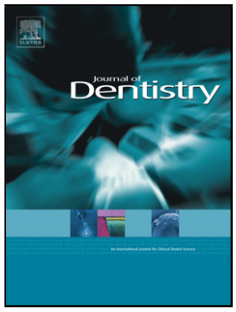

Title: Self-perceived changes in oral health-related quality of life after receiving different types of conventional prosthetic treatments: A cohort follow-up study

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Title: Self-perceived changes in oral health-related quality of life after receiving different types of conventional prosthetic treatments: A cohort follow-up study.

Short title: Changes in OHRQoL after conventional prosthetic treatments.

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Key words: Oral health-related quality of life; patient satisfaction; fixed dental prostheses; metal-based removable partial dentures; acrylic removable dentures; undergraduate students.

Abstract

Objectives: To evaluate the changes in oral health-related quality of life (OHRQoL) reported by subjects treated with conventional prostheses. **Methods:** A consecutive sample of 153 patients seeking prosthodontic rehabilitation was recruited. Socio-demographic and prosthetic-related factors (Eichner Index; number of occlusal, aesthetic, and lost units) were registered. Baseline impacts on OHRQoL were collected using the OHIP-14 questionnaire. One month after treatment, the participants answered whether the prostheses had generated better, equal, or poorer effects within the 14 items of a retrospective scale (Post-OHIP). The study patients were compared with the reference population (P-population; n = 123) in terms of OHRQoL. Such P-Population consisted of Spanish adults wearing conventional dental prostheses who were not seeking any dental treatment. The reliability and validity of the tests applied and the factor structure of the Post-OHIP were investigated. A Poisson regression model was calculated to predict what items would change favourably after treatment. **Results:** Four prosthetic cohorts were established according to the types of rehabilitations performed: 1-FDPs: metal-ceramic fixed dental prostheses; 2-M-RPDs: metal-based removable partial dentures; 3-ADs: acrylic partial dentures and 4-CDs: complete dentures. Both tests confirmed adequate psychometric properties. Most items of the Post-OHIP consistently loaded on a single factor. Patients requiring ADs or CDs reported significantly lower baseline OHRQoL than those needing M-RPDs or FDPs. Pain/discomfort was the only hampering issue subsequent to removable rehabilitation. M-RPDs are expected to provide the significantly highest therapeutic improvements. **Conclusions:** Patients perceived benefits in chewing ability, aesthetics and satisfaction with their mouth after receiving conventional dental prostheses.

Clinical significance: Conventional prosthetic therapy enhances patients' overall well-being although it can cause discomfort and chewing dysfunction in more than 20% of subjects. Metal-based removable partial dentures are the most predictable in terms of patient satisfaction. The higher the clinical impairment felt by patients, the higher the increase in OHRQoL after rehabilitation.

1. Introduction

Oral health-related quality of life (OHRQoL) is a multidimensional construct that refers to the extent to which oral conditions may disrupt an individual's normal functioning.[1] Over the past three decades, a large variety of questionnaires has been developed to evaluate OHRQoL in cross-sectional studies.[2] Based on Locker's conceptual model,[3] the Oral Health Impact Profile (OHIP) has verified satisfactory psychometric properties and has demonstrated to be the most sensitive method of detecting dissatisfaction with prosthetic rehabilitations.[1,4] Such scale uses a frequency-based approach and ranges from a 49-item profile[5] to a 14-item abbreviated index that shows a high degree of agreement with the results of the large form.[6]

Notwithstanding the long-term success of implant-based restorations, the world population growth rates along with the extended life expectancy may lead to an increasing demand for conventional prostheses.[7] Moreover, this treatment modality allows avoiding surgical risks, difficulties, and costs associated with implant prostheses.[8] To date, most studies assessing the impact of prosthetic restorations on OHRQoL have focused on comparing the quality of life provided by implant-retained overdentures *versus* complete dentures.[1,9,10] Hence, there is a lack of research evaluating the level of well-being supplied by conventional fixed and removable prostheses, even though such treatments are still the most commonly requested worldwide.[11,12] As far as we know, two studies have contrasted different types of conventional prostheses in terms of self-rated oral health status.[13,14] In the work of John *et al.,*[13] all tested rehabilitations enhanced the patients' quality of life. However, acrylic and metal-based removable partial dentures were included in a unique group, the German extended-OHIP index was used and the participants' perceptions of change (better, equal, or worse) were not detailed in their study. Meanwhile, Fromentin and Boy-Lefèvre[14] did not find significant differences in patient satisfaction depending on the type of prosthetic treatment. Nevertheless, a different study protocol was followed.

This is therefore the first investigation that evaluates the self-rated satisfaction of patients treated with fixed dental prostheses, metal-based removable partial dentures, acrylic removable partial dentures, and complete dentures in which the OHIP index was used. Besides the OHIP-14sp (Spanish-validated version),[15] a 14-item Post-OHIP scale was utilized in an effective, retrospective

way, so that the changing direction of numerous items were addressed after prosthodontic restoration.

All of the prosthetic treatments were performed by undergraduate dental students under faculty supervision. Given that the students' work was monitored at every stage by specialized professors in teaching prosthodontics, the results of this study may be extrapolated to other comparable populations.

The aim of this study was to assess the changes in OHRQoL after different conventional prosthetic treatments and to predict the therapeutic improvements that might be expected for potential patients on the basis of their socio-demographical profile, clinical status, and type of rehabilitation to be performed.

2. Materials and methods

2.1. Study protocol

Individuals seeking dental prostheses were recruited from the University Dental Clinic of Salamanca (Spain) following a consecutive sampling procedure from January 2009 to January 2011. Subjects were invited to take part in the study when they first attended the clinic. No screening process or exclusion criteria were applied.

The population database previously used for validating the OHIP-14sp[15] was considered in this study for comparison purposes. This sample, henceforth called "P-Population", consisted of 123 Spanish adults wearing conventional dental prostheses who were not seeking dental treatment.

This clinical trial was conducted following the ethical principles of medical investigation involving human subjects under the Helsinki Declaration of the World Medical Association (http://www.wma.net) and the Spanish Law 14/2007 of July 3rd for Biomedical Research (http://www.boe.es).[1] All of the participants were briefed about the purpose and process of the study.

Information on socio-demographic factors such as gender, age, and occupation was obtained.[16] The Eichner Index,[17] the number of occlusal and aesthetic units, and the number of teeth

needing replacement were the prosthetic-related variables registered for each patient before any prosthetic treatment was performed (baseline).[18,19]

The Eichner Index is based on the presence or absence of occlusal contact in four supporting areas: the left and right premolar and molar regions. For wearers of removable dentures, the Eichner category is determined by considering the natural and fixed prosthetic units after removing their prostheses. Arches codified as "A" show occlusal contacts in the four supporting zones; those classified as "B" contain occlusal contacts in one to three supporting zones; and those coded as "C" have no antagonistic contacts.[17,20]

Based on previously published protocols,[15,19] each pair of natural or fixed-prosthetic antagonistic premolars or molars was considered an occlusal unit (OU). The total OUs for each patient were annotated, ranging from 0 to 10. Therefore, ten OUs were recorded when all opposing pairs of premolars and molars were in contact at the maximal intercuspal position (2 pairs of antagonistic premolars and 3 pairs of antagonistic molars in each side of the dental arch).

The number of aesthetic units (AUs), defined as the natural or fixed-prosthesis-replaced maxillary aesthetic teeth (between canines), was assessed, and values ranged from 0 to 6 in each case.[19]

Although tooth replacement should not necessarily be regarded as the mainstay of therapy for bounded edentulous spaces,[21,22] the "number of teeth needing replacement" (TNR) was addressed for each patient, fluctuating between 0 and 28.

As better consistency has been found for short recall periods,[23] data on participants' self-rated oral health status were recorded at baseline and one month after the completion of treatment (follow-up). All survey procedures were authorised by the University of Salamanca's Human Subjects Certification Committee. Confidentiality was maintained.[1]

During the first visit, the volunteers were asked to complete the OHIP-14sp questionnaire (Spanish-validated version of the OHIP-14).[15] Aided by a trained interviewer, the subjects filled out the OHIP-14sp concerning 14 situations of impact. The situations of impact were conceptually divided into seven dimensions or domains (functional limitation, pain, psychological discomfort, physical disability, psychological disability, social disability and handicap). Such situations of

impact are listed below: speaking clearly (item 1), sense of taste (item 2), painful aching (item 3), uncomfortable eating (item 4), self-consciousness (item 5), tension (item 6), unsatisfactory diet (item 7), interrupted meals (item 8), difficulty in relaxing (item 9), being embarrassed (item 10), being irritable with others (item 11), occupational role (item 12), unsatisfactory life (item 13) and inability to function (item 14).

Frequency was codified using a Likert-type scale with five options;[6] from which the following are considered impact responses: "hardly ever" (score 1), "occasionally" (score 2), "fairly often" (score 3) and "very often" (score 4). The response "never" (score 0) implies the total absence of impact. The OHIP-14sp outcome variable varies from 0 to 56, such that the higher the total score, the higher the level of impact on oral well-being and quality of life, and thus, the lower the satisfaction of the patient.[1]

The most appropriate type of prosthodontic rehabilitation for each participant was agreed upon three professors of prosthodontics. Data from clinical exploration, panoramic and periapical radiographs and diagnostic models mounted on a semiadjustable articulator were employed for treatment planning. Surgical, periodontal and restorative treatments were completed before prosthetic rehabilitation when necessary. The prostheses were made by undergraduate students in their final year under the close supervision of prosthodontics professors. The patients' written consent was obtained in all cases.

One month after receiving the prosthetic treatment, a retrospective evaluation –called Post-OHIP– of the changes in self-rated satisfaction was carried out using a 14-item questionnaire derived from the original OHIP-14. This type of retrospective measurement has been published elsewhere.[19,24] The subjects answered whether the dentures had generated a "better", "equal", or "worse" effect on each of the following items of the Post-OHIP: speaking clearly (item 1), taste and odour of mouth (item 2), pain or physical discomfort (item 3), ease of oral hygiene (item 4), partner relations (item 5), being worried about the mouth (item 6), chewing ability (item 7), satisfactory eating (item 8), aesthetic when smiling (item 9), social relations (item 10), satisfaction with the state of the mouth (item 11), performing daily tasks or roles (item 12), life satisfaction

(item 13) and use of prescription or over-the-counter (OTC) drugs to alleviate oral problems (item 14).

Two total impact-scoring methods were used for the pre- and post-OHIP measurements: *(a)* With the "simple count method" (-SC), the total impact score at baseline was calculated by summing the number of items of the OHIP-14sp responded as "occasionally" or "more frequently" (scores ≥ 2), while the total score at follow-up was obtained by summing the number of Post-OHIP items answered as "better". The simple count summary score varies in the 0-14 range for both scales. Changes in OHRQoL were determined by subtracting the number of items that turned positive (Post-OHIP-SC) from the number of items showing impact at baseline (OHIP-SC).[15,24]

(b) With the "additive method" (-AD), the total impact score at baseline was calculated by adding-up the individual scores recorded for the 14 items of the OHIP-14sp scale.[15] The total impact score at follow-up resulted from summing the data collected for all the Post-OHIP responses, which were coded as follows: "better" = +1, "the same" = 0 and "worse" = -1. With this approach, it is possible to determine whether the OHRQoL has improved, remained the same, or worsened after the prosthetic treatment.[19,24] Using the additive method at baseline, the higher the impact score, the greater the impairment in OHRQoL. Conversely, for the retrospective analysis (Post-OHIP), a total impact score higher or lower than zero indicates a positive or negative global effect, respectively. The additive summary score ranges from 0 to 56 for the baseline assessment (OHIP-AD) and from -14 to +14 for the Post-OHIP-AD.[4,19,24,25]

Furthermore, immediately before and one month after being treated, patients were asked about their perceived satisfaction with oral health status, aesthetics, chewing ability and global satisfaction with their mouth. Each of these subjective perceptions can be assumed to vary in a continuous range from a negative to a positive zone. Hence, respondents specified their level of agreement to each of the mentioned statements by indicating a position along the continuous line of a 100-mm visual analogue scale (VAS).[26] Subjects could thereby declare themselves to be "dissatisfied", "neutral", or "satisfied", offering values situated left to the midpoint of the line, on the midpoint, or to the right of the midpoint, respectively.[27]

To ensure that neither the students nor the clinic staff had access to the patients' baseline and follow-up responses, the completed forms were placed in sealed envelopes. The pre- and post-operative assessments were then linked by means of a unique identification code for each participant.

2.2. Data analysis

The main psychometric characteristics (reliability and validity) of both the OHIP-14sp and the Post-OHIP questionnaires were examined. As each item measured different aspects of the same attribute, reliability was evaluated by analysing the internal consistency of the scales through the use of the inter-item correlation, the average inter-item correlation, the Cronbach's alpha and the alpha value if an item was deleted.[24, 28-31] Criteria validity (which measures how well each test predicted the OHRQoL based on information obtained from other variables) and construct validity (or the extent to which the OHRQoL was actually recorded)[15,24,31] were evaluated by contrasting the pre- and post-OHIP scores with the self-perceived satisfaction with the mouth.

Bartlett's Sphericity and the Kaiser-Meyer-Olkin (KMO) tests, which are measures of sampling adequacy, were run to make evident the underlying factor structure of the Post-OHIP. In addition, a principal components' analysis (PCA) was performed together with the rotation method: the Varimax plus Kaiser normalisation was employed in order to achieve a simpler structure at follow-up. Items were assigned to the rotated factors when they had a loading of 0.5 or greater on a single factor.[24,32] Factors with an eigenvalue of less than 1 were disregarded to avoid distortion.

After evaluating the psychometric properties of the questionnaires, all of the data gathered in the study were analysed according to well-established statistical methods used in related research.[1,4,10,19,33] Normal data distribution was confirmed by the Kolmogorov-Smirnov test and homogeneity of variances was verified according to the Levene's test.[33] Then, the Student's t-test and the ANOVA with Bonferroni post-hoc analysis were run to compare the level of OHRQoL among the study groups.

A Poisson regression analysis was completed taking the number of positive items obtained in the Post-OHIP as the dependent variable. Since the dispersion of the dependent variable biased

the estimation of the standard error, it was corrected using the quotient between the deviance and the degree of freedom of the model (2.296), as the scale parameter of such model.

Data were processed by using the Statistical Package for the Social Sciences (software v.18.0) (SPSS/PC+, Inc.; Chicago, IL, USA) taking the cut-off level for the statistical significance at $\alpha = 0.05$.[1,4,10]

3. Results

3.1. Participants

All patients seeking prostheses at the University Dental Clinic of Salamanca (Spain) during the period 2009-2011 were included in the study. At baseline, the study sample consisted of 153 subjects aged from 18 to 87 years (mean age: 64.9 ± 10.7; men = 52.9%). Most participants were of middle class extraction.

In the database of a related study developed in the same reference population,[15] 123 Spanish adults were wearing dental prostheses and were not seeking dental treatment when they were examined. These subjects (who have been taken in this study as a baseline reference of OHIP scores), had different types of prosthetic rehabilitations, *i.e.,* metal-ceramic tooth-supported fixed dental prostheses (n = 97; 77.6%), acrylic partial dentures (n = 13; 10.4%), metal-based removable partial dentures (n = 12; 9.6%) and complete dentures (n = 3; 2.4%). The mean age for this group ("P-population"; n = 123)[15] was 49.1 ± 8.9 years (women = 58.4%).

The study patients (n = 153) were assigned to four treatment groups or "prosthetic cohorts" depending on each patients' needs when they first attended the dental clinic: Group 1 (FDPs): metal-ceramic tooth-supported fixed dental prostheses (30.1%), Group 2 (M-RPDs): metal-based removable partial dentures (38.6%), Group 3 (APDs or ADs): acrylic partial dentures retained by wire clasps (15.7%) and Group 4 (CDs): full dentures (15.7%). At follow-up, 8 patients (5.2%) dropped out of the study and were therefore excluded in subsequent analyses.

3.2. Reliability and validity

The internal consistency (or reliability) of the OHIP-14sp and the Post-OHIP instruments was supported by alpha values of 0.86 and 0.81, respectively. In both cases, an overall distribution of positive inter-item correlations was confirmed and alpha values were lower or equal when either item was deleted.

Both instruments had satisfactory content validity because they focus on the physical, psychological and social activities that might be impaired by oral conditions before (OHIP-14sp) and after prosthodontic therapy (Post-OHIP). The study subjects did not mention any situation of impact that was not collected by the OHIP-14sp and the Post-OHIP.

As the 14 items of such questionnaires and all of the possible responses are presented together in a matrix, thus facilitating self-completion by patients, the face validity of the two indexes has been considered adequate. In this regard, the participants declared that they understood all items of both scales.

Some prosthetic-related and subjective variables were found to modulate the baseline and follow-up OHIP impact scores in the expected direction. This confirmed suitable criterion and construct validity for these indexes.

3.3. Factor analysis

Results from the Bartlett's Sphericity test (χ^2 = 856.459, p < 0.0001) suggested the existence of latent factors in the Post-OHIP scale. The KMO measure produced a global value of 0.32. Three components with eigenvalues above 1 emerged from the factor analysis of the Post-OHIP and were supported by the elbow in the corresponding scree plot of eigenvalues. Such three factors explained the 51.1% of the total variance and were named according to the items loading.

The first factor, called "functional well-being", was the most explanatory (29.6% of variance). This factor was formed by the combination of items 1, 2, 3, 7 and 8 (*i.e.,* speaking clearly, taste and odour of mouth, pain, chewing ability, and satisfactory eating, respectively). The second factor named "social well-being" comprised item 4 (ease of oral hygiene), item 5 (partner relations), item 10 (social relations), item 12 (occupational role) and item 13 (life satisfaction). The

third factor, called "psychological well-being", included items 6, 9, 11 and 14 (*i.e.*, being worried about the mouth, smile aesthetics, satisfaction with the state of the mouth and use of prescription or OTC pain-relieving drugs, respectively). Such factor structure revealed that most items consistently and coherently loaded on a single factor.

3.4. Modulating variables

At baseline (n = 153), the impact on OHRQoL was not significantly modulated by the patients' gender or age (Table 1). At follow-up (n = 145), men reported the significantly highest improvement in self-satisfaction ($p < 0.01$) while age yielded no significant differences (Table 1). In addition, the mean OHIP-SC impact score of the study patients over the age of 65 years was significantly lower (1.9 ± 2.1) than it was for their younger counterparts (3.6 ± 3.2) (t-test = -3.528; $p < 0.001$).

Within the P-population (n = 123),[15] the mean OHIP-SC score was significantly higher for women (3.9 ± 3.5) than it was for men (2.2 ± 2.0) (t-test = -3.369; $p < 0.001$). Furthermore, the OHIP-SC score was significantly higher in the 88 subjects who were under 55 years old (3.6 ± 3.2) with respect to their older counterparts (1.9 ± 2.1).

In the study sample (n = 153), the candidates for acrylic dentures (either ADs or CDs) reported a significantly worse baseline perception of their OHRQoL ($p < 0.001$) with respect to those patients requiring M-RPDs or FDPs (Table 1). However, in the post-operative period (n = 145), the self-perceived benefits did not differ depending on the type of prosthesis made (Table 1).

Among the P-population (n = 123),[15] the type of the existing prosthesis had no effect on the self-rated OHRQoL (F = 1.075; $p = 0.36$). Nonetheless, those participants wearing M-RPDs (OHIP-SC = 2.0 ± 2.8) or CDs (OHIP-SC = 1.7 ± 2.1) tended to express lower impact scores than those having FDPs (OHIP-SC = 3.3 ± 3.0) or ADs (OHIP-SC = 3.9 ± 3.9).

At baseline (n = 153), the study patients who required ADs scored significantly higher on the functional limitation domain than did candidates for M-RPDs or FDPs ($p < 0.01$). The psychological discomfort subscale was significantly more impaired among patients requiring M-RPDs, ADs, or CDs than it was for FDP candidates ($p < 0.01$). Additionally, both the physical and

social disability domains were significantly more affected in AD candidates than in the remaining partially dentate subjects ($p < 0.01$). Although the type of prosthesis resulted in no significant differences within the Post-OHIP items, individuals treated with ADs tended to observe lesser improvements in physical- and social-related issues than did patients receiving CDs or M-RPDs.

Table 2 discloses the prosthodontic variables underlying the OHRQoL scores at both the baseline and the follow-up assessments. Subjects belonging to the C category of the Eichner Index experienced significantly more impairment at baseline than those classified in the A category ($p < 0.05$). The Eichner class did not yield significant differences after prosthetic rehabilitation.

Initially, a linear relationship between OUs and OHRQoL was not found, but after dichotomizing this variable, patients with < 6 OUs registered significantly higher OHIP scores than did their counterparts ($p < 0.01$). Such discriminative cut-off point between groups (OUs = 6) was therefore used for making comparisons. At follow-up, the number of OUs resulted in no significant differences (Table 2).

Patients having < 6 AUs and/or needing replacement of at least 4 teeth reported significantly higher impact scores at baseline and better improvements in self-perceived satisfaction after prosthetic treatment ($p < 0.05$) (Table 2).

These clinical factors did not significantly modulate the OHRQoL scores within the P-population.[15] However, a trend towards a lower impact on OHRQoL was detected among those subjects of the P-population[15] belonging to the Eichner A category, having ≥ 6 OUs, 6 AUs and < 4 TNR.

3.5. Therapeutic effect

Within the study sample (n = 145), the dental prosthetic therapy was associated with an improved well-being sensation regarding these items: chewing ability (item 7) in 58.7% of the volunteers, smile aesthetics (item 9) in 70.03% of the participants, and satisfaction with the state of the mouth (item 11) in 73.7% of the patients (Fig. 1). Pain (item 3) and chewing ability (item 7) worsened in 26.5% and 20.47% of the treated patients, respectively. Partner relations (item 5) and performance of daily tasks or roles (item 12) were not impaired in the short term (Fig. 1).

After receiving removable prosthetic treatments (M-RPDs, ADs, or CDs), pain or physical discomfort (item 3) was the only negatively impacted issue. FDPs were more comfortable than ADs ($p < 0001$) (Fig. 2).

At follow-up, M-RPDs provided significantly better improvements than FDPs in ease of oral hygiene (item 4) and partner relations (item 5) ($p < 0.05$). In fact, FDPs increased difficulties of oral hygiene and determined no changes in satisfaction with partner relations (Fig. 2). Although the type of prosthodontic rehabilitation performed yielded no significant differences with regard to satisfactory eating (item 8), FDPs seemed to facilitate eating the most (Fig. 2).

Table 3 summarises the impact scores on OHRQoL stratified by self-perceived satisfaction components at baseline and follow-up. Before prosthetic treatment, most participants felt satisfied with their global quality of life (69.9%), smile aesthetics (64.7%), chewing function (56.9%), and self-rated oral health status (56.2%). Notwithstanding the scoring method used (-SC or -AD), patients disappointed with their self-perceived oral health, aesthetics and chewing function reached significantly higher baseline OHIP-14 impacts ($p < 0.001$). The preoperative global satisfaction determined no significant differences in the OHIP scores (Table 3), but it was mainly correlated with chewing satisfaction ($r = 0.80$; $p < 0.001$), aesthetic satisfaction ($r = 0.65$; $p < 0.001$) and oral health satisfaction ($r = 0.64$; $p < 0.001$). At follow-up, subjects reporting positive global satisfaction (n = 107; 73.8%) perceived significantly more items that changed positively (5.5 ± 2.5) than did disappointed patients (1.1 ± 1.3) ($p < 0.001$) (Table 3).

Figure 3 depicts the impact scores assessed in the P-population (n = 123)[15] and also the impact values recorded before (n = 153) and after (n = 145) the prosthetic treatments were carried out in this study. The impact on OHRQoL was higher for subjects seeking prosthetic rehabilitation (study sample; n = 153) than it was for prosthetically restored patients who were not seeking any dental treatment (P-population; n = 123).[15] At follow-up (n = 145), the impact was reduced in all the prosthetic cohorts of this study, to at least that reported for the P-population.[15] People wearing ADs formed the group with the highest impact both in the P-population[15] and the study sample. M-RPDs wearers reported low impact scores in all measurements.

No significant differences were found in the P-population[15] depending on the type of the existing prostheses, although AD wearers tended to be more negatively-impacted (OHIP-SC = 3.9 ± 3.9) than M-RPD (OHIP-SC = 2.0 ± 2.8) or CD wearers (OHIP-SC = 1.7 ± 2.1). Subjects bearing FDPs in the P-population[15] reported a moderate impact (OHIP-SC = 3.3 ± 3.0). According to the follow-up study, the baseline impact on OHRQoL among the candidates for acrylic dentures (either partial or complete) was significantly higher than that reported for M-RPDs or FDPs candidates ($F = 8.365$; $p < 0.001$). In this regard, no significant differences in the Post-OHIP-SC scores were detected after treatment (Table 1, Fig. 3). However, M-RPDs tended to provide better self-rated improvements than FDPs.

A significant Poisson regression model was generated (Omnibus test = $\chi^2_M = 12.916$; $p < 0.001$) (Table 4), showing that the number of positive changes after prosthetic treatment could be predicted with information about the patients' gender and the type of rehabilitation to be performed (which in turn depended on each patient's needs). The regression coefficients revealed that, on average, three items would change positively at follow-up. Nonetheless, the highest improvements were expected for men (OR = 1.07-1.74 items; $p = 0.014$) and for patients rehabilitated with M-RPDs (OR = 1.05-1.90 items; $p = 0.024$) (Table 4).

Regarding the factor structure of the Post-OHIP scale, the therapeutic benefit was mainly noticed in the "functional" and "psychological well-being" factors, with no differences among groups. Nevertheless, within the "social well-being" factor, patients receiving M-RPDs perceived significantly more improvements in OHRQoL than those treated with FDPs.

4. Discussion

The outcomes of dental prosthetic therapy are so variable that they cannot be reliably assessed only by clinical measurements.[34] This study estimates the impact of conventional prosthodontic treatments on OHRQoL by means of a validated questionnaire (OHIP-14sp) and a multi-item retrospective scale (Post-OHIP) that have proven adequacy and effectiveness in a socio-demographically comparable population.[19] The qualitative responses used by the Post-OHIP to judge the direction of change (*i.e.,* "worse", "equal" and "better") solve the difficulty of what

degree of change is necessary to be considered meaningful. They also avoid the so-called "floor phenomenon",[35] which occurs when the worsening suffered by a patient cannot be reflected by change scores, as the subject had reported the lowest value possible in the preoperative evaluation.[36]

Intra-subject within-item or within-dimension comparisons can be only made when the same scale is used before and after prosthetic treatment. However, the Post-OHIP retrospective design used in this study compensated for the relatively poor responsiveness of the OHIP-14 to assess changes by means of effect size calculations.[16,37] Thus, the Post-OHIP index contained 9 items of the OHIP-14sp[1,15] and five other items taken from specific questionnaires on the impact of dental prostheses on quality of life[1,4,19], *i.e.*, ease of hygiene, partner relations, aesthetics on smiling, satisfaction with the mouth and using prescription/OTC drugs for alleviating oral health problems. As a result, more complete information was obtained after prosthetic treatment by keeping the same number of items, taking into account that short questionnaires are more effectively administered and receive a higher response rate.[6]

The reliability of both questionnaires was supported by the high Cronbach's alpha values obtained in our study, which pointed to a satisfactory internal consistency.[31] The longitudinal data on OHRQoL confirmed the content and face validity attributed to the Post-OHIP.[19] According to the findings of Ziebland,[38] our patients perceived a more complex situation than that expressed by a global transition judgment, as they reported improvements in some dimensions, deteriorations in others and no change in yet others[15,24] (Figs. 1 and 2). Nonetheless, close associations between global measures of health status and multi-item questionnaires have been recognized,[39] so that the former have been recommended to assess the validity of the latter.[40] In our study, the overall criterion and construct validity of both instruments were confirmed after contrasting the impact scores with subjective perceptions of oral well-being and prosthetic-related variables. On the one hand, patients who were unsatisfied at baseline with their self-assessed oral health status, aesthetics and chewing function, obtained the highest OHIP scores; while patients who were overall dissatisfied at follow-up attained the significantly lowest Post-OHIP values (Table 3). On the other hand, the baseline levels of impact on daily performance revealed a significant and coherent

relationship with a number of prosthetic-related variables (Table 2), which is consistent with the literature.[19,41] FDP candidates showed the least psychological discomfort, as they normally have more functional, occlusal and aesthetic units and fewer missing teeth than do those candidates for removable prostheses. Accordingly, candidates for ADs or CDs, who classically exhibit more clinical impairment, reported significantly higher OHIP scores than those needing M-RPDs or FDPs (Table 1).

One of the main findings of the present investigation is that both the OHIP-14sp and the Post-OHIP serve to discriminate between prosthodontic groups, even when they are not specific indicators of prosthetic well-being (Table 1 and Fig. 2). This is somewhat paradoxical because the OHIP-14 was derived from the extended OHIP-49 original version after excluding denture-related questions.[6] Despite this, a generic indicator of OHRQoL that demonstrates its discriminative capacity among prosthodontic groups may expand its clinical applications, such as allowing comparisons among different patient populations or dental treatments concerning oral health-related satisfaction.[15,24] The baseline impact scores in our study were higher than those reported for fixed and removable denture wearers of the Spanish population who did not seek prosthetic treatment (P-population; n = 123)[15] (Fig. 3).[19] Thus, it could be assumed that some disruption in OHRQoL could underlie the motivation for seeking dental prosthetic treatment (Fig. 3).

Despite their differences in clinical indications and design, previous research frequently gathered M-RPDs and ADs in a single group concerning the OHRQoL. The authors are aware that similar baseline clinical conditions were not compared in this investigation. In that hypothetic case, distinct prosthetic interventions could have been randomized, as in several studies.[10,18,26] However, this research assessed the performance of conventional treatments indicated for different clinical oral conditions by using OHIP-related instruments at baseline and follow-up observations. This study has demonstrated that subjects requiring M-RPDs or FDPs had comparably lower impact on the functional limitation domain than did ADs candidates. Moreover, patients requiring ADs were more physically and socially impaired than M-RPDs or FDPs candidates *($p < 0.05$).* FDPs were significantly more comfortable than ADs at follow-up. In turn, M-RPDs facilitated the oral hygiene

and improved the partner relations more than did FDPs (Fig. 2). Such results justify the independent estimation made for different types of removable partial dentures.

Undoubtedly, our main finding is that, one month after treatment, conventional prostheses allow patients to reach the level of satisfaction previously measured in the reference population not seeking any dental treatment[19] (Fig. 3). Chewing, aesthetics, and self-satisfaction with the mouth were the expected items to change positively. Then, conventional prosthetic treatment may be suitable for restoring oral functions satisfactorily, even when it is performed by dental students.[42]

In a preceding study that used a single-point questionnaire,[43] the highest improvement on systemic health status was achieved after removable prosthetic treatment. A recent literature review also stated that removable partial dentures increased the general quality of life of partially edentate patients.[11] Although differences in study protocols make comparisons difficult, these results are in line with ours with regard to M-RPDs (Table 1). The Poisson regression model reveals that the significantly highest therapeutic benefit may be predicted for M-RPDs candidates. This could be partly attributed to the fact that acrylic partial dentures are primarily indicated in case of extensive tooth loss. As metal-framed removable partial dentures are usually recommended for shorter edentulous spaces and include cast clasps, they are less bulky and more comfortable and retentive than acrylic-based dentures. Among other psychological advantages, metal-based removable partial dentures facilitate the oral hygiene for most (Fig. 2) and do not require complete crown preparations as they do not cover the teeth.

However, it should be noted that a worrying proportion of patients experienced worsening conditions after prosthetic treatment, mainly in comfort (26.5%) and chewing ability (20.6%) (Fig. 1). The majority of these patients were new removable denture wearers who had not yet become familiar with their prostheses. Some authors have reported similar results among recently rehabilitated patients.[13,19,44]

Regrettably, 20 of the 24 patients belonging to the CD cohort were treated with full dentures both in the maxilla and the mandible, whereas the remaining 4 patients were only treated with CDs in the upper jaw. Hence, there is insufficient cell size to assess whether the position of the full dentures impinges the OHRQoL or not, and thus, future research should address this topic.

Besides the abovementioned features of conventional prostheses and the subjective perceptions of patients, the results achieved may have been influenced by the students' skills in their final year and the professors' quality of teaching. Clinical time dedicated to evidenced-based practice may enhance the students' confidence.[45,46] and the excellence of the dental prostheses they will perform in the future.[47] Therefore, it is essential that undergraduate programmes continually evaluate their portion of the restorative curricula to verify that the needs of society are being met.[48] In this study, the quality of the prosthetic treatments performed by undergraduate dental students was indirectly tested, for the first time, in terms of improvement in patient satisfaction. Related research conducted in different countries would offer interesting feedback on the satisfaction of patients with prostheses administered by college-level students.

5. Conclusions

Within the limitations of this study, it may be concluded that most patients accessing dental care resources improved in chewing ability, smile aesthetics and satisfaction with the state of their mouth after receiving conventional prosthetic treatment. However, there is concern that more than 20% of the rehabilitated patients reported lower levels of comfort and chewing ability. Metal-based removable partial dentures seem to be the most predictable treatment option to improve patient satisfaction. The most clinically impaired patients (having fewer functional, occlusal and aesthetic units and more missing teeth) reached the highest benefits after prosthetic rehabilitation. Further studies are needed to corroborate such results in other broader settings.

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Figure legends:

Figure 1: Distribution of the Post-OHIP items in the study patients (n = 145).

Footnote: Item 1: *Speaking clearly.* Item 2: *Taste and odour of mouth.* Item 3: *Pain or physical discomfort.* Item 4: *Ease of oral hygiene.* Item 5: *Partner relations.* Item 6: *Being worried about the mouth.* Item 7: *Chewing ability.* Item 8: *Satisfactory eating.* Item 9: *Aesthetic when smiling.* Item 10: *Social relations.* Item 11: *Satisfaction with the state of the mouth.* Item 12: *Performing daily tasks or roles.* Item 13: *Life satisfaction.* Item 14: *Use of prescription or over-the-counter (OTC) drugs to alleviate oral problems.*

Figure 2: Mean Post-OHIP scores recorded depending on the prosthetic cohorts (n = 145).

Footnotes: ***(a):*** Item 1: *Speaking clearly.* Item 2: *Taste and odour of mouth.* Item 3: *Pain or physical discomfort.* Item 4: *Ease of oral hygiene.* Item 5: *Partner relations.* Item 6: *Being worried about the mouth.* Item 7: *Chewing ability.* Item 8: *Satisfactory eating.* Item 9: *Aesthetic when smiling.* Item 10: *Social relations.* Item 11: *Satisfaction with the state of the mouth.* Item 12: *Performing daily tasks or roles.* Item 13: *Life satisfaction.* Item 14: *Use of prescription or over-the-counter (OTC) drugs to alleviate oral problems.* ***(b)*** CD: *Complete dentures.* RPD-ACRYLIC: *Acrylic removable partial dentures.* RPD-METAL: *Metal-based removable partial dentures.* FP: *Fixed dental prostheses.*

Figure 3: Impact scores measured in the reference population bearing prostheses who were not seeking prosthetic treatment (n = 123; OHIP-14-SC); and in our study sample, at baseline (n = 153; OHIP-14-SC) and one month after rehabilitation (n = 145; Post-OHIP-SC), depending on the treatment group. The number of items that changed positively was subtracted from the number of items having impact at baseline.

Footnote: CD: *Complete dentures.* RPD-ACRYLIC: *Acrylic removable partial dentures.* RPD-METAL: *Metal-based removable partial dentures.* FP: *Fixed dental prostheses.*

Table 1

Impact on OHRQoL stratified by gender, age and prosthetic treatment				
Assessment	**Baseline (n = 153)**		**Follow-up (n = 145)**	
Scoring method	**OHIP-SC**	**OHIP-AD**	**Post-OHIP-SC**	**Post-OHIP-AD**
	Mean (standard deviation)			
All patients (n = 153)	3.4 (3.1)	11.2 (10.5)	4.4 (3.0)	3.2 (4.2)
Gender				
Female (n = 72)	3.8 (3.1)	12.6 (12.3)	3.7 (2.7) [d]	2.1 (4.4) [d]
Male (n = 81)	3.1 (3.0)	9.9 (10.6)	5.0 (3.1) [c]	4.1 (3.7) [c]
	t-test = 1.459 *p* = 0.147	t-test = 1.564 *p* = 0.120	t-test = - 2.762 *p* = 0.007	t-test = - 2.925 *p* = 0.004
Age				
< 65 years (n = 60)	3.5 (3.2)	11.5 (10.5)	3.8 (2.7)	2.5 (4.2)
≥ 65 years (n = 93)	3.4 (3.0)	11.0 (10.6)	4.7 (3.1)	3.7 (4.1)
	t-test = 0.255 *p* = 0.799	t-test = 0.252 *p* = 0.801	t-test = - 1.793 *p* = 0.075	t-test = - 1.697 *p* = 0.092
Prosthetic cohort				
FDPs (fixed dental prostheses) (n = 46)	2.7 (2.7) [a]	8.6 (8.4) [a]	3.6 (2.7)	2.5 (4.2)
M-RPDs (metal-based removable partial dentures) (n = 59)	2.7 (2.4) [a]	8.4 (7.7) [a]	5.0 (3.0)	3.9 (4.1)
ADs (acrylic partial dentures) (n = 24)	5.6 (3.6) [b]	18.8 (12.7) [b]	3.8 (3.0)	1.9 (3.9)
CDs (complete dentures) (n = 24)	4.6 (3.5) [b]	15.4 (12.8) [b]	4.7 (3.2)	3.7 (4.3)
	ANOVA F = 8.365	ANOVA F = 9.037	ANOVA F = 2.321	ANOVA F = 1.791

	$p < 0.001$	$p < 0.001$	$p = 0.078$	$p = 0.152$
[a,b] For each tested variable, different letters in the same column indicate the existence of significant differences after Bonferroni test				

OHRQoL stratified by prosthodontic features				
Assessment	**Baseline (n = 153)**		**Follow-up (n = 145)**	
Scoring method	**OHIP-SC**	**OHIP-AD**	**Post-OHIP-SC**	**Post-OHIP-AD**
	Mean (standard deviation)			
All patients	3.4 (3.1)	11.2 (10.5)	4.4 (3.0)	3.2 (4.2)
Category of Eichner Index				
A (n = 29)	2.3 (2.4) [a]	7.8 (8.3) [a]	3.8 (2.3)	2.6 (4.1)
B (n = 95)	3.4 (3.1)	11.1 (10.4)	4.5 (3.1)	3.2 (4.3)
C (n = 29)	4.6 (3.3) [b]	15.1 (12.0) [b]	4.4 (3.2)	3.5 (4.0)
	ANOVA F = 3.901 *p* = 0.022	ANOVA F = 3.494 *p* = 0.033	ANOVA F = 0.636 *p* = 0.531	ANOVA F = 0.308 *p* = 0.736
Number of occlusal units (OUs)				
≥ 6 (n = 24)	2.0 (2.3) [a]	6.7 (7.4) [a]	3.8 (2.3)	2.4 (4.4)
< 6 (n = 129)	3.7 (3.1) [b]	12.0 (10.8) [b]	4.5 (3.1)	3.3 (4.1)
	t-test = - 3.171 *p* = 0.003	t-test = - 2.991 *p* = 0.005	t-test = - 1.233 *p* = 0.225	t-test = - 0.965 *p* = 0.336
Number of aesthetic units (AUs)				
= 6 (n = 65)	2.8 (2.8) [a]	9.0 (9.0) [a]	3.8 (2.7) [d]	2.4 (4.3)
< 6 (n = 88)	3.9 (3.2) [b]	12.8 (11.2) [b]	4.8 (3.1) [c]	3.7 (4.0)
	t-test = - 2.133 *p* = 0.035	t-test = - 2.208 *p* = 0.029	t-test = - 2.120 *p* = 0.036	t-test = - 1.901 *p* = 0.057
Number of teeth needing replacement (TNR)				
≥ 4 (n = 59)	4.3 (3.3) [b]	14.4 (11.5) [b]	5.0 (2.8) [c]	4.1 (3.4)
< 4 (n = 94)	2.9 (2.8) [a]	9.2 (9.3) [a]	4.0 (3.1) [d]	2.6 (4.5)
	t-test = - 2.133 *p* = 0.035	t-test = - 2.208 *p* = 0.029	t-test = - 2.120 *p* = 0.036	t-test = - 1.901 *p* = 0.057

[a,b] For each tested variable, different letters in the same column indicate the presence of significant differences after Bonferroni post-hoc contrast

Table 2

Table 3

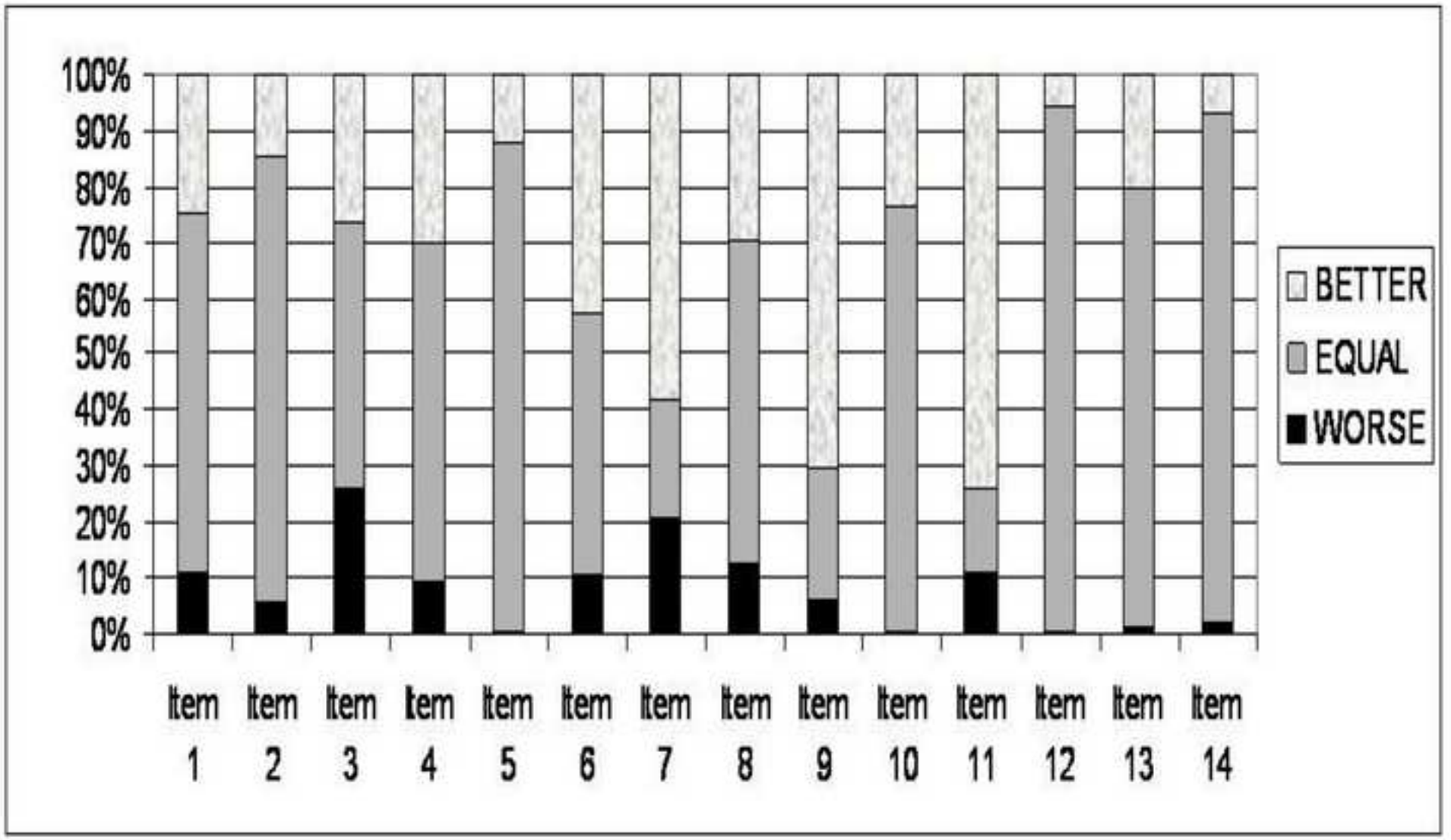
OHRQoL stratified by self-rated satisfaction components				
Assessment	**Baseline (n = 153)**		**Follow-up (n = 145)**	
Scoring method	**OHIP-SC**	**OHIP-AD**	**Post-OHIP-SC**	**Post-OHIP-AD**
	Mean (standard deviation)			
All patients	3.4 (3.1)	11.2 (10.5)	4.4 (3.0)	3.2 (4.2)
Self-perceived oral health status				
Dissatisfied (n = 67)	4.7 (3.2) [b]	15.5 (11.0) [b]	4.2 (3.0)	2.6 (4.4)
Satisfied (n = 86)	2.5 (2.6) [a]	7.8 (8.7) [a]	4.5 (3.0)	3.6 (3.8)
	t-test = 4.631 $p < 0.001$	t-test = 4.644 $p < 0.001$	t-test = - 0.550 $p = 0.583$	t-test = - 1.433 $p = 0.154$
Aesthetic satisfaction				
Dissatisfied (n = 54)	5.1 (3.2) [b]	16.9 (11.1) [b]	4.9 (2.8)	3.8 (4.1)
Satisfied (n = 99)	2.5 (2.6) [a]	8.1 (8.8) [a]	4.0 (3.1)	2.8 (4.2)
	t-test = 5.445 $p < 0.001$	t-test = 5.005 $p < 0.001$	t-test = 1.772 $p = 0.079$	t-test = 1.282 $p = 0.202$
Chewing satisfaction				
Dissatisfied (n = 66)	5.3 (3.1) [b]	17.9 (10.6) [b]	4.5 (3.1)	2.7 (4.6)
Satisfied (n = 87)	2.0 (2.1) [a]	6.0 (6.8) [a]	4.2 (2.9)	3.5 (3.8)
	t-test = 7.492 $p < 0.001$	t-test = 7.942 $p < 0.001$	t-test = 0.581 $p = 0.566$	t-test = - 1.039 $p = 0.301$
Global satisfaction				
Dissatisfied (n = 38)	3.8 (3.0)	12.3 (10.0)	1.1 (1.3) [d]	- 1.6 (3.3) [d]
Satisfied (n = 107)	3.3 (3.1)	10.6 (10.6)	5.5 (2.5) [c]	4.9 (2.9) [c]
	t-test = 0.878 $p = 0.381$	t-test = 0.828 $p = 0.409$	t-test = - 13.679 $p < 0.001$	t-test = - 11.403 $p < 0.001$

Table 4

Poisson regression of the post-treatment benefits concerning gender and type of prosthesis (n = 145)								
Hypothesis Contrast							**Odds Ratio (CI-95%)**	
Parameter	**B**	**Standard error**	**Wald Chi Square**	**df**	***p*-value**	**Odds Ratio**	**Lower OR**	**Upper OR**
(Intersection)	1.11	0.14	63.103	1	0.000	3.03	2.30	3.98
CDs	0.21	0.20	1.136	1	0.287	1.23	0.84	1.81
ADs	0.06	0.21	0.082	1	0.775	1.06	0.70	1.61
M-RPDs	0.34	0.15	5.065	1	0.024	1.41	1.05	1.90
FDPs	0	-	-	-	-	1	-	-
Gender	0.31	0.13	6.059	1	0.014	1.36	1.07	1.74
Scale	2.30							

Dependent variable: number of positive items obtained with the Post-OHIP scale

Figure 1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Item 12
Item 13
Item 14

Figure 2

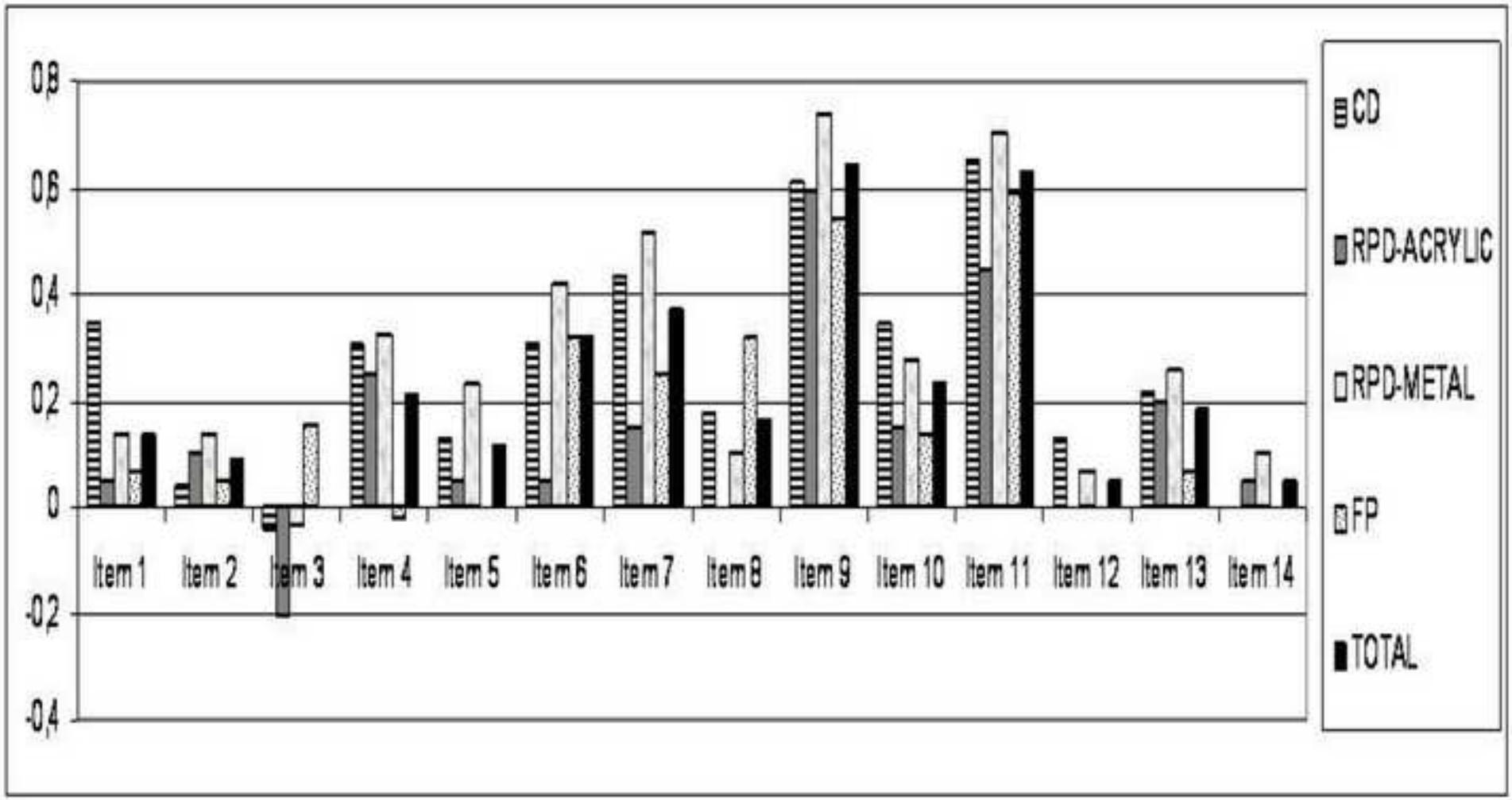
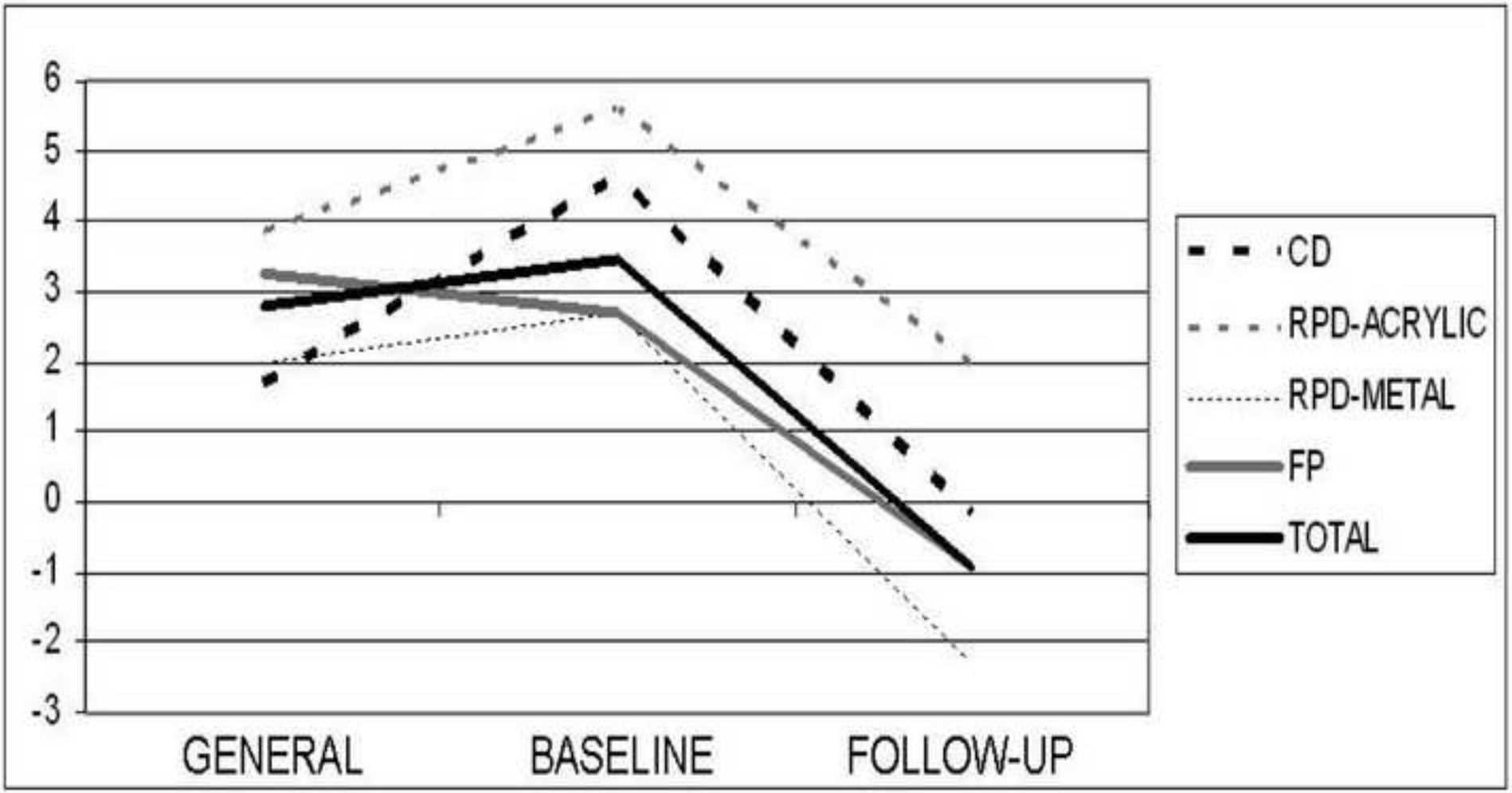

0,8
0,6
0,4
0,2
0
-0,2
-0,4
Item 1
Item 2
Item 3
Item 4
Item 5
Item 6
Item 7
Item 8
Item 9
Item 10
Item 11
Item 12
Item 13
Item 14
CD
RPD-ACRYLIC
RPD-METAL
FP
TOTAL

Figure 3


6
5
4
3
2
1
0
-1
-2
-3
GENERAL
BASELINE
FOLLOW-UP
CD
RPD-ACRYLIC
RPD-METAL
FP
TOTAL