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Double Full-Arch Versus Single Full-Arch, Four Implant-Supported Rehabilitations: A Retrospective, 5-Year Cohort Study

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Dental implants; immediate function; All-on-4.

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Abstract

Purpose: To report the 5-year outcome of the All-on-4 treatment concept comparing double full-arch (G1) and single-arch (G2) groups.

Materials and Methods: This retrospective cohort study included 110 patients (68 women and 42 men, average age of 55.5 years) with 440 NobelSpeedy groovy implants. One hundred sixty-five full-arch, fixed, immediately loaded prostheses in both jaws were followed for 5 years. G1 consisted of 55 patients with double-arch rehabilitations occluded with implant-supported fixed prostheses, and G2 consisted of 55 patients with maxillary single-arch rehabilitations or mandibular single-arch rehabilitations occluded with natural teeth or removable prostheses. The groups were matched for age (±6 years) and gender. Primary outcome measures were cumulative prosthetic (both interim and definitive) and implant survival (Kaplan-Meier product limit estimator). Secondary outcome measures were marginal bone levels at 5 years (through periapical radiographs and using the patient as unit of analysis) and the incidence of mechanical and biological complications. Differences in survival curves (log-rank test), marginal bone level (Mann-Whitney U test), and complications (chi-square test) were compared inferentially between the two groups using the patient as unit of analysis with significance level set at $p \leq 0.05$.

Results: No dropouts occurred. Prosthetic survival was 100%. Five patients lost 5 implants (G1: n = 3; G2: n = 2) before 1 year, rendering an estimated cumulative survival rate of 95.5% (G1: 94.5%; G2: 96.4%; Kaplan-Meier, $p = 0.645$, nonsignificant). The average (SD) marginal bone level was 1.56 mm (0.89) at 5 years [G1: 1.45 mm (0.77); G2: 1.67 mm (0.99); $p = 0.414$]. The incidence rate of mechanical complications (in both interim and definitive prostheses) was 0.16 and 0.13 for G1 and G2, respectively ($p = 0.032$). The incidence rate of biological complications was 0.06 and 0.05 for G1 and G2, respectively ($p = 0.669$).

Conclusions: Based on the results, rehabilitating double- or single-arch edentulous patients did not yield significant differences on survival curves. The incidence of mechanical complications was significantly higher for double-arch rehabilitated patients but nevertheless, these mechanical complications did not affect the long-term survival of either the prostheses or the implants.

The success of an edentulous rehabilitation is dependent on the development of shared goals for both the patient and the clinical team. New and improved treatment procedures, such as the continuous development of dental implant therapies, the evaluation of issues concerning prosthetic function, and prosthesis quality, are necessary to successfully rehabilitate the edentulous patient.[1] The use of removable prosthetics frequently leads to mucosal irritation, under-extension of the denture bases, incorrect jaw relationships, incorrect occlusal vertical dimension, and inadequate posterior palatal seal.[2] Some pathological manifestations of denture use include stomatitis, traumatic ulcers, irritation-induced hyperplasia, altered taste perception, burning mouth syndrome, and gagging. Some rehabilitation therapies do not replace dimensional changes of the lower third

of the face caused by continued resorption of the mandibular alveolar bone, which causes greater difficulties for denture construction: overall, removable dentures do not obtain the physiological, psychological, and social complete satisfaction of the individual who needs full-arch rehabilitation.[3] Oral implant placement may prevent the continued resorption of bone and has been associated with increased mandibular bone height distal to the implant location.[4,5] High success rates have been reported when rehabilitating completely edentulous patients using four or more implants, and in the late 1990s, various authors published clinical reports regarding the possibility of early or immediate loading of implants with fixed provisional full-arch restorations.[6-8]

In 2003, Maló et al[9] introduced the All-on-4 treatment concept. This protocol requires the placement of four interforaminal implants in the mandible, with the distal implants tilted distally by 30° to achieve a more favorable distribution of implants, thereby minimizing cantilever extensions that could jeopardize osseointegration of the distal implants.[10]

Immediate loading in the edentulous maxilla is perceived as a greater challenge than in the mandible, mostly due to the lower bone density in this jaw. Furthermore, implant anchorage in the totally edentulous maxilla is often restricted because of bone resorption, a frequent condition in the posterior regions of the jaws where bone grafting is often indicated. Implant tilting has been shown to be a good alternative to bone grafting in the maxilla, as indicated in the clinical results of several studies.[11-13] By tilting the posterior implant, a more posterior implant position can be reached, reducing the cantilever compared to axially placed implants. Cantilever extensions seem to be associated with a decreased prosthetic survival rate.[14-16] Tilting the posterior implant can also provide improved implant anchorage by engaging the apex of the implants with the cortical bone of the anterior wall of the sinus and the nasal fossae.[17]

The use of four implants in the maxilla is supported by results from short- and long-term clinical studies.[12,13,17-19] Good clinical outcomes from studies using protocols in which four implants were placed to support a full-arch prosthesis indicate that the placement of additional implants may not be necessary for successful implant treatment of edentulous jaws.[19,20]

More recently, several authors have noted that the use of the All-on-4 treatment concept with a 30° inclination of the distal implants reduced the maximum stress in the distal crestal bone,[21,22] with no difference in marginal bone resorption between tilted and straight implants.[23] Furthermore, other authors[24] reported no significant differences in loading parameters when comparing the use of more implants, demonstrating the importance of conceding enough space between implants.

The implant surgical protocol may influence the outcome of full-arch rehabilitation in the long-term, as can the size of cantilever, bar material, and type of bone.[25] A recent systematic review[26] stated that biologic and technical complications occur continuously over time as a result of fatigue and stress.

Fazi et al[10] reported that when comparing several implant numbers and positions, the use of the All-on-4 treatment concept not only reduced load bearing from bone, but also from implants and frameworks. Rehabilitating the completely edentulous patient is still a challenge. The rate for absence of complications in prosthetic full-arch rehabilitations is less than 30% at 5 years and 8% at 10 years,[26] with the most common complications being peri-implant bone loss, screw fracture, hypertrophy or hyperplasia of the soft tissue around the rehabilitation, and chipping or fracture of the veneering material, which requires repair, maintenance, time, and cost to both the clinician and patient.

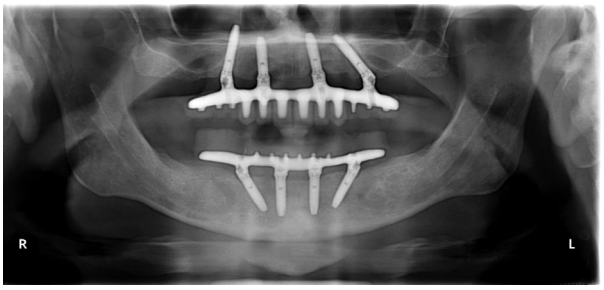

Figure 1 Orthopantomography of a double full-arch All-on-4 rehabilitation.

The biomechanics of double full-arch edentulism and the effect of an implant-supported fixed prosthesis as opposing dentition is not known to a great extent, with few clinical studies addressing this issue.[6,8,27,28] It may be that an implant rehabilitation as opposing dentition constitutes a risk factor for late implant loss.[27] Studies addressing this finding in immediate function implants are nonexistent.

The aim of this retrospective cohort study was to compare the outcome of double full-arch versus single full-arch rehabilitations in long-term outcome. This study aimed to determine the influence of opposing dentition on the treatment outcome of immediate implant-supported fixed prostheses for rehabilitation of completely edentulous jaws. The null hypothesis was that there is no difference in the long-term outcome of implant-supported fixed rehabilitations, regardless of the opposing dentition.

Materials and methods

This article was written following Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.[29] This retrospective cohort study was performed at a private rehabilitation center (Malo Clinic, Lisbon, Portugal). This study was approved by an independent ethical committee (Ethical Committee for Health; Authorization no. 014/2010). The inclusion criterion was edentulous arches, or arches with hopeless teeth, in need of fixed implant restorations as requested by the patient. As exclusion criteria, patients presenting with emotional instability, and patients who were not followed at the rehabilitation center were excluded from the study. From January 2004 to December 2006, a total of 149 patients were rehabilitated with full-arch rehabilitations according to the All-on-4 treatment concept (Nobel Biocare, Göteborg, Sweden) in both jaws on the same day, and 311 patients were rehabilitated with one full-arch rehabilitation according to the All-on-4 treatment concept (maxilla: 153; mandible: 158). Fifty-five patients were randomly selected from the double full-arch rehabilitations (Group 1 [G1]; Fig 1) using a random sequence generator. The patients with single full-arch were selected based on the

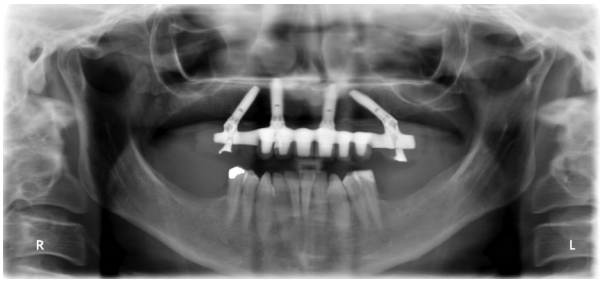

Figure 2 Orthopantomography of a maxillary single full-arch All-on-4 rehabilitation.

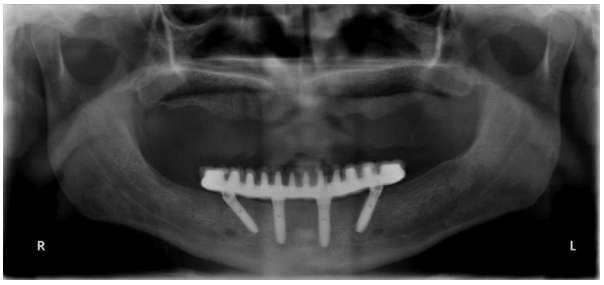

Figure 3 Orthopantomography of a mandibular single full-arch All-on-4 rehabilitation.

absence of an opposing dentition containing implant-supported fixed prostheses, and matching for age (± 6 years of a double full-arch patient) and gender with patients from G1. Of the 169 patients with single full-arch rehabilitation who qualified in the matching procedure, 55 were randomly selected (group 2 [G2], 26 maxillae and 29 mandibles; Figs 2 and 3), resulting in a total of 110 patients (68 women and 42 men; average age = 55.5 years old [standard deviation: 8.9 years]; range: 38 to 80 years old) having received a total of 660 NobelSpeedy implants (Nobel Biocare AB, Gothenburg, Sweden). As opposing dentition, patients from G1 presented an implant-supported fixed prosthesis (n = 55), while in G2 there were 35 patients with natural teeth, and 20 had a removable prosthesis.

Sample size calculation

The sample size calculation was performed using a software program (power and sample size calculations, version 3.0.34, Dupont WD and Plummer WD Jr, Department of Biostatistics, Vanderbilt University, Nashville, TN). The authors planned a study with one control per experimental subject, an accrual interval of 6 time units (1 year = 1 time unit), and additional follow-up after the accrual interval of 3 time units. Prior data indicated that the median survival time on the control treatment was 6 time units.[13,30] If the true median survival times on the control and experimental treatments are 6 and 3 time units, respectively, it was deemed necessary to include 55 experimental subjects and 55 control subjects to be able to reject the null hypothesis that the experimental and control survival curves are equal with probability (power) 0.8. The type I error probability associated with this test of this null hypothesis was 0.05.

Surgical protocol

The patients' medical histories were reviewed, together with clinical observation (treatment planning) and complementary radiographic exams with an orthopantomography (for bone height evaluation) and computerized tomography scan (for bone volume and evaluation of anatomical structures evaluation such as the dental nerve). The surgical procedures were described in previous reports following the All-on-4 treatment concept.[13,30]

Immediate provisional prosthetic protocol

Implant-supported fixed prostheses of high-density acrylic resin (PallaXpress Ultra; Heraeus Kulzer GmbH, Hanau, Germany) with titanium cylinders (Nobel Biocare AB) were manufactured at the dental laboratory and inserted on the same day (G1: 110; G2: 55). Anterior occlusal contacts and canine guidance during lateral movements were preferred in the interim prosthesis. No cantilevers were used in the interim prostheses. The emergence positions of the screw-access holes at the posterior implants of the prostheses were normally at the level of the second premolar, and the prostheses were designed to hold a minimum of 10 teeth due to the favorable position achieved by the posterior tilting of the distal implants.

Final prosthetic protocol

Considering patient desires, a metal ceramic implant-supported fixed prosthesis with a titanium framework and all-ceramic crowns (Procera Ti framework, Procera crowns, NobelRondo ceramics; Nobel Biocare AB), or a metal-acrylic resin implant-supported fixed prosthesis with a Ti framework (Procera Ti framework) and acrylic resin prosthetic teeth (Heraeus Kulzer GmbH) was used to replace the interim prosthesis. In this definitive prosthesis, the occlusion mimicked natural dentition. The definitive prosthesis was typically delivered 6 months postsurgically.

Outcome measures

Primary outcome measure was prosthetic survival and implant survival. Prosthetic survival (both interim and definitive) was based on function, with the necessity of removing the prostheses classified as failure. Implant survival was based on the Malo Clinic survival criteria:[13] (1) implant fulfilled its purported function as support for reconstruction; (2) it was stable when individually and manually tested; (3) no signs of persistent infection observed; (4) no radiolucent areas around the implants; (5) demonstrated a good esthetic outcome in the rehabilitation; and (6) allowed the construction of an implant-supported fixed prosthesis that provided patient comfort and good hygienic maintenance. The implants removed were classified as failures. Secondary outcome measures were marginal bone level, biological complications (peri-implant pathology; fistulae formation, abscess formation), and mechanical complications (loosening or fracture of any prosthetic component).

Marginal bone level

Periapical radiographs were made using the parallel technique with a film holder (Super-bite; Hawe-Neos, Bioggio, Switzerland). The holder's position was adjusted manually for an

estimated orthogonal film position. A blinded operator examined all radiographs of the implants for marginal bone level. Each periapical radiograph was scanned at 300 dpi with a scanner (HP Scanjet 4890; HP Portugal, Paço de Arcos, Portugal), and the marginal bone level was assessed with image analysis software (Image J version 1.40g for Windows; National Institutes of Health, Bethesda, MD). The reference point for the reading was the implant platform (the horizontal interface between the implant and the abutment), and marginal bone level was measured to the first contact between implant and bone. The radiographs were accepted or rejected for evaluation based on the clarity of the implant threads: a clear thread guarantees both sharpness and an orthogonal direction of the radiographic beam towards the implant axis. Calibration of the radiographs was performed using the implants' platform diameter. The marginal bone levels, evaluated on periapical radiographs, were registered at 5 years of follow-up. The bone levels were averaged per patient and presented using the rehabilitation as unit of analysis.

Statistical analysis

Patient-related survival (using the patient as unit of analysis and considering the first incidence of implant failure) was computed using the Kaplan-Meier product limit estimator (SPSS 17.0; SPSS Inc., Chicago, IL) with comparison of survival curves between groups through the log-rank test. The incidence of mechanical and biological complications, systemic compromises, smoking habits, and bruxism between both groups was analyzed by the chi-square test. The marginal bone levels were compared between the two groups using the Mann-Whitney test after testing the variable for normality through the Kolmogorov-Smirnov test. The level of significance was 0.05. Statistics were computed using the Statistical Package for Social Science (SPSS 17.0).

Results

A total of 26 patients presented at least one systemic condition (G1: 11 patients; G2: 15 patients, $p = 0.369$); 33 patients were smokers (G1: 19 patients; G2: 14 patients, $p = 0.298$), and 37 patients were suspected to be heavy bruxers (G1: 22 patients; G2: 15 patients, $p = 0.158$). No dropouts occurred in this study, and the patients were followed for 5 years. Five patients lost five implants (G1: 3 patients; G2: 2 patients), rendering an estimated survival rate of 95.5% (Kaplan-Meier; Table 1). All implant failures occurred during the first year of follow-up and were counted as early failures. No failures of the prostheses occurred, rendering a 100% survival rate. The estimated patient-related cumulative survival rates (CSRs) after 5 years of follow-up were 94.5% for G1 and 96.4% for G2 (Kaplan-Meier; Table 2 and Fig 4). Survival curves did not differ significantly between the two groups ($p = 0.645$, log-rank test). At 5 years of follow-up, 94 of the 110 patients had readable radiographs (86%). The bone level was on average −1.56 mm (SD = 0.89 mm) overall; −1.45 mm (SD = 0.77 mm) for G1 (maxilla: −1.44 mm [SD = 0.88 mm], mandible: 1.42 mm [SD = 0.82 mm]) and −1.67 mm (SD = 0.99 mm) for G2 (Table 3; maxilla: 1.72 mm [SD = 1.03 mm], mandible: 1.63 mm [SD = 1.01 mm]). The difference in marginal bone level between the two groups was nonsignificant ($p = 0.414$).

The incidence rate of mechanical complications (considering both interim and definitive prostheses) over the 5 years of follow-up was significant between the two groups with 0.16 [(45/55)/5] for G1 and 0.13 [(35/55)/5] for G2 ($p = 0.032$). For G1, the type of mechanical complications were fracture of the prosthesis (41 patients), abutment screw loosening (21 patients), and prosthetic screw loosening (6 patients), with 21 patients presenting more than one complication. While for G2 there were fractures of the prosthesis in 31 patients (23 patients with natural teeth as opposing dentition and 8 patients with removable prosthesis as opposing dentition), abutment screw loosening in 12 patients (11 patients with natural teeth as opposing dentition and 1 patient with removable prosthesis as opposing dentition) and prosthetic screw loosening in 2 patients (both with natural teeth as opposing dentition), with 9 patients presenting more than one complication (all with natural teeth as opposing dentition). For G1, the majority of complications occurred in the interim prosthesis (n = 29 patients; fractured prostheses = 28 patients) compared to the definitive prosthesis (n = 16 patients; fractured prostheses = 13 patients), and 15 patients with complications in both prostheses; while for G2, the majority of complications occurred in the definitive prosthesis (n = 19 patients; fractured prostheses = 15 patients) compared to the interim prosthesis (n = 16 patients; fractured prostheses = 16 patients), and 2 patients with complications in both prostheses. Thirty patients (37.5%) suspected of being heavy bruxers experienced mechanical complications (18 patients in G1, 12 patients in G2). The prosthetic planning for patients who presented mechanical complications was adjusted in an attempt to resolve the complications. The loosening of prosthetic components was addressed by re-tightening the prosthetic components; the prosthesis fracture was addressed by mending the prosthesis (acrylic resin) or repairing the ceramic (metal ceramic prosthesis). The common strategy addressing both complications (prosthetic components loosening and fractures) was the adjustment of the occlusion and manufacture of a night-guard.

The patient-related incidence rate of biological complications over the 5 years of follow-up for the two groups was 0.06 [(16/55)/5] for G1 and 0.05 [(14/55)/5] for G2, with no significant differences between the groups ($p = 0.669$). For G1, there were 15 incidences of peri-implant pathology and one fistulae formation (n = 16 implants, 7.2%); while for G2 there were 12 incidences of peri-implant pathology, one of suppuration and one abscess formation (n = 14 implants, 6.4%). Thirteen of the patients (G1: 7 patients; G2: 6 patients) with biological complications were smokers. Eighty-one percent of the patients (13/16) in G1 and 86% (12/14) of the patients in G2 presenting biological complications also presented mechanical complications.

Discussion

The difference in survival rate between the two groups (G1: 94.5%; G2: 96.4%) was not significant; however, a significant difference was registered between both groups concerning mechanical complications. Therefore, the null hypothesis stating

Table 1 Implant survival of the completely edentulous rehabilitations using the rehabilitation as unit of analysis (Kaplan-Meier product limit estimator)

Time (months)	Status (0 = non failure; 1 = failure[a])	Cumulative proportion surviving at the time		No. of cumulative events	No. of patients at risk
		Estimate	Std. error		
Overall rehabilitations					
0	0	–	–	0	110
3	2	0.982	0.013	2	108
6	1	0.973	0.016	3	107
7	1	0.964	0.010	4	106
10	1	0.955	0.020	5	105
12	0	–	–	5	105
24	0	–	–	5	105
36	0	–	–	5	105
48	0	–	–	5	105
60	0	–	–	5	105

[a]Failure was defined as the first implant to fail in one patient.

Table 2 Implant survival of the completely edentulous rehabilitations using the rehabilitation as unit of analysis (Kaplan-Meier product limit estimator); survival distribution between the 2 study groups

Time (months)	Status (0 = non failure; 1 = failure[a])	Cumulative proportion surviving at the time		N of cumulative events	N of patients at risk
		Estimate	Std. error		
Group 1 (double full-arch rehabilitations)					
0	0	–	–	0	55
3	1	0.982	0.018	1	54
6	1	0.964	0.025	2	53
7	1	0.945	0.031	3	52
12	0	–	–	3	52
24	0	–	–	3	52
36	0	–	–	3	52
48	0	–	–	3	52
60	0	–	–	3	52
Group 2 (single full-arch rehabilitations)					
0	0	–	–	0	55
3	1	0.982	0.018	1	54
10	1	0.964	0.025	2	53
12	0	–	–	2	53
24	0	–	–	2	53
36	0	–	–	2	53
48	0	–	–	2	53
60	0	–	–	2	53

Difference between groups in survival was not significant ($p = 0.645$, log-rank test).

[a]Failure was defined as the first implant to fail in one patient.

that there is no difference in the experimental and control group survival curves could be partially rejected. The overall 95.5% (patient-related) CSRs at 5 years for the immediate loading protocol in double full-arch rehabilitations and the overall marginal bone level of 1.56 mm apical to the implant platform after 5 years (group 1: 1.45 mm; group 2: 1.67 mm) was within the limits of previous reports on the rehabilitation of edentulous jaws using the same protocol in single full-arch rehabilitations.[13,19,30] In a longitudinal study on the survival of implants in the rehabilitation of the edentulous mandible using the All-on-4 treatment concept, a CSR of 94.8% at 5 years using the patient as unit of analysis was reported.[30] Another study evaluating the 5-year outcome of the same concept in the maxilla reported a 93% CSR using the patient

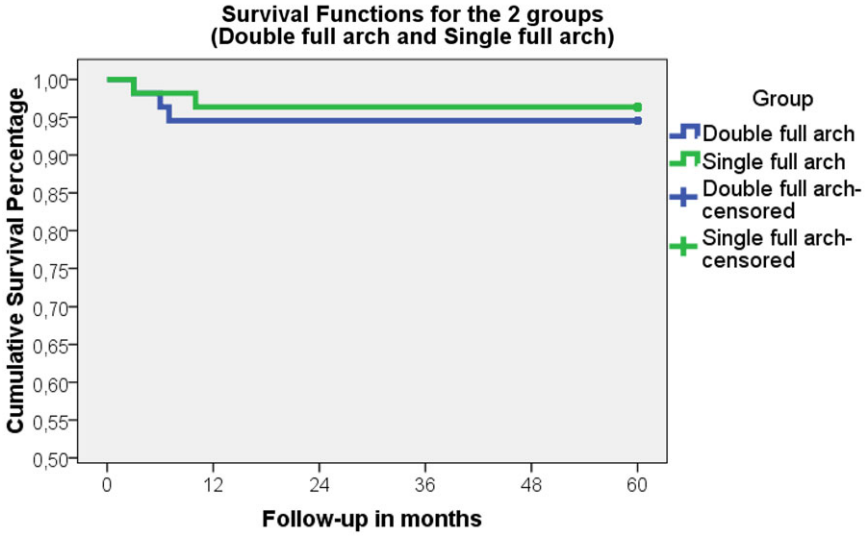

Figure 4 Survival estimation for both groups using the patient as unit of analysis and calculated through the Kaplan-Meier product limit estimator. No significant difference was registered between the two survival curves ($p = 0.645$, log-rank test).

Table 3 Marginal bone level, situated apically to the implant platform, after 5 years of follow-up with the patient as unit of analysis in groups 1 and 2

	Group 1: All-on-4 double full-arch		Group 2: All-on-4 single full-arch	
Average (mm)[a]	1.45[b]		1.67[b]	
Standard deviation (mm)	0.77		0.99	
Number	46		48	
Frequencies	N	%	N	%
0 mm	0	0.0%	1	2.1%
0.1-1.0 mm	15	32.6%	15	31.3%
1.1- 2.0 mm	24	52.2%	17	35.4%
2.1-3.0 mm	4	8.7%	9	18.8%
>3.0 mm	3	6.5%	6	12.5%

[a]Overall marginal bone level was 1.56 mm (0.89 mm).

[b]Difference between groups in marginal bone level was not significant ($p = 0.414$).

as unit of analysis together with −1.95 mm of marginal bone level.[13] An additional study evaluating the 5-year outcome of immediate function implants in completely edentulous maxillary rehabilitations with different degrees of bone resorption (low-to-high bone resorption) reported an 88.6% CSR using the patient as unit of analysis.[19] There were also no significant differences in marginal bone level or the incidence of biological complications between the two groups.

There was a significantly higher incidence of mechanical complications in double full-arch rehabilitations (occluding with implant-supported fixed prostheses) compared to single full-arch rehabilitations (occluding with natural teeth and removable dentures). A previous study reporting the long-term outcome of up to 10 years of a retrievable metal ceramic implant-supported fixed prostheses with milled titanium frameworks and all-ceramic crowns registered a twofold increase in the probability of crown fracture in the presence of a metal ceramic implant-supported fixed prosthesis opposing dentition.[31] A retrospective analysis of porcelain failures of implant-supported metal ceramic crowns and fixed partial dentures (FPDs) investigating patient- and implant-specific predictors of ceramic failure reported that metal ceramic prostheses (single crown or FPDs) had approximately 7 times higher odds of porcelain fracture and 13 times greater odds of a fracture requiring either repair or replacement when in occlusion with another implant-supported restoration, as compared to opposing a natural tooth.[32] Nevertheless, the explanation for this result cannot rule out other variables including not only a lack of proprioception by the patient and/or the lack of shock-absorbing capacity by the prosthesis, but also relating to technical failure in the manufacturing process, occlusion failure in controlling the occlusion following predetermined guidelines, or parafunctional movements by the patient, all these variables acting independently or in association.[31-33] In our study, 84% of the patients with mechanical complications were either suspect of being heavy bruxers or presented an implant-supported fixed

prosthesis as opposing dentition. This implies that these patients may benefit from a prosthetic protocol including periodic clinical maintenance appointments in short intervals for occlusion evaluation and the use of a night-guard prescribed from the initial stage of implant rehabilitation to decrease the probability of mechanical complications. Nevertheless, these mechanical complications did not affect the long-term survival of the prostheses or the implants, demonstrating that those procedures are safe and effective.

The biological complication incidence rate, mainly peri-implant pathology, affected patients at a similar rate in both groups. These biological complications seemed to cluster in a determined number of patients, as 13 of the 16 patients in G1 (81%) and 12 of the 14 patients in G2 (86%) also presented mechanical complications, suggesting a synergetic effect between mechanical and biological complications, a situation that has been previously described in a systematic review investigating the effect of occlusal overload on peri-implant tissue health in the animal model.[34] Furthermore, biological complications occurred in 44% (7/16 patients) and 43% (6/14 patients) from G1 and G2, respectively, who were smokers. These results find parallels in the literature, where a recent systematic review reported smoking, together with history of periodontitis and poor oral hygiene as risk indicators for peri-implant pathology.[35]

The limitations of this study include: the retrospective design; being performed in a single center, which implies further validation in different social and cultural backgrounds; the different subgroups in G2 (single full-arch patients occluding with removable prostheses or natural teeth) as the amount of forces that can be generated by denture patients versus dentate patients is different; and the possible differences on the occlusal concept followed for the different subgroups, as these were chosen according to the specific conditions and treatment plan performed for the patient and not according to a specific inclusion criteria as a prospective study would imply. The strengths of this study include the long-term follow-up of 5 years and the use of a control group in the study design. Randomized controlled trials should be performed to confirm these results and investigate the effectiveness of using a controlled prosthetic protocol on the long-term outcome of double full-arch rehabilitated patients.

Conclusions

Rehabilitating double full-arch or single full-arch patients did not yield significant differences on implant survival and marginal bone level in the long-term follow-up; however, the incidence of mechanical complications registered was significantly higher for double full-arch patients than for single full-arch patients.

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