Oral Health–Related Quality of Life and Full-Arch Immediate Loading Rehabilitation: An Evaluation of Preoperative, Intermediate, and Posttreatment Assessments of Patients Using a Modification of the OHIP Questionnaire

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The aim of this study was to assess oral health–related quality of life (OHRQoL) of patients before, during, and after completion of implant-supported full-arch immediate loading rehabilitation according to the Columbus Bridge Protocol. Twenty-five patients with compromised dentition were rehabilitated according to the Columbus Bridge Protocol and were assessed for OHRQoL using 4 questionnaires specifically designed for this study and inspired by the Oral Health Impact Profile questionnaire. Patients assessed themselves before surgery, during the healing period (1 week and 2 months after surgery), and after definitive prosthodontic treatment (4 months after surgery). The questionnaires specifically investigated patients' pain, comfort, home oral hygiene habits, satisfaction related to esthetics, masticatory ability, phonetics and general satisfaction with the treatment. Patients reported an improvement of OHRQoL after full-arch immediate-loading rehabilitation. A statistically significant improvement in esthetics and chewing ability was found. After 4 months 92% of the patients did not feel tense about their smile, 96% did not indicate problems relating to other people or smiling, and 92% did not have difficulty eating some foods. Phonetics were a critical issue, especially in the intermediate phase of healing. One week after surgery, the percentage of patients who were very satisfied with phonetics slightly decreased from 48% to 36%. The assessment of patients' OHRQoL related to full-arch immediate-loading implant therapy exhibited a significant improvement in quality of life. The questionnaires herein presented could be an effective tool to evaluate patients' reaction to oral rehabilitation.

Key Words: dental implants, patient satisfaction, oral health–related quality of life, treatment outcomes, immediate loading

INTRODUCTION

Immediate loading of implant-supported complete arch prostheses for the edentulous mandible and maxilla is a predictable procedure, able to provide patients with a fixed rehabilitation within a few hours.[1–5] A fixed prosthesis supported by implants associated with immediate loading is claimed to represent a very satisfying treatment option for patients.[6] In fact, patient esthetics and function are rehabilitated in a very short span of time. However, patients' satisfaction has not been specifically investigated for this kind of treatment. Current implant studies are mainly focused on the evaluation of survival rates and clinical parameters, such as bone resorption and peri-implant tissue inflammation.[7] When the degree of patient satisfaction is anecdotally reported, it is usually based on a subjective evaluation by the treating dentist and may therefore be biased to a certain degree. Patient's opinions influence treatment and may be very important in producing satisfying results with dental implant rehabilitation. Therefore, an understanding of patients' assessments may be helpful for evaluating the effect of treatment. Growing recognition that quality of life is an important outcome of dental care[8] has

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TABLE 1

Characteristics of the study population (n = 25)

	Value
Sex	
Male	10
Female	15
Mean age (y)	60.08 (range: 39–86)
Smokers	5 (20%)
Cause of tooth extraction	
Periodontal disease	16
Endodontic problems	5
Destructive carious lesions	3
Already edentulous	1
Arch treated	
Upper	16
Lower	6
Both	3
Antagonist's condition	
Natural teeth	11
Removable prostheses	2
Columbus Bridge	6
Fixed prostheses	6

created a need for a range of instruments to measure oral health–related quality of life (OHRQoL). In 1994, Slade and Spencer[9] first developed the Oral Health Impact Profile (OHIP), a 49-item questionnaire divided into 7 sections according to content: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. Other questionnaires were subsequently developed.[10,11] Numerous studies have evaluated patients' satisfaction after dental therapies,[11] but only a few studies[10,12–16] have focused on patients' satisfaction after complete implant rehabilitations in order to evaluate the effect of implant therapy on OHRQoL. In most published studies, satisfaction is assessed before and after rehabilitation, neglecting the intermediate period—the healing phase leading to osseointegration.[17,18] Moreover, many studies only evaluated OHRQoL before or after dental treatment.[19] John et al[20] investigated OHIP scores at various times, but only during patient follow-up after prosthodontic treatment. A pretreatment evaluation was lacking. A study by Eitner et al[21] assessed OHRQoL during the intermediate healing period; they included patients needing a general implant therapy and did not focus only on patients needing complete implant rehabilitation. Furthermore, they did not investigate patient condition before therapy. Other researchers evaluated patient satisfaction during the intermediate period by comparing patients wearing mandibular conventional dentures or implant overdentures,[22] focusing only on the phonetic aspect and oral myofunctional behavior,[13] or investigating speech intelligibility only.[23]The aim of the present study was to investigate satisfaction and comfort of patients treated with implant-supported, complete immediate-loading prostheses according to the Columbus Bridge Protocol (CBP).[2–4,24] The CBP is a surgical and prosthodontic protocol for the rehabilitation of atrophic edentulous jaws using distal tilted implants. Sufficient bone volume is required to accommodate a minimum of 4 implants in the selected host bone sites, avoiding bone grafting procedures. Fixed screw-retained prostheses fabricated according to a specific prosthodontic protocol—no distal cantilevers, shock absorbing occlusal surfaces, cast passively fitting metal framework for optimal rigidity—are placed 24 hours after surgery.

The null hypothesis tested in the present research was that there are no differences in patients' OHRQoL before and after treatment with the CBP. In particular, patient satisfaction related to mastication ability, esthetics, and phonetic function were investigated. Secondary aims were to evaluate the reasons leading patients to require an immediate-loading rehabilitation, pain, and swelling after treatment and patients' smoking habits, home oral hygiene procedures before and after treatment, and patient satisfaction regarding the rehabilitation and the care provided by the clinical team.

Materials and Methods

Between November 2014 and February 2016, a consecutive cohort of 25 patients was selected for the present study (Table 1). Patients referred to the Division of Implant and Prosthetic Dentistry of the University of Genoa (Department of Surgical Sciences) were enrolled if they met the following inclusion criteria: systemically good health and absence of contraindications for implant therapy, edentulous upper or lower jaw or unfavorable prognoses of remaining teeth, desire to be treated with complete arch fixed prostheses supported by immediately loaded dental implants, and bone volume adequate to avoid regenerative techniques. A history of smoking or parafunctional habits did not disqualify any patient (5 were smokers), although smokers were advised to quit smoking. All of the patients were volunteers and each was asked to answer the questionnaires designed for this study at different points in time. They agreed to return for the required follow-up appointments and provided informed consent, which included a full discussion of the benefits, risks, complications of the treatment, and alternative treatment options. No incentives were provided for patients who participated in the study. All treatments were performed in agreement with the World Medical Association Helsinki Declaration. The study was approved by the local ethical committee of Genoa University (Genoa, Italy). Table 1 shows the characteristics of the study population.

Surgical and prosthodontic protocol

Each patient, treated at the Division of Prosthodontics of the University of Genoa, underwent a careful clinical evaluation before treatment and volumetric computed tomograms were used to select and plan implant placement sites. The surgical and prosthetic protocol used was the CBP, which was developed for rehabilitation of atrophic, edentulous jaws using distal tilted implants (parallel to the anterior sinus wall [maxilla], obliquely angled above the mental foramen [mandible]). The protocol required bone volume to accommodate 4 to 6 implants with tapered design, external hexagon connections, acid-etched surfaces, and implant lengths $\geq$10 mm. The main goal of the surgical phase was to place implants with high initial primary stability as indicated by insertion torque values of at least 40 Ncm.

To increase the likelihood of obtaining high implant primary stability, implant sites were underprepared. Angled

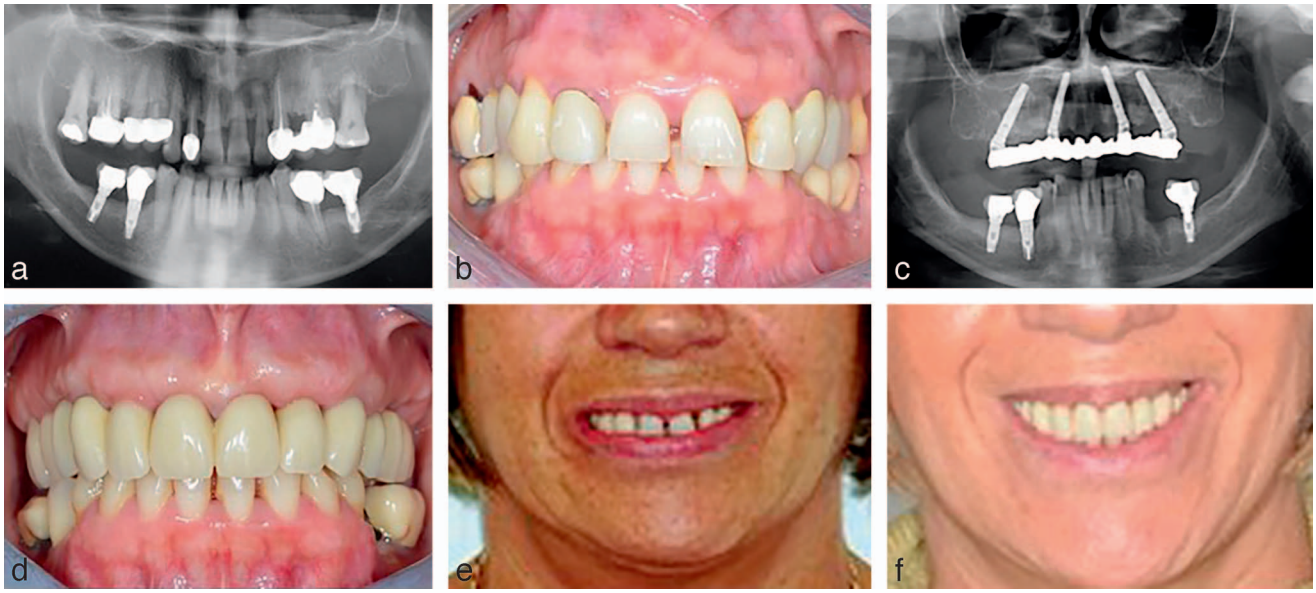

Figure 1. One of the patients included in the study sample. (a) Presurgical panoramic radiograph. (b) Intraoral view before surgery. (c) Panoramic radiograph image after rehabilitation of the upper jaw following the Columbus Bridge Protocol. (d) Intraoral view of the rehabilitation. (e) Patient's smile before rehabilitation. (f) Patient's smile after rehabilitation.

implants were used in the distal areas where the extensions of the maxillary sinus precluded placement of vertical implants at least 10 mm in length. No surgical guides were used. Conical abutments (0°, 17°, 25°, 45°) were used to optimize the position of the screw access openings of the implants within the prostheses.

Preoperative antibiotic prophylaxis (amoxicillin 750 mg + clavulanic acid 125 mg) was administered every 12 hours starting 2 days before surgery. This continued for the next 6 days. Immediately after surgery, 4 mg of dexamethasone was injected into the perioral tissues to minimize swelling and inflammation. An additional 30 mg of ketorolac was also given to patients as a long-acting analgesic. In the days after surgery, patients were instructed to continue to take analgesics as needed for any residual discomfort. The actual dose and type of medication was based on the needs of the individual patient.

The prosthodontic phase of the CBP attempted to control occlusal loads and thereby reduce the risk of overloading peri-implant bone, respecting the following key points: immediate splinting of the implants thanks to a rigid framework, passive-fitting screw-retained prosthesis, shock-absorbing veneering material, absence of cantilever in the immediate provisional prosthesis, and careful check of occlusal scheme following Beyron determinants of a physiologic/therapeutic occlusion.[25]

The prostheses delivered 24 hours after surgery were endowed with cast metal frameworks (in palladium alloy) to provide increased strength and rigidity and to splint the implants. Rigid frameworks are also believed to favor a more even load distribution among supporting implants.[26] The occlusal surfaces of the prostheses were made of composite resin, which is a relatively elastic material with the ability to dampen occlusal loads compared with more rigid materials.[27]

All of the prostheses were fabricated to allow for oral hygiene procedures, including flossing around the conical abutments and the intaglio surfaces of the provisional prostheses. The prostheses were designed with convex shapes on the intaglio surfaces with no sharp line angles or concavities in order to minimize plaque accumulation, thus facilitating home care procedures. Specific written hygienic and dietary guidelines for the postsurgical period were delivered to patients.[28] In particular, patients were instructed to use periodontal gel (0.5% chlorhexidine), a soft bristle toothbrush, spongy dental floss, and interdental brushes at the appropriate time of healing. Figure 1 shows one of the patients included in the study sample.

The questionnaires were specifically designed for this study and were inspired by the OHIP documentation. Each patient answered 4 questionnaires:

Questionnaire 1: 26-item questionnaire at a presurgical appointment (T0)
Questionnaire 2: 33-item questionnaire 1 week after surgery (T1)
Questionnaire 3: 29-item questionnaire 2 months after surgery (T2)
Questionnaire 4: 29-item questionnaire 4 months after surgery (T4).

All of the questionnaires included 16 common questions that were considered for the statistical analysis; the questions were related to pain, mastication ability, phonetics, esthetics, home hygiene procedures, patient satisfaction, and comfort related to their oral condition and to the customer assistance provided by the dental team before and after the intervention. Additional questions (that were not common to all questionnaires) included questions about cause of tooth extraction, reasons for choice of therapy, pain, puffiness and foods eaten after surgery, and opinions on the influence of implant therapy on quality of life. All patients were informed that their responses would be anonymous, and each completed the questionnaire

alone, with a clinician available to help if needed. The questionnaires were marked with the clinical chart number to preserve anonymity but allow the investigators to compare the answers at the different points in time. Phonetic and mastication competence, esthetic satisfaction, and ability to perform oral hygiene were rated on a scale of 1 to 5 (1 = no, 2 = little, 3 = sufficient, 4 = yes, 5 = yes, very much), whereas pain, patient comfort, and psychological aspects related to oral health were investigated through dichotomous questions (yes/no). Additionally, a few qualitative open questions (why?) were asked, and there was an area for the patient to provide comments.

Statistical analysis

Statistical analysis and methodology were reviewed by an independent statistician. Only questions common to all questionnaires were considered for statistical purposes. Friedman 2-way analysis of variance by ranks or Cochran test (with appropriate post hoc pairwise comparisons) were applied to identify any difference over time in each item of the questionnaires. Pairwise comparisons were performed by applying Dunn-Bonferroni post hoc tests.

Results

Twenty-five patients (15 women, 10 men; mean age = 60.08 years) respecting the inclusion/exclusion criteria were identified (Table 1). All the patients agreed to be included in the study and attended the scheduled recall appointments. No patients dropped out, and the attrition rate was 0%. As a consequence, data from 25 patients were collected and analyzed (112 implants). No patients were completely edentulous. All the patients had hopeless residual teeth that were extracted the day of surgery; implants were immediately inserted in postextractive sites. At the end of the study period all the implants were stable and in function, and all the original fixed prostheses were functioning and did not need to be replaced. Two minor fractures of the veneering material occurred and were adjusted the same day.

Results for noncommon questionnaire items

The presurgical questionnaires revealed that periodontitis was the most frequent cause of tooth extraction; in fact, 16 patients (64%) were affected by clinical attachment loss and tooth mobility. The main therapeutic options proposed in place of the CBP were tooth-supported fixed bridges, removable prosthesis, or implant therapy with bone graft; these solutions were considered "painful," "provisional," or "not effective" by the majority of the patients. Moreover, the main factor that led patients to choose the CBP was the quick delivery of the prosthesis (24 hours after surgery), as stated by patients.

The questionnaires administered 1 week after surgery highlighted that implant therapy was almost painless: 14 patients (56%) did not report pain at all in the first day after surgery, and 15 (60%) did not feel pain during the following days. Swelling caused by surgery was restricted: only 1 patient complained about it. The use of ice in the first 2 days was widespread and effective. All the patients followed the dietary instructions received before surgery, and ate soft or liquid foods, such as ice cream, yogurt, and soup. The results of the questionnaires completed 2 months and 4 months after surgery were similar. The majority of the patients said they had gotten used to the new dentures as they had their own natural teeth; some patients (7 after 2 months and 8 after 4 months) only felt small differences compared with their natural dentition. No patients reported that they were unable to adapt to the CBP. The pain was absent by 2 and 4 months after surgery. The care support by the clinicians was perceived as punctual and effective, although 4 patients reported that the wait time was too long, even though all therapies were completed in the estimated time. Finally, 17 patients believed implant rehabilitation improved their quality of life in a very significant way: 6 reported a satisfying improvement and only 2 described a moderate enhancement in their life.

Comparison of preoperative, intermediate, and posttreatment esthetic satisfaction

Results regarding esthetic satisfaction are shown in Figure 2. During the preoperative phase most patients were not satisfied with the esthetic appearance of their teeth (60%), even though this did not influence their ability to engage with other people (88%), and they did not avoid smiling (72%). Satisfaction regarding esthetics significantly increased after treatment. The first week after surgery, 80% of patients were not embarrassed about smiling and none avoided smiling. These positive results were confirmed after 4 months, when 92% of the patients did not feel tense about their smile and 96% did not have problems relating to or smiling at other people.

Comparison of preoperative, intermediate, and posttreatment mastication satisfaction

Fifty percent of patients were not satisfied with their mastication ability and 80% avoided eating some foods before surgery, but these percentages decreased after implant treatment. Moreover, positive results about pain sensation and avoiding eating with other people were recorded (Figure 2).

Comparison of preoperative, intermediate, and posttreatment phonetic satisfaction

Satisfaction about phonetic ability slightly decreased immediately after surgery, probably because of the normal physiological adjustment period patients needed to adjust to the new prosthesis (Figure 2).

Comparison of preoperative, intermediate, and posttreatment smoking and oral hygiene procedures

The number of smokers temporarily decreased immediately after surgery because the patients were motivated to restrict smoking to improve tissue healing. Questionnaire responses indicated that difficulties in performing oral hygiene were limited, and the type of brush used remained almost unchanged during this study (Tables 2 through 4).

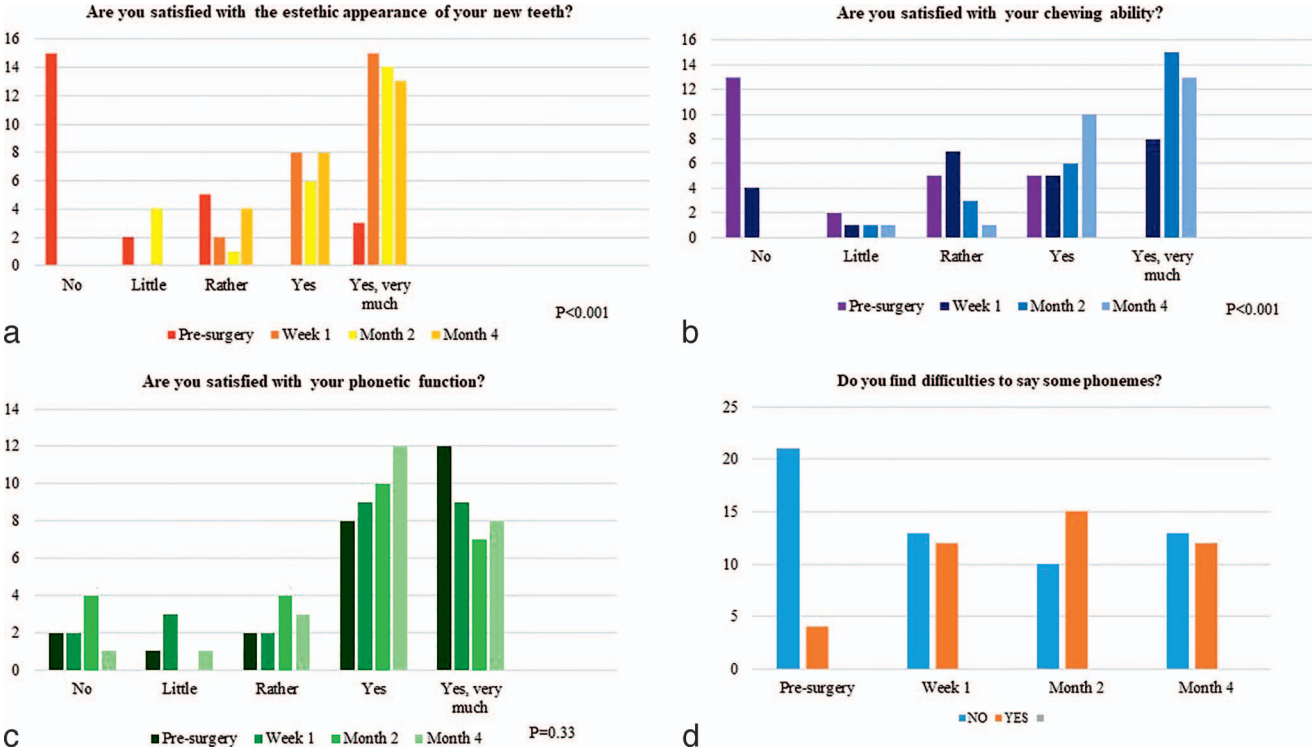

Figure 2. Answers to the anonymous questionnaires at the different time points. (a) Results about esthetic satisfaction. (b) Results about chewing improvement. (c and d) Results about phonetic ability.

Discussion

This study investigated presurgical, intermediate, and posttreatment OHRQoL of patients treated with full-arch immediate-loading rehabilitation according to the CBP. Analysis of the questionnaires regarding patient satisfaction demonstrated a high degree of satisfaction for this type of treatment. Some articles have anecdotally reported a high degree of satisfaction for patients treated with full-arch immediate-loading rehabilitation.[4,15] However, because of the lack of reports of preoperative, intermediate, and posttreatment information about patients' satisfaction for this kind of rehabilitation, it is difficult to compare our outcomes to others. Most recent research about patients treated with complete arch rehabilitation compared their expectations before and after implant therapy[12] or only after the treatment[13]. Intermediate assessments were missing. A previous prospective study by Pera et al[24] reported that 10-year outcomes for patients rehabilitated according to the CBP for the upper jaw demonstrated good outcomes at the long-term follow-up. In fact, 163 implants were inserted in 34 patients and only 10 implants failed during the first 12 months. However, information regarding OHRQoL and patient satisfaction was missing. Most studies on dental implants are based on evaluation of the survival rate and functionality of implants through radiographic and clinical

Table 2

Answers to the anonymous questionnaires regarding smoking habits*

	No	Yes
If a smoker, have you already restarted smoking?		
Week 1		
No.	2	3
%	40.0%	60.0%
Month 2		
No.	0	5
%	0%	100.0%
Month 4		
No.	0	5
%	0%	100.0%

*$P = .11$ (Cochran Q test).

Table 3

Answers to the anonymous questionnaires regarding oral hygiene procedures*

	No	Little	Rather	Yes	Yes, Very Much
Do you find difficulties in cleaning your teeth?					
Presurgery					
No.	16	0	3	6	0
%	64.0%	.0%	12.0%	24.0%	0.0%
Week 1					
No.	21	2	2	0	0
%	84.0%	8.0%	8.0%	0.0%	0.0%
Month 2					
No.	19	0	4	2	0
%	76.0%	0.0%	16.0%	8.0%	0.0%
Month 4					
No.	16	3	4	2	0
%	64.0%	12.0%	16.0%	8.0%	0.0%

*$P = .12$ (Friedman).

TABLE 4

Answers to the anonymous questionnaires regarding oral hygiene instruments*

	Soft Brush	Medium Brush	Electric Brush	Others
What instruments do you use to perform your oral hygiene now?				
Presurgery				
No.	11	10	4	0
%	44.0%	40.0%	16.0%	0.0%
Week 1				
No.	13	4	3	5
%	52.0%	16.0%	12.0%	20.0%
Month 2				
No.	11	10	4	0
%	44.0%	40.0%	16.0%	0.0%
Month 4				
No.	13	10	2	0
%	52.0%	40.0%	8.0%	0.0%

*$P = .83$ (Friedman).

exams to quantify implant therapy outcomes. However, the success of implant rehabilitation cannot be determined only by clinical parameters, although a successful implant therapy with a small number of failed implants is the best foundation to improve patient satisfaction. Identifying objective parameters to quantify the level of patient satisfaction is not easy. Only a few studies have focused on the patient's view on how implant therapy affected OHQoL. Research on this topic is still developing, and the correlation between clinical parameters and the patient's perception of therapy success is often inadequate or not significant. Moreover, it has been demonstrated that oral disorders have a more extended impact on everyday life than that suggested by other studies.[14] The current study introduces new questionnaires to investigate patient reaction after immediate-loading implant therapy. The OHIP questionnaire, one of the most sophisticated instruments for assessing oral health quality of life, is a standardized method of evaluating patient satisfaction. The OHIP questionnaire, designed in Australia, was quickly exported to other countries based on a cross-cultural validation. The topic of the cross-cultural adaption of health-related self-reported measure has been debated in the literature.[29] The adopted instruments must be culturally and socially appropriate for the local population as well as demonstrate good psychometric properties. In Italy, a pilot study[30] was carried out, in which the original Italian Oral Health Impact Profile (containing 49 questions) was translated. According to the authors, the analysis of the data collected from the administration of the questionnaire showed good reliability; however, it was excessively time consuming. The same research group decided to translate and evaluate the shorter and self-administered Italian Oral Health Impact Profile (containing 14 questions; IOHIP-14) scale in a larger sample population.[31] The authors concluded that the IOHIP-14 is an acceptable method to assess the impact of oral health on quality of life.

During the present research, questionnaires specifically created for patients rehabilitated with immediately loaded complete prostheses were developed, with simplicity being the key consideration. Indeed, patients completed all the items in the 3 questionnaires by themselves, and no patients needed the clinicians' help or further explanations. In this study. these questionnaires appeared a useful instrument to investigate patients' OHRQoL and satisfaction and to detect aspects of the treatment that may need improvement. In particular, in contrast to findings of other studies[10,15,16] that identified increased phonetic satisfaction immediately after surgery, the present study highlighted a decrease in phonetic ability after surgery. We can explain this result with the normal physiological adjustment period needed by the patient to the new prosthesis. A longer follow-up would help clinicians assess whether this parameter improves over time.

The most important limits of this study are as follows. A consecutive sampling was performed and the sample was small (25 patients). Consecutive samples are vulnerable to selection bias and possible uncontrolled intervening variables; a larger random sample size would better approximate the population of patients that are candidates for full-arch immediate-loading rehabilitation. However, the number of involved patients was considered sufficient, as it was larger or similar to that of other similar studies.[21] The sample may also be considered representative of the population because it was well distributed demographically in terms of gender (10 men, 15 women) and age (range = 39–86 years).

The 4-month follow-up was limited but sufficient to identify significant results of implant therapy and patient perceptions, even though a longer follow-up could show interesting results and probably better outcomes, highlighting the importance of questionnaires as a useful tool to improve clinical practice and patient satisfaction;

No control group was used because all patients filled out a presurgical questionnaire, so each patient served as his or her own control. However, a control using other prosthetic or surgical options was lacking. One limitation to the current study is that the selected patients were all well disposed toward immediate implants and the CBP. In fact, they reported that the main factor that led them to choose the CBP was the quick delivery of the prosthesis (24 hours after surgery). This may indicate that the high percentage of favorable responses may be due to selection bias.

We stress that the findings of the same questionnaires, if applied to a wide variety of patients treated in a wide range of clinical settings by a wide range of practitioners, may be critically different from what we report here. All the patients included in the present research were treated by experienced clinicians in a university division specializing in implant prosthodontics following a strictly codified surgical and prosthodontic protocol (the CBP) that has already demonstrated optimal outcomes in long-term studies.[24] Reported outcomes may be sensitive to clinician experience, and a learning curve is required to achieve comparable favorable results. Future research, including a larger sample size, a longer follow-up period, and possibly multicenter studies, would be useful to confirm the present results and provide useful clinical recommendations generalized from the observations of this study.

Despite such limitations, we consider the questionnaires presented in this article to be useful tools that can be easily applied in different settings with patients rehabilitated with

full-arch immediate-loading rehabilitation following different surgical and prosthodontic protocols.

Conclusions

The present study investigated patients' OHRQoL and satisfaction after a complete-arch immediate-loading rehabilitation following the CBP pointing out the improvement of patients' quality of life after therapy. The results related to the main investigated parameters (chewing ability, estethics, and phonetics) were positive, with phonetic function being the most challenging, especially in the intermediate phase of healing. Further studies with a longer follow-up and a larger sample of patients are needed to generalize the results from this study.

Abbreviations

CBP: Columbus Bridge Protocol
OHIP: Oral Health Impact Profile
OHRQoL: oral health–related quality of life
IOHIP-14: Italian Oral Health Impact Profile

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Note

The authors declare no conflict of interest.

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