

A Comparison of Endodontic Treatment Factors, Operator Difficulties, and Perceived Oral Health–related Quality of Life between Elderly and Young Patients



SIGNIFICANCE

This study addresses gaps in knowledge and limitations in previous studies on endodontic treatment in elderly patients. This study is timely and disproves misconceptions and discrimination when treating elderly patients in today's aging society.

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ABSTRACT

Introduction: The purpose of this study was to compare endodontic treatment factors, treatment difficulties, and oral health–related quality of life (OHRQOL) between elderly and young patients. **Methods:** A total of 150 adults, 75 elderly (≥ 65 years) and 75 young patients (18–64 years), were recruited. Operators enumerated difficulties associated with communication, diagnosis, rubber dam application, access cavity preparation, canal localization, working length determination, instrumentation, and obturation after root canal treatment. The number of treatment visits, maxillary first molars with a second mesiobuccal canal, and the technical quality of the root filling were registered. Patients filled out questionnaires on pain, attendance of regular dental visits, esthetics, and masticatory function and the Oral Health Impact Profile-14. **Results:** Significantly more elderly had necrotic pulp ($P < .001$) and needed root canal treatment on teeth with full-coverage crown/bridge abutment ($P < .001$). It was significantly difficult to perform access cavity preparation and localize root canals on the elderly and on teeth with a full-coverage crown/bridge abutment. In regression analysis, the elderly presented with difficulties only during canal localization ($P < .05$). Second mesiobuccal canals were obturated in 43.5% of the young patients and 23.1% of the elderly patients. There were no significant differences in the number of treatment visits or the technical quality of root filling between the 2 groups. There were no significant differences in pain sensation, esthetics, masticatory function, or regular dental visits between the 2 groups. Elderly patients reported a significantly better OHRQOL ($P < .05$). Patients experiencing pain, patients needing treatment on anteriors/premolars, and females reported a significantly poorer OHRQOL ($P < .05$). **Conclusions:** The elderly presented with treatment difficulty during canal localization and had better OHRQOL compared with young patients. (*J Endod* 2021;47:1844–1853.)

KEY WORDS

Age-related changes in the pulp; canal localization; gerodontology; second mesiobuccal canal; Oral Health Impact Profile-14

A person of a chronological age of 65 years or older is referred to as “elderly.” The number of elderly, currently at 703 million globally, is expected to more than double in the next 30 years to about 1.5 billion. One in 6 people will consequently be over the age of 65 years, up from 1 in 11 in 2019¹. A survey on endodontists of the American Board of Endodontics found that patients over 65 years of age comprised 26% of all patients requiring endodontic treatment².

Ageism, a term first coined by Butler³ in 1968, refers to negative attitudes or prejudice toward older persons. Ageism results from stereotyping and myths surrounding old age. An investigation of dentists' knowledge and attitudes toward the elderly suggests that dentists hold negative stereotypes and have inaccurate perceptions of the elderly⁴.

Endodontic treatment in the elderly is theoretically the same as in young patients. However, endodontic considerations in the elderly are not without challenges. It is estimated that 1 in 3 persons between 65 and 74 years old have some degree of hearing loss and that 16%–20% have mild cognitive impairments^{5,6}. These medical conditions may result in communication difficulties. Therefore, dentists may inadvertently offer limited services to elderly patients, resulting in suboptimal care⁷.

A recent study in the United Kingdom reported that age discrimination in health care could mean that elderly patients did not receive the same standard of care as young patients⁸. In a classic study by Braun and Marcus⁹, treatment planning for patients over 60 years of age was different than for young patients, with an emphasis on extractions and removable prostheses. Unfortunately, age-related declines in orofacial sensorimotor functions means there will be impairment of biting forces, chewing, swallowing, and speech¹⁰. Moreover, each added year with an edentulous mandible increases the odds of residual ridge resorption, causing temporomandibular disorder and problems with the retention of removal prostheses, among others, in the elderly¹¹. The loss of natural dentition has been shown to be associated with dementia in the elderly¹². The impairment of adaptive and compensatory processes means that the elderly may have trouble adapting to the loss of teeth, new dental prostheses, or oral implants. Therefore, retaining natural teeth is the most preferable treatment option for the elderly. Furthermore, a recent systematic review reported that old age and systemic disease do not influence nonsurgical root canal treatment (RCT) outcomes¹³.

Health authorities worldwide are now confronting an increasing public health challenge, including a growing burden of oral disease among older people¹⁴. Endodontic treatment aims to improve quality of life (QOL)¹⁵. The original Oral Health Impact Profile (OHIP) instrument was based on Locker's conceptual framework and the World Health Organization's International Classification of Impairments, Disabilities and Handicaps consisting of 49 items¹⁶. This form has been simplified and adapted into a shorter form called the OHIP-14, which contains 14 items testing 7 composite domains¹⁷. The OHIP-14 measure can potentially uncover how endodontic disease and treatment are viewed from the perspective of the patient^{18,19}.

There is currently a gap in knowledge as to what aspects of endodontic treatment are challenging when treating an elderly patient. The primary aim was to compare treatment factors and difficulties encountered by

operators when performing RCT between the elderly and young patients. The secondary aim was to measure perceived oral health-related quality of life (OHRQOL) and self-evaluation of regular dental visits, esthetics, and masticatory function. The hypothesis is that it is more difficult to perform RCT on elderly patients, and the elderly have a poorer OHRQOL.

MATERIALS AND METHODS

Participants

More than 150 participants, including patients and endodontic treatment providers (operators), were recruited in this study. All patients received root canal treatment by operators at a private faculty practice in the city of Bergen, Norway, or at the undergraduate or postgraduate clinic at the Department of Endodontics at the Institute of Clinical Dentistry, Medical Faculty, University of Bergen, Bergen, Norway. The participants were recruited between February 2019 and October 2020. Both patients and operators were interviewed on the day of obturation.

Inclusion and Exclusion Criteria

Adults >18 years of age were included in the study. No sex differences were applied. All treatment procedures on a patient had to be performed by the same operator.

Patients who refused to participate or sign the written consent form were excluded. Questionnaires with missing data were also excluded.

Data Collection

The study was composed of three questionnaires, 2 for the patients and 1 for the operator. In addition, the following variables were registered: tooth number, coronal status, diagnosis, teeth with a second mesiobuccal (MB2) canal, the number of treatment visits, interappointment exacerbations, and the technical quality of root fillings.

Patient-Based Assessments

The first patient-based assessment form was a questionnaire on the experience of pain when treatment was initiated using a 10-cm visual analog scale (VAS) with "no pain" (VAS = 0) to "worst pain imaginable" (VAS = 10). Patients were asked to self-report if they were satisfied with the esthetics of their dentition and masticatory function. The responses were recorded as "satisfied" and "not satisfied."

The second was an assessment of OHRQOL using a previously translated version of the OHIP-14. The OHIP-14 questionnaire was originally translated into Norwegian by an experienced researcher and was back

translated into English independently by 2 dental researchers whose first language was English. The translated version of the original OHIP-14 questionnaire is widely used in epidemiologic studies^{20,21}. Each question was assessed based on the following response scale: 0 = "never," 1 = "hardly ever," 2 = "occasionally," 3 = "fairly often," and 4 = "very often" in the last 6 months. The individual domain score is derived by summing up responses of the 2 items within a particular domain where scores can range from 0–8. A total OHIP-14 summary score is derived by summing responses to all items, and scores can range from 0–56. A high score indicated poorer OHRQOL.

Operator Assessments

The operators assessed difficulties related to communication, diagnostics, and technical aspects of RCT, which encompassed rubber dam application, access cavity preparation, localization of the root canals, working length determination, instrumentation, and obturation related to the particular patient and treatment. Operators had to select 1 of the 3 following options in a questionnaire: easy, average, or difficult. Furthermore, operators were given the opportunity to report any other difficulties they encountered during treatment.

Technical Quality Evaluation of the Root Filling

The technical quality of the root filling was evaluated by 1 examiner (I.Z.-P.) after calibration, and a consensus was reached with a specialist in endodontics (S.R.H.) when in doubt. Postoperative radiographs were categorized according to the following criteria suggested by Ray and Trope²²: briefly, technical quality was broadly categorized as "good endodontics" if all canals were obturated, no voids were present, and the fill of the main gutta-percha point was within 0–2 mm from the radiographic apex and "poor endodontics" if 1 or more of the criteria in "good endodontics" were not met. The intraexaminer agreement test resulted in a reproducibility that was considered acceptable (Cohen κ = 0.84).

Statistical Analyses

All data were analyzed using SPSS software (Version 25; IBM Corp, Armonk, NY). Treatment difficulties were dichotomized as being not difficult (a combination of easy and average) and difficult. A comparison between groups with respect to demographics, patient-based assessment data, treatment difficulties, and the technical quality of root fillings was conducted using the chi-square test for categorical data. The internal consistency of the

TABLE 1 - The Demographic Data, Clinical Tooth Characteristics, and Patients' Self-evaluation Report for Elderly and Young Patients

Group	Variables	Young (n = 75)	Elderly (n = 75)	P value
Sex	Male	44	37	NS
	Female	31	38	
Age*	Years ± SD	47.5 ± 11.7	74.3 ± 4.9	<.001
	Range	25–64	65–88	
Coronal status*	Caries/restoration	57	35	<.0001
	Crown/bridge abutment	18	40	
Tooth type	Anterior/premolar	29	34	NS
	Molar	46	41	
Pulpal diagnosis*	Pulpitis	29	10	<.0001
	Pulp necrosis	29	50	
	Previously root-filled tooth	17	15	
Experience of pain	Yes	26	23	NS
	No	49	52	
VAS for pain	Mean ± SD	6.50 ± 2.5	5.5 ± 2.3	NS
	Range	1–10	2–8	
Regular dental visits	Yes	65	68	NS
	No	10	7	
Self-evaluation of dental esthetics	Satisfactory	59	67	NS
	Nonsatisfactory	16	8	
Self-evaluation of masticatory function	Satisfactory	68	67	NS
	Nonsatisfactory	7	8	
Number of treatment visits	1–3	65	67	NS
	>3	10	8	
Postoperative pain	Yes	7	9	NS
	No	68	66	
Frequently treated teeth	Maxillary right first molar	10	9	NA
	Maxillary left first molar	13	4	
	Mandibular right first molar	7	7	
	Mandibular left first molar	6	7	
Maxillary first molars	MB2 was obturated	10	3	NS
	MB2 not obturated	13	10	

NA, not applicable; NS, not significant; SD, standard deviation; VAS, visual analog scale.

P value obtained using the chi-square test for categorical data.

*Statistical significance ($P < .05$).

OHIP-14 questionnaire was examined by computing Cronbach alpha coefficients. A Student *t* test was used to compare the 7 domains and the total OHIP-14 scores separately for each evaluation. Data for the significantly different independent variables for access cavity preparation and canal localization were analyzed using binary logistic regression. A *P* value $\leq .05$ was considered significant.

Ethical Considerations

This research was approved by the Regional Committees for Medical and Health Research Ethics West, Norway (REK 2018/2118), and was performed in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. All participants were over

18 years of age and gave written informed consent. The data were deidentified after collection to observe the privacy rights of human subjects.

RESULTS

A total of 150 endodontic patients with a mean age of 60.9 ± 16.2 years were recruited in this study. Of these 150 participants, 75 were categorized as young (<65 years old) and 75 as elderly (≥ 65 years old). The data collected during treatment are presented in [Table 1](#).

Significantly more elderly patients needed root canal treatment on teeth with pulpal necrosis as the diagnosis and a coronal status of full-coverage crowns or bridge abutment ($P < .01$, [Table 1](#)). The most frequently treated teeth were first molars;

maxillary right ($n = 19$, 12.7%), maxillary left ($n = 17$, 11.3%), mandibular right ($n = 14$, 9.3%), and mandibular left ($n = 13$, 8.7%) ([Table 1](#)) molars. This was followed by mandibular right second molars ($n = 9$, 6.0%). A total of 36 maxillary first molars, 23 in young patients and 13 in elderly patients, were treated. The MB2 canal was obturated more frequently in young patients ($n = 10$, 43.5%) compared with elderly patients ($n = 3$, 23.1%), but this was not statistically significant ([Table 1](#)).

It was significantly more difficult for operators to perform access cavity preparation ($P < .05$) and canal localization ($P < .01$) on elderly patients compared with young patients ([Fig. 1](#)). Teeth with a crown and bridge abutment presented with significant difficulties during access cavity preparation and canal

localization as well (Fig. 2). Binary regression analysis with access cavity preparation and canal localization as independent variables showed that only canal localization was significantly difficult on elderly patients ($P < .05$; odds ratio = 2.66; 95% confidence interval, 1.18–5.99). Although treatment providers or operators had varied levels of expertise, difficulty was registered as easy, average, or difficult based on the need for assistance, the time taken to complete a procedure, and the extensive use of visual aids (eg, a dental operating microscope).

The technical quality of root fillings was registered as poor in 22% of the treated teeth (Fig. 3). There were no significant differences in the quality of root fillings between the elderly and young patients (Fig. 3). However, teeth presenting with difficulties during working length determination ($P < .05$), instrumentation ($P < .05$), and obturation ($P < .01$) resulted in significantly poor technical quality of root fillings (Fig. 4).

Results from the OHIP-14 questionnaire are presented in Table 2. The Cronbach alpha coefficient for all 14 items in the OHIP-14 questionnaire was 0.885, which is considered good. This indicates the extent to which participants who respond positively to 1 item also respond positively to other items, validating high internal reliability. Elderly patients had a significantly better OHRQOL on several domains compared with younger patients. Patients who experienced pain and women had significantly poorer OHRQOL compared with patients without pain and men,

respectively. Patients who needed treatment on anteriors and premolars had a significantly poorer OHRQOL compared with patients who needed treatment on molars (Table 2). There were no differences in OHRQOL on patients who claimed to visit or not visit a dentist regularly.

DISCUSSION

The main findings from this study were that it was difficult to locate canals on elderly patients. It was significantly difficult to perform access cavity preparation and canal localization on teeth with full-coverage crowns/bridge abutments. Significantly more elderly patients had teeth with full-coverage crowns/bridge abutments and pulpal necrosis. The MB2 canal was obturated less frequently in elderly patients. Difficulties during working length determination, instrumentation, and obturation resulted in poor technical quality of root fillings. The elderly patients needing RCT had a significantly better OHRQOL compared with young patients. Patients who were female, needing treatment on anteriors/premolars, and those who experienced endodontically related pain had a significantly poorer OHRQOL.

Age-Related Changes/Diagnosis

Age-related changes in teeth are an inevitable physiological process with morphologic and histologic changes. A continuous deposition of secondary dentin results in the reduction of the pulpal space dimension and narrowing of the

root canals with increasing age^{23,24}. In 1950, Gustafson²⁵ estimated age based on the narrowing of the pulp cavity. The aging process has been shown to cause pulp stone formations, calcifications, increased fibrosis, and reduced innervation^{23–25}. Age-related physiological changes may give unreliable results during vitality testing of the dental pulp in elderly patients. This may have contributed to the reason why elderly patients presented with necrotic pulp significantly more frequently than young patients.

Access Cavity Preparation

It was significantly more difficult to perform access cavity preparation and canal localization on teeth with full-coverage crown/bridge abutment. Although calcifications are more prevalent with aging, it can also be a consequence of inflammatory changes in the dental pulp in young teeth²⁶. Swift and Byers²⁷ reported that pulpal response to injury is similar between young and old teeth. Caries, dental restorations, crown preparations, and periodontal disease can accelerate pulpal aging²⁸. Access cavity preparation on teeth with a full-coverage crown was difficult because it was not possible to estimate radiographically the location of pulp horn(s), the size of the pulp chamber, or the height of the pulpal floor. The lack of information from the preoperative radiographs can create uncertainty and guesswork during access cavity preparation, contributing to the difficulty experienced by the operators in this study.

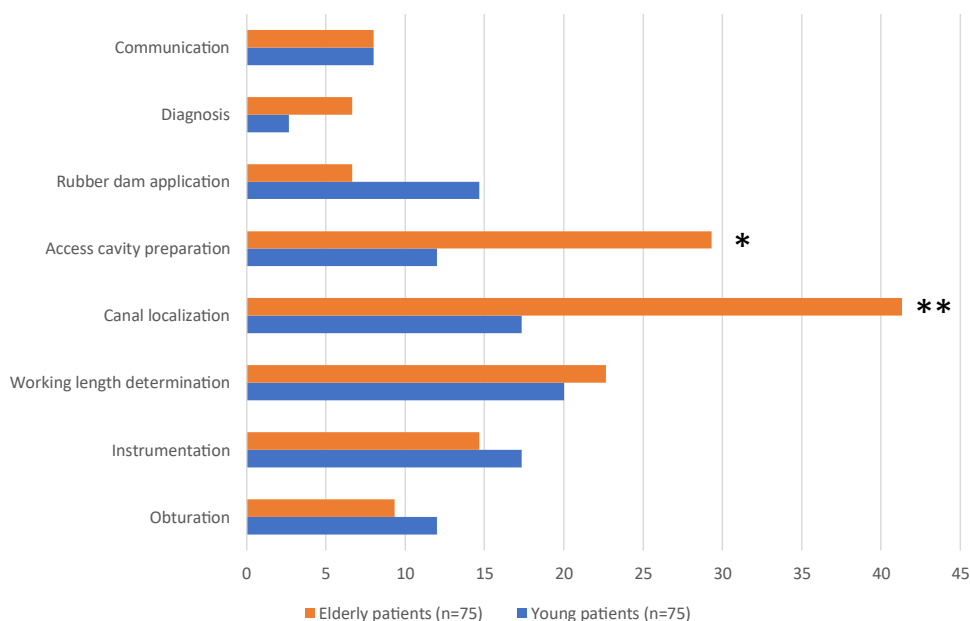


FIGURE 1 – The percentage of teeth presenting with difficulties during RCT. A comparison between elderly and young patients. Significant differences during access cavity preparation and canal localization. * $P < .05$. ** $P < .01$.

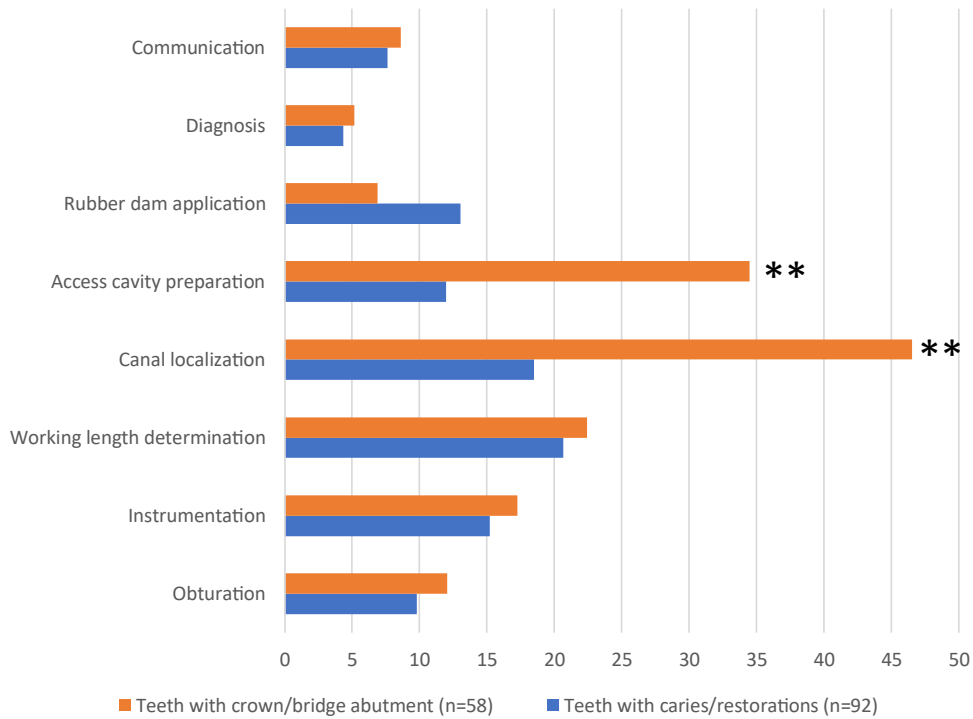


FIGURE 2 – The percentage of teeth presenting with difficulties during RCT. A comparison between teeth with a crown or bridge abutment versus teeth with caries or fillings. Significant differences during access cavity preparation and canal localization ** $P < .01$.

Canal Localization

In the regression analysis, only canal localization was difficult in the elderly patients with an odds ratio of 2.6, indicating that it was approximately 3 times more difficult to localize canals in the elderly patients than in the young patients. Aboshi et al²³ reported that the

coronal one third of the root correlated with age-related changes and not the middle or apical third of the root canal. This suggests that age-related narrowing or obliteration of the coronal one third can lead to difficulty during canal localization but not necessarily when negotiating a file to the working length. This

finding is in agreement with the current study because difficulty was encountered during canal localization but not during working length determination, instrumentation, or obturation, confirming that the middle and apical thirds of the root canal were patent in elderly patients. Teeth with a crown/bridge abutment

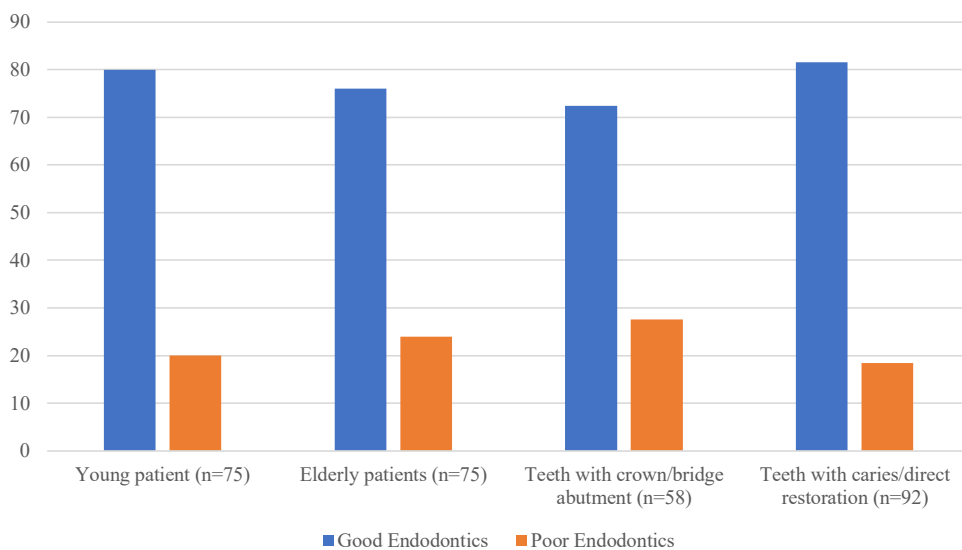


FIGURE 3 – The percentage of teeth with “good” and “poor” endodontics. No significant differences between young and elderly patients or between teeth with a crown or bridge abutment and teeth with caries or restorations.

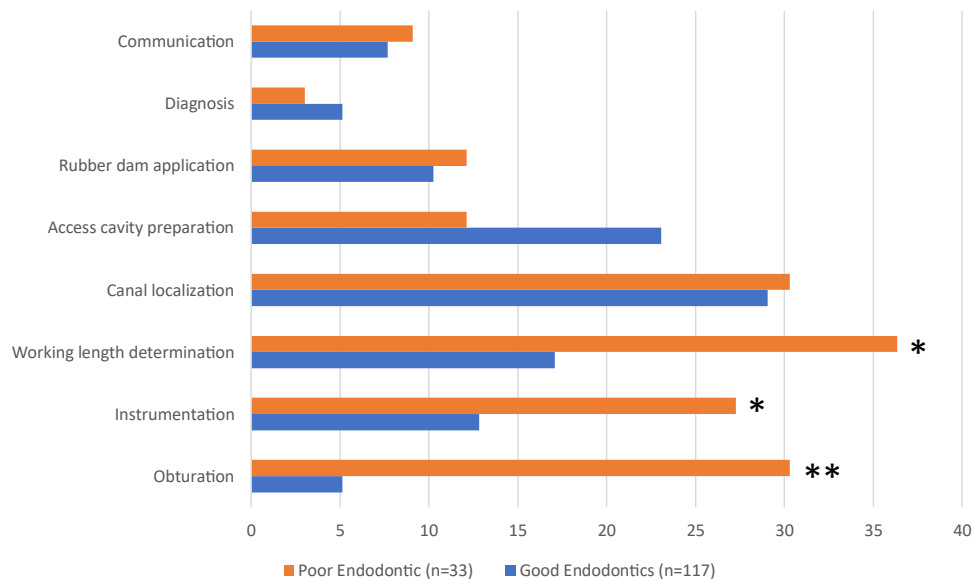


FIGURE 4 – The percentage of teeth presenting with difficulties during RCT. A comparison between teeth with “good endodontics” versus “poor endodontics.” Significant differences during working length determination, instrumentation, and obturation. * $P < .05$. ** $P < .01$.

presented difficulty during canal localization similar to elderly patients. This is most likely due to the accelerated injury-induced pulpal aging after crown preparation²⁸.

The localization of the MB2 canal in a clinical setting is lower than in *in vitro* studies^{29–31}. In a large PennEndo database study, the MB2 canal was located in 43.61% of first maxillary molars³¹. In this study, the MB2 canal was obturated in 43.5% of young patients, which is in agreement with previous studies^{30,31}. However, in elderly patients, the MB2 canal was obturated less frequently (23.1%). Iqbal and Fillmore³¹ reported that age was a significant contributor to the number of canals being located. *In vitro* and clinical studies that reported a higher number of MB2 canal localizations did not report the age of the patient. Age-related calcifications could have led to MB2 canals being obliterated and therefore not obturated in this study. Furthermore, only obturation of a separate MB2 canal was registered in this study. Therefore, localization of the MB2 canal without instrumentation or if the MB2 canal combined into a single mesiobuccal canal after instrumentation was not reported in this study. There were no significant differences in obturation of the MB2 canal between elderly and young patients; however, the sample size of the maxillary first molar was limited, and, therefore, these results are not conclusive. A recent clinical study by Studebaker et al²⁹ reported that the MB2 canal was often not localized in maxillary molars with full-coverage crowns, suggesting difficulty in canal localization. This is in agreement with the

findings in this study in which difficulty was encountered during canal localization on teeth with a full-coverage crown/bridge abutment.

Other Treatment Difficulties

In this study, communication and diagnosis were not different between the elderly and young patients. Elderly patients may have complex medical histories and/or physical disabilities. However, the elderly patients in this study were not given any special treatment compared with the young patients, and there were no significant differences in the number of treatment visits.

Rubber dam application was more difficult on young patients, but this finding was not significant. This was probably due to the need for pretreatment modification before rubber dam isolation on young patients with large carious lesions. Several operators commented on difficulties in achieving anesthesia on patients presenting with pulpitis and post removal during retreatment. However, there were too few incidences for formal analysis.

Sensation of Pain

The elderly did not experience a reduced sensation of pain, which was measured with the VAS, compared with young patients. This was unexpected because reduced innervation of the aging dental pulp should result in reduced pain sensation²⁴. The VAS was similar to a previous study on patients with endodontic pain³². Postoperative pain was reported by 16 (10.7%) patients from both

groups. The elderly patients in this group did not have a higher incidence of postoperative exacerbations, suggesting a similar immune response as young patients.

Technical Quality of Root Filling

There were no significant differences in the technical quality of root fillings between the elderly and young patients. Interestingly, cases in which operators encountered difficulties during working length determination, instrumentation, and obturation resulted in a significantly poorer technical quality of treatment. These difficulties were not limited to the elderly patients.

OHRQOL

Endodontic treatment improves QOL according to the latest review by Neelakantan et al¹⁵. Patients experiencing pain reported significantly poorer QOL in all domains, except functional limitation. This is not surprising because pain naturally has a large impact on the QOL of an individual. Elderly patients in this study reported significantly better OHRQOL. This finding is contrary to our expectation because the combination of endodontic problems with accumulated age-related oral disease was expected to result in a poorer OHRQOL. However, these findings are in agreement with several studies that demonstrated a significant reverse age association with OHIP-14 scores^{20,33}. Young people perceive oral health as having a greater impact on their QOL than older people³⁴. It has been proposed that older individuals may

TABLE 2 - The Mean \pm Standard Deviation of Oral Health–related Quality of Life (Oral Health Impact Profile [OHIP]-14) for the 7 Domains and the Total OHIP Score according to Patient Variables

Variables	Functional limitation	Physical pain	Psychological discomfort	Physical disability	Psychological disability	Social disability	Handicapped	Total OHIP score
Elderly (<i>n</i> = 75)	0.60 \pm 1.40	1.16 \pm 1.42	0.84 \pm 1.69	0.37 \pm 0.90	0.77 \pm 1.40	0.60 \pm 0.99	0.59 \pm 1.26	4.93 \pm 6.74
Young (<i>n</i> = 75)	0.45 \pm 0.89	2.03 \pm 1.81	1.72 \pm 2.10	0.80 \pm 1.50	0.96 \pm 1.42	0.68 \pm 1.30	0.77 \pm 1.49	7.41 \pm 7.88
<i>P</i> value	NS	<.01*	<.01*	<.05 [†]	NS	NS	NS	<.05 [†]
Men (<i>n</i> = 81)	0.40 \pm 0.86	1.25 \pm 1.38	1.00 \pm 1.77	0.37 \pm 0.77	0.54 \pm 1.07	0.40 \pm 0.83	0.49 \pm 1.12	4.44 \pm 5.44
Women (<i>n</i> = 69)	0.68 \pm 1.44	2.00 \pm 1.89	1.61 \pm 2.11	0.84 \pm 1.61	1.25 \pm 1.65	0.93 \pm 1.39	0.90 \pm 1.61	8.20 \pm 8.81
<i>P</i> value	NS	<.01*	NS	<.05 [†]	<.01*	<.01*	NS	<.01*
Absence of pain (<i>n</i> = 101)	0.50 \pm 1.25	1.20 \pm 1.52	0.99 \pm 1.67	0.41 \pm 0.82	0.65 \pm 1.20	0.42 \pm 0.90	0.39 \pm 0.96	4.55 \pm 5.60
Presence of pain (<i>n</i> = 49)	0.57 \pm 1.00	2.41 \pm 1.70	1.88 \pm 2.33	0.96 \pm 1.79	1.31 \pm 1.69	1.10 \pm 1.45	1.29 \pm 1.85	9.51 \pm 9.39
<i>P</i> value	NS	<.01*	<.05 [†]	<.05 [†]	<.05 [†]	<.01*	<.01*	<.01*
Molar (<i>n</i> = 87)	0.38 \pm 1.00	1.52 \pm 1.52	0.98 \pm 1.60	0.37 \pm 0.764	0.63 \pm 1.09	0.57 \pm 0.95	0.56 \pm 1.04	5.01 \pm 4.96
Anteriors and premolars (<i>n</i> = 63)	0.73 \pm 1.35	1.70 \pm 1.88	1.70 \pm 2.30	0.89 \pm 1.67	1.19 \pm 1.71	0.73 \pm 1.38	0.84 \pm 1.73	7.78 \pm 9.66
<i>P</i> value	NS	NS	<.05 [†]	<.05 [†]	<.05 [†]	NS	NS	<.05 [†]
Regular dental visits (<i>n</i> = 133)	0.50 \pm 1.15	1.59 \pm 1.70	1.23 \pm 1.90	0.53 \pm 1.14	0.85 \pm 1.37	0.64 \pm 1.10	0.67 \pm 1.82	6.02 \pm 7.03
No regular dental visits (<i>n</i> = 17)	0.71 \pm 1.40	1.65 \pm 1.58	1.65 \pm 2.34	1.00 \pm 1.90	1.00 \pm 1.72	0.65 \pm 1.54	0.76 \pm 1.82	7.41 \pm 10.10
<i>P</i> value	NS	NS	NS	NS	NS	NS	NS	NS

NS, not significant.

**P* < .01.†*P* < .05.

experience pain differently than younger individuals because of previous experience and may consider dental problems to be minor compared with systemic diseases²¹. A related effect may be that the need for RCT is more in line with expectations among the elderly. The elderly may see RCT as an opportunity to maintain good oral health and retain natural dentition, whereas young patients may perceive the need for RCT as a negative surprise. Endodontic problems in anteriors and premolars have a greater impact on QOL than on molar teeth. This is most likely due to esthetic concerns associated with anteriors and premolars. Another interesting finding is the sex difference in QOL; women needing RCT reported a significantly poorer QOL than men. Women experiencing a poorer OHRQOL has been reported in other Scandinavian epidemiologic studies^{20,21}. It might be possible that women are more conscious about their appearance and health, therefore having endodontic problems could have affected their QOL more than men. In a systematic outcome study, Torabinejad et al³⁵ reported that women tended to demonstrate more pretreatment anxiety than men. Women in this study may have felt more anxious over endodontic treatment than men, resulting in a poorer QOL. Further investigations are needed to evaluate the postendodontic treatment outcome and QOL in women.

One limitation of this study was that chronological age was used to differentiate the elderly from young patients. A recent study indicated that there are large differences worldwide in the onset and patterns of accumulating age-related burden of disease³⁶. The equivalent age to an average 65-year old in a global scale is 73 years for the Norwegian population (ie, a 73-year old in Norway is considered to be equivalent to a 65-year old

when age-related disease is taken into consideration). The highest score was attained by people living in Japan at 76.1 years and the lowest in Papua New Guinea at 45.6 years according to the Global Burden of Disease scale³⁶. The findings of the study facilitate the shift from thinking not just about chronological age but also about health status and disease severity of aging populations. Therefore, a 65-year old in this study population was perhaps healthier than a person of similar age in other countries.

The clinical implication of this study is to caution against stereotypic perceptions of elderly patients. The treatment difficulty associated with canal localization can be overcome with the use of magnification and illumination, either in the form of a dental operating microscope or dental loupes. The operators in the study provided treatment with the aid of a dental operating microscope when necessary. The elderly did not receive a technically “poor” quality of treatment, implying that the use of magnification is imperative to achieve a good technical quality of root fillings. Elderly patients in this study attended regular dental visits and were satisfied with dental esthetics and mastication. Studies on endodontic treatment challenges often depicted difficulties related to treatment on elderly who were frail, were medically compromised, or had a physical disability. However, there is a large population of the elderly who are physically fit, are healthy, and want to retain their natural teeth. According to the Global Burden of Disease Study in 2015³⁷, 65-year-old men in Norway can expect to live for 18.6 years, of which 14.4 years will be healthy life years. Sixty-five-year-old Norwegian women can expect to live for 21.5 years, of which

16.7 years will be healthy life years. Treating the elderly while they are in the “healthy life year” stage is important to reduce endodontic problems later in life when they succumb to a compromised stage of medical and physical disability and/or are living in nursing homes.

Future research needs to address endodontic treatment challenges in the elderly who are older than in this study group, particularly the eldest (>75 years), and elderly who are frail and/or living in nursing homes. The high incidence of elderly people having necrotic dental pulp despite regular dental visits deserves further investigation. Furthermore, the incidence of the location and obturation of the MB2 canal in elderly patients and the treatment outcome require further investigation.

In conclusion, the elderly presented with treatment difficulty during canal localization. This problem can be overcome with the use of magnification tools during canal localization. The perceived OHRQOL among the elderly needing RCT was better than for young patients.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Sivakami Rethnam Haug: Supervision, Project administration, Resources, Conceptualization, Investigation, Formal analysis, Resources, Validation, Writing – review & editing.

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The authors deny any conflicts of interest related to this study.

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