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Quality of life and satisfaction of patients two years after endodontic and dental implant treatments performed by experienced practitioners

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ABSTRACT

Objectives: To compare oral health related quality of life (OHRQoL) and patients' satisfaction with root canal treatment (RCT) and dental implant (DI) therapy performed by experienced practitioners.
Methods: Patients with both an RCT and a DI performed respectively by an endodontist and an oral surgeon with more than 15 years of experience two years prior to the study were included. The survival and satisfactory outcome of both treatments were verified with clinical and radiographic data. Participants completed two constructed questionnaire (one for each treatment). OHRQoL assessment included 24 items (OHIP-14 plus other relevant 10 items from the original OHIP-49 questionnaire). Satisfaction regarding duration, cost and pain (both during and after treatment) of treatment was assessed with a 0-10 scale and perceptions with true/false questions. Weighted sums for each dimension, total OHIP scores, prevalence of impact and general satisfaction of patients were then calculated for DI and RCT and compared using the Wilcoxon test for related samples. Patients' perceptions were compared with Chi-square test.
Results: Total OHIP scores were low for both treatments (8.82 and 7.87, respectively for RCT and DI). No significant differences were detected in OHIP total score or any dimension, except for physical pain (significantly higher for RCT than DI (p=0.044)). All patients were satisfied with both treatments; however, patients recalled that pain during treatment was significantly worse for RCT than DI (p=0.003).
Conclusions: High long-term OHRQoL and satisfaction is expected with either DI or RCT performed by experienced practitioners; however, physical pain dimension is higher for RCT.
Clinical significance: This study demonstrated a high satisfaction and long-term quality of life of patients undergoing both DI and RCT if treatments provide a functional balance and are performed by experienced practitioners. Very importantly, all participants had received both treatment modalities and being their own control eliminates individual variability.

1. Introduction

Quality of life (QoL) is affected by the number and position of remaining teeth in the dental arch [1]. As such, the main objectives in clinical practice are both the preservation of natural dentition and the replacement of lost teeth to provide the best possible functional balance for patients [2]. Root canal treatment (RCT) allows the preservation of natural teeth while preventing or eradicating the infection of the root canal space [3], while dental implants (DI) and prosthetic restorations allow the replacement of lost teeth [2]. In fact, recent advances in implant dentistry have affected treatment planning for patients with pulpal or periodontal diseases as well as those who have already lost their natural teeth [4]. Moreover, clinical decision making for compromised teeth has become a complex process [5,6] with two predictable alternatives, either the preservation of a specific tooth with endodontic procedures or the extraction of the tooth and replacement with implants. Guidelines and decisional tree charts have been published to help systematize such planning [7,8]; however, clinical decision making is an intricate process. It should not only contemplate tooth or treatment factors [9,10] but also, include personal preferences from both the operator [11,12] and very importantly the patient [13].

From a clinician perspective, survival and success rates, as well as viability of treatments are the main factors taken into consideration [5, 10]. However, it is complicated to compare the success rates for both treatment options since the definition of the term "success" vary considerably in scientific literature. The absence of clinical signs or

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symptoms plus either radiographic evidence of normal periodontal ligament space (strict criteria) or reduction of apical lesion size (loose criteria) is considered success for endodontic treatments[3]. However, most studies only determine the survival of implants and include cases with peri-implantitis or associated bone loss. Thus, it is difficult to compare endodontic outcome studies with strictly defined success criteria and implant outcome data based on survival. In fact, a similar survival and success rates have been reported for both treatment options. When success rates of both treatment modalities were directly compared, Doyle et al. [5] reported a significantly higher success rate after RCT (82.1%) than DI (73.5%), considering success the absence of peri-implant radiolucency or mobility for DI and a periapical Index (PAI) lower than 3 for RCT, and similar survival rates, 95% and 94% respectively for DI and restored root canal treated teeth [5]. On the other hand, Hannahan and Eleazer reported a similar success rate for DI and RCT but a higher need for post-treatment interventions after DI [14].

Furthermore, there has been a paradigm shift in health care in recent years; rather than relying solely on the perspective of clinicians, the assessment of treatment needs and treatment outcomes from the perspective of patients has been incorporated for a more reliable clinical decision making [15]. From the patient perspective, dental caries and tooth loss have a negative impact to QoL [13]. An adequate treatment plan should ameliorate the burden of oral diseases, improve life quality and hence consider patient-centred outcomes to decide whether to preserve or extract a tooth [16]. Both generic health-related QoL (HRQoL) and specific oral health-related QoL (OHRQoL) have been used to test the impact of treatments [17]. The Oral Health Impact Profile (OHIP) is a common method to measure OHRQoL [18]. Originally developed by Slade and Spencer (1994), it included 49 items that measure the impact of oral disorders on patients well-being [19]. A shorter OHIP-14 form was later suggested by Slade in 1997 [20]. The hierarchy of outcomes is based on the World Health Organizations of Impairments, Disabilities and Handicaps [18], and Locker's theoretical framework for measuring oral health. Locker's model suggests that the impact of diseases is sorted into a hierarchy with five oral ailments (impairment, functional limitation, pain and discomfort, disability, and handicap) that are sequentially related [21]. At the same time, both OHIP-49 and OHIP-14 contemplate seven dimensions based on Locker's model: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap [22].

Different studies have demonstrated positive outcomes and health gains after dental treatment in different areas, including RCT and DI [15, 23,24]. Recently, Wigsten *et al.* reported a higher improvement in both HRQoL and OHRQoL after RCT compared to a tooth extraction one month after treatment [25]. However, the replacement of the lost teeth was not considered in the study and tooth loss has a negative impact in patients QoL [1]. In fact, literature comparing patient-centred outcomes after RCT and DI is quite sparse. Gatten et al. observed a high satisfaction 1 year after treatment when different patients were submitted either to RCT or DI in a university setting [26]. However, it would be interesting to understand long-term preferences and perceptions of patients treated with both an RCT and DI by experienced clinicians, and with both the restored endodontically treated tooth and the implant-supported fixed prostheses fully functional. Therefore, the aim of this study was to compare long-term QoL and general satisfaction with RCT and DI of patients that have been submitted to both treatment modalities performed by experienced practitioners.

2. Materials and methods

This study was conducted with the approval of the Ethics Committee for Clinical Research CIC Saint Carlos Hospital (resolution number: 19/259-E). The STROBE checklist was followed.

Clinical databases of two private practices were searched for patients who had been submitted to both treatment modalities (RCT and DI) between 2017 and 2019 for a paired study design. Only those subjects having satisfied the following criteria were included in the study: patients 18 years old or older and having been submitted to both a DI and RCT between 2017 and 2019 performed respectively by the same oral surgeon and endodontist, both with more than 15 years of experience.

Subjects with the following criteria were excluded: pregnancy, history of medication for chronic pain, compromised immune response, cognitive difficulties or uncontrolled systemic diseases, absence of final restoration or prothesis or no written informed consent provided. Patients whose forms were incomplete or inadequately filled out were excluded also.

A sample size calculation was performed based on a previous study [26]. Considering an anticipated drop-out rate of 10%, a minimum sample size of 25 participants was required to detect differences for an effect size of 0.80 with an alpha error of 0.05.

2.1. Data collection

Twenty-seven patients met the inclusion criteria, were recalled and invited to participate in the study. Participants were informed about the purpose and process of the study, risks, benefits, and their right to self-determination regarding participation. All patients agreed to participate in the study and written consent was obtained before their enrolment (Fig. 1).

Clinical and radiographic data were obtained at the time of the study to verify the survival and outcome of both the restored endodontically treated tooth and the implant-supported fixed prostheses. Digital periapical radiographs were obtained using the parallel technique from both the root canal treated teeth and the dental implant. The absence of bone loss surrounding implants and the absence of periapical and periradicular lesions in endodontically treated teeth was confirmed. Clinical data such as pain to palpation or percussion, mobility and periodontal probing were registered. Only one patient presented pain to percussion and pathologic periodontal probing and was excluded from the study after confirming a diagnosis of tooth fracture.

The remaining 26 participants completed the following questionnaires to determine long-term OHRQoL and satisfaction with the root canal treatment and dental implant.

2.2. Questionnaires

Two constructed questionnaires (one for RCT and the other for DI) were given to all participants. Each questionnaire consisted of two different parts: the first part intended to assess OHRQoL and the second part addressed patients´ perceptions and satisfaction with the treatment received.

For OHRQoL assessment the questionnaire included 24 items: the 14 items in the OHIP-14 form [20] plus 10 extra relevant items from the original OHIP-49 questionnaire [19].

Table 1 shows the list of items included for each domain and specifies the correspondence of each item with those in OHIP-49 and OHIP-14. Specifically, it included multiple-choice questions to be answered with a 5-point Likert scale (never/hardly ever/occasionally/fairly often/always) for 7 domains: functional limitation (5 questions), handicap (2 questions), physical disability (4 questions), physical pain (4 questions), psychological disability (3 questions), psychological discomfort (3 questions) and social disability (3 questions). Respondents were asked to indicate how frequently they have experienced each problem after treatment, based on the five-point Likert scale.

In the second part of each questionnaire, participants were inquired about their satisfaction regarding duration of treatment, treatment cost and pain (both during and after treatment) in a 0-10 scale. Lastly, the questionnaire included the following 4 true/ false questions regarding their perceptions with the treatment received:

- Did your overall oral health improve immediately after treatment?

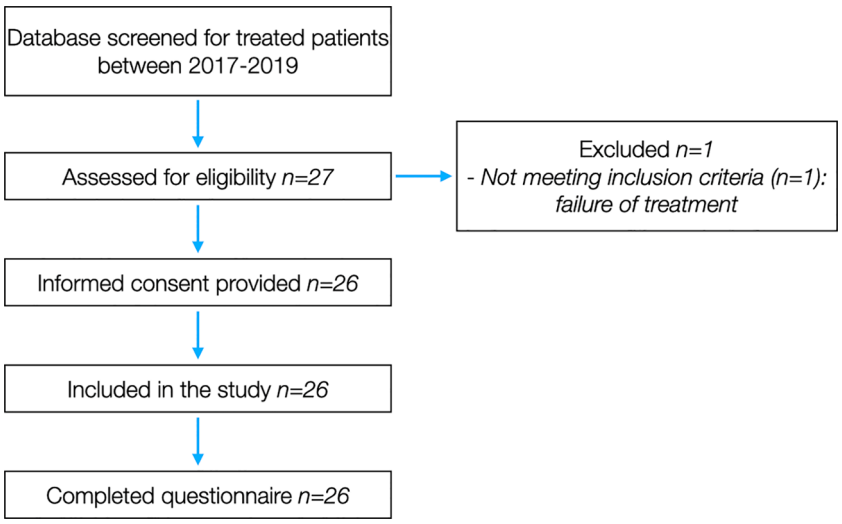

Fig. 1. Diagram showing selection of patients for the study.

- Did your overall oral health improve later?
- Are you satisfied with the dental treatment received?
- In a long-term basis, would you undergo the same treatment again?

2.3. Statistical analysis

2.3.1. OHRQoL assessment

Responses measured with the 5-point Likert scale were coded from 0 to 4: 0 (Never), 1 (Hardly ever), 2 (Occasionally), 3 (Fairly often) and 4 (Always). Coded responses were then multiplied by the corresponding weight suggested by Slade [20] for each specific question. The specific weight for each item is included in Table 1. Weighted sums for each dimension were then calculated independently for DI and RCT and compared using the Wilconxon test for related samples, after confirmation of the violation in the assumption of the normal distribution of data. Prevalence of impact (PI) was also calculated for both the originally described OHIP-14 [20] and for all 24 questions included in the present study (OHIP-24). After confirmation of the violation in the assumption of the normal distribution of data, Wilconxon test was again used to compare results between the two treatment options.

2.3.2. Satisfaction assessment

Likewise, general satisfaction of patients with DI and RCT in terms of duration of treatment, treatment cost and pain (both during and after treatment) was compared between the 2 treatment options with Wilcoxon test. Chi- square test was used to compare TRUE/FALSE responses regarding patients´ perceptions with the treatments received.

3. Results

All 26 patients participating in the study filled out the questionnaires completely and adequately. Mean age of participants was 60.65 years (SD 9.93); 16 were women (61.54%) and 10 (38.46%) men. In relation to location, 50% of implants and teeth were mandibular and 50% maxillary.

Table 1 shows mean (SD) OHIP scores for each dimension, and prevalence of impact for all OHIP items. No significant differences were detected either in OHIP total score or any OHIP items between RCT and DI ($p>0.05$), except for the physical pain dimension. Patients showed a significantly higher score when evaluating RCT than DI in this dimension ($p=0.044$). A higher score in the OHIP implies a worse QoL.

Table 1 also shows the prevalence of impact for RCT and DI for all items included in the questionnaire. A low impact was observed for almost all the items included in the OHIP questionnaire with 73.1-100% of responses ranging from “Never” to “Hardly ever” with no significant differences between groups. A higher impact was only observed for the item “food catching” for both groups.

Table 2 shows mean (SD) patient satisfaction regarding general cost and duration of treatment and pain during and after treatment. No significant differences were detected in the satisfaction of patients between RCT and DI regarding pain after treatment, treatment cost and duration; however, patients recalled that pain during treatment was significantly worse for RCT than DI ($p=0.003$).

All patients reported being satisfied with the treatment received, and all agreed they would undergo the treatment again if necessary. Only one patient considered that his oral health did not improve immediately after treatment either with RCT or DI.

4. Discussion

The present study aimed to compare long-term QoL and satisfaction of patients after being submitted to 2 different dental treatments. All patients in the study had at least one tooth preserved with an RCT and dental restauration, and another tooth replaced with a DI at least 2 years before the evaluation. Moreover, all treatments were performed by specialist with more than 15 years of experience in their respective field. These are the main methodological differences between the present study and previous studies that have also addressed QoL after dental procedures [26,27]. Having all patients received both treatment modalities and being their own control to address their satisfaction and perceptions about QoL after RCT and DI eliminates the individual variability present in the rest of the published studies.

Moreover, the questionnaire used in the present study had two different parts. The first evaluated OHRQoL with a modified version of pre-existing OHIP questionnaire and a second part evaluated patient satisfaction at least 2 years after having received both an RCT and a DI.

A common instrument to assess QoL in relation to oral disorders is the OHIP developed by Slade and Spencer [19]. It became a comprehensive measure of self-reported dysfunction, discomfort and disability attributed to oral conditions. Relevant dimensions of impact are defined by a range of questions, each one with a specific weight depending on the severity of the item that each question covers. The seven conceptual dimensions of impact are functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap [22].

The original OHIP contained 49 questions to address the 7 domains [19], but it was later simplified in a shorter questionnaire that maintained the original 7 conceptual dimensions [20]. This simplified

Table 1
Mean (SD) OHIP scores for each dimension, and prevalence of impact for all OHIP items. Items in each dimension, correspondence to OHIP-49 and OHIP-14, and specific weights are also listed.

Dimension	***Item***	**OHIP-49 (Specific weight)**	**OHIP-14**	***Mean (SD) OHIP scores***			***Prevalence of impact***									
							Never (%)		Hardly ever (%)		Sometimes (%)		Often (%)		Always (%)	
				RCT	DI	*p value*	RCT	DI	RCT	DI	RCT	DI	RCT	DI	RCT	DI
Functional limitation				1.79 (2.67)	2.04 (1.81)	>0.05										
	Difficulty chewing	Q1 (1.253)					84.2	84.6	11.5	11.5	-	-	3.8	-	-	3.8
	Trouble pronouncing words	Q2 (1.036)	Q1				88.5	92.3	7.7	7.7	-	-	3.8	-	-	-
	Noticed tooth that doesnt look right	Q3 (0.747)					92.3	84.6	3.8	11.5	3.8	3.8	-	-	-	-
	Taste worse	Q6 (0.931)	Q2				84.6	92.3	11.5	7.7	3.8	-	-	-	-	-
	Food catching	Q7 (1.181)					42.3	23.1	34.6	50	19.2	23.1	-	3.8	3.8	-
Physical pain				2.49 (2.91)	1.59 (1.81)	0.044										
	Painful aching	Q9 (1.213)	Q3				50	69.2	34.6	26.9	7.7	3.8	7.7	-	-	-
	Sensitive teeth	Q12 (1.053)					50	57.7	42.3	38.5	7.7	3.8	-	-	-	-
	Painful gums	Q14 (1.088)					61.5	65.4	30.8	30.8	3.8	3.8	3.8	-	-	-
	Uncomfortable to eat	Q15 (0.998)	Q4				69.2	76.9	23.1	19.2	3.8	3.8	-	-	3.8	-
Psychological discomfort				1.31 (3.31)	1.53 (3.63)	>0.05										
	Worried	Q19 (2.006)					76.9	73.1	11.5	15.4	7.7	3.8	-	3.8	3.8	3.8
	Self-conscious	Q20 (1.902)	Q5				96.2	96.2	3.8	-	-	3.8	-	-	-	-
	Tense	Q23 (2.025)	Q6				92.3	92.3	3.8	3.8	-	-	-	-	3.8	3.8
Physical disability				0.69 (1.65)	0.45 (0.8)	>0.05										
	Less flavor in food	Q26 (1.051)					84.6	76.9	11.5	23.1	3.8	-	-	-	-	-
	Diet unsatisfactory	Q29 (1.022)	Q7				96.2	92.3	-	7.7	3.8	-	-	-	-	-
	Avoid smiling	Q31 (1.070)					92.3	96.2	7.7	3.8	-	-	-	-	-	-
	Interrupt meals	Q32 (0.952)	Q8				88.5	76.9	3.8	19.2	3.8	3.8	-	-	3.8	-
Psychological disability				0.93 (3.38)	0.79 (1.64)	>0.05										
	Difficult to relax	Q35 (1.646)	Q9				92.3	84.6	-	7.7	3.8	3.8	-	-	3.8	3.8
	Concentration affected	Q37 (1.638)					92.3	96.2	-	3.8	7.7	0	-	-	-	-
	Been embarrassed	Q38 (1.437)	Q10				96.2	92.3	3.8	-	-	7.7	-	-	-	-
Social disability				1.44 (3.51)	1.25 (2.54)	>0.05										
	Avoid going out	Q39 (1.572)					88.5	88.5	-	-	-	3.8	-	-	11.5	7.7
	Irritable with others	Q42 (2.236)	Q11				84.6	84.6	7.7	11.5	7.7	3.8	-	-	-	-
	Difficulty doing Jobs	Q43 (1.805)	Q12				92.3	92.3	3.8	-	3.8	7.7	-	-	-	-
Handicap				0.2 (0.58)	0.19 (0.7)	>0.05										
	Life unsatisfying	Q47 (1.567)	Q13				96.2	96.2	3.8	-	-	3.8	-	-	-	-
	Unable to function	Q48 (1.879)	Q14				92.3	96.2	7.7	3.8	-	-	-	-	-	-
Total				8.82 (15.7)	7.87 (8.4)	>0.05										

Table 2
Satisfaction with treatment regarding cost, duration of treatment and pain (during and after treatment) for both groups.

Items	*RCT Mean (SD)*	*DI Mean (SD)*	*p*
Cost	5.69 (+/- 2.56)	6.23 (+/-2.53)	0.098
Time	4.85(+/-2.86)	5.15(+/-3.13)	0.464
Pain during treatment	3.00(+/-2.73)	1.93(+/-2.33)	0.003
Pain after treatment	2.12(+/-2.94)	2.00(+/-2.51)	0.778

OHIP-14 has been used to determine treatment impact in different areas of dentistry and has been translated to different languages [28]. Dugas et al. used another modified version of the OHIP to measure OHRQoL among endodontic patients, including 17 out of the original 49 items to include those that the authors considered relevant for endodontic diseases [29]. Likewise, the present study included 10 items from the original OHIP-49 to the OHIP-14 to compare OHRQoL after RCT and DI. The 10 questions added were considered relevant for the analysis. Specifically, in the dimensions psychological discomfort and disability, it seemed interesting to understand if the patients worried or concentration was affected after any of the treatment options. The rest were included in the domains related to functional limitation, physical pain, physical and social disability considering that all patients included in the study had a functional restored endodontically treated teeth or DI prothesis. For this reason, inquiring about certain aspects such as aesthetic alterations, aching in gums, or avoiding going out or smiling, were considered relevant items when the impact of both treatment plans was compared. Therefore, an OHIP-24 was used in the present study.

Some authors have further simplified the scoring method in the OHIP using a "simple count method" or an "additive method" [26,27,30]. Although these simpler methods have been considered a valid alternative, accounting for the specific item weights improved the performance of the OHIP [31]. Originally, the specific weight of each item was considered when calculating the total score for each dimension [22]. This method accounted for the severity of impacts, and it is considered to be the most sophisticated measure of oral health [17]. The present study used the original scoring method considering the specific weight of each item in a given dimension.

On the other hand, a standard questionnaire has not yet been suggested to measure the satisfaction of patients with a dental procedure [32]. Both general and specific questions have been used, but it has been suggested that an overall "global" question tends to generate false-positive responses from patients, while specific questions might prompt patients to think deeper and give more detailed responses [33].

In the present study, patient satisfaction was evaluated through eight specific questions, regarding pain, duration and cost of treatments, perception of health improvement and willingness to undergo treatment again. In fact, previous studies have shown that these items influence patients´ decisions when different treatment options are balanced [34].

Mostly, patients participating in the present study demonstrated high long-term satisfaction with both RCT and DI, without significant differences between both treatment options. These results might have been influenced by the fact that treatments were performed in private practices and by specialists with more than 15 years of experience. Hamasha and Hatiwsh evaluated OHRQoL and patient satisfaction after RCT performed either by a dental student or an specialist in endodontics and found higher satisfaction with the later [35]. In fact, in our study 73.1% to 100% of participants responded that they never or hardly ever experienced most of the OHRQoL impact items after their treatment. There was only one item, "food catching" that had a higher impact across participants (23% for RCT and 26.9% for DI). This item is not included in the OHIP-14 form and therefore was not reported by Gatten *et al.* who reported that "painful aching", "uncomfortable to eat", "self-conscious" and "felt tense" were the most commonly experienced OHRQoL impacts after treatments[26]. It is relevant to understand that patients´ concern is related to the retention of food and hence, it is more dependent on the coronal restauration than on the RCT or DI itself.

A significant improvement in OHQoL after both RCT and DI have been individually reported in several studies [36,37]. Filius et al. observed how QoL significantly improved one year after DI when compared to the absence of teeth [36]. Likewise, Liu *et al.* compared the changes in OHIP before and after endodontic treatment, and observed significant differences one and six months after treatment [37]. In the present study patients treated in the two years previous to the study were included, which allows for a longer term evaluation of quality of life.

Patients reported low OHIP scores for both RCT (mean score = 8.82) and DI (mean score= 7.78) with no significant differences between treatment modalities. Low OHIP scores after treatment indicates a high quality of life. Similarly, low scores have been reported for endodontic treatments [30,38] and DI [27] before, although all these studies used the simplified scoring methods to calculate OHIP total scores. On the other hand, the results of the present study differed from those obtained by Gatten *et al.* in terms of OHIP scores for some dimensions. They reported a significantly higher mean severity score for RCT, and also detected significant differences between treatments regarding psychological discomfort and psychological disability [26]. On the contrary, mean severity score did not differ between treatments in the present study and the only significant difference detected was related to physical pain.

Patients showed high satisfaction with both treatment modalities, and most importantly all of them would agree to pursue the same treatment plan again. However, perceptions about "pain during treatment" were significantly worse for RCT than DI. Pain management in endodontics might be complicated by several pre-treatment factors. Previous studies linked the risk of intra-operative pain to patient́s anxiety and the presence of preoperative pain [39,40]. In fact, patients frequently seek for endodontic therapy when they are in pain. On the contrary, treatment with DI is usually scheduled when the patient is in a good health condition. Indeed, this may influence the subjective perceptions for pain. But still, this is a very interesting result derived from the present study that should foster critical thinking for the endodontic community. Two years after treatment patients still recall suffering pain during an endodontic procedure; however, they seem not to care about the total duration of time until the final prothesis can be placed after a DI or the total cost of the procedure. There were no significant differences in patients´ perceptions regarding these 2 parameters.

Patients´ perspectives are determining factors in the decision-making process of choosing a treatment option. The results of the present study showed that QoL after treatment is similar for RCT and DI, except for the physical pain dimension. The decision of preserving natural dentition should always prevail, when possible, but an effort should be made to better manage intraoperative pain in endodontics to enhance long-term perceptions of patients. At the same time, these results must be taken with caution. These findings cannot be extrapolated to RCT or DI treatments performed by novel clinicians, graduate or undergraduate students. The present study tried to address OHRQoL and satisfaction of patients after different treatment options performed by expert clinicians with more than 15 years of experience; and hence, the findings are limited to those patients attended by experienced practitioners. Further research should be undertaken to investigate if OHRQoL and satisfaction of patients are similar for both treatment options when performed by novel operators or students. Future directions should also include long-term outcome studies that further help in the complex decision-making process between RCT and DI.

5. Conclusions

Within the limitations of this retrospective study, the results suggest:

- A high long-term quality of life and general satisfaction with either DI or RCT performed by experienced practitioners.

- Patients perceived that both treatments improved their oral health and would undergo the same treatment protocol again if necessary.
- Satisfaction of patients regarding pain after treatment, cost and duration of treatment did not differ between RCT and DI; however, patients recalled that pain during treatment was significantly worse for RCT than DI. Likewise, patients rated the physical pain dimension more negatively for RCT than for DI.

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All authors contributed to the present manuscript.

CRediT authorship contribution statement

Elena Sanz: Conceptualization, Methodology, Investigation, Writing – original draft. **Magdalena Azabal:** Methodology, Writing – review & editing. **Ana Arias:** Conceptualization, Methodology, Formal analysis, Data curation, Writing – review & editing, Supervision.

Declaration of Competing Interest

There is no conflict of interest related to this investigation.

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All authors contributed to the present manuscript. There is no conflict of interest related to this investigation.

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