Patient-Reported Outcomes of Immediate Versus Conventional Loading with Fixed Full-Arch Prostheses in the Maxilla: A Nonrandomized Controlled Prospective Study

David Peñarrocha-Oltra, DDS, PhD[1]/Maria Peñarrocha-Diago, MD, DDS, PhD[2]/
Luigi Canullo, DDS, PhD[3]/Ugo Covani, MD, PhD[4]/Miguel Peñarrocha, MD, PhD[5]

Purpose: *To compare patient satisfaction and postoperative pain and swelling for immediate versus conventional loading in partially edentulous patients requiring extraction of the remaining maxillary dentition and rehabilitation with fixed full-arch prostheses.* ***Materials and Methods:*** *This prospective, controlled, nonrandomized study with 12-month follow-up included 30 consecutive patients scheduled for fixed full-arch implant-supported maxillary rehabilitation. Fifteen patients were treated with conventional loading (control group) and the next 15 with immediate loading (test group). Ten-centimeter visual analog scales were used as assessment tools. Patient overall satisfaction and specific satisfaction with esthetics, chewing, speaking, comfort, self-esteem, ease of cleaning, and treatment duration were assessed preoperatively and at 3 and 12 months postoperatively. Postoperative pain and swelling levels were recorded daily during the first week. Statistical analysis was performed using Mann-Whitney and Wilcoxon rank sum tests,* $\alpha = .05$. ***Results:*** *One test group patient was excluded, so the final sample included 29 patients. Between baseline and 3 months, in the test group general satisfaction and all specific satisfactions increased significantly with the exception of speech; in the control group overall satisfaction and self-esteem did not change, satisfaction with esthetics increased significantly, and satisfaction with speech, chewing, and comfort decreased significantly. After 12 months, satisfaction was significantly higher in the test group with the exception of ease of cleaning. Between 3 and 12 months, satisfaction improved in both groups but to a greater degree in the control group. After 12 months, there were no differences in satisfaction. No differences were found in either mean postoperative pain/swelling or maximum pain/swelling at the studied time points.* ***Conclusions:*** *Patient satisfaction for immediate loading was significantly higher than for conventional loading during the osseointegration period. After 12 months, when final prosthetic rehabilitations had been in function for some time, differences had disappeared. No differences were found between loading protocols in postoperative pain or swelling.* Int J Oral Maxillofac Implants 2014;29:690–698. doi: 10.11607/jomi.3516

Key words: *immediate dental implant loading, loading protocols, patient outcomes assessment, patient satisfaction*

According to classic protocols, implants should remain unloaded during osseointegration.[1] This standard protocol for restoration of the completely edentulous jaw with an implant-supported full-arch prosthesis has been reported to produce favorable results.[2,3] However, the patients must undergo an edentulous period during which they are provided with provisional removable dentures. Edentulism can

[1]Master in Oral Surgery and Implant Dentistry, Department of Stomatology, Valencia University Medical and Dental School, Valencia, Spain.
[2]Professor of Oral Surgery, Department of Stomatology, Valencia University Medical and Dental School, Valencia, Spain.
[3]Collaborating Lecturer on the Master's Degree in Oral Surgery and Implant Dentistry, Department of Stomatology, Valencia University Medical and Dental School, Valencia, Spain; Private Practice, Rome, Italy.
[4]Full Professor, Department of Surgery, University of Pisa, Pisa, Italy.
[5]Chairman of Oral Surgery, Department of Stomatology, Valencia University Medical and Dental School, Valencia, Spain.

Correspondence to: Dr Miguel Peñarrocha Diago, Cirugía Bucal, Clínicas Odontológicas, Universitat de València, Gascó Oliag 1, 46021–Valencia, Spain. Email: Miguel.Penarrocha@uv.es

be disabling and handicapping and has a profound negative impact on the quality of life, even for those individuals who apparently cope well with dentures.[4,5] In response to this difficulty, the dental profession has popularized the immediate loading protocol, in which the implants' occlusal function is established within a week of implant placement.[6] Combined with immediate postextraction implant placement, this protocol could benefit partially edentulous patients who are obliged to have all their remaining teeth extracted, as it would avoid the traumatic edentulous status to which they are unaccustomed.

Several studies have produced convincing results in support of immediate loading with provisional fixed full-arch prostheses using both immediately and nonimmediately placed implants.[7–11] However, these studies have evaluated success in terms of implant survival, prosthetic success, and peri-implant bone loss,[7–11] while the true goals of implant therapy are the restoration of function, esthetics, and patient satisfaction, which should be the main factors determining treatment success.[12,13]

There are several advantages associated with immediate loading with fixed full-arch prostheses: immediate function and esthetics, avoidance of stage-two surgical procedures to expose submerged implants, and avoidance of provisional removable dentures.[14] Due to their nature, these advantages are empirically associated with higher patient satisfaction or quality of life; however, the rehabilitation of edentulous arches using immediate loading protocols has rarely been the subject of patient-centered research.[15]

A few studies have evaluated differences in satisfaction before and after the immediate loading treatment, finding very favorable results with this therapy.[15–17] Only two studies have compared loading protocols in the edentulous maxilla.[18,19] Cannizzaro et al[18] studied patient satisfaction with immediate loading compared with early loading in the edentulous maxilla, finding that patients were significantly more satisfied with immediate loading. Fischer and Stenberg investigated early loading versus conventional loading, finding no difference in satisfaction.[19]

A review of the literature indicates that early loading yields higher implant failure rates than immediate loading while providing no advantages,[6] but the clinical dilemma of whether immediate or conventional loading will produce better outcomes remains. As far as the authors of the present study are aware, no study has compared these treatment alternatives in terms of patient satisfaction.

The use of immediately loaded fixed full-arch prostheses, and/or the avoidance of a provisional removable denture, could also influence patients' postoperative discomfort. However, few studies have investigated this aspect, and the information available is limited to studies that report that some patients experienced slight pain or swelling.[14,20–22] Only two studies have assessed postoperative pain or swelling using questionnaires and scales in patients treated with immediately loaded fixed full-arch prostheses, but neither of them compared loading protocols.[15,23]

The aim of the present prospective, controlled, nonrandomized study was to compare immediate and conventional loading protocols in partially edentulous patients requiring extraction of the remaining maxillary dentition and rehabilitation using dental implants and fixed full-arch prostheses in terms of patient-reported outcomes. Patient satisfaction and perceived postoperative pain and swelling were assessed.

MATERIALS AND METHODS

Study Design and Patient Selection

This clinical, prospective, controlled, nonrandomized study was performed at the Oral Surgery Unit of the Faculty of Medicine and Dentistry, University of Valencia (Spain) to assess differences in patient-reported outcomes between immediate and conventional loading. Implant- and prosthetic-centered outcomes have been presented in a previous report.[24] Between April 2008 and April 2010, 30 consecutive patients with seriously unfavorable prognoses for their maxillary dentition who required implant-supported fixed full-arch prosthetic rehabilitation supported by immediate and nonimmediate implants were recruited. Inclusion and exclusion criteria are detailed in Table 1.

The procedure performed (immediate or conventional loading) was determined by the established treatment protocol for this type of patient at the Oral Surgery Unit at the time of the surgery. Accordingly, 15 consecutive patients fulfilling the inclusion criteria were treated following a conventional loading protocol (control group) prior to July 2009. Simultaneously, a learning period on the subject of immediate loading took place in the Oral Surgery Unit and subsequently, starting in September 2009, an immediate loading protocol with fixed full-arch prosthesis was implemented for suitable patients. The next 15 consecutive patients fulfilling the inclusion criteria were treated following this protocol (test group).

This research was performed following the Declaration of Helsinki guidelines regarding research on humans; accordingly all patients were informed about the study and procedures and were asked to sign a written informed consent form before taking part. The study design was approved by the ethical board of the University of Valencia (Ref: H1275992266359).

Table 1 Subject and Implant Inclusion and Exclusion Criteria

Inclusion criteria:
Age > 18 years
Full Mouth Plaque Score and Full Mouth Bleeding Score ≤ 25%
Partially edentulous maxilla with indication to have all remaining teeth extracted
Definitive rehabilitation with fixed full-arch implant-supported prosthesis
Sufficient bone height and width to place six to eight implants, with minimum length 10 mm and minimum diameter 3.8 mm without performing bone grafting procedures (sinus lifting, block bone grafts, or guided bone regeneration); coverage of peri-implant defects and/or gap filling with autologous bone or tricalcium ß-phosphate did not prevent inclusion in the study.
Patients receiving six or more implants in the maxilla with insertion torque ≥ 35 Ncm
Signature of informed consent form
Minimum follow-up of 12 months after implant loading
Exclusion criteria:
Sites with acute infection
Medical conditions contraindicating implant surgery
Pregnant and lactating patients
Smokers
Patients with a history of bisphosphonate therapy
Patients receiving chemotherapy or radiotherapy of head and neck
Severe bruxism
Poor oral hygiene or noncooperative patients
Incomplete data gathering or failure to attend scheduled control appointments

Treatment Procedures

The surgical and prosthetic procedures used have been thoroughly described in a previous report.[24]

Surgeries were performed under local anesthesia using 4% articaine with 1:100,000 epinephrine and intravenous conscious sedation performed by an anesthesiologist using 1% propofol solution (Diprivan, Astra Zeneca) and midazolam (Dormicum, Roche Farma). Extractions of remaining teeth were performed as atraumatically as possible, and each patient received six to eight Kohno SP implants (Sweden & Martina). Mucoperiosteal flaps were only elevated when needed to visualize bone or for regeneration. Particulate autogenous bone obtained from drilling was used to fill peri-implant bone defects; when it was not possible to obtain sufficient autogenous bone from drilling, ß-tricalcium phosphate (KeraOs, Keramat) was used.

A minimum of six implants with adequate primary stability (insertion torque ≥ 35 Ncm) was required as inclusion criteria for participation in the study. In the immediate loading group, implant positions were recorded intraoperatively. Acrylic provisional full-arch screw-retained metal-reinforced prostheses with no distal cantilevers were placed within the first week after the implant surgery. In the control group, implants were left submerged during the healing period, and patients were provided with provisional removable dentures.

Patients were prescribed 1 g amoxicillin (Glaxo–SmithKline) twice daily for 6 days, starting 1 hour prior to surgery,[25] 600 mg ibuprofen (Bexistar, Laboratorio Bacino) 3 times per day for 5 days, and chlorhexidine 0.12% mouthrinse (GUM, Butler/Sunstar) twice daily, commencing 3 days prior to surgery and continuing for 2 weeks thereafter. Patients were instructed in adequate hygiene maintenance, and a soft diet was recommended for 8 weeks. Sutures were removed 7 days after the surgery.

In both groups, the procedures for fabricating the definitive prostheses began approximately 10 to 12 weeks after implant surgery, and these were inserted 4 weeks later. Screw-retained full-arch metal-ceramic prostheses were fabricated with distal cantilevers of up to 10 mm. Patients were included in a recall scheme; patients were reinstructed in oral hygiene when necessary, and a professional calculus and plaque removal procedure was performed every 6 months.

Data Collection

All data collection was made by a single trained clinician, who was neither the surgeon nor the prosthodontist, following a preestablished questionnaire.

Patient age (at the time of implant placement), sex, the primary reason for extraction of the remaining maxillary dentition (periodontal disease, caries, endodontic failure), the number of implants, and the type of recipient site (immediate postextraction socket or healed bone) were recorded on the day of surgery.

Before the implant therapy, overall satisfaction of the patients with their baseline oral status and specific satisfaction with respect to five factors—esthetics, chewing function, speech function, comfort, and self-esteem—was assessed using visual analog scale (VAS) questionnaires. These factors provided an insight into which aspects had been improved as a result of implant-supported restorations, compared with patient satisfaction prior to treatment.[26] Patients were asked to mark their responses on 10-cm VAS with a scale ranging from 0 (completely dissatisfied) to 10 (completely satisfied). The questionnaire was carefully explained to the patients, and any uncertainties were resolved before they gave their responses. Three months after implant placement, before delivery of the definitive restoration, patients were asked to complete a similar questionnaire to assess their satisfaction with either the provisional immediately loaded fixed prosthesis (test group) or the provisional removable denture (control group). In this case, specific satisfaction regarding two additional factors, ease of cleaning and treatment duration, was assessed. Finally, at the 12-month control

Table 2 Details of the Patient Sample and Homogeneity Analysis Between Study Groups

		Immediate loading	Conventional loading	Test (*P* value)
Age (years)		53.1 ± 10.6	57.6 ± 8.8	MW = 4,204.5 (.83)
Sex (No. women/men)		7/7	9/6	χ^2 = 11 (.91)
Opposing arch	Natural or fixed tooth-supported	6	7	χ^2 = 13.27 (.58)
	Fixed metal–acrylic resin implant-supported	4	3	
	Fixed metal-ceramic implant-supported	2	4	
	Removable implant-supported	2	1	
Primary reason for tooth extraction	Periodontal disease	10	11	χ^2 = 9.17 (.47)
	Caries	1	3	
	Endodontic failure	3	1	

χ^2 = chi-square test; MW = Mann-Whitney test

Table 3 Details of the Implant Sample and Homogeneity Analysis Between Study Groups

		Immediate loading	Conventional loading	Test (*P* value)
Position	Anterior region	49	43	χ^2 = 11.06 (.136)
	Premolar region	30	34	
	Molar region	15	22	
Length (mm)	10	23	16	MW = 4,036.5 (.122)
	11.5	30	31	
	13	18	33	
	15	8	7	
Diameter (mm)	3.8	11	13	χ^2 = 3.01 (.23)
	4.25	75	71	
	5.0	8	15	
Type of recipient site	Immediate socket	49	56	χ^2 = 12.17 (.37)
	Healed bone	45	43	

visit, the same questionnaire was used to assess satisfaction with the definitive fixed prosthesis.

After implant surgery, a questionnaire to record perceived postoperative pain and swelling was also delivered to all patients, in which patients were asked to register pain and swelling once daily during the first week after the surgery. VAS with "absence of pain/swelling" and "extreme pain/swelling" as left- and right-end anchorage words were used. Questionnaires were collected and checked for missing data at the beginning of the suture removal visit.

Statistical Analysis

Statistical analysis was performed using nonparametric tests because of the patient sample size. The chi-square test and the Mann-Whitney test (MW) were used to evaluate homogeneity within the two groups with regards to a series of demographic and clinical parameters. The MW test for independent samples was used to assess differences in patient satisfaction, postoperative pain, and swelling between the two groups. The Wilcoxon rank sum test was used to evaluate changes in patient satisfaction between time points. Statistical analysis was completed using SPSS Statistics 17.0 software (SPSS/IBM) with $\alpha = .05$. A biostatistician with expertise in dentistry analyzed the data without knowledge of group assignment.

RESULTS

One patient belonging to the test group failed to attend the scheduled recall visits for personal reasons and was excluded from the study. The final patient sample consisted of 29 patients (16 women and 13 men) with a mean age of 55.4 ± 9.8 years (range, 28 to 77 years). All the patients included for study underwent a minimum 12-month follow-up, the average being 20 months (range, 12 to 36 months). Tables 2 and 3 detail the demographic and clinical characteristics of the

patient and implant samples. No statistically significant differences existed between the two study groups regarding any of the recorded demographic and clinical parameters. Five patients in the test group and four in the control group presented with one to two implants (all distal implants placed in the molar region) with insufficient primary stability (< 35 Ncm) to be immediately loaded. These patients received "short" prostheses that terminated at the first/second premolar.

At baseline, patient mean overall satisfaction and specific satisfaction with esthetics, chewing function, self-esteem, and comfort ranged between 3.5 and 5.0 in both groups, and it was 8.0 and 7.6 for the immediate and conventional loading protocols, respectively, for speech function. No differences existed between the two groups. Between baseline and the three-month assessment in the immediate loading group, overall satisfaction and specific satisfaction increased significantly for all parameters with the exception of speech function, which remained stable. However, in the conventional loading group overall satisfaction and self-esteem did not vary, while satisfaction with esthetics increased significantly and satisfaction with speech function, chewing function, and comfort decreased significantly. At the 3-month assessment, patient mean overall satisfaction and satisfaction with all the specific factors ranged between 7.4 and 8.9 in the test group, while in the control group mean values were 7.9 for ease of cleaning, 6.4 for esthetics, 4.9 for overall satisfaction and treatment duration, 4.7 for speech function, 4.6 for self-esteem, 2.9 for chewing function, and 2.7 for comfort. Statistical analysis showed significant differences between loading protocols in overall satisfaction and for all the specific parameters except ease of cleaning. Satisfaction increased in both groups between the 3- and 12-month assessments for all parameters, but improvement was greater in the control group. At the 12-month assessment, overall satisfaction and satisfaction with all the specific factors ranged between 8.2 and 9.4 in both groups, and significant differences between the groups no longer existed. Table 4 shows median, mean, standard deviation, and range values for patient satisfaction with both loading protocols at the different time points. Table 5 shows the results of the statistical tests performed to study differences in patient satisfaction between the groups at the different time points and between time points within the two groups.

Table 6 shows median, mean, standard deviation, and range values for postoperative pain and swelling with both loading protocols throughout the first week after the surgery. The comparative statistical analysis yielded no significant differences between loading protocols regarding perceived postoperative pain or swelling levels at any of the time points studied. Mean maximum postoperative pain was reached 24 hours after surgery in both groups, 3.9 ± 2.9 for the test group and 3.3 ± 2.7 for the control group, without statistically significant difference ($P = .621$). Mean maximum postoperative swelling was reached 48 to 72 hours after the surgery in both groups, and was 4.8 ± 2.7 for the test group and 5.3 ± 2.9 for the control group; differences between study groups were not statistically significant ($P = .847$).

DISCUSSION

Patient-centered outcomes after full-arch rehabilitation with immediate loading of screw-retained restorations or conventional loading with provisional dentures during osseointegration were evaluated by self-administered questionnaires. Answers were recorded on VAS, a standard in patient-reported outcome measures for dental implant research.[27] Pjetursson et al[13] found a correlation between the results obtained with qualitative questions and VAS, and recommend VAS alone or a combination of both. Quality of life questionnaires are another frequently used method to study changes in patient perception resulting from immediate loading therapy.[17,27] A highly positive association has been reported between oral health–related quality of life and satisfaction with treatment,[28] and so it was decided to assess patient satisfaction alone to make the procedure easier for the patients. Broad, nonspecific questions have been shown to lead to a high number of false-positive responses,[26] so satisfaction with a series of specific factors was assessed in addition to overall satisfaction. The evaluation criteria assessed at all time points—overall satisfaction, esthetics, chewing function, speech function, comfort, and self-esteem—are among the most frequently used criteria in prosthetic and implant therapy research.[26] Two additional criteria were introduced to compare loading protocols and the prosthetic types associated with these protocols: ease of cleaning and treatment duration.

With the immediate loading protocol, overall satisfaction and specific satisfaction for all the studied parameters increased significantly between baseline and three months, with the single exception of speech function. This agrees with several case series studies that have evaluated patient satisfaction with fixed full-arch immediate loading, which found significant differences between time periods before and after this therapy.[15–17]

On the contrary, with the conventional loading protocol, overall satisfaction and self-esteem did not change significantly between baseline and 3 months; satisfaction with speech function, chewing function, and comfort decreased significantly, and only

Table 4 Median, Mean, Standard Deviation, and Range VAS values (Scale, 10 = Maximum) for Patient Satisfaction at Different Time Points with Both Loading Protocols

		Baseline		3 months		12 months	
		IL (N = 15)	CL (N = 15)	IL (N = 14)	CL (N = 15)	IL (N = 14)	CL (N = 15)
Esthetics	Median	4.2	3.8	8.2	6.2	9.1	10.0
	Mean	4.0	3.5	7.6	6.4	8.9	9.3
	SD	2.2	2.0	1.8	1.3	0.9	1.2
	Range	0–8	0–7	4–10	4–8	7–10	6–10
Chewing function	Median	4.8	4.5	8.0	3.2	9.1	9.0
	Mean	5.0	5.0	7.7	2.9	9.1	9.4
	SD	1.7	1.7	2.0	2.0	1.0	0.9
	Range	0–8	2–8	3–10	2–6	7–10	7–10
Speech function	Median	8.1	8.0	7.5	5.0	9.3	9.0
	Mean	8.0	7.6	7.6	4.7	9.1	8.9
	SD	1.4	1.6	1.9	1.7	0.9	1.1
	Range	5–10	3–9	5–10	3–8	8–10	7–10
Comfort	Median	5.3	4.9	8.5	3.2	9.0	9.2
	Mean	5.0	5.0	8.3	2.7	9.1	9.2
	SD	1.6	1.7	1.6	2.2	0.8	0.9
	Range	1–8	0–8	5–10	1–6	6–10	7–10
Self-esteem	Median	4.5	4.7	8.1	4.8	9.0	9.0
	Mean	4.5	4.5	8.0	4.6	9.0	9.2
	SD	1.3	1.5	1.7	1.6	1.0	0.9
	Range	0–8	0–8	5–10	1–8	6–10	6–10
Ease of cleaning	Median			7.5	8.1	8.1	8.3
	Mean			7.4	7.9	8.2	8.5
	SD			2.1	1.2	1.1	1.5
	Range			5–10	5–10	6–9	6–10
Treatment duration	Median			9.0	5.0	8.8	8.0
	Mean			8.9	4.9	9.0	7.9
	SD			1.2	0.9	1.1	2.2
	Range			5–10	1–6	7–10	5–10
Overall	Median	5.0	5.2	8.5	5.0	9.0	9.0
	Mean	4.5	4.8	8.3	4.9	8.9	8.8
	SD	1.8	1.7	1.1	1.3	0.7	1.0
	Range	0–8	0–7	6–10	2–6	7–10	6–10

CL = conventional loading; IL = immediate loading.

Table 5 *P* Values of the Analysis Performed to Compare Patient Satisfaction Between Loading Protocols and Between Time Points

	P value						
	IL vs CL (MW)			Baseline vs 3 months (Wilcoxon)		3 vs 12 months (Wilcoxon)	
	Baseline	3 months	12 months	IL	CL	IL	CL
Esthetics	.380	.004*	.133	< .001*	< .001*	.015*	< .001*
Chewing function	.402	< .001*	.234	< .001*	< .001*	.004*	< .001*
Speech function	.540	< .001*	.533	.232	< .001*	.008*	< .001*
Comfort	.351	< .001*	.780	< .001*	< .001*	.039*	< .001*
Self-esteem	.488	< .001*	.602	< .001*	.140	.014*	< .001*
Ease of cleaning		.621	.591			.176	.147
Treatment duration		< .001*	.505			.679	.003*
Overall	.415	< .001*	.715	< .001*	.125	.046*	< .001*

* statistical significance, decreasing difference

Table 6 Statistical Analysis Performed to Compare Postoperative Pain and Swelling (Recorded Daily for 1 Week) with Both Loading Protocols

		Pain			Swelling		
		IL	CL	*P* value (MW)	IL	CL	
24 h	Median	3.0	3.0	.949	3.0	3.0	.652
	Mean	2.9	2.8		2.5	3.4	
	SD	2.4	2.6		2.1	3.3	
	Range	0–8	0–7		0–7	0–10	
48 h	Median	2.0	2.0	.747	4.0	4.0	.591
	Mean	2.5	2.7		3.7	4.8	
	SD	2.5	2.4		3.0	3.0	
	Range	0–8	0–7		0–10	0–10	
72 h	Median	1.0	2.0	.505	4.0	4.0	.533
	Mean	2.1	2.5		3.9	4.7	
	SD	2.6	2.2		3.3	3.0	
	Range	0–7	0–7		0–10	0–9	
96 h	Median	1.0	2.0	.377	3.5	4.0	.533
	Mean	1.6	2.3		3.4	4.1	
	SD	2.7	2.1		3.3	2.9	
	Range	0–8	0–6		0–10	0–9	
120 h	Median	0.0	1.0	.425	2.5	4.0	.400
	Mean	1.4	1.9		2.6	3.5	
	SD	2.6	2.0		2.3	2.9	
	Range	0–8	0–5		0–8	0–8	
144 h	Median	0.0	0.0	.477	2.0	2.0	.400
	Mean	1.0	1.5		1.8	2.5	
	SD	1.9	1.8		1.9	2.2	
	Range	0–6	0–5		0–6	0–6	
168 h	Median	0.0	0.0	.451	0.0	1.0	.377
	Mean	0.8	1.1		1.1	1.7	
	SD	1.5	1.4		1.7	1.9	
	Range	0–4	0–4		0–5	0–5	

satisfaction with esthetics increased significantly. As a result, at the 3-month visit, patients wearing a provisional fixed immediately loaded prosthesis were more satisfied than those wearing a provisional removable denture, with the exception of ease of cleaning. The test group reported higher mean VAS values by two to five points on a scale from 0 to 10 (Table 4), which can be considered not only statistically but also clinically significant.

No similar study comparing the immediate and conventional loading protocols with fixed full-arch rehabilitations in the maxilla has been found, but in a randomized clinical trial comparing immediate and early loading, patients in the immediately loaded group were significantly more satisfied than early loaded patients. Fixed implant-supported prostheses have proved to be more satisfactory than implant-retained overdentures,[29,30] and these in turn are more satisfactory than conventional dentures,[31,32] which coincides with the outcomes of this 3-month assessment, given that the main difference between the two loading protocols is the type of provisional prosthesis. Accordingly, once the definitive prosthesis was delivered, satisfaction increased not only in the conventional loading group but also in the immediate loading group, except for ease of cleaning. Similarly, a series of immediately loaded patients reported further significant improvements in eating comfort, speaking comfort, and esthetics between 1 week and 12 months.[15] Dierens et al[15] suggest that this significant improvement over time might be explained by the fact that the memory of the surgery is still fresh after a week, while this memory fades with the passing of time and the gain in comfort starts to predominate. However, in the present study satisfaction with the immediately loaded prosthesis was assessed 3 months after the surgery, which suggests that the further improvement in the immediate loading group might be associated with the better performance of the definitive prosthesis compared to the provisional.

Ease of cleaning was perceived as adequate by patients in both study groups after 3 and 12 months, with no significant differences between provisional and definitive prostheses. Dierens et al[15] presented VAS scores of 86.1 and 86.8 for ease of cleaning with provisional immediately loaded and definitive full-arch rehabilitations.

Satisfaction regarding treatment duration increased significantly between 3 and 12 months in the control group, possibly suggesting that some time after being rehabilitated, conventionally treated patients tend to accept the delay associated with the standard protocol.

The increase in satisfaction between 3 and 12 months was higher in the conventionally loaded group, so at the 12-month visit patients from both groups were equally highly satisfied with the definitive fixed implant-supported rehabilitation. This agrees with other results reported in the literature.[33–35]

In the present study, patients generally reported absent-to-low postoperative pain and low-to-moderate postoperative swelling, with the exception of a few more severe cases in both groups. In the literature, pain following implant surgery is described as light by most patients and only moderate to severe by a minority,[36,37] while swelling is the most important symptom.[36] Postoperative pain and swelling have not been well detailed in studies of immediate loading in the edentulous maxilla. Cannizzaro et al[23] studied a series of patients treated with flapless surgery, and 3 to 4 days after the surgery 8 patients reported having felt no pain, 18 reported light pain, 6 moderate pain, and 1 severe pain. In this same study, the researcher observed no swelling in 11 patients, light swelling in 8, moderate swelling in 10, and severe swelling in 4. Dierens et al[15] studied 50 patients and obtained a mean

pain perception of 18 over 100 and a mean swelling of 46 over 100. In the present study, no differences between loading protocols were found regarding either mean postoperative pain/swelling at any of the studied time points or maximum postoperative pain/swelling. In agreement with the literature,[36,37] maximum pain and swelling were reported during the first 3 days following surgery in both groups.

The outcomes of the present investigation, especially in regards to differences in patient satisfaction between the loading protocols, which are not only statistically significant but could also be clinically relevant, justify from a patient point-of-view the use of immediate loading in cases of a failing remaining maxillary dentition. However, the careful evaluation and selection of appropriate cases is key to achieve predictable successful results with this treatment alternative; thus, the patient and implant inclusion and exclusion criteria used in the study were very strict. The conventional loading protocol should, for now, remain the gold standard in cases considered of risk or nonideal due to the conditions of the patient (eg, medical conditions such as diabetes, smoking, or severe bruxism) or to an insufficient number of implants with adequate primary stability.

CONCLUSIONS

Within its sample size and design limitations, the present study observed that partially edentulous patients requiring extraction of the remaining maxillary dentition and rehabilitation using dental implants were more satisfied when treated with immediately loaded provisional fixed prostheses than with the conventional loading protocol, whereby provisional removable dentures are used during the osseointegration period. Differences in satisfaction at the 3-month assessment between the loading protocols were not only statistically significant but could also be clinically relevant. At the 12-month assessment, when all patients were habituated to their final metal-ceramic rehabilitations, differences between the two groups no longer existed.

No significant differences were found between the two loading protocols in perceived postoperative pain or swelling during the first week following implant surgeries.

ACKNOWLEDGMENTS

A grant holder of the VALi+d aid program for Young Researchers awarded by the regional government of Valencia (Consellería de Educación, Generalitat Valenciana, Valencia, Spain) participated in the present study. The authors reported no conflicts of interest related to this study.

REFERENCES

1. Brånemark PI. Osseointegration and its experimental background. J Prosthet Dent 1983;50:399–410.
2. Adell R, Eriksson B, Lekholm U, Brånemark PI, Jemt T. Long-term follow-up study of osseointegrated implants in the treatment of totally edentulous jaws. Int J Oral Maxillofac Implants 1990;5:347–359.
3. Jemt T, Lekholm U. Implant treatment in edentulous maxillae: A 5-year follow-up report on patients with different degrees of jaw resorption. Int J Oral Maxillofac Implants 1995;10:303–311.
4. Fiske J, Davis DM, Frances C, Gelbier S. The emotional effects of tooth loss in edentulous people. Br Dental J 1998;184:90–93.
5. Strassburger C, Kerschbaum T, Heydecke G. Influence of implant and conventional prostheses on satisfaction and quality of life: A literature review. Part 2: Qualitative analysis and evaluation of the studies. Int J Prosthodont 2006;19:339–348.
6. Esposito M, Grusovin MG, Achille H, Coulthard P, Worthington HV. Interventions for replacing missing teeth: Different times for loading dental implants. Cochrane Database Syst Rev 2009;21(1):CD003878. doi: 10.1002/14651858.CD003878.pub4.
7. Degidi M, Piattelli A, Felice P, Carinci F. Immediate functional loading of edentulous maxilla: A 5-year retrospective study of 388 titanium implants. J Periodontol 2005;76:1016–1024.
8. Balshi SF, Wolfinger GJ, Balshi TJ. A prospective study of immediate functional loading, following the Teeth in a Day protocol: A case series of 55 consecutive edentulous maxillas. Clin Implant Dent Relat Res 2005;7:24–31.
9. Gillot L, Cannas B, Buti J, Noharet R. A retrospective cohort study of 113 patients rehabilitated with immediately loaded maxillary cross-arch fixed dental prostheses in combination with immediate implant placement. Eur J Oral Implantol 2012;5:71–79.
10. Gallucci GO, Morton D, Weber HP. Loading protocols for dental implants in edentulous patients. Int J Oral Maxillofac Implants 2009;24 (suppl):132–146.
11. Peñarrocha-Diago MA, Maestre-Ferrín L, Demarchi CL, Peñarrocha-Oltra D, Peñarrocha-Diago M. Immediate versus non-immediate placement of implants for full-arch fixed restorations: A preliminary study. J Oral Maxillofac Surg 2011;69:154–159.
12. Papaspyridakos P, Mokti M, Chen CJ, Benic GI, Gallucci GO, Chronopoulos V. Implant and prosthodontic survival rates with implant fixed complete dental prostheses in the edentulous mandible after at least 5 years: A systematic review. Clin Implant Dent Relat Res 2013 Jan 11. doi:10.1111/cid.12036. [Epub ahead of print]
13. Pjetursson BE, Karoussis I, Bürgin W, Brägger U, Lang NP. Patients' satisfaction following implant therapy. A 10-year prospective cohort study. Clin Oral Implants Res 2005;16:185–193.
14. Crespi R, Capparè P, Gherlone E, Romanos GE. Immediate occlusal loading of implants placed in fresh sockets after tooth extraction. Int J Oral Maxillofac Implants 2007;22:955–962.
15. Dierens M, Collaert B, Deschepper E, Browaeys H, Klinge B, De Bruyn H. Patient-centered outcome of immediately loaded implants in the rehabilitation of fully edentulous jaws. Clin Oral Implants Res 2009;20:1070–1077.
16. Erkapers M, Ekstrand K, Baer RA, Toljanic JA, Thor A. Patient satisfaction following dental implant treatment with immediate loading in the edentulous atrophic maxilla. Int J Oral Maxillofac Implants 2011;26:356–364.
17. Van Steenberghe D, Glauser R, Blombäck U, et al. A computed tomographic scan-derived customized surgical template and fixed prosthesis for flapless surgery and immediate loading of implants in fully edentulous maxillae: A prospective multicenter study. Clin Implant Dent Relat Res 2005;7(suppl 1):S111–120.
18. Cannizzaro G, Torchio C, Leone M, Esposito M. Immediate versus early loading of flapless-placed implants supporting maxillary full-arch prostheses: A randomised controlled clinical trial. Eur J Oral Implantol 2008;1:127–139.
19. Fischer K, Stenberg T. Three-year data from a randomized, controlled study of early loading of single-stage dental implants supporting maxillary full-arch prostheses. Int J Oral Maxillofac Implants 2006;21:245–252.

20. Pieri F, Aldini NN, Fini M, Corinaldesi G. Immediate occlusal loading of immediately placed implants supporting fixed restorations in completely edentulous arches: A 1-year prospective pilot study. J Periodontol 2009;80:411–421.
21. Strietzel FP, Karmon B, Lorean A, Fischer PP. Implant-prosthetic rehabilitation of the edentulous maxilla and mandible with immediately loaded implants: Preliminary data from a retrospective study, considering time of implantation. Int J Oral Maxillofac Implants 2010;26:139–147.
22. Grunder U. Immediate functional loading of immediate implants in edentulous arches: Two-year results. Int J Periodontics Restorative Dent 2001;21:545–551.
23. Cannizzaro G, Leone M, Esposito M. Immediate functional loading of implants placed with flapless surgery in the edentulous maxilla: 1-year follow-up of a single cohort study. Int J Oral Maxillofac Implants 2007;22:87–95.
24. Peñarrocha-Oltra D, Covani U, Aparicio A, Ata-ali J, Peñarrocha-Diago M, Peñarrocha-Diago M. Immediate versus conventional loading for the maxilla with implants placed into fresh and healed extraction sites to support a full-arch fixed prosthesis: Nonrandomized controlled clinical study. Int J Oral Maxillofac Implants 2013;28:1116–1124.
25. Esposito M, Grusovin MG, Loli V, Coulthard P, Worthington HV. Does antibiotic prophylaxis at implant placement decrease early implant failures? A Cochrane systematic review. Eur J Oral Implantol 2010;3:101–110.
26. Strassburger C, Heydecke G, Kerschbaum T. Influence of prosthetic and implant therapy on satisfaction and quality of life: A systematic literature review. Part 1—Characteristics of the studies. Int J Prosthodont 2004;17:83–93.
27. McGrath C, Lam O, Lang N. An evidence-based review of patient-reported outcome measures in dental implant research among dentate subjects. J Clin Periodontol 2012;39(suppl 1):193–201.
28. Michaud PL, de Grandmont P, Feine JS, Emami E. Measuring patient-based outcomes: Is treatment satisfaction associated with oral health-related quality of life? J Dent 2012;40:624–631.
29. Brennan M, Houston F, O'Sullivan M, O'Connell B. Patient satisfaction and oral health-related quality of life outcomes of implant overdentures and fixed complete dentures. Int J Oral Maxillofac Implants 2009;25:791–800.
30. Zitzmann NU, Marinello CP. Treatment outcomes of fixed or removable implant-supported prostheses in the edentulous maxilla. Part I: Patients' assessments. J Prosthet Dent 2000;83:424 -433.
31. Awad MA, Rashid F, Feine JS. The effect of mandibular 2-implant overdentures on oral health-related quality of life: An international multicentre study. Clin Oral Implants Res 2013 Jun 4. doi:10.1111/clr.12205. [Epub ahead of print]
32. Thomason JM. The use of mandibular implant-retained overdentures improve patient satisfaction and quality of life. J Evid Based Dent Pract 2012;12:182–184.
33. Al-Omiri M, Hantash RA, Al-Wahadni A. Satisfaction with dental implants: A literature review. Implant Dent 2005;14:399–406.
34. Sandberg G, Stenberg T, Wikblad K. Ten years of patients' experiences with fixed implant-supported prostheses. J Dent Hyg 2000;74:210–218.
35. Peñarrocha M, Carrillo C, Boronat A, Martí E. Level of satisfaction in patients with maxillary full-arch fixed prostheses: Zygomatic versus conventional implants. Int J Oral Maxillofac Implants 2007;22:769–773.
36. Hashem AA, Claffey NM, O'Connell B. Pain and anxiety following the placement of dental implants. Int J Oral Maxillofac Implants 2006;21:943–950.
37. Al-Khabbaz AK, Griffin TJ, Al-Shammari KF. Assessment of pain associated with the surgical placement of dental implants. J Periodontol 2007;78:239–246.