

# The All-on-Four treatment concept: A systematic review of the past 5 years

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Dissertação conducente ao Grau de Mestre em Medicina Dentária (Ciclo Integrado)

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Trabalho realizado sob a Orientação de Mestre Juliana de Sá

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## Agradecimentos

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## Resumo

Durante vários anos as abordagens para uma reabilitação fixa total maxilar/mandibular seria a colocação de 6 a 8 implantes, sendo os implantes posteriores frequentemente implantados muito próximos de importantes zonas anatômicas, como: forame mentoniano, seio maxilar ou nervos.

Para contornar esse problema, os implantes curtos foram a primeira técnica colocada em evidência, mas o protocolo All-on-Four mostrou resultados superiores, com uma taxa de sucesso a longo prazo mais elevada, tornando-se o compromisso perfeito para uma solução custo-benefício.

Nos dias de hoje, o conceito de tratamento All-on-four é reconhecido como o "*golden standard*" em implantologia e está difundido em todo o mundo. Esta técnica permite que pacientes que não têm condições financeiras ou físicas de colocar mais implantes para suportar a prótese (ou qualquer enxerto ósseo complexo), tenham um plano de tratamento que responde a quase todas as suas demandas e expectativas.

A base do protocolo All-on-4 destaca-se pela colocação de 4 implantes tanto na maxila como na mandíbula, 2 na zona anterior verticalizados e 2 nas zonas posteriores inclinados (máximo de 45 °) que permitem evitar zona anatômica sensível.

A "ferulização" dos implantes por meio de uma prótese fixa após cirurgia (cirurgia com carga imediata) permite compensar a inclinação dos implantes e garantir uma boa osseointegração.

No entanto, existem complicações (biológicas e/ou técnicas) que permanecem suficientemente raras para incentivar o dentista a escolher este plano de tratamento.

**PALAVRAS\_CHAVE:** "All-on-four", "all-on-4", "carga imediata", "prótese suportada por 4 implantes", "implantes angulados", "implantes inclinados"

## Abstract

In the past few years, approaches to rehabilitate fully edentulous jaw were made with 6 to 8 implants however the posterior implants were often too close to some anatomical structure such as mental foramina, maxillary sinus, or nerves. While short implants were the first technic put forward to overcome these issues, the All-on-Four protocol has shown much better results with higher long-term success rate making it the perfect compromise for a cost-effective solution.

Nowadays, the All-on-four treatment concept is recognized as the "gold standard" in implant dentistry and has been widely adopted throughout the world. The treatment offers patients who are unable to financially or physically afford more implants to support prosthesis (or any complex bone grafts), a treatment plan that answer almost all their demands and expectations.

The main idea of the All-on-four protocol is to place 4 implants in each jaw, 2 vertical anterior and 2 posteriors tilted (maximum of 45°) to ensure the anatomical zone is avoided.

The "ferulization" of the implants by a fixed prosthesis after the surgery, (immediate loading protocol surgery) compensates the inclination of the implants, and ensures good osseointegration.

Complications do however exist (biologicals and/or technicals), but cases remain rare enough to encourage dentists to choose this treatment plan over alternatives.

**KEYWORDS:** "All-on-four", "all-on-4", "immediate loading", "prosthesis supported by 4 implants", "angulated implants", "tilted implants"

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## List of abbreviations and acronyms:

SSR = Success rate

SSRI = Success rate implant

SSRP = Success rate prosthesis

SR = Survival rate

SRI = Survival rate implants

SRP = Survival rate prosthesis

MBL = Major bone loss

A04 = All-on-4

A05 = All-on-5

A06 = All-on-6

N.B = Nota bene

CBCT = Cone Beam Computed Tomography

VS = Versus

IL = Immediate Loading

## 1. Introduction

Regarding the constant augmentation of life expectancy, we can say that nowadays, one of the most challenging issues in oral health is the rehabilitation of the edentated jaw. In Portugal 10% of the population has a total lack of tooth and the OMS even estimated 30% of the total edentated jaw in the world by 2030. This condition affects the entire population.<sup>1,2</sup>

This is undoubtedly a problem, knowing that their requirements in reference to comfort and efficiency increase inversely to their oral condition.<sup>2</sup>

Dentists are faced with demands of solutions for these patients, which has led to the development of techniques, that are now reported with very high SR, SSR and minimum MBL.<sup>3,4, Figure 2</sup>

The first tentative of implantation was made during Ancient Egyptian dynasties, where it was limited to transplantation from one patient to another. Instantaneously, this highlighted the possibility of infection and bacterial contamination.<sup>5</sup>

In 1985, Branemark defined osseointegration as *"a direct anatomical and functional junction between the reshaped living bone and the surface of the loaded implant"*, and led to a period called the Branemark period where protocols are majorly made in 2 surgical steps.<sup>6</sup>

Protocols in 1 surgical step, are promptly put in place, to better meet patient's needs.<sup>7-9</sup> At that point, the healing time is rapidly moving from 3/6 months to 6/8 weeks always to reduce the time of surgery and protocol.<sup>10-12</sup>

IL which for decades had been non-conceivable because of the fibrous interposition it was resulting in, is now a viable solution. This protocol has two imperatives, one is logistic and the other one is biologic, always following the concept of osseointegration. Some authors

say that IL is the fact of placing the prosthesis directly after the installation of the implants, others enlarge this time interval to 24h or even 48h after. <sup>13-15</sup>

IL has been chosen over other loading technics because: it allows the patient to leave the appointment directly with new teeth; treatment remain faster with only one surgical intervention and reducing appointment time leaves the patient with more free time; healing time is significantly reduced; the use of a fixed prosthesis is much more comfortable for the patient than the removable prosthesis and better manages soft tissues; work is easier for the practitioner and needs less adjusts/retouch's. <sup>13-16</sup>

The protocol to rehabilitate patients with complete fixed prosthesis supported by implants is often between 6 and 8 implants, respecting parallelism between the force's and implant's axes. <sup>2</sup>

This is a viable solution but the position of the posterior implants is often established very close to the anatomical structure (mental foramina, nerves, ...) Where past techniques were choosing shorter implants, the A04 treatment is using long angulated posterior implants. The two anterior implants are in a vertical position and the two posteriors are in a distal angulation of maximum 45°. The reunion of the implants by a fixed prosthesis allows to compensate the inclination of the implants and assure a good osseointegration. <sup>16</sup>

The 2 posteriors implants are inclined (max 45°), in the maxillary because of the maxillary sinus, and in the mandible are distally tilted regarding the occlusion plan, next to premolars. Anterior implants are placed around the median sagittal plane. <sup>19</sup>

In this study, we reviewed the literature of the past 5 years and concentrate our explanations on the technique that is nowadays considered as the "most suitable and effective" to rehabilitate a case of the edentated jaw: the complete fixed supported-implants prosthesis, and specifically on a technique that was described by Dr. Paulo Malo in Portugal initially in 1993, and used for the first time in 2003. <sup>4</sup>

## **2- Objectives and hypothesis**

The purpose of this systematic review was to assess the efficiency of the treatment of totally edentulous patients, who have had recourse to the A04 protocol, by comparing SR, SSR, MBL and realize a revision of the proper technic by enumerating the protocol's steps.

### 3- Material and Methods

A bibliographic search was performed on PubMed, Google Scholar, and Research Gate, using the following combination of terms: "All-on-four", "all-on-4", "immediate loading", "prosthesis supported by 4 implants", "angulated implants", "tilted implants".

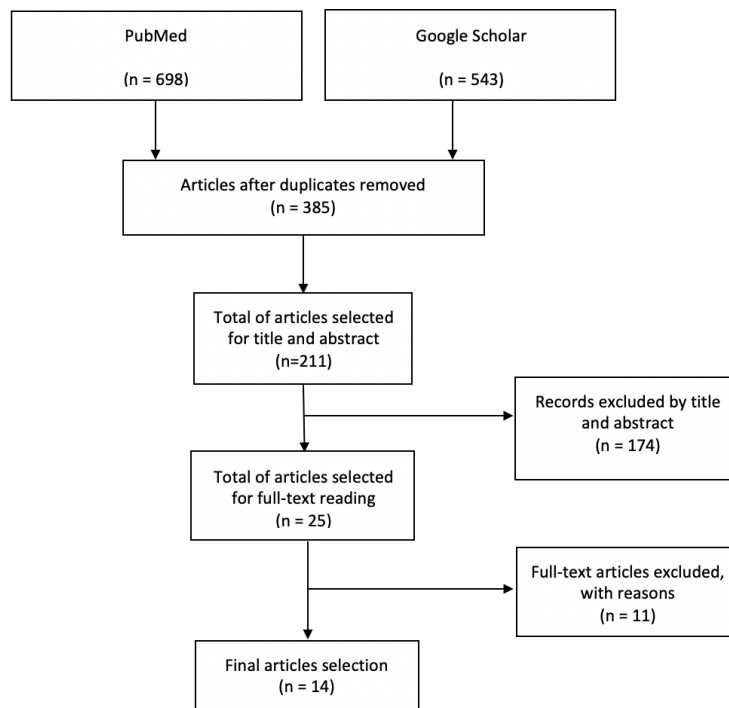
The bibliographic revision of this study contains 14 articles in total, all about the A04 treatment, dully analyzed according to the following criteria of inclusion : Articles in English and Portuguese, with full text, belonging to the category of clinical trial and randomized controlled trial, with a publication date in the past 5 years, with keywords or association of keywords, with resume considered as relevant for the study and articles present in the bibliography of articles found at the initial search, which arouse some interest for the development of this work. Excluding criteria was the article that did not meet the inclusions criteria.

The total number of articles (14 articles) were compiled, and duplications removed. A first evaluation of the abstracts was done to determine whether the articles corresponded to the objective of the study. The selected articles were read and analyzed individually as to their purpose and relevance. For this study, the following fact was considered: authors, publication date, study type, objectives, sample (n° of patients and implants), study duration, and results.

## 4- Results

The literature search identified a total of 698 articles in PubMed and 543 in Google Scholar, as shown in the PRIMAS flow diagram in Figure 1. After duplicates were removed, 856 were excluded. The 385 articles remaining were thoroughly analyzed and selected for title and abstract, lasting 211 articles. Of those studies, 25 were selected after full-text reading and 11 excluded because they did not provide good data considering the purpose of this study. After the final articles were selected, a total of 14 articles were finally chosen and included in this review. Of the 14 studies chosen, 9 investigated on a study duration inferior or equal to a period of 96 months, five other articles had a study duration up to 360 months. Out of those 14 articles, 2 analyzed the outcome of a unique patient that has been treated with the All-on-4 treatment, all the others 12 articles choose a sample from 25 to 1072 patients.

Figure 1 : PRISMA flow diagram



The main conclusions are drawn in this manner:

- The treatment demonstrated extremely high percentages of SR and SSR for implants and prosthesis.
- Data of MBL are completely respecting the Albrektsson standard and are between 1 and 1,5 mm during the first year and < to 0,2 mm annually after the implant's first year of pose.
- Some complications have been highlighted: technicals such as fracture, loss of screws and biologicals like pain, suppuration, periimplantitis, implants infection or abscess. One study reported a case of lower lip paresthesia on 2 patients resolved spontaneously.
- Some authors showed an increased link between smoking patients and those who had complications, others demonstrated higher survival rate for smokers patients.
- Patients with osteoporosis tend to have a lower SR.
- Placing implants directly on post-extractive implants site showed a better outcome in comparison with healed site.
- No significant difference was put forward in relation to the techniques A04, A05 and A06, we can therefore conclude that it is more judicious from any point of view, to only use 4 implants. This allows the patient to save money because less implants are put in place, but also greatly reduces the time of the surgery.

Relevant data are summarized in Table 1.



**Table 1:** Relevant data from the selected studies

Authors and publications dates	Study type	Objectives	Sample	Date of surgery and study duration (SD)	Results	Success Rate Survival Rate MBL
Tallarico et al - 2016	Clinical research	Analyze technical and biological complication on patients with All-on-four treatment	56 patients (31 women/25 men), all older than 18 years old. 224 implants	-Implant surgery between January 2008 and December 2013. -SD: 7 years	-1 implant failed on a smoker - total of 10 technical and 4 biological complications reported, all minor and resolved. - lower MBL in post extractive implants regarding implants placed in healed sites.	-SSRI:98,2% -SSRP:82,1% -SRI:99,2% -SRP:100% -MBL start=0,97 ± 0,43 mm -MBL /y = 0,15 ± 0,07 mm
Babbush et al - 2016	Cohort study	Asses the bone condition after the placement of immediately loaded prosthesis supported by 4 implants	169 patients ( 66 women/102 men) , all between 20 and 89 years old. 856 implants	Implants surgery between October 2008 and September 2011. SD: 12-36 months	-2 fail during definitive impressions - 618 implants were placed in post-extraction sites, 238 in healed sites.	-SRI:99,8% -SRP:100% -MBL start= 1,16±0,71 mm - Mean MBL from baseline to FU =0,14±0,59 mm
Tallarico et al- 2016	Prospective observational study	Appraise SSR and SR of implant-supported complete arch fixed dental prosthesis put on 4 implants, following the A04 protocol	30 patients (18 women/12men), with middle age of 67,4 years old. 120 implants	Implants surgery between January 2008 and December 2011. SD: from 36 to 84 months	-1 implant failed -Total of 8 technical and 3 biological complications reported, all resolved.	-SRI:99,2% -SRP:100% - MBL start=1,16 ±0,40mm - Mean MBL between 1 and 2y= 0,21±0,11mm -Mean MBL between 2 and 3y=0,16 ±0,07mm -MBL 3y: 1,52±0,41mm
Tallarico et al- 2016	Randomized controlled trial	Measure SR, MBL and identify complications in patients with A04 and A06.	40 patients (21 men/19W), middle-aged 63 years old. 200 implants	Implants surgery between June 2007 and December 2009. SD:60-84 months	-All-on-4 showed more complication during the follow-up -All-on-6 showed more implants failure (5%) -MBL from baseline to	-6 A06 failed (5%) VS 1 All-on-4 (1,25%) -MBL 1y: For A04 =1,05±0,35mm For A06=0,96±0,29mm -MBL 5y: For A04= 1,71±0,42mm

					follow was not statistically different between the 2 technics.	And for A06=1,51±0,36mm
Niedermaier et al – 2016	Retrospective clinical trial/cohort study	Compare SR on the patient with 4 to 6 immediate loaded implants	380 patients ( 192 W/188M), aged between 24 and 92 years old. 2081 implants	Implants surgery between February 2007 and December 2013. -SD: 7 years	- No significant difference between 4,5 and 6 implants, comparing SR. -Significant differences only between healthy and patients with diseases (ex: osteoporosis) - Regarding MBL, no significant differences between axial and tilted implants	-SR A04:96,5% -SR A05:96,6% -SR A06:99,7% -SR axial implants:98,4% -SR tilted implants:96,1% -SR healthy patients:97,2% -SR diseased patients:96,5% -MBL start: For tilted implants =0,90±0,66mm and for axial implants=0,85±0,67 mm -MBL 5 years: For tilted implants 1,30±0,42mm and for axial implants 1,30±0,35mm
Lopes et al – 2017	Retrospective report / Clinical Research	Evaluate SR of implants and MBL on the patient treated with Nobel Guide A04 treatment concept, to rehabilitate the edentulous jaw	111 patients, 532 implants	Implants surgery between February 2005 and November 2010  -SD: 7 years for implants and prosthesis and 5 years for MBL	-16 patients were lost during follow up -bruxism and smoking have a negative impact on implants	-SRP:97,8% -SRI 7years:94,5% -MBL5y:1,3mm
Siadat et al – 2018	Case report	Follow up of a unique case of A04 treatments with a Toronto prosthesis.	1 female patient of 55 years old	-SD: 8,5 years	-After 7 years, the 2 distal implants of the left jaw were replaced (on patient's demands, because he wanted a better esthetic prosthesis) by straights ones in a little more distal place. - In a case of an A04 procedure, less support is brought to restrain the occlusal charge. Toronto bridge could be an idea	

					to remediate this problem.	
Balshi et al – 2018	Clinical report	Follow a case of mandibular AO4 treatment	1 female patient of 53 years old	Implant surgery in May 1987. -SD:30 years	- Initial treatment plan was to put 6 implants, but for financial reasons, the patient chooses 4. -No loss of implants -No loss of prosthesis but some fracture happened - Complications: fracture of teeth, fracture of the prosthesis	-Excellent MBL
Malo et al – 2019	Clinical research	Estimate long term SR, MBL, SSR of AO4 treatment in the mandible	471 patients (286 W/185M), Middle age: 57,7 years old. 1884 implants.	Implants surgery between April 1998 and December 2006 -SD:10-18 years	- 27 patients died during the study (5,7%) -149 lost during follow up (31,6%) - 4 prostheses were lost - Patients with MBL in excess (27) were supposed to be a consequence of the previous failure of the implant, smoking, biological complications.	-Mean MBL 10 years= 1,72 mm -MBL 15years:2,32 mm -SRP:98,8% -SRI:93% -SSRI:91,7%
Malo et al – 2019	Clinical research	Follow up patients up to 13 years and evaluate the SR, SSR, and MBL of the AO4 treatment concept	1072 patients (442 W/630M), Patients middle age from 20 to 88 years old. 4288 implants.	SD:5-13 years	-18 patients died during the study (1,7%) - 219 lost during follow-up (20,4%) - 125 implants failed and were removed	-SSRP:99,2% -SSRI:93,9% -SRI:94,7% -Mean MBL 5 years=1,18 mm -Mean MBL 10years:1,67 mm
Elsyad et al – 2019	Randomized controlled clinical study	Evaluation of patient treated with AO4, clinically and radiographically. The first group with an overdenture milled bar and the	36 patients (14W/22M). 144 implants	SD:1 year	-2 implants failed - Both groups are successful. - Milled bar showed lower plaque indices and probing depth.	-SRI:98,6%

		second one with a fixed prosthesis.				
Vafaei et al – 2019	Retrospective review / Cohort study	Evaluate the effectiveness of A04 treatment	25 patients (15W/10M), 124 implants	SD: from 40,7 to 139,7 months	-3 implants failed in 2 patients -1 prosthesis failed due to implants loss	- SRP: 97,9% -7 implants (4 patients) had excess MBL regarding Albrektsson norm
Lemos-Gulinelli et al – 2020	Retrospective study	Evaluate main complications of A04 treatment	32 patients (19W/13M) from 41 to 90 years old. 128 implants	SD: from 2010 to 2018	-13 loss of osseointegration - 15 surgical and 20 prosthetics complications, all most frequent in the mandible.	-SRI:90,44%
Toia et al – 2021	Original Research	Compare MBL change on 7 cases of A04 and A06 treatment	56 patients (30W/26M), mean aged of 67 years old. 280 implants	-Implants surgery between April 2013 and September 2015 -SD: 3 years	-MBL didn't show a significant difference between A04 and A06 - 1 implant was lost on a patient with A06 - Few complications (fractures)	-MBL A06 start =0,14±0,32 mm -MBL A06 1 year= 0,16±0,35 mm -MBL A06 3 years= 0,12±0,26 mm  -MBL A04 start=0,30±0,50 mm -MBL 1year=0,24±0,31 mm -MBL 3years=0,24±0,38 mm  -SRI A04:100% -SRI A06:99,4%

## 5. Discussion

The history of implantology can be divide into different periods, with each one, there are specificities. <sup>Figure 2</sup> Osseointegration is the major concept around implantology and has been defined by Branemark et al., as *"a direct anatomical and functional junction between the reshaped living bone and the surface of the loaded implant"*. While doing an implant surgery, the objective is always to respect this concept. The other concept around the A04 treatment is the one of IL, selected over other types of loading because of all the advantages it brings. Nevertheless, it would be difficult to give an exact definition of it, as the opinions of the authors on this subject differ. Some authors say that IL is the fact placing the prosthesis directly after the installation of the implants, others enlarge this time interval to 24h or even 48h after. <sup>13-15</sup>

In this study, we concentrate our explanations on the technique combining both concept of osseointegration and immediate loading and that is nowadays considered as the "most suitable and effective" to rehabilitate a case of the edentated jaw: the complete fixed supported-implants prosthesis, and especially on a technique that was described by Dr. Paulo Malo in Portugal initially in 1993, and used for the first time in 2003: The A04 treatment concept. <sup>4</sup>

This treatment has indications and contraindications listed in this table:

<i><b>ALL-ON-FOUR</b></i>	
<i><b>Indications</b></i>	<i><b>Contraindications</b></i>
The dissatisfaction of the patient regarding his actual removable prosthesis <sup>2</sup>	Patient with a mouth opening under 50 mm <sup>19</sup>
Prevention of bone resorption <sup>2</sup>	Risky occlusal context (ex: antecedent of fracture of teeth or prosthesis, bruxism) <sup>19</sup>
Patients with teeth, which following a series of extractions, will soon be completely edentulous <sup>2</sup>	Patient with antecedents of endocarditis <sup>19</sup>

Patients who want to avoid osseous transplantation, surgery like sinus lift <sup>2</sup>	Patients under Bisphosphonates IV <sup>2</sup>
Patients looking for a technic with an excellent SSR <sup>2</sup>	Patients with regular smoking and alcoholism, drugs habits <sup>20,21</sup>
Patient with high esthetic exigence <sup>2</sup>	Patients with infection or inflammation in the place where the implants should be placed <sup>20,21</sup>
Patients who need an easily follow up <sup>2</sup>	Patients with diseases such as coagulation problems, autoimmune diseases, diabetes, metabolic diseases affecting bone <sup>20,21</sup>
Patients who want an immediate new dentition without waiting after the surgery <sup>2</sup>	Patients that already have contraindications for oral surgery <sup>20,21</sup>
Atrophic maxila and mandibule on patient ASA 1 and 2, with or without tooth <sup>17</sup>	Pregnant women, or in lactation <sup>20,21</sup>
-5 mm of bone width minimum, and 10 mm of bone height minimum between canines in the maxilla <sup>18</sup> -5 mm of bone width minimum and minimum 10mm of bone height between canines in the mandible <sup>18</sup>	-When the bone height is inferior to 7 mm in the maxilla or madible <sup>18</sup>
Patient with Cawood and Howell Class IV, V, and VI <sup>17</sup>	Patients that did radiotherapy or chemotherapy in the last year <sup>20,21</sup>
Minimum dimension of the alveolar process in the maxilla (between the mesial wall of the maxillary sinus and the mental nerves) <sup>17</sup>	Patients with poor hygiene and motivation <sup>20,21</sup>
Patients without the financial capacity to put more implants <sup>19</sup>	

The main idea in relation to this protocol is to put 2 anterior implants in a vertical position and the two posteriors are in a distal angulation of maximum 45°. Then, the implants are reunited by a fixed prosthesis, that allow to compensate the inclination of the implants and assure good osseointegration. <sup>16</sup>

There are two ways of performing this surgery, one uses a conventional guide standardized for A04 surgery, the other one uses "3D diagnostics and a custom-designed surgical

template to correctly drill and position the implants". This study will be described the 1<sup>st</sup> one.<sup>22</sup>

N.B: If the patient has already a prosthesis in good condition and correctly adapted to his mouth, it can be used to fabricate the provisory prosthesis. This protocol is for a patient without a previous one. <sup>22</sup>

Protocol for this treatment must abide by the following, beginning with a consultation with the patient to know his expectations, his needs, and motivation, with intra and extra oral photography, anamnese, and 1<sup>st</sup> intention radiographic (retro alveolar sum up, followed by a orthopantomography and a CBCT from which we can add if necessary Conventional Spiral Tomographic RX, tomodensitometry or implants simulation assist by laptop). Followed by a clinical exam with registration and evaluation of the smile line, median line, labial support, vertical dimension, intermaxillary relation in centric relation, soft and hard tissues, occlusion. Then, choose the form and color of the future teeth. <sup>19</sup>

Preoperative meds prescriptions/recommendations must be practiced as state in the following: 1h before surgery, 2g of amoxicillin with clavulanic acid OR clindamycin if the patient is allergic to penicillin. Eat normally, do not use mouthwash and have perfect hygiene, wear comfortable clothes, eat well before surgery. <sup>23-25</sup>

Initially, we focus on the maxillary inferior by doing a local infiltrative anesthesia with an incision made from 1<sup>st</sup> molar to 1<sup>st</sup> molar for flap elevation. Then, position the A04 Guide by doing an osteotomy of approximately 8mm in the midline. It's constructed by a titanium band with a hole, to be in occlusal relation with the antagonist arcade, and stabilized by central steam on the medial axis. At that time, posteriors site are prepared by drilling to a maximum of 45° in the posterior zone, to reduce the cantilever, according to the density of the bone and insert the implant. Insertion force (torque) must be between 35 and 45 N/cm. If necessary bone can be regularized with a bur. Same procedure, on the opposite side. <sup>22</sup>,

Figure 3

Afterwards, preparation of anterior sites: prepare the site axially, choosing the perfect localization remembering that they have to be at a safe distance from the posterior implant, which is tilted. They are placed around the medial line following the concavity of the mandibular symphysis and tilted to vestibular. Bone can be regularized if necessary with a bur. Same procedure, on the opposite side. Make an RX to check the positions of the implants. Perfect posteriors implants position should be forward to the mental foramen, averting the nerve twist.<sup>22-25</sup>

Lastly, is the maxillary superior where all the steps are the same as the mandible, except for the preparation of posteriors sites, because the sinus has to be taken into consideration. The anterior wall of the maxillary sinus needs to be identified correctly by doing a small window on it (on the lateral wall of the maxilla) and draw the limit. Then, the preparation of the posterior site can be at 4 mm from the sinus wall. The drill needs to be at a maximum of 45°. Same procedure, on the opposite side. Then make a RX to check the positions of the implants.<sup>22-25, Figure 4</sup>

The length of the implant has to be between 10 and 18 mm, diameter 4 cm for the posterior implant and 3,3 or 4 cm for the anterior one.<sup>22</sup>

Following is the prosthetic part, mini abutments are placed on each implant, tighten for the posterior site to 15 N/cm and 35 N/cm for anterior. The flap needs to be sutured on both maxillary (this can also be added healing caps). Provisional prosthesis, previously made, is loaded with silicone putty to make the impression of the abutments. Four holes are made to allow the abutments to enter through the prosthesis. If healing caps are applied, they must be removed at this step and have to put impression abutment. The space between the abutment and the prosthesis has to be filled with acrylic, and the impression abutment is cut, screws are then put to stabilize the prosthesis tighten for the posterior site to 15 N/cm and 35 N/cm for anterior. Occlusion and centric relation need to be checked with articulation paper and adjust thanks to a bur, if necessary. Therefore, temporarily coping access holes that need to be blocked with provisory cement. A panoramic radiograph must



be made, to confidently confirm that positions, depth, and angulation of all the implants are good. Finally, a 6 months checkup, to verify everything is going well (no sign of inflammation infection, or pain) to put the definitive prosthesis.<sup>23-25</sup>

Ultimately, during the 6 days post-surgery patient need to take 1g amoxicillin and clavulanic acid OR 300 mg of clindamycin if allergic to penicillin always keeping in mind that pharmacological therapy can be adapted, depending on patient needs and dentist protocol, by adding anti-inflammatory (during four days from the 4th-day post-surgery), and analgesics (for surgery day and following).<sup>22</sup>

Currently, implant's success is evaluated by a lot of different factors:

- The first one is SSR, which is the % of success among some attempts, and which characterize implants that are not only in the mouth but also functional.<sup>18-25</sup>
- The second one is SR and tends to characterize implants that are still in the buccal cavity of the patient at the exact time of the examination without according any importance to the state of the prosthesis. Therefore, an implant that is in the mouth but not functional will have a high SR but a low SSR.<sup>18-25</sup>
- The third is MBL, which is the one characterizing the level of the bone. Albrektsson et al, determined criteria of success regarding implants and established that major bone loss has to be between 1 and 1,5 mm during the first year and < to 0,2 mm annually after the implant's first year of pose (= Albrektsson standard).<sup>18-25</sup>

## 5.1 Mean calculation

In globality, the follow-up of patients treated with the A04 concept showed really good results.<sup>26-39</sup>

- Mean SSRI is 95,25 %, calculated based on 4 articles<sup>26,30,34,35</sup>

- Mean SSRP is 92,6 % calculated based on 3 articles<sup>26,30,35</sup>
- Mean SRI is 97,46 % calculated based on 8 articles <sup>26-29,30,34-36</sup>
- Mean SRP is 98,7 % calculated based on 7 articles<sup>26-29,31,34,39</sup>
- Mean MBL at first year is 1,015 mm calculated based on 7 articles<sup>26-30,34,35</sup>
- Mean MBL per year after surgery is 0,14 mm calculated based on 2 articles. <sup>26,27</sup>

Some articles did not include all evidence to each variable therefor, making it impossible to calculate within the 14 articles chosen for this study.

## 5.2 Review of the complications associated with the treatment

Tallarico et al., (2016), did a study with the objective to evaluate biological and technical complications. With the results obtained, it was concluded to 8 technicals and 3 biologicals complications in a total of 11 patients during the follow-up period; 6 technicals and one biological during the healing period, and 2 technicals and 2 biologicals after definitive prosthesis delivery. All in which were resolved with complete success. Biological complications were suppuration, pain, periimplantitis the technical ones were. Also, tree prosthetics screws were reported loose in the temporary prosthesis in 3 patients, resolved by retightening the screws and asked the patient to not eat food that will need excess mastication effort. Some fractures of the provisory prosthesis during the healing period were mentioned.<sup>26</sup>

Lopes et al., (2016) study registered 91 patients on 111 with complications in the provisory prosthesis (fractures of abutments or prosthesis, screw loose) and 33 patients had complications with the definitive prosthesis (fractures of abutments or prosthesis, screw loose). Lopes et al., (2016) study showed 32 patients with mechanical complications in the definitive prostheses (such as fractures), and 34 patients presented biological complications (such as soft tissue inflammation, implants infections).<sup>31</sup>

Vafaei (2019) is the only author to have reported lower lip paraesthesia on 2 patients, resolved spontaneously after 4/5 weeks.<sup>37</sup>

Elsyad (2019) noted a higher plaque and gingival index, and pocket depth for anterior implants at 12 months for fixed prosthesis comparing to milled bar prosthesis.<sup>36</sup>

Biological complications occurred for Malo et al., (2019) on 312 implants in 203 patients with suppuration/abscess and periimplantitis, all significantly related with smokers patients in his study with 13 years follow up.<sup>35</sup>

Balshi (2019) mentioned in his 30 years follow-up study significant wear and abrasion of the acrylic on denture teeth with some gingival resin fracture, as a common prosthodontic complication.<sup>33</sup>

Complications, in the study of Lemos-Gulinelli (2020), were mostly surgical (loss and bone fracture) and prosthetics (loose or fracture of prosthesis) all more frequent in the mandible.<sup>38</sup>

### **5.3 Case of patients with initial pathologies and smokers**

Niedermaier et al., (2016) had a "healthy patients group" (222 patients) and other groups with patients having a pathology (158): "diabetes group", "osteoporosis group", "cardiovascular disease group", the "3 at the same time group", or an "other group" pathology (regrouping thyroidal dysfunction, gastritis or asthma). Significant different results for a patient with osteoporosis (only 94,1%) and the other group (only 92,9% of SR). The study also demonstrated a higher survival rate for the 141 smokers patients (98,6%).<sup>30</sup>

Tallarico et al., (2016) described a lower MBL during the first year for post-extractive implants site in comparison with healed sites that could probably be explained by the technic used for socket preservation.<sup>26</sup>

Malo et al., (2019) in their 2 studies follow up of 13 and 18 years, contrary to Niedermaier's, conclusion to an acute relation between implant failures on smokers. As well as male patient and mechanical complications.<sup>30,34,35,</sup>

#### **5.4 Comparison of cases of a prosthesis supported by 5 and 6 implants**

Tallarico et al., (2016) objective was to compare 5 years outcomes of patients treated with A04 VS A06. They concluded more complications with the A04 protocol, and more implants failure with the A06 but not enough statistically different to say that it has to be taken into count.<sup>29</sup>

Niedermaier (2016) compared 7 years outcomes of patients treated with prosthesis on 4,5 and 6 implants, results showed that there is no significant difference between the 3 technics. We can conclude that, regarding the cost of each implant, there is no necessity to put more than 4 implants.<sup>30</sup>

Toia et al., (2021) compared, like Tallarico et al (2016) cases of A04 VS A06 and conclude zero significant difference between the two treatments at 3 years follow-up regarding bone loss.<sup>39</sup>

## 5.5 Limits of the study

The interpretation of the results should be made with caution considering the study limitations.

Tallarico et al., (2016) limited his study to the patient treated on their sup maxillary, so the result can be only generalized to the maxillary superior. <sup>26</sup>

Tree studies have extended follow-ups, with a maximum of 30 years with Balshi et al., (2018), knowing that the A04 protocol are most of the time loaded on the patient that have already reached a certain age, studies like the one of Balshi et al., (2018), Malo et al., (2019), and Vafaei et al., (2019) had a significant amount of patient deceased before the end of the previous initial follow-up. On the other hand, a too-small follow-up of 1 year like the one of ELSyad et al., (2019) can be a little bit too small to be able to predict and analyze an official outcome. <sup>33-37</sup>

Also, a lot of patients were lost to follow-up.

The study of Siadat et al., (2018) and Balshi et al., (2019) was a unique case report, so the sample was too small to generalize the outcomes. <sup>32,33</sup>

The increased plaque accumulation, of the ELSyad (2019) study, may be attributed to the decreased manual inexterity of elderly patients resulting in reduced cleaning. <sup>36</sup>

Niedermaier et al., (2016) suggests that not the bone quality but, the bone quantity is superior in the group of smokers due to the earlier point of time of both, tooth loss and surgical dental treatment which can explain the curious conclusion about smoker patient having a better SR then non-smokers. <sup>30</sup>

To conclude, the results obtained in the previous studies can be explained by the difference in age, oral hygiene, and also by the equipment, they are using and mostly by the technic the dentist is using to perform the protocol.

## 6. Conclusion

The results of this present study stand the hypothesis that the rehabilitation of the edentated jaw using the AO4 protocol is predictable and reliable with a very high SSR, SR, and data of MBL compatible with the standard of Albrektson.

Moreover, complications exist, they can be either biologicals or technicals but remain rare enough to encourage dentist to choose this treatment plan

This technic may decrease significantly treatment time and counter to prosthesis loaded on more implants which is the perfect compromise for a cost-effective solution.

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## 8. Annex

Figure 2: Diagram of history and genesis of implantology, illustration of each important period with some relevant articles

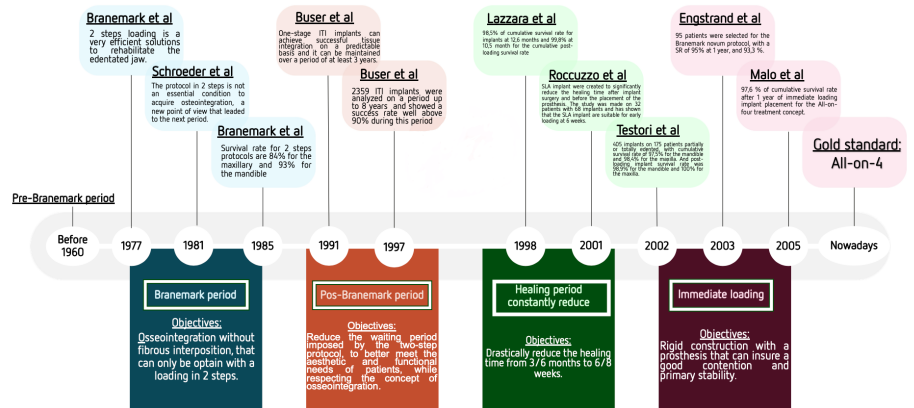


Figure 3: Implants placement in the mandible (All-on-4 ®Treatment concept procedures manual Nobel biocare).



Figure 4: Implants placement in the maxillary (All-on-4 ®Treatment concept procedures manual Nobel biocare).

