ORIGINAL RESEARCH

Oral Health-Related Quality of Life Following Root Canal Treatment of First Permanent Molars Among Children. A Cross-Sectional Study

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Aim: This study aimed to assess the Oral Health-Related Quality of Life (OHRQoL) of pediatric patients (9–18 years old) who underwent root canal treatment (RCT) on first permanent molars (FPMs).

Methods: A cross-sectional study was conducted at three healthcare centers in Jeddah, Saudi Arabia. Participants (n = 482) completed the validated OHIP5-Ar questionnaire to assess OHRQoL. Responses were classified as "optimal" (no problems) or "less than optimal" (any reported problems). Logistic regression analyzed the relationship between OHRQoL and sociodemographic factors.

Results: There were 66.8% children reported optimal OHRQoL after RCT. Logistic regression showed no significant association between optimal OHRQoL and gender, family income, or location of treated tooth. However, although not statistically significant. Treating only one FPM with RCT (compared to multiple teeth) and lower family income (compared to higher income) were more likely to have decreased or increased odds of optimal OHRQoL (AOR = 0.684 or 1.424; respectively).

Conclusion: RCT on FPMs can be a successful treatment option for pediatric patients, offering optimal oral health-related quality of life.

Keywords: oral health-related quality of life, root canal treatment, first permanent molars, children

Introduction

First permanent molars (FPM) erupt between ages 6 to 12 years, and play a crucial role in mastication and facial development. Unfortunately, they are highly susceptible to caries and trauma, often requiring intervention, which in some cases necessitates root canal treatment (RCT).[1,2] While RCT aims to relieve the symptoms and preserve the tooth, its impact on a child's quality of life remains complex. Oral health-related quality of life (OHRQoL) could be used to evaluate patient-reported outcomes of dental management from the patient's prospective,[3] complementing traditional assessments based solely on clinical outcomes. The use of OHRQoL adds emotional and biopsychosocial aspects, including perceptions of an individual's position in life, making it an important evaluation method for dental management techniques.[4] Studies have reported a negative impact of caries and dental trauma on quality of life,[5,6] while dental management and restoration of caries have shown to improve quality of life.[7,8] Several studies have assessed OHRQoL after RCT.[9–11] Gatten et al aimed to compare the quality of life of patients with RCT-treated tooth with patients with implant-fixed prostheses. The results showed that the scores of OHRQoL for both groups were similar.[10] Moreover, RCT patients reported that their RCT-treated teeth were similar to natural ones.[10]

Although these studies evaluated the OHRQoL of patient treated with RCT, their populations were adults. Nevertheless, the effect of caries and dental treatment on children's quality of life differs from that of adults.[12] Moreover, children and adolescence psychosocial status changes with age and development.[12–14] Therefore, the outcome of these studies cannot be generalized on children.

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To date, the literature has limited research on the effect of RCT on the OHRQoL of pediatric patients following RCT in FPM. Therefore, the Aim of this study was to assess the OHRQoL of patients regarding RCT for FPM and to evaluate related factors. Thus, the null hypothesis for this study is that there is no significant difference in the OHRQoL based on socioeconomic status of the child and RCT-related factors.

Materials and Methods

This cross-sectional study was conducted at three major healthcare centers; King Abdulaziz University Dental Hospital (KAUDH), King Fahad Armed Forces Hospital (KFAFH), and King Abdulaziz Medical City (KAMC), Jeddah, Saudi Arabia. It was approved by the Institutional Review board (IRB) of Faculty of Dentistry at King Abdulaziz University (172-11-19), Institutional Review board (IRB) of Ministry of National Guard at King Abdullah International Medical Research Center ((REC 407), and Research Ethics Committee of King Fahad Armed Forces Hospital ((H-01-R-005).

Subject

The Information Technology (IT) Department was contacted to filter the electronic file system in the three included centers. Pediatric patients who visited the included centers between September 1, 2010, and June 30, 2019, were screened. Subjects were enrolled in this study if they were healthy and underwent RCT in FPM at the age between 9 and 18 years old (with closed root apices) (15). Medically compromised children or those who received RCT after 18 years old were excluded from the study.

The sample size calculation was conducted using OpenEpi, Version 3, based on the results of 25% of the sample, at which the outcome factor ie, child RCT satisfaction was found to be 72%. The sample size required was 114 patients.

Validity and Reliability of Assessment Tool

The OHIP-5 scale was used to evaluate OHRQoL in this study. The English language OHIP-5 was validated by Naik et al, who reported that the construct validity score was 0.46, and reliability score determined by Cronbach's alpha was 0.75 (16). The Arabic language OHIP-5 was validated by Alhajj et al, who concluded that the convergent validity score was 0.44, and reliability score determined by Cronbach's alpha was 0.78 (17). A panel of experts (four-consultants in Pediatric Dentistry and three-consultants in Endodontics), familiar with questionnaire formulation, were contacted to assess and evaluate the content validity of the questionnaire. Assessment of relevance for each question was done by using a scale from 1 to 4, with 1 being the lowest and 4 being the highest. The Content Validity Index (CVI) was 0.93, indicating that the questionnaire is valid. Reliability was determined by testing the internal consistency and Cronbach's alpha result was 0.885.

Methodology

From the electronic record of the hospitals, the names of children who had RCT treatment during the period between September 1, 2010, to June 30, 2019, were recruited. Files were then screened according to the inclusion criteria. Eligible patients were identified and contacted via phone by a single clinician. After explaining the study's purpose and procedures, verbal consent was obtained from each participant.

The study utilized a two-part questionnaire. The first section gathered general demographic information about the participants, socioeconomic information, and information regarding the provided treatment. The second section focused on OHRQoL, using the validated OHIP5-Ar instrument (17). Five questions from the OHIP5-Ar addressed health-related problems experienced by the participants following their RCT. These questions were answered on a 5-point Likert scale: 0 = never, 1 = hardly ever, 2 = occasionally, 3 = fairly often, and 4 = very often. For each participant, the five Likert scale responses were categorized into two groups: Group 1: Optimal OHRQoL, signifying all responses of 0 ("never"). Group 2: Less than Optimal OHRQoL, encompassing any response from 1 to 4 ("hardly ever" to "very often") on at least one OHIP5-Ar question.

The scores of the five questions were then summed to determine the frequency of participants falling into each category: either achieving "optimal OHRQoL" across all questions or falling into "less than optimal" in any one of them.

The statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) ver. 22 (IBM Corp., Armonk, NY, USA) for Mac OSX software. The threshold for statistical significance was set at $P \leq 0.05$. The statistical analysis tests included descriptive and frequencies for qualitative data, and Chi-square test for categorical data,

Fisher's exact test for dichotomous variables with at least one cell count of less than five. Regression analysis measuring the Adjusted Odds Ratio (AOR) for the relationship between OHRQoL optimal score (dependent factor) and socio-demographic factors, frequency of teeth treated with RCT, location on the arch, and time elapsed from the day of treatment to the date of the research (independent factors) was conducted to overcome the effect of confounding factors.

Results

A total of 811 patients were identified, of whom 482 patients agreed to participate in this study resulting in a response rate of 59.4%. The distribution of participants among the treatment centres was as follow: 174 (36.1%) patients were treated at UDH, 138 (28.6%) patients were treated at KFAFH, and 170 (35.3%) patients were treated at KAMC. Female patients comprise a higher proportion, with 65.8% females compared to 34.2 male participants.

At treatment time, the patients' age ranged from 9 to 18 years, with a mean age of 14 years ± 2.4 years. At assessment time, the patients' age ranged from 10.1 to 29 years, with mean age of 19.6 years ± 3.5 years.

In terms of family income, the majority of patients came from middle-income families (65.8%). A smaller percentage of patients came from low-income (13.3%) and high-income (21%) families. The education level of the patients' parents also varied. The fathers of the majority of patients had a high level of education (78.6%). In contrast, a larger percentage of patients' mothers had a low level of education (35.1%). Among the included patients, the majority (77.8%) had one RCT-treated FPM. See Table 1.

The OHRQoL of the participants was assessed using the OHIP5-Ar questionnaire (17). Among the 482 children who agreed to participate, a large majority reported never experiencing several common oral health concerns mentioned in the

Table 1 Distribution of Patients According to Demographic Data, Healthcare Center, and Number of Root Canal Treatment per Patient (N = 482)

Demographic Data		No. of Subjects (%)
Age (years)	**At treatment visit** mean ± SD, range	14± 2.4, 9–18
	At assessment time mean ± SD, range	19.6± 3.5, 10.1–29
Healthcare Center	UDH	174 (36.1)
	KFAFH	138 (28.6)
	KAMC	170 (35.3)
Gender	Males	165 (34.2)
	Females	317 (65.8)
Nationality	Saudi	390 (80.9)
	Non-Saudi	92 (19.1)
Family income	Low	64 (13.3)
	Moderate	317 (65.8)
	High	101 (21)
Father's education level	Low	39 (8.1)
	Moderate	64 (13.3)
	High	379 (78.6)
Mother's education level	Low	169 (35.1)
	Moderate	125 (25.9)
	High	188 (39)
No. of RCT	One RCT	375 (77.8)
	Two RCTs	90 (18.7)
	Three RCTs	15 (3.1)
	Four RCTs	2 (0.4)

Abbreviations: No, Number; RCT, Root Canal Treatment; RCTs, Root Canal Treatments; UDH, University Dental Hospital; KFAFH, King Fahad Armed Forces Hospital; KAMC, King Abdulaziz Medical Center.

Table 2 Frequency of OHRQoL Questions Scores (N = 482)

Question	Zero	More Than Zero
Difficulty in chewing any food	337(69.9)	145 (30.1)
Painful aching in teeth	335 (69.5)	147 (30.5)
Uncomfortable about the appearance of teeth	375 (77.8)	107 (22.2)
Less flavor of food	461 (95.6)	21 (4.4)
Difficulty in doing usual jobs	366 (75.9)	116 (24.1)
Total OHRQoL score	322 (66.8)	160 (33.2)

Notes: Scoring: "Zero"= never experienced any of the oral health related problem; and More than zero is combination of (hardly ever, occasionally, fairly often and very often) experienced any of the oral health related problem.
Abbreviation: OHRQoL, Oral Health Related Quality of Life.

questionnaire. Particularly, 337 (69.9%) stated they never had difficulty chewing, 335 (69.5%) never had painful aching in their teeth, and 375 (77.8%) never felt uncomfortable about their teeth's appearance. Overall, 66.8% of the children reported never experiencing any of the OHRQoL issues assessed by the questionnaire falling into the category of having an optimal OHRQoL. See Table 2

To address the effect of confounding factors, logistic regression analysis was conducted. It found no statistically significant relationship between the dependent factor with optimal OHRQoL after RCT and the independent factors (P > 0.05). Although not statistically significant, treating one FPM with RCT increased the adjusted odds ratio for the optimal OHRQoL score compared to those with more than one tooth treated with RCT (P = 0.128; OR: 1.424). Moreover, low family income decreased the adjusted odds ratio of optimal OHRQoL compared to high family income (P0.542; AOR:0.684), indicating a tendency for lower family income to have lesser optimal OHRQoL than those with higher family income. See Table 3.

Table 3 Logistic Regression Analysis for the Effect of Gender, Family Income, Parental Education Level, and Tooth Location (Independent Factors) on Excellent OHRQoL Score (Dependent Factor)

Variable		Optimal OHRQoL (Zero Score) N(%)	Less Than Optimal OHRQoL (> zero) N(%)	OHRQoL
				AOR (95% CI) P-value
Gender	Male	110 (34.2)	55 (34.4)	0.964(0.643–1.447) 0.86
	Female	212 (65.8)	105 (65.6)	1
Family income	Low	43 (13.4)	21 (13.1)	0.684 (0.202–2.32) 0.542
	Moderate	211 (65.5)	106 (66.3)	0.951 (0.559–1.618) 0.853
	High	68 (21.1)	33 (20.6)	1
Mother education	Low	119 (37)	50 (31.3)	1.220 (0.858–2.171) 0.499
	Moderate	77 (23.9)	48 (30)	0.761 (0.451–1.283) 0.305
	High	126 (39.1)	62 (38.8)	1
Father education	Low	26 (8.1)	13 (8.1)	1.075 (0.29–3.99) 0.295
	Moderate	45 (14)	19 (11.9)	1.242 (0.538–2.643) 0.841
	High	251 (78)	128 (80)	1

(Continued)

Table 3 (Continued).

Variable		Optimal OHRQoL (Zero Score) N(%)	Less Than Optimal OHRQoL (> zero) N(%)	OHRQoL
				AOR (95% CI) P-value
Arch	Upper	104 (32.3)	62 (38.8)	0.764 (0.509–1.149) 0.196
	Lower	218 (67.7)	98 (61.3)	1
Number of RCT in each child	One tooth	258 (80.1)	117 (73.1)	1.424 (0.903–2.245) 0.128
	>One tooth	64 (19.9)	43 (26.9)	
Time elapsed$^\$$ *Mean±SD*		5.54±2.92	5.61±2.88	0.989 (0.923–1.09) 0.751
Patient age at RCT time *Mean±SD*		14±2.34	14 ±2.34	1.006 (0.926–1.094) 0.882

Note: $^\$$Time elapsed from the day of treatment to the date of the study in years.
Abbreviation: OHRQoL, Oral Health-Related Quality of Life.

Discussion

This study assessed the OHRQoL of pediatric patients who underwent RCT on FPMs. It utilized the OHIP-5 questionnaire, previously validated and translated into numerous languages.[15–17] The OHIP-5 is recognized for its conciseness and ability to reliably measure the influence of oral health on OHRQoL for adults, making it well-suited for pediatric research, minimizing participant burden while providing valuable insights into the impact of dental procedures on their well-being.

In the present study, more than half of the included patients (64.6%) had optimal OHRQoL following RCT. This result aligns with the conclusion of Hamedy et al in their narrative review as they reported that improvement in patients' quality of life following RCT is extremely high.[18] Moreover, Dugas et al[9] in their study reported that RCT resulted in positive effect on the quality of life. Wigsten et al[19] included 85 patients from six public dental clinics in Sweden to evaluate the effect of RCT on their quality of life compared to patients with extracted teeth. It was found that patients who had RCT had improved quality of life at 1-month follow up. While among the extraction group, similar improvement was not noticed.[19] Liu et al[20] in their study concluded that patients requiring RCT are deemed to have a lower quality of life. However, the above-mentioned previous studies included investigation of the quality of life in adult patients, which does not match the current study age group, thus comparing results was not achievable.

When the effect of patients' characteristics, namely gender and family income, on OHRQoL was evaluated, regression analysis was conducted and no significance was found. A previous study investigated the difference in OHRQoL based on gender and concluded that the OHRQoL was better among male patients compared to females, but the difference is not statistically significant. Nevertheless, comparison with the current study result could not be done as they used different assessment tool and applied the study on different age group.[21] This study showed better OHRQoL with higher family income. Although this difference was not statistically significant, it is supported by a previous systematic review conducted to evaluate the effect of parental socioeconomic status on children's OHRQoL. It was concluded that the majority of the studies suggested that children from families with higher socioeconomic status have better OHRQoL.[22]

The study has multiple strength. It involved multiple major hospitals in Jeddah city, catering to a heterogeneous population. Children underwent RCT treatment over a period of nine years were screened. The duration from the treatment commencement to the research date and its impact on the children's quality of life was evaluated. To date, no such study has been conducted. However, limitations of the study include a lower response rate, although nearly 60% aligns with acceptable ranges as per Baruch, Y. (1999).[23] Additionally, the socioeconomic distribution of the sample reflects the overall population, with over half belonging to families with moderate income and high parental education, which was found to be aligned with other studies in Jeddah, Saudi Arabia,[23] potentially allowing the generalizability of the research findings. Future prospective research might aid in minimizing the patients' recall bias and aid in confirming

the emerged trends of the current study. Moreover, the OHRQoL of pediatric patients treated with RCT in their compromised FPM could be compared with other management methods such as extraction.

Conclusion

RCT on FPMs can be a successful treatment option for pediatric patients, offering optimal oral health related quality of life. While logistic regression analysis did not yield significant results, it suggested potential associations between the number of treated teeth, family income, and oral health-related quality of life. Further investigation is needed to validate these trends.

Abbreviations

OHRQoL, Oral Health-Related Quality of Life; FPM, first permanent molars; RCT, root canal treatment; QoL, quality of life.

Data Sharing Statement

The data used in this study is available upon reasonable request from the corresponding author.

Ethics Approval and Informed Consent

This study complies with the Declaration of Helsinki. It was ethically approved by the Institutional Review board (IRB) of Faculty of Dentistry at King Abdulaziz University (172-11-19), Institutional Review board (IRB) of Ministry of National Guard at King Abdullah International Medical Research Center ((REC 407) and Research Ethics Committee of King Fahad Armed Forces Hospital ((H-01-R-005). Consent to participate was acquired from the participants' parents and/or guardians before they were included in the study. The ethics committees were informed of the parental verbal consent process.

Author Contributions

Conception: HJS, NB, WD; Study design: HJS, NB, WD; Methodology: HJS, NB, WD, JT, MIA, RZ, AB; Execution: HJS, NB, WD; Acquisition of data: HJS, WD, JT, MIA, RZ, AB; Data analysis and interpretation: HJS, WD; Project administration: HJS, NB, WD; Supervision: HJS, NB, WD; Writing – original draft: HJS, WD, NB; Writing and editing of final draft: HJS, NB, WD. All authors contributed to the methodology, drafting or revising the article, have agreed on the journal to which the article will be submitted, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

Disclosure

The authors declare no conflicts of interest in this work.

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