



International journal of interdisciplinary dentistry

ISSN: 2452-5588

ISSN: 2452-5596

Sociedad de Periodoncia de Chile Implantología
Rehabilitación Odontopediatria Ortodoncia

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International journal of interdisciplinary dentistry, vol. 13, no. 2, 2020, pp. 76-79
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ORIGINAL ARTICLE



Incidence of surgical and prosthetic complications in total edentulous patients rehabilitated by the All-on-Four® technique: a retrospective study.

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Trabajo recibido el 20/04/2020
Aprobado para su publicación el 11/07/2020

ABSTRACT

Objective: To analyze the level of survival and the main complications presented by total edentulous patients after the All-on-Four® treatment, through a retrospective analysis. **Methods:** The medical records of 32 rehabilitated patients, between 2010 to 2018 were selected, presenting a total of 128 implants with subsequent fixed prostheses. The following variables were analyzed: gender, age, patient's systemic condition, time of implant installation, number of implants, and surgical and prosthetic complications. **Results:** the procedures were performed over on average 5.9 years ago and were more prevalent in female patients (59.6%). Out of the 32 patients selected 75% presented some systemic alteration, with hypertension being the most frequent disease. Regarding the implant placement, the rehabilitation in the mandible was more prevalent (62.5%), while in the maxilla (31.2%), and in the bimaxillary region (6.25%). As for the complications, out of 128 implants installed, 13 presented loss of osseointegration, leading to a survival rate of 90.44% (94.3% mandible and 83.3% maxilla). Furthermore, 15 surgical and 20 prosthetic complications were diagnosed. Among the surgical complications, the most frequent were loss (5-33%) and bone fracture (3-20%), while the most frequent prosthetic complications included loosening and/or fracture of the prosthetic component and prosthetic fracture (6-30%). **Conclusion:** All-on-Four® is a procedure that has a high survival rate.

KEY WORDS

Dental Implants; Jaw; Edentulous; Intraoperative.

Int. J. Inter. Dent Vol. 13(2); 76-79, 2020.

INTRODUCTION

Oral rehabilitation in patients with maxilla and mandible atrophy is a current challenge for dental professionals. Implant-supported fixed implants involving immediate loading provide the patients with a higher degree of satisfaction and are becoming more popular and safe due to the high survival rate of the implants. One treatment option for atrophic ridges, in which the patient wishes for a fixed prosthesis without reconstructive surgery, is the All-on-Four® treatment technique⁽¹⁾.

The All-on-Four® treatment concept was developed in the 1990s. Its features include: *full-arch rehabilitation with only four implants, two straight anterior implants and two 45° angled implants in the posterior region; * immediate function - for patients fit for immediate implant loading; and * graft-free procedure - the bone grafting is avoided by tilting the posterior implants and using available bone. Thus, it is possible to fully rehabilitate the edentulous jaws with minimal bone volume and a high probability of success⁽¹⁻⁶⁾.

The inclination of the implants is advantageous and necessary as it reduces the length of the cantilever, increases the prosthetic support and allows the manufacture of up to 12 elements prostheses, which increases the masticatory efficiency⁽¹⁻⁶⁾, thus reducing the need to lift the maxillary sinus membrane and bone grafts. It also allows the installation of longer implants, once it avoids areas of noble anatomic structures including mandibular canal and mental foramen⁽⁷⁻⁹⁾.

However, the All-on-Four® technique has some limitations, such as the need to make a provisional acrylic prosthesis that increases the risk of fractures, as the force applied to angled implants can cause bone crest injuries up to five times larger than parallel implants⁽⁹⁻¹⁰⁾. In addition, there are few long-term follow-up studies in the literature investigating the effects of this technique⁽⁵⁾.

Patzelt et al.⁽¹¹⁾ (2013) performed a systematic literature review and described that in 4.804 implants installed on patients, only 74 were lost. The failure rate was higher in the first year after the surgical procedures. According to the authors, the failures were mainly related

to mobility (19%), non-osseointegration (5%), infections (3%) and systemic alterations (1%). With respect to the prostheses, the most frequent complication was the fracture of the acrylic portion, where 57 prostheses were fractured out from the total of 1.201 installed⁽¹¹⁾.

The high survival rates and the low incidence of complications strongly demonstrates the predictability of implant treatment, regardless of the chosen protocol^(2,4,12-13). The challenge today is not to prove functionality, but to develop simpler and more cost-effective treatment protocols for the patients⁽⁴⁾.

Therefore, this study aimed to investigate the survival rate of rehabilitation of total edentulous patients who underwent treatment using the All-on-Four® technique at the Postgraduate Implantology Clinics of the University of Araraquara, São Paulo, Brazil, within the period from 2010 to 2018. The researchers accept the hypothesis that the All-on-Four® technique provides adequate predictability rehabilitation for edentulous ridges. The specific objectives included: 1) to evaluate the survival rate of implants installed following the All-on-four® technique protocol; 2) to evaluate the surgical complications resulting from the treatments performed with the All-on-Four® technique; and 3) to evaluate the prosthetic complications resulting from the treatments performed with the All-on-Four® technique.

MATERIALS AND METHODS

Patient Selection

This study was conducted initially by the selection of dental records of patients attended at the Postgraduate Implantology Clinics of the University of Araraquara, São Paulo, Brazil, between the years of 2010 to 2018, after submission and due approval by the Human Research Ethics Committee (number 94312318.0.0000.5383).

The inclusion criteria of the patients in this study were based on the following documentation: 1) medical records of patients rehabilitated with implants using the All-on-Four® technique in the last 8 years (2008 - 2018) at the implant clinics of the University of Araraquara; 2)

Anamnesis and free and informed consent forms completely filled and signed, being requested at the time of filling out the medical record and agreeing that the data regarding their clinical profile could be used in scientific research, however without their personal identification data. The exclusion criteria of the patients in this study were based on medical records of patients treated outside of the determined study timing period, patients still under dental treatment, and/or patients with incomplete forms or anamnesis data.

Data Collection and Analysis

Data analysis regarding clinical, surgical and prosthetic factors of the patients was performed through cataloging tables and sheets. The following data were categorized: gender, age, patient's systemic condition, implant size and diameter, number of implants, peri-implant tissue condition, osseointegration-related failures, and prosthetic rehabilitation. The data was qualitatively and quantitatively analyzed, and then transformed into percentage, to facilitate discussion and comparison with the literature reports.

RESULTS

Thirty-two All-on-Four® implant-supported rehabilitation patients were treated between 2010 and 2018 at the Araraquara University Implant Dentistry Outpatient Clinic (Figure 1-6). The treatments were performed on average 5.92 years ago, in 19 (59.65%) female patients and 13 (40.35%) male patients, totaling 128 implants installed.

The age range of the study population was 41-90 years. The highest number of rehabilitations occurred in patients aged from 61-70 years (43.75%), followed by patients aged from 51-60 years (34.37%), 41-50 years (12.5%), 71-80 years (6.25%) and the lowest number of rehabilitations was found in the group of age 81-90 years old (3.12%) (Table 01).

Of 32 patients selected in this study, 24 presented at least one type of systemic impairment, corresponding to 75% of the population



Figure 1. Initial Clinical Analysis exemplifying in the maxilla, the all on four technique.

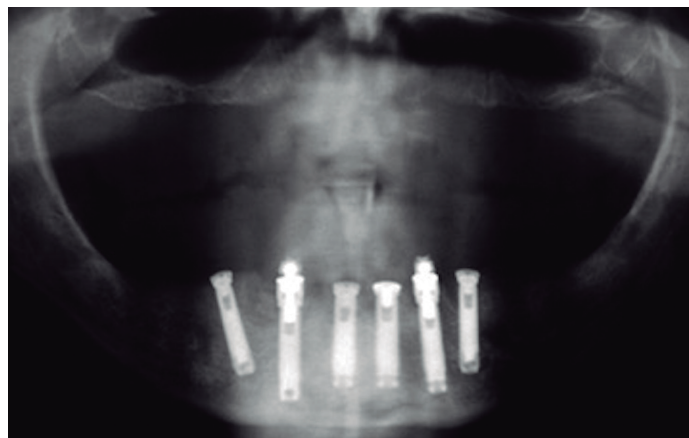


Figure 2. Initial Radiographic Analysis.



Figure 3. Clinical aspect Immediately after implant placement.

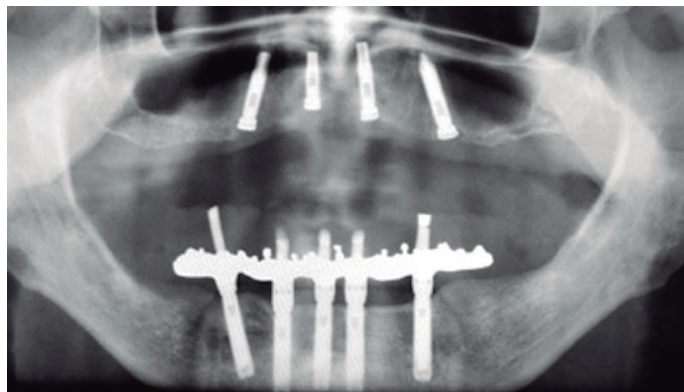


Figure 4. Radiographic appearance after implant installation.



Figure 5. Clinical aspect after the placement of the prosthesis.

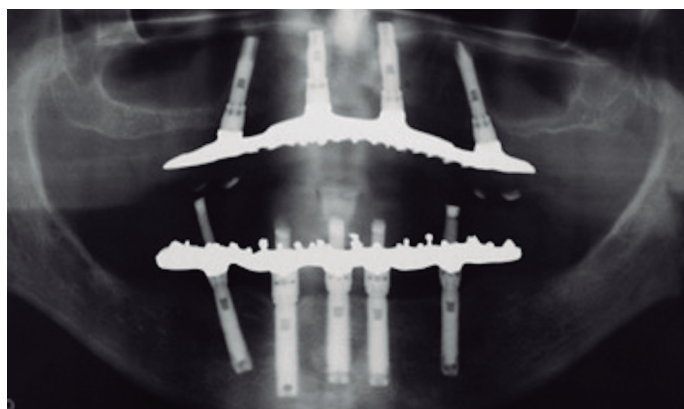


Figure 6. Radiographic appearance after the placement of the prosthesis.

Systemic Diseases

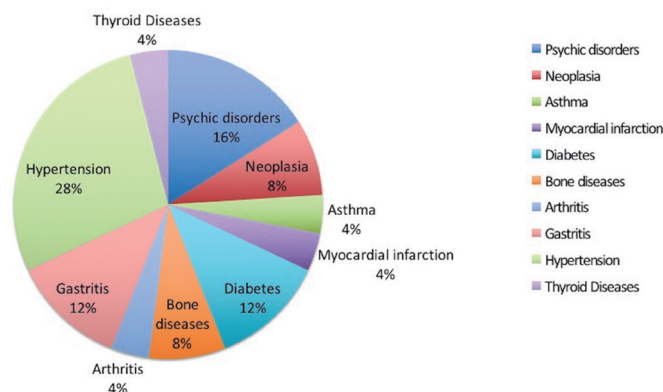


Figure 7. Preoperative systemic alterations.

Table 1: Patients distribution according to age and systemic alterations.

Age	Patients	Systemic alterations
41-50	4	2
51-60	11	9
61-70	14	10
71-80	2	2
81-90	1	1
Total	32	24

analyzed, some of the patients had also concurrently diseases. The most prevalent systemic alteration observed was hypertension, reported by 28% of patients with a positive history of illness, followed by depression (16%), diabetes and gastritis (12%) (Figure 07 and Table 01).

Regarding implant placements, rehabilitation with the All-on-four® protocol in the mandible was more prevalent, being performed in 20 patients (62.5%), followed by the treatment of the maxillary region performed in 10 patients (31.25%) and by the treatment of the bimaxillary region that was performed only in 2 patients (6.25%). The antagonist arch showed 11 total prostheses, 11 implant prostheses, 6 natural teeth, 3 edentulous and 1 fixed prosthesis.

Out of 136 implants installed, 13 presented loss of osseointegration, thus the survival rate observed in this study is 90.44%. 88 mandibular implants were installed with the survival rate 94.3% and 48 maxilla implants with a 83.3% survival rate. In addition, 15 surgical and 20 prosthetic complications were diagnosed, totaling 48 complications (Table 02). The surgical and prosthetic complications were more common in mandible. Among the surgical complications, the most frequent were loss (5-33%) and bone fracture (3-20%), while the most frequent prosthetic complications included loosening and/or fracture of the prosthetic component (6-30%) and prosthesis fracture (6-30%) (Tables 03 and 04).

DISCUSSION

Dental surgeons are currently looking for several alternatives to treat cases of total edentulism, once it is a challenge to rehabilitate patients who are in this state without the need of any prior procedure, such as bone grafts and maxillary sinus lifting, which results in higher dental morbidity, longer surgical time and higher costs^(2,10,14).

An alternative treatment for these cases is the All-on-Four® technique, in which two vertical implants are installed in the anterior region and two distally inclined implants in the posterior region with the possibility of loading, eliminating the additional surgical procedure^(2,15). It also allows the restoration of the dental function immediately, avoiding procedures that increase treatment costs and/or risks of patient dental morbidity, as well as the complications inherent to the classical procedures⁽³⁻⁵⁾.

In this study, the survival rate of the implants installed following the All-on-Four® protocol was 89.85% past over an average period of 5.9 years of treatment completion. Pomares et al. (2009)⁽²⁾, Maló et al.

Table 2: Patients distribution according to implants installed and its complications.

Total Patients	Implants Installed	Lost Implants	Surgical Complications	Prosthetic Complications
32	136	13	15	20

Table 3: Type and incidences of surgical complications.

Surgical Complications	N (Maxilla)	N (Mandible)	N (Total)
Bone Loss	1	4	5
Bone fracture	0	3	3
Implant fracture	1	1	2
Loss of Stability	2	0	2
Mucositis	0	1	1
Abscess	0	1	1
Soft tissue dehiscence	0	1	1
Total	4	11	15

Table 4: Type and incidences of prosthetic complications.

Prosthetic Complications	N (Maxilla)	N (Mandible)	N (total)
Loosening or fracture of the prosthetic component	1	5	6
Fracture of the Prosthetic	2	4	6
Aesthetics	0	2	2
Metal Bar fracture	1	1	2
Prosthesis Mobility	1	1	2
Nibble on lips and cheeks	0	1	1
Phonetic Alteration	0	1	1
Total	5	15	20

(2011 and 2012)^(10,15) and Crespi et al. (2012)⁽¹⁶⁾ evaluated the same protocol and observed survival rates of approximately 93 to 97% over a period of 5 years. These studies reported that the complications encountered in performing the All-on-Four® technique were low and did not differ from the classical technique, concluding that the All-on-Four® concept for rehabilitation of the total edentulous jaw using implants in immediate function is a viable technique in the medium and long term.

The low survival rate obtained in the present study, when compared to other researches, could be related to the high prevalence (75%) of patients who presented some systemic alteration, especially due to hypertension (28%), diabetes (12%), psychiatric disorders (16%) and bone diseases (8%), which can directly influence the osseointegration during the rehabilitation⁽¹⁷⁾. Another factor that should be considered is the implant control care; it was observed in the dental reports that some patients skipped the regular maintenance, which also increases the risk of implant losses and complications.

The main complications observed in this study were: bone loss (33%), prosthetic fracture (30%), loosening and/or prosthetic component fracture (30%) and bone fracture (20%). In a recent literature review on All-on-Four® complications, Soto-Peñaloza et al. (2017)⁽⁴⁾ reported the fracture of the acrylic prosthesis as the main prosthetic complication, failure that can be resolved by occlusal adjustments⁽¹⁸⁾, while the loosening and/or loss of screws can be solved by tightening the screws, occlusal adjustment and also by offering the proper use guidance⁽¹⁰⁾. Another very common complication is the higher losses of inclined implants when compared to the vertical ones^(15,19). Depending on the posterior implant positioning and the degree of mandibular atrophy, the presence of cantilevers may be inevitable, which increases the risk of mechanical complications in the prostheses (up to 50%)⁽⁹⁾.

The All-on-four technique is a procedure that has a high survival

rate. However, it can predispose the patient to more risks related to implant and prosthesis success, being extremely important for implant distribution and loading prosthetic (immediate / immediate) option.

CLINICAL RELEVANCE

The All-on-Four® treatment concept was developed in the 1990s, that it is possible to fully rehabilitate the edentulous jaws with minimal bone volume and a high probability of survival. However, technique has some limitations, such as the need to make a provisional acrylic prosthesis that increases the risk of fractures, as the force applied to angled implants can cause bone crest injuries up to five times larger than parallel implants. In addition, there are few long-term follow-up studies in the literature investigating the effects of this technique.

FUNDING

The authors declare that they have no funding.

COMPETING INTERESTS

The authors declare that they have no competing interests.

ACKNOWLEDGMENTS

None.

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