persons) varied from 1.51 ± 0.13 (in the RCT group) to 1.61 ± 0.14 (in the pulpotomy group). Also, Asgray et al¹⁹ reported that the proportion of patients taking postoperative analgesics was greater in the RCT group than in the pulpotomy group. Eren et al¹² found that there were no significant intergroup differences regarding the proportions of patients who reported no postoperative analgesic use or those who took at least one analgesic from the time the anaesthetic wore off throughout the 7 days. There were also no significant differences amongst the groups with respect to overall median intake of analgesic.

Moreover, proportions of patients in each group who required analgesic intake varied from 68.2% (in the RCT group) to 45.5% (in the pulpotomy group).

However in another study by Taha et al²⁰, only one patient reported the intake of analgesics postoperatively. Moreover, in study by Taha and Abdulkhader¹⁵, none of the patients reported the intake of analgesics after the procedure. In addition, Galani et al¹⁷ reported that there was a statistically significant difference in analgesic intake ($P < .05$), as patients in the RCT group had taken analgesics for pain relief, whereas none of the patients in pulpotomy group had taken analgesics within 7 days of treatment. In our study, a greater percentage of RCT patients (>80% of the group) tended to require analgesics within the first 24 h after the emergency procedure, as postoperative pain is more likely to arise within the first 24 hours following root canal therapy⁵. The present study demonstrates that pulpotomy can be performed in significantly shorter time than root canal treatment in accordance to previous^{4,12}. According to Eghbal et al⁴ time varied from 69.73 ± 2.6 (in the RCT group) to 35.37 ± 1.27 (in the pulpotomy group) while in the study conducted by Eren et al¹² duration of the treatment was significantly between both groups as the RCT group was associated with the longest procedures (median, 24 min) followed by the pulpotomy group (median, 5 min).

Conclusion

Pulpotomy has considerably reduced the patient's analgesic consumption compared to root canal treatment. Pulpotomy can be performed in shorter time than Root canal treatment.

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