Research Square

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A 10 Year Follow-up of Denture Satisfaction and Oral Health-Related Quality of Life with Implant-Retained Mandibular Overdentures

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Research article

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Abstract

Background: This 10-year follow-up study reports denture satisfaction and oral health-related quality of life of edentulous patients treated with two-implant mandibular overdentures.

Methods: This is a follow-up of a previous study carried out between 1997 – 2005. Originally, the patients were randomly divided into two groups: one receiving two- implant mandibular overdentures (IODs) and another, relined mandibular dentures (RCDs). The latter group were offered and accepted IODs at two years, which then became another IOD group. The main outcome variable of this study is patient opinion over time of the IODs. The participants completed a self-administered questionnaire containing demographics, 15 variables of denture satisfaction, and 20 questions of the Oral Health-Related Impact Profile (OHIP-20). Comparison between groups were made with Mann-Whitney U-tests for denture variables and T-tests for OHIP-20 variables. Changes over time were analysed with multilevel linear models for denture variables and multilevel ordinal regression analyses for OHIP-20 variables.

Results: Of the 54 original participants, 29 responded. Disregarding patients who had died at 10 years, this represented a response rate 76%. In the IOD group, the degree of denture satisfaction and OHIP-20 scores remained high and stable over the 10-years period for all but one variable. The RCD group showed a modest improvement of denture satisfaction and OHIP-20 scores for the first two years. After treatment with IODs, these variables improved at 10 years to the same level as the original IOD group.

Conclusions: The positive effect on denture satisfaction and oral health-related quality of life of edentulous patients treated with two-implant mandibular overdenture remains unchanged 10 years after treatment, confirming the advice that this should be the standard treatment for the edentulous mandible.

Trial registration: This study was approved by Norwegian Committee for Medical Research Ethics in Norway, Health Region West (2017/618) the 16th of May 2017.

Background

Patients who are affected by the loss of all teeth face disabilities that must be adequately addressed. Edentulism limits some of the patients' vital functions, such as speaking and eating (1) and may reduce subjective oral health and quality of life (2). These aspects are commonly assessed with the patients' degree of satisfaction with their dentures and their oral health-related quality of life (OHRQoL). The former is often composed of global and specific questions related to satisfaction with dentures; the latter is a multidimensional concept that focuses on how well-being of individuals is affected by oral problems (3).

Mandibular overdentures retained by two osseointegrated implants (IODs) overcome several of the limitations associated with conventional complete dentures and are shown to improve OHRQoL of edentulous patients (4–7). Conventional complete mandibular dentures and IODs have been compared in a number of studies. The findings indicate the superiority of IODs in terms of OHRQoL (1, 8–10). Based on such results, the McGill Consensus and later the York Statement concluded that the standard treatment for the edentulous mandible should be an IOD (11, 12). However, it should be noted that the insertion of new conventional dentures also tends to improve both OHRQoL and patient satisfaction (13), albeit to a lesser extent than IODs.

The insertion of dental implants to support a mandibular overdenture is regarded as a safe and predictable treatment. Mostly, short-time studies on IODs have been published (5, 14–18). Some uncertainty therefore exists regarding long-term results. As the number of elderly with IODs is rapidly increasing, this question becomes ever more important (19). Currently, to our knowledge, there is only one long-term follow-up study in which the 5, 10 and 20 years findings on clinical, radiographic and patient-reported outcomes with IODs were reported in three separate publications (20–22). The participants in that study were satisfied with their OHRQoL and prostheses at all times of recording. However, evidence from only one study needs to be corroborated. In our previous publication, findings on OHRQoL at baseline, three months and two-year were presented (23). This study reports present status and long-term trends of both OHRQoL and denture satisfaction after 10 years, thus expanding the knowledge on subjective long-term clinical outcome of IODs.

Methods

Study design and sample

The present study is a follow-up of a previous one carried out in the time period 1997–2005 by Gjengedal et al (23). Its participants originally consisted of 54 edentulous patients with complete dentures of satisfactory technical quality who were nevertheless dissatisfied with their mandibular denture. The patient sample was randomly allocated into two groups. One group (n = 28) had their existing mandibular denture converted into IODs, the other (n = 26) had their conventional mandibular denture relined (RCD). After two years the RCD group were offered the IOD treatment modality, which they all accepted. Hereafter this group thus became an IOD group. The main outcome variables of this study are changes over time in patient opinion of IODs and the status at 10 years.

Ethics approval and consent to participate

This study was approved by Norwegian Committee for Medical Research Ethics in Norway, Health Region West (2017/618) the 16th of May 2017. The surviving original participants received a letter in 2019 inviting them to take part in the present follow-up study. This letter contained information about the study and a form with informed consent to be signed if they wished to participate and a questionnaire.

Assessments

The questionnaire contained demographic items and 15 aspects of patient opinion of dentures. These included global assessments on patient satisfaction with maxillary and mandibular dentures considered together and with the maxillary and mandibular dentures respectively. The questionnaire also included specific aspects associated with wearing dentures: comfort, retention, fit, occurrence of soreness or pain, aesthetics (of both maxillary and mandibular dentures) and chewing, which were all registered on a 4-point Likert scale. The categories ranged from very satisfied to dissatisfied (see Table 3 and supplementary file 1) or, in the case of occurrence of soreness or pain, no soreness or pain, little soreness or pain, some soreness or pain, much soreness or pain. A 3-point Likert scale was used for the variables: speech (no problems, some problems, major problems) and the degree of usage of the mandibular denture (day and night, day only, never).

Table 3

Level of satisfaction of denture variables at 10 years (IOD + RCD)				
Variable	**Very satisfied (%)**	**Satisfied (%)**	**Not quite satisfied (%)**	**Dissatisfied (%)**
Both dentures considered together	8 (28)	11 (38)	9 (31)	1 (3)
Satisfaction, maxillary dentures	7 (24)	15 (52)	5 (17)	2 (7)
Satisfaction, mandibular denture	6 (21)	12 (43)	9 (32)	1 (4)
Comfort, maxillary denture	8 (28)	16 (55)	4 (14)	1 (3)
Comfort, mandibular denture	7 (25)	12 (43)	7 (25)	2 (7)
Retention, maxillary denture	5 (17)	15 (52)	7 (24)	2 (7)
Retention, mandibular denture	7 (25)	11 (39)	7 (25)	3 (11)
Fit, maxillary denture	9 (32)	16 (57)	3 (11)	0 (0)
Fit, mandibular denture	9 (33)	14 (52)	2 (7)	2 (7)
Aesthetics, maxillary denture	5 (18)	18 (64)	5 (18)	0 (0)
Aesthetics, mandibular denture	8 (29)	13 (46)	6 (21)	1 (4)
Chewing	5 (19)	15 (56)	6 (22)	1 (4)

Questions on occurrence of relines, fractures, renewals, troublesome instability of the mandibular denture and loss of Locator attachments were also asked; responses were dichotomised into no and yes.

In addition, the questionnaire included 20 items of the Oral Health Impact Profile (OHIP-20), which is designed to assess edentulous patients' OHRQoL (see supplementary file 2) (24). OHIP-20 questions are grouped into seven domains. Each specific oral health problem associated with denture wear is rated on a 6-point Likert scale ranging from at no time (1) to all the time (6). The OHIP-20 sum-score thus ranges between 20 and 120; a high score indicating oral health problems.

Statistical analyses

Statistical analyses were performed with IBM SPSS version 25 (IBM Corp, NY, US) and Stata version 15 (Stata Corp, TX, US). Standard descriptive statistics were calculated for all variables. Changes over time, at 3 months, 2 years and 10 years, for the IOD and the RCD groups, regarding denture satisfaction, were separately analysed using multilevel ordinal regression analyses taking the repeated measures for individual over time into account. Changes in the OHIP- 20 scores over the same time periods and groups were correspondingly analysed using multilevel linear models. Comparisons were made between the RCD and IOD groups at 10 years and between drop-outs and remaining patients at baseline with regard to denture satisfaction and the OHIP-variables, using independent sample Mann-Whitney U-test and independent samples T-test respectively. When multiple comparisons were made, Scheffee's method was used for post hock analyses based on the corresponding multilevel regression analysis.

Results

Sample

At 10 years follow-up, 16 of the 54 patients who participated in the original project had died. Of the 38 remaining patients, 29 responded and their responses analysed. This equals a response rate of 76%. The 9 drop-outs consisted of 4 patients with severe health problems and 5 who were non-reachable.

Demographics

The 29 responding patients consisted of 17 females (mean age 75 years, range 57–90, sd 8.30) and 12 males (mean age 77, range 67–84, sd 4.85).

Changes occurring over time

Changes occurring over 10 years for patient satisfaction with the mandibular denture are shown in Fig. 1 and for OHIP-20 sum score in Fig. 2.

Overall analyses over time of denture satisfaction are shown in Table 1. In the IOD group, only satisfaction with the mandibular denture showed a border-line significant reduction after 10 years. The post hock analysis showed a significant difference (p = 0.015) between 2 years and 10 years.

Table 1

Denture variables over time		
Variable	**ANOVA p-value**	
	IOD	RCD
Both dentures considered together	0.288	0.010
Satisfaction, maxillary dentures	0.495	0.664
Satisfaction, mandibular denture	0.049	0.001
Comfort, maxillary denture	0.122	0.423
Comfort, mandibular denture	0.052	< 0.001
Retention, maxillary denture	0.346	0.368
Retention, mandibular denture	0.062	0.002
Fit, maxillary denture	0.955	0.280
Fit, mandibular denture	0.149	0.008
Soreness or pain, maxillary denture	0.712	0.060
Soreness or pain, mandibular denture	0.231	0.003
Aesthetics, maxillary denture	0.849	0.056
Aesthetics, mandibular denture	0.717	0.062
Chewing	0.165	0.003
Speech	0.398	0.206

In the RCD group, significant differences between the time periods were found in chewing, both dentures considered together and all variables pertaining to the mandibular one, except aesthetics. Post hock analyses of these variables

show that there were significant improvements in denture satisfaction between recordings made before intervention with implants and overdenture (3 months and 2 years) and after intervention (8 years), with p-values ranging between < 0.001 and 0.007. Data of usage of the mandibular denture were insufficient for computation of differences over time.

Overall analyses over time of OHIP-20 domains and sum scores for the IOD and RCD groups are shown in Table 2. None of the variables of the IOD group showed significant differences over the 10 years observation period (all p > 0.05). Regarding the RCD group, all the variables except the domain handicap showed significant changes after the intervention with implants and overdenture. Apart from handicap, the post hock analyses showed significant differences between 2 years and 10 years for all OHIP-20 domains and sum score, with p-values ranging between < 0.001 and 0.034. Between 3 months and 10 years, post hock analyses showed significant differences for functional limitation, physical pain, psychological disability and social disability, with p-values ranging between < 0.001 and 0.034.

Table 2

OHIP-20 domains and sum score over time								
IOD group					RCD group			
Variable	**3 months**	**2 years**	**10 years**	**ANOVA**	**3 months**	**2 years**	**10 years**	ANOVA
				p-value				p-value
	Score (Std.Err.)	Score (SD) (Std.Err.)	Score (SD) (Std.Err.)					
Functional limitation	7.52 (13.51)	6.23 (0.56)	7.43 (0.65)	0.268	11.23 (0.74)	11.42 (0.75)	8.09 (1.02)	0.005
Physical pain	7.61 (0.65)	7.37 (0.70)	8.16 (0.82)	0.725	12.65 (0.93)	13.41 (0.94)	7.25 (1.19)	< 0.001
Psychological discomfort	3.85 (0.38)	3.96 (0.41)	3.94 (0.48)	0.981	5.19 (0.60)	6.20 (0.60)	3.83 (0.77)	0.006
Physical disability	6.57 (0.58)	6.77 (0.62)	6.76 (0.72	0.954	10.50 (1.02)	11.48 (1.03)	8.11 (1.33)	0.035
Psychological disability	3.57 (0.34)	3.45 (0.36)	3.60 (0.42)	0.944	5.35 (0.62)	6.03 (0.63)	3.46 (0.78)	0.002
Social disability	4.21(0.36)	3.84 (0.38)	4.53 (0.45)	0.430	4.85 (0.61)	5.15 (0.61)	3.86 (0.66)	0.037
Handicap	3.28 (10.56)	2.89 (0.30)	3.19 (0.36)	0.764	4.35 (0.53)	4.40 (0.54)	3.37 (0.68)	0.226
Sum score OHIP-20	35.82 (2.49)	34.55 (2.68)	37.68 (3.14)	0.707	54.04 (4.32)	58.06 (4.36)	37.31 (5.18)	< 0.001

Comparison between the RCD and IOD groups at 10 years

RCD and IOD groups were not significantly different at 10 years, neither in terms of any of the denture variables (p-values ranging from 0.11 to 0.93) nor OHIP-20 domains or sum score (p-values ranging from 0.41 to 0.82).

The level of satisfaction with dentures and OHIP-20 at 10 years, IODs and RCDs pooled

The patients' level of denture satisfaction at 10 years is shown in Table 3. Dissatisfaction with the dentures ranged between 0 and 3 patients (0–11%). The latter number referred to the retention of the mandibular denture. Also, the

maxillary denture did not cause any soreness or pain for 11/29 patients (38%), little soreness or pain for 15/29 (52%) some soreness or pain for 3/29 (10%) and much soreness or pain for 0. The corresponding numbers for the mandibular denture were 9/28 (32%), 16/28 (57%), 3/28 (11%) and 0. In regard to speech, 16/28 (57%) of the patients had no problems, 11/28 (39%) had some problems and 1/28 (4%) had major problems. The mandibular denture was used day and night by 18/28 (64%), during daytime only by 9/28 (32%) and never by 1/28 (4%).

The scores of OHIP-20 domains and sum score at 10 years are shown in Table 4. The least oral health problems were found for the domains Handicap and Psychological disability, with scores 3.31 and 3.78, respectively.

Table 4

Level of OHIP-20 at 10 years (IOD + RCD)	
Variable	**Score (sd)**
Functional limitation	7.98 (3.43)
Physical pain	8.03 (3.22)
Psychological discomfort	4.04 (2.46)
Physical disability	7.18 (3.52)
Psychological disability	3.79 (2.52)
Social disability	4.16 (2.26)
Handicap	3.31 (2.02)
Sum score OHIP-20	38.61 (15.58)

Drop-out analysis: Comparison at baseline between drop-outs and responders at 10 years
There were no statistically significant differences at baseline between drop-outs and responders for any of the denture variables (p-values ranging from 0.14 to 0.97) or for any of the domains and sum scores of OHIP-20 (p-values ranging from 0.27 to 0.95).
Maintenance, repairs and technical problems of the mandibular denture at 10 years
The mandibular denture was found unstable by 12/26 (46%) of the patients, and 6/24 (25%) of the mandibular dentures were relined. Also, 7/28 (25%) of mandibular dentures had fractured and 8/28 (29%) of them were renewed. Locator attachments were replaced in 2/17 (7%) of cases. Moreover, 9/28 (32%) of the maxillary dentures were remade.

Discussion

The main finding of this study indicates an immediate improvement of denture satisfaction and OHRQoL after treatment with mandibular overdentures retained by two implants, which was maintained throughout the follow-up period of 10 years. The striking effect of such treatment on OHRQoL and denture satisfaction is further demonstrated by the fact that the RCD group only showed a modest improvement after baseline, but a radical one after they received IODs.

One of the most important objectives of any kind of treatment is that the patients are satisfied with the outcome. Seeing that the data upon which these results are based are subjective assessments by the patients, and the positive effect is maintained over such a long period of time, this objective is undoubtedly achieved for the present

patient sample. These findings thus tend to corroborate the McGill Consensus Status on Overdentures (11) and the York Consensus Status (12), that implant retained overdentures should be regarded as the first-choice standard of care for edentulous patients.

An important consideration is to what extent findings can be regarded as representative for the general edentulous population. On the one hand, there is no doubt that the present patient sample was highly selected: One of the original intake criteria was that they should all be dissatisfied with their existing mandibular denture (23). Also, some of them had dentures made by dental students under the supervision of qualified university teachers, and might for that reason be atypical. Furthermore, both the surgical and prosthodontic two-implant mandibular overdenture treatment were performed by specialists in their fields, and the number of participants was fairly small. The fact that many participants were lost, mainly due to mortality during the follow-up period, may theoretically also bias the results.

On the other hand, it seems likely that patients who were dissatisfied with their mandibular denture, would also be the most challenging to satisfy. Less than 1/3 of the patient sample was recruited from dental school patients. The rest were recruited, either by advertisements in seven newspapers in the city of Bergen and surrounding regions, or by referrals from several general dental practitioners (23). Thus, patients from both urban and rural areas participated.

True, the patient sample of this study was small. However, treatment with two-implant mandibular overdentures is presently shown to have a striking and long-lasting favourable effect on patient satisfaction with the dentures and OHRQoL. This makes bias due to a small patient sample less likely. The same is indicated by the fact that, excluding deceased patients, 76% of the patients responded at 10 years. Also, in Norway, public subsidy of such treatment is on condition that insertion of implants is performed by specialists in oral surgery and overdentures made by prosthodontists or specially trained and qualified general practitioners.

Moreover, the theoretical possibility of bias due to differences between remaining patients and drop-outs seems less likely, as no statistically significant differences were found between the two groups for any of the variables of denture satisfaction or OHRQoL at baseline. Even though, for the above reasons, it seems likely that the present findings might also be representative for other edentulous patients, this supposition must be tested with other patient samples and other settings.

Presently, to our knowledge, there is only one investigation in which the 5, 10 and 20 years findings on patient-reported outcomes with IODs have been reported (20–22). Different methods of recording patient satisfaction and OHRQoL were used in each of these. Consequently, the development over time could not be reported; only the end outcomes. In the 20-years report (20), OHRQoL was measured with the non-disease-specific EQ-5D and EQ VAS QoL (25). Neither OHRQoL, as measured by these instruments, nor the level of the outcomes can therefore be directly compared with the present OHIP-20 results. Nevertheless, the concurrent main findings of these two long-term studies unequivocally indicate that the level of satisfaction and OHRQoL remains high, even after such long periods of observation.

Other studies, with shorter follow-up periods of 3 (15, 26) and 5 years (14) respectively, appear to show similar significant improvement of OHRQoL after being treated with IODs. By contrast, no such difference was found in a retrospective study (27) conducted after four years between patients treated with IODs and conventional dentures. Unlike the follow-up studies, these patients were not seeking treatment, which might explain the difference. Also, the

considerable human capacity to adopt to difficult situations may have played a part. The shorter-term reports all used OHIP-14, the results of which are not directly comparable with the presently used OHIP-20.

Two of these studies also report denture satisfaction (26, 27), but with instruments different from each other and the present study. Even if not directly comparable, apparent high levels of denture satisfaction were recorded.

As indicated above, not only changes over time, but also the level of OHRQoL and denture satisfaction are of clinical interest. In the present study, the OHIP-20 sum score was 38.61 at the end of the observation period. This level is 18.61 points from the theoretically most favourable score of 20 of this scale (range 20–120), which appears to be similar to short-term post-operative results reported by others (9). However, a major problem when comparing present OHIP sum scores with those of others, is that different numbers of items and categories are sometimes used measuring basically the same phenomenon.

A case in point is OHIP-EDENT, which, compared to OHIP-20, contains 19 items versus 20, categories ranging from 0–4 versus 1–6 and a theoretical range of 0–95 versus 20–120. A pre-intervention sum score norm of 28.6 has been reported, based on a meta-analysis of OHIP-EDENT (28). However, if the OHIP-EDENT range is regarded as a continuum ranging from 0–100 per cent, then this sum score is 30.1% (28.6/95) from the theoretical minimum. The corresponding present post-intervention OHIP-20 sum score was 18.61% (38.61- 20) from the minimum value, which may appear lower and perhaps more favourable. This supposition is strengthened by the fact that the wording of all but one of the items of the two OHIP versions are identical.

Denture dissatisfaction ranged between 0 and 3 patients (0–11%) for all variables in our study. Although these levels cannot be directly compared with others, the steep decline of OHIP-20 score depicted in Fig. 1, indicating radical improvement of OHRQoL, and the low number of denture dissatisfaction, testify to a subjectively successful treatment.

Of the present OHIP-20 domains, handicap, psychological disability and psychological discomfort show low scores, indicating that these areas are the least challenging for the patients. Similar short-term results have been reported by others (10).

Over the 10-year follow-up period a number of maintenance problems arose. Thus, about ¼ of the patients reported that their mandibular denture had to be relined or had fractured. Even more patients had their dentures remade. Some of the remakes may be related to the fact that new mandibular dentures were not made at baseline, but the existing dentures were converted to overdentures (23). Furthermore, almost half of the patients experienced problems with the stability of the overdentures, most likely because of wear caused by Locator matrixes that frequently had to be replaced.

Conclusions

Within the defined limitations, the findings of this study indicate that a high degree of denture satisfaction and OHRQoL can be achieved and remain stable over a period of 10 years after intervention with two-implant mandibular overdenture, even among patients dissatisfied with their dentures at baseline.

STROBE guidelines

This study adheres to STROBE guidelines

Abbreviations

IOD
Implant OverDenture
RCD
Reline Conventional Denture
OHIP-20
Oral Health Impact Profile-20
OHIP-EDENT
Oral Health Impact Profile for Edentulous
OHRQoL
Oral Health-Related Quality of Life

Declarations

Ethics approval and consent to participate: This study was approved by Norwegian Committee for Medical Research Ethics in Norway, Health Region West (2017/618). An informed consent to participate in the study was obtained from all participants.

Consent for publication: All patients participating in this study received a letter containing information about the study and a form with informed consent to be signed if they wished to participate and a questionnaire. All 29 participants in the study signed this form. In so doing, they consented that the information given could be used for publication.

Availability of data and materials: The data are not publicly available for reasons of anonymity. The dataset used and/or analysed during the current study is available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Author´s contributions: GM collected data from all patients, supplied and up-dated the original dataset and provided inputs to the manuscript. CS collected and helped organise the data. SAL chose the appropriate statistical methods and analysed the data. EB interpreted the results and edited the final version of the manuscript. HG made available the original dataset and provided essential inputs to the design of the study and manuscript. All authors contributed to, read and approved the final manuscript.

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29. Supplementary. files.
30. *Supplementary file 1*.
31. Denture. satisfaction (questionnaire).
32. *Supplementary file 2*.
33. OHIP-20. (Questionnaire).

Figures

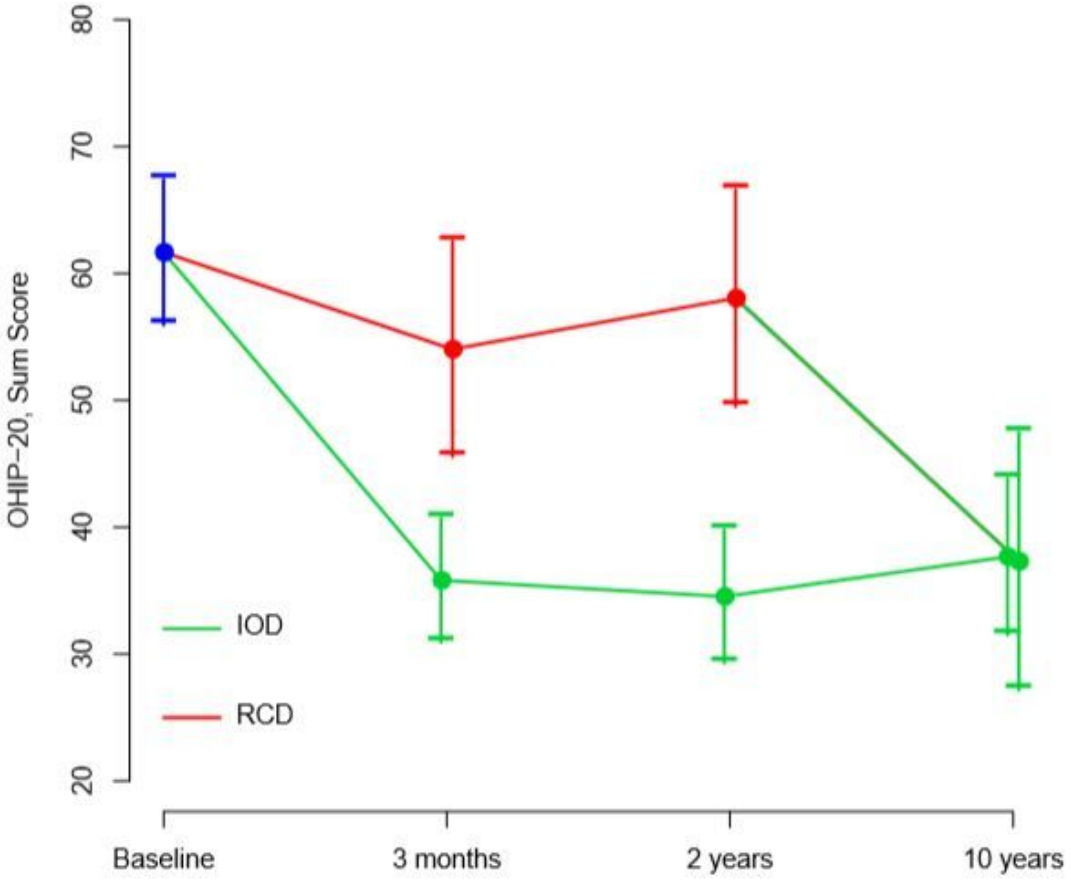

Figure 1

Changes occurring over time in OHIP-20 sum score for mandibular dentures

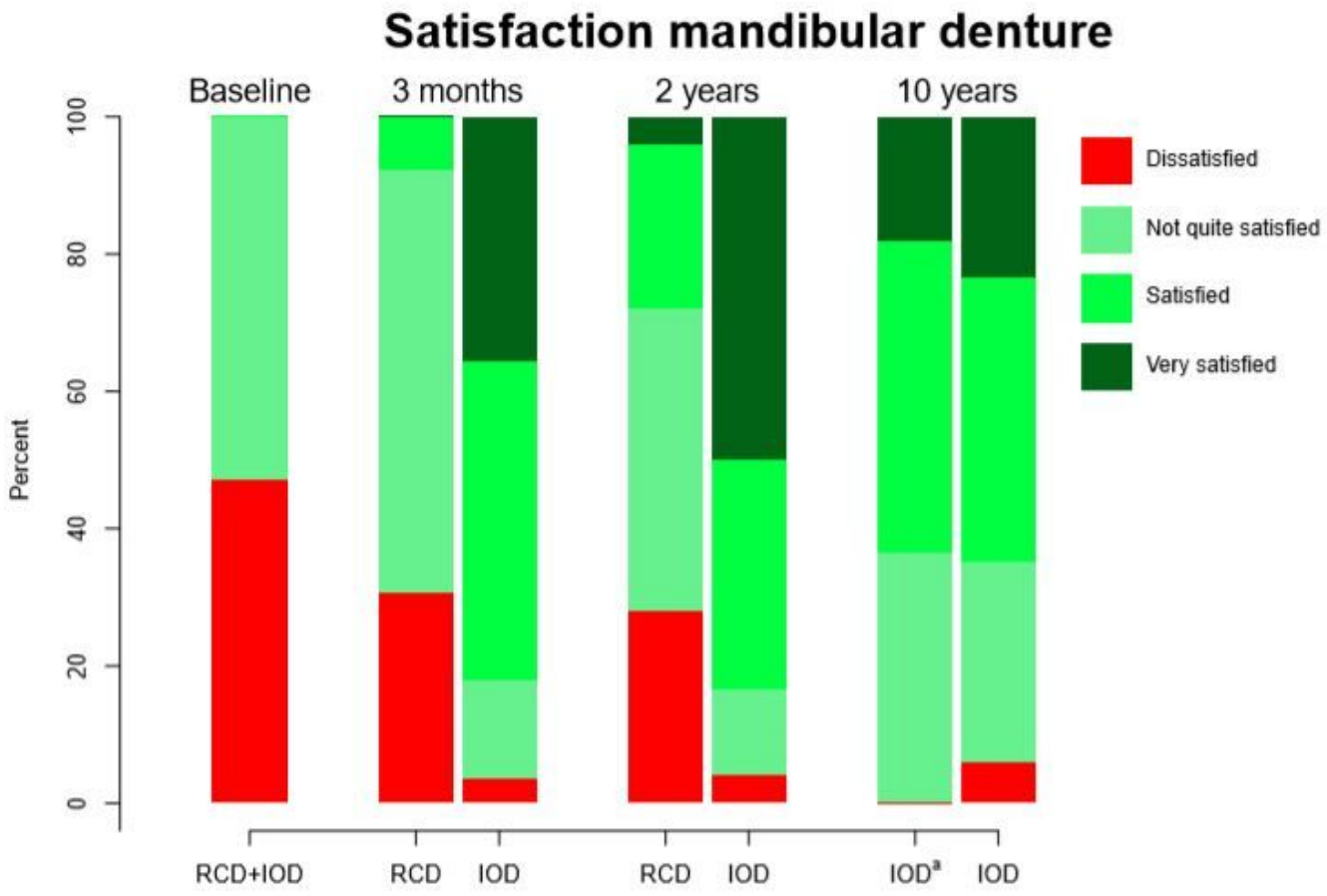

Figure 2

Changes occurring over time in denture satisfaction for mandibular dentures. IODa is the original RCD group after receiving two-implant overdentures.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- OHIP20Questionnaire.docx
- Denturesatisfactionat10yearsquestionnaire.docx