



ORIGINAL ARTICLE

Comparison of all-on-4 and all-on-6 techniques in implant-supported rehabilitation: scientific analysis of the literature

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ABSTRACT

Introduction. Implant-supported rehabilitation of edentulous arches has evolved considerably with the introduction of the All-on-4 and All-on-6 protocols. By relying on immediate loading strategies and a reduced number of implants, these concepts have contributed to improved functional outcomes, prosthetic stability, and patient comfort. In this context, the present article provides a comparative analysis of both techniques based on recent findings from the international literature. **Methods.** A structured bibliographic search was conducted using PubMed and Google Scholar, including publications in both English and French. Only clinical studies addressing the All-on-4 and All-on-6 protocols were considered eligible. Of the 83 articles initially identified, 16 met the predefined inclusion criteria and were selected for detailed analysis. The evaluated outcomes included osseointegration, implant and prosthetic survival, marginal bone loss, biological and mechanical complications, and patient satisfaction. **Results.** Comparable osseointegration rates were reported for both protocols, ranging from 94.6% to 100%. Overall implant survival exceeded 95% in most studies, with no statistically significant differences observed between the two techniques. The All-on-6 protocol may offer a slight advantage in specific clinical situations — such as atrophic maxillae, bruxism, and extended cantilevers — although this finding is not consistently reported across the literature. Prosthetic survival approached 100% for both techniques; however, the strict success rate — defined as prostheses requiring no maintenance or repair — was occasionally lower with the All-on-4 protocol. Biological complications, including peri-implantitis and mucositis, were reported more frequently in All-on-4 configurations (10.3%) than in All-on-6 (1%) in some studies. Mechanical complications such as fractures and screw loosening occurred at comparable rates in both groups, although rigid splinting was associated with a reduction in their incidence. Patient satisfaction remained high for both approaches (86–97%), with a slight tendency in favor of All-on-6 reported in some studies, particularly in complex clinical cases. **Conclusion.** Both the All-on-4 and All-on-6 protocols can be considered reliable options for full-arch implant-supported rehabilitation. The All-on-4 protocol remains a less invasive and more cost-effective approach, but may be associated with greater biomechanical stress and a slightly higher incidence of complications. In contrast, the All-on-6 protocol may provide improved force distribution, lower complication rates, and greater predictability in situations involving increased biomechanical risk. Protocol selection should therefore be guided by the individual clinical profile of each patient: All-on-4 is particularly suited to cases of severe posterior atrophy, while All-on-6 is preferable when bone volume permits or when risk factors such as bruxism, low bone density, or long cantilevers are present.

Keywords: All-on-4, All-on-6, dental implants, complete rehabilitation, implantology.

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1. INTRODUCTION

The treatment of complete edentulism remains a significant challenge in contemporary dentistry. Conventional complete dentures often fail to provide sufficient stability and masticatory efficiency, leading not only to functional impairment but also to aesthetic limitations and psychosocial discomfort. These limitations have contributed to the growing reliance on fixed implant-supported rehabilitations. [1,2]. Progress in biomaterials and clinical technologies has supported the development of therapeutic approaches intended to streamline surgical protocols, lower treatment costs, avoid bone augmentation procedures, and permit immediate loading [3].

Introduced by Paulo Maló in 2003, the All-on-4 concept relies on the placement of four implants, including two axially positioned anterior implants and two posterior implants tilted between 30° and 45°. This configuration enables the avoidance of critical anatomical structures, such as the maxillary sinuses and mental foramina, while increasing the anterior–posterior implant spread [1]. The All-on-6 concept represents an evolutionary approach designed to enhance the biomechanical stability of the dental arch by incorporating two additional, evenly distributed implants. This protocol aims to optimize load distribution, decrease the risk of mechanical overload, and improve the long-term durability of the prosthesis [1].

Despite their efficacy, the choice between the two protocols remains a subject of debate. No absolute consensus exists regarding their respective superiority, particularly concerning their precise indication, their long-term biomechanical behavior, or their cost-effectiveness. This ambiguity creates a real uncertainty among clinicians, who often must decide between All-on-4 or All-on-6 without strict recommendations based on standardized clinical criteria.

Objectives

The primary objective was to evaluate and compare the survival rates of implant-supported restorations using the All-on-4 and All-on-6 protocols. The secondary objectives were to compare the clinical outcomes (stability, periodontal health, complications) of the two techniques, and to compare the level of patient satisfaction regarding function, aesthetics, and comfort.

2. MATERIALS AND METHODS

Article Selection

A bibliographic search was conducted in English and French using PubMed and Google Scholar. The search combined Medical Subject Headings (MeSH) and free-text keywords with Boolean operators: (“All-on-4” OR “All-on-6”) AND (“dental implants” OR “Dental Implants” [MeSH]) AND (“prosthesis, implant-supported” OR “implant-supported prosthesis” OR rehabilitation) AND (“implant survival” OR “survival rate” OR “marginal bone loss” OR complications OR “treatment outcome”). Equivalent French terms were also included. The search was limited to publications from 2003 to 2024, which correspond to the introduction and development of the All-on-4 concept.

Eligible studies included randomized controlled trials, observational cohort studies, and case reports that allow for comparison of the All-on-4 and All-on-6 protocols. Excluded studies were *in vitro*, *in silico* (including finite element analyses), narrative reviews, meta-analyses, and those lacking sufficient outcome reporting. Study selection followed PRISMA guidelines. After removing duplicates, titles and abstracts were screened against predefined eligibility criteria. Full texts of relevant articles were then assessed for inclusion.

The initial search identified 83 articles. After eliminating duplicates and an initial review of titles and abstracts, 40 articles were selected for full analysis. At this stage, the excluded articles did not meet the study objectives or inclusion criteria, thus precluding clinical extrapolation. After full evaluation, 24 articles were excluded, primarily due to the absence of comparison criteria, insufficient data, methodological heterogeneity, or incomplete reporting of results. Ultimately, 16 studies were deemed relevant and included in the qualitative synthesis (Figure 1).

Analysis Criteria

The analysis of the selected studies focused on several key clinical and prosthetic outcomes, including osseointegration, implant survival rate, prosthetic survival rate, marginal bone loss, mechanical and biological complications, as well as patient satisfaction.

These 16 studies are summarized in the Tables and classified according to the Author/Year, Study Type, the Technique Evaluated, Number of Patients/Implants, Main Parameters Studied, Follow-up Duration, and Essential Results (Table 1).

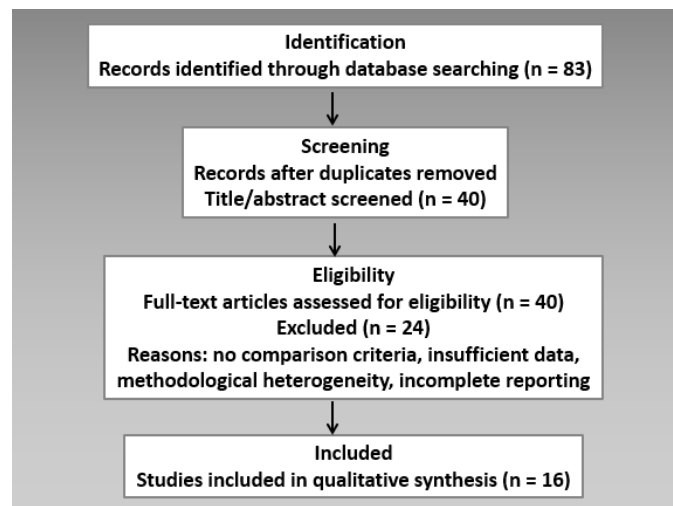


Figure 1. Selection Procedure.

Table 1. Summary of Included Studies.

Author/Year	Study Type	Technique Evaluated	N (Patients / Implants)	Main Parameters Studied	Follow-up Duration	Essential Results	Conclusions
Gerardo La Monaca et al., 2022	Retrospective Cohort Observational Study	All-on 4 / All-on-6	28P / 164 I	Implant survival, success and survival of prostheses, MBL, biological and prosthetic complications	1–10+ years	Implant survival: 89.7% All-on-4 / 99% All-on-6; prosthesis success 58.8% All-on-4 / 43.8% All-on-6; prosthesis survival 88.2% All-on-4 / 100% All-on-6; MBL similar between groups; biological complications more frequent in All-on-4 (10.3% vs 1%)	All-on-6 showed slightly fewer biological complications.
Shahinaz Sayed Mohamed et al., 2020	Randomized Clinical Trial (RCT)	All-on-4 / All-on-6	10 P / 10 I	Implant survival, plaque and gingival index, probing depth, implant stability, peri-implant bone resorption	12 months	Implant survival: 85% All-on-4 / 100% All-on-6; Plaque and gingival index increased only in All-on-4; Pocket depth higher and stability reduced in All-on-4; Significantly higher bone resorption in All-on-4	All-on-6 is recommended for the atrophic maxilla (better clinical and radiological results).
Hadi Antoun et al., 2012	Retrospective Cohort Observational	All-on-4 / All-on-6	44 P / 205I	Implant survival, prosthetic complications, fractures, marginal bone loss	17.6 months	3 implants lost and replaced, minor cosmetic and prosthetic fractures, 6.4% marginal bone loss	Immediate loading with 4 mandibular or 6 maxillary implants is reliable in the short and medium term for complete edentulous rehabilitation.
Michael Korsch et al., 2021	Retrospective Cohort Study	Definitive All-on-4	126 P / 544I	Implant and prosthesis survival, biological and technical complications, severe losses	1 year	33 complications in 27 patients: 19 biological (2 PR, 17 DR), 14 technical (6 PR, 8 DR). 10 severe complications (implant lost: 1 PR, 9 DR). Implant survival rate: 98.2% (PR 99.4%, DR 97.6%). Restoration survival rate: 94.4% (PR 97.6%, DR 92.6%).	PR and DR show comparable complication rates over 1 year. Implant losses primarily occur in the male posterior maxilla.
Thomas J. Balshi et al., 2013	Retrospective Cohort Observational	All-on-4™ (Brånemark implants, tilted vs axial)	152 P / 800I	Implant/prosthesis survival (CSR), implant orientation, sex, arch	2.5 years	Overall CSR: 97.3%; maxilla 96.3%, mandible 97.8%; Prosthesis survival: 99%	The All-on-4 is a reliable method for rehabilitating edentulous arches, regardless of arch, sex, or implant orientation.
Ahmed Fayyad, 2022		Mandibular All-on-4 with immediate prosthesis:	12 P / 48 I	Prosthetic complications (detachment, fractures, dysfunction)	6 months	Group I (non-splinted): 100% of patients presented prosthetic complication. Group II (splinted): 33.3% of patients presented complication.	All-on-4 with immediate loading is viable, but non-splinted implants are more likely to cause prosthetic complications.

	Randomized Clinical Trial (RCT)	non-splinted vs splinted implants with titanium wire					Splinting with titanium wire reduces complications.
Charles A. Babbush et al., 2011	Retrospective Cohort Observational	All-on-4 with NobelActive implants	165 P / 708	Implant survival (CSR), prosthesis survival	23 months	Overall implant CSR: 99.6% (maxilla 99.3%, mandible 100%). Definitive prosthesis survival: 100%.	All-on-4 with NobelActive implants and immediate prosthesis is highly reliable in the short and medium term.
S. Wentaschek et al., 2017	Retrospective Cohort Observational	All-on-6	10 P / 60 I	Periostest (PT), ISQ, implant and prosthesis survival	42 to 84 months	3 implants lost in 3 patients (1 axial, 2 tilted) to 5% loss. PT and ISQ increased after 3 months.	Immediate All-on-6 protocol is effective and comparable to other protocols; tilted implants are more at risk; posterior maxillary rehabilitation remains a challenge.
Wim Slot et al., 2013	Randomized Controlled Trial (RCT)	4 vs 6 posterior maxillary implants to support a bar overdenture	66 P	Implant and prosthesis survival, clinical scores, bone resorption, patient satisfaction	1 year	Implant survival: 100% (4 implants) vs 99.5% (6 implants). Overdenture survival: 100% in both groups. Marginal bone resorption: 0.35 mm (4 implants) vs 0.46 mm (6 implants). Low and similar clinical scores. Similar patient satisfaction.	Overdenture on 4 implants is not inferior to that on 6 implants for the posterior maxilla, with comparable clinical, radiological, and satisfaction results.
Yan Zhang et al., 2023	Retrospective Cohort Study	All-on-4 vs All-on-6, immediate fixed prostheses	217 P / 1222 I	Implant and prosthesis survival, biological and technical complications, MBL, influencing factors (age, bruxism, cantilever, bone density, prosthesis type)	3-13 years	No general significant difference between All-on-4 and All-on-6 for implant/prosthesis survival and MBL. All-on-6 more predictable in older patients, with natural/fixed opposing dentition, bruxism, low bone density, long cantilever, or acrylic temporaries	In the long term, no general significant difference between All-on-4 and All-on-6. However, All-on-6 may be more predictable in certain specific clinical conditions and is preferred by some intermediate-level clinicians.
Takashi Uesugi et al., 2023	Retrospective Cohort Study	All-on-4	561 patients / 2364 implants	Cumulative survival of implants and patients, risk factors (maxilla vs mandible, multivariate analysis)	3-17 years	Implant CSR: 97.4% maxilla, 98.9% mandible. Patient CSR: 94.4% maxilla, 96.7% mandible. Maxillary survival significantly lower, especially in the first 24 months. Maxilla identified as the main risk factor.	All-on-4 shows high long-term survival rates. The maxilla presents a higher risk of implant failure.
Marco Tallarico et al., 2015	Randomized Controlled Trial (RCT)	All-on-4 vs All-on-6 with guided surgery and immediate loading	40 patients	Implant and prosthesis survival, biological and technical complications, marginal bone loss, periodontal parameters	5 years	7 implants lost: 6 All-on-6 (5%), 1 All-on-4 (1.25%), no significant difference. No prosthetic failure. Complications similar between groups. MBL: 1.71 ± 0.42 mm All-on-4 vs 1.51 ± 0.36 mm All-on-6 (ns). Periodontal parameters similar.	Both concepts are predictable options for the rehabilitation of completely edentulous patients in the medium term.
Paulo Maló et al., 2019	Retrospective Cohort Study	All-on-4	1072 patients / 4288 implants	Implant and prosthesis survival, MBL at 5 and 10 years, biological and mechanical complications, risk factors	10-18 years	Prosthetic success: 99.2%. Implant cumulative survival: 94.7%, implant success: 93.9%. Mean MBL: 1.18 mm (5 years), 1.67 mm (10 years). Incidence of biological complications: 7.8% of implants, mechanical complications: 58.8% temporaries, 7.3% definitive. Risk factors: male sex, smoking, mechanical complications.	Maxillary All-on-4 is predictable and safe in the long term with low marginal bone loss and high rates of implant and prosthetic success.

Jessica Lemos-Gulinelli et al., 2020	Retrospective Cohort Study	All-on-4	32 patients / 128 implants	Implant survival, surgical and prosthetic complications, patient factors	1-8 years	13 implants lost to Overall CSR: 90.44% (mandible 94.3%, maxilla 83.3%). 15 surgical complications (loss, bone fracture) and 20 prosthetic complications (loosening, component/prosthesis fracture).	All-on-Four shows a high survival rate, but surgical and prosthetic complications are frequent, particularly in the maxilla and in patients with comorbidities.
Dhanashree A. Minase et al., 2024	Clinical Case	All-on-6, implant-supported fixed prosthesis	1 P / 1 arch / 6 implants	Implant planning, complete prosthetic rehabilitation	/	Successful rehabilitation of the complete edentulous arch with 6 implants. Careful planning and precise execution.	All-on-6 is a reliable option for the rehabilitation of atrophic maxillae, offering good clinical and radiological outcomes.
Paulo Maló et al., 2003	Retrospective Cohort Study	Mandibular All-on-4 with Brånemark implants, immediate fixed prosthesis	32 P / 128 I	Implant and prosthesis survival, bone resorption	12 months	3 implants lost in 3 patients \to 97.6% cumulative survival at 1 year; mean marginal bone loss 0.9 mm \pm 1.0 mm)	Immediate function on 4 implants in the completely edentulous maxilla is a viable approach, with a good survival rate and acceptable bone stability.

MBL = Marginal Bone Loss, A6= All on 6, A4 = All on 4, Plaque Index (PI), Gingival Index (GI), Profondeur de sondage (PD), Stabilité implantaire (ISQ), Perte osseuse marginale (MBL), CSR =Cumulative Survival Rate.

3. RESULTS

Study Selection

A total of 16 articles were included after selection from 83 initially identified publications. Among them, 4 were clinical trials (RCTs), 11 were observational cohort studies, and 1 was a case report, which reflects the predominance of observational studies in the evaluation of All-on-4 and All-on-6 protocol (Figure 2).

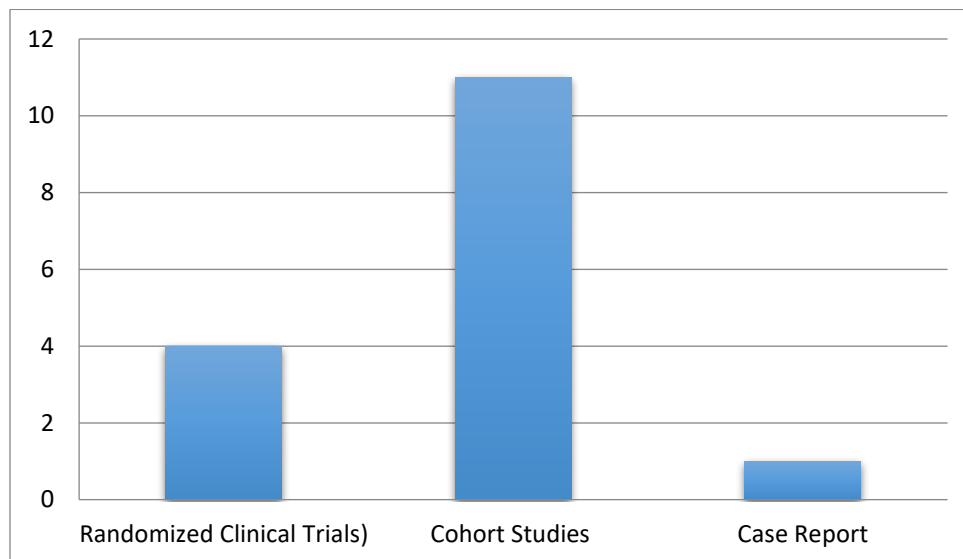


Figure 2. Distribution of Articles by Study Type.

Follow-up Period

Ten studies presented a follow-up period greater than one year, while six studies had a follow-up equal to or less than one year (Figure 3). This heterogeneity reflects the variability in objectives, ranging from the evaluation of immediate outcomes to the analysis of long-term stability.

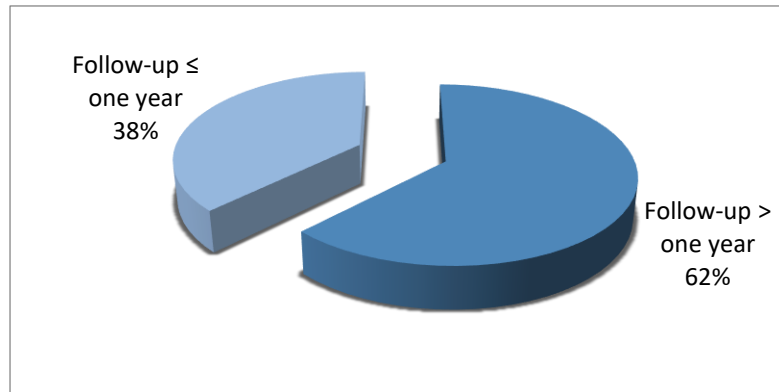


Figure 3. Distribution of Studies by Follow-up Period.

Studied Techniques

Of the selected studies, eight investigated the All-on-4 protocol exclusively, two focused solely on All-on-6, and six provided a direct comparison between the two techniques. This distribution underscores the historical predominance of the All-on-4 approach in the literature, reflecting its status as the most extensively documented full-arch rehabilitation method to date.

Osseointegration Rate

Based on the reviewed literature, osseointegration appears to be similar between the All-on-4 and All-on-6 protocols. All studies assessed osseointegration, with reported rates ranging from 94.6% to 100%, although early failures were observed during the initial healing phase [1]. In the study by La Monaca G. (2022), which included a 10-year follow-up, 5.4% of implants (8 out of 149) failed due to lack of osseointegration, predominantly in the maxilla [1]. Another cohort study involving 44 patients and 205 implants reported a lower failure rate of 1.46% [6]. Early failures generally occur during the provisional phase. For example, a study analyzing 708 implants documented only 0.4% early failures [2], while another reported that all 10 implants lost among 544 were lost within the first three months post-placement [3].

Multiple factors may influence these outcomes. Regarding the protocol, a comparative study reported an osseointegration rate of 100% for the 4-implant group and 99.5% for the 6-implant group, with no significant difference [4]. In terms of risk factors, failures are more frequently observed in the posterior maxilla and in male patients, and are also associated with low bone density and smoking habits [6].

Implant Survival

The reported overall implant survival rates varied between 85% and 100% (Figure 4) depending on the study design and follow-up duration. The majority of implant failures occurred within the first year after placement, primarily due to biological and anatomical factors. Survival rates vary according to implant location (maxilla vs. mandible) and the protocol used. Uesugi T., 2023, highlighted a significant long-term difference (up to 17 years), with survival of 94.4% in the maxilla versus 96.7% in the mandible [5]. This trend is supported by Balshi TJ (96.3% maxilla vs. 97.8% mandible) [1] and by Jessica Lemos-Gulinelli, where maxillary survival drops to 83.3% compared to 94.3% in the mandible [3].

Survival rates for both All-on-4 and All-on-6 are consistently high, above 89%, with reported differences that remain modest and only occasionally reach statistical significance depending on the study. A 10-year study shows a significant difference ($p = 0.007$) in favor of All-on-6 (99.0%) compared to All-on-4 (89.7%) [8]. However, Zhang Y., 2023, reported no statistical difference (Hazard Ratio = 1.0) [2], and some studies even report a slightly higher 5-year survival rate for All-on-4 (98.75%) compared to All-on-6 (95%), though not

statistically significant [6]. Hassan SS reported that the group with more implants (Group 2) achieved a 100% survival rate, significantly higher than the 85% of Group 1 ($p = 0.03$) [14].

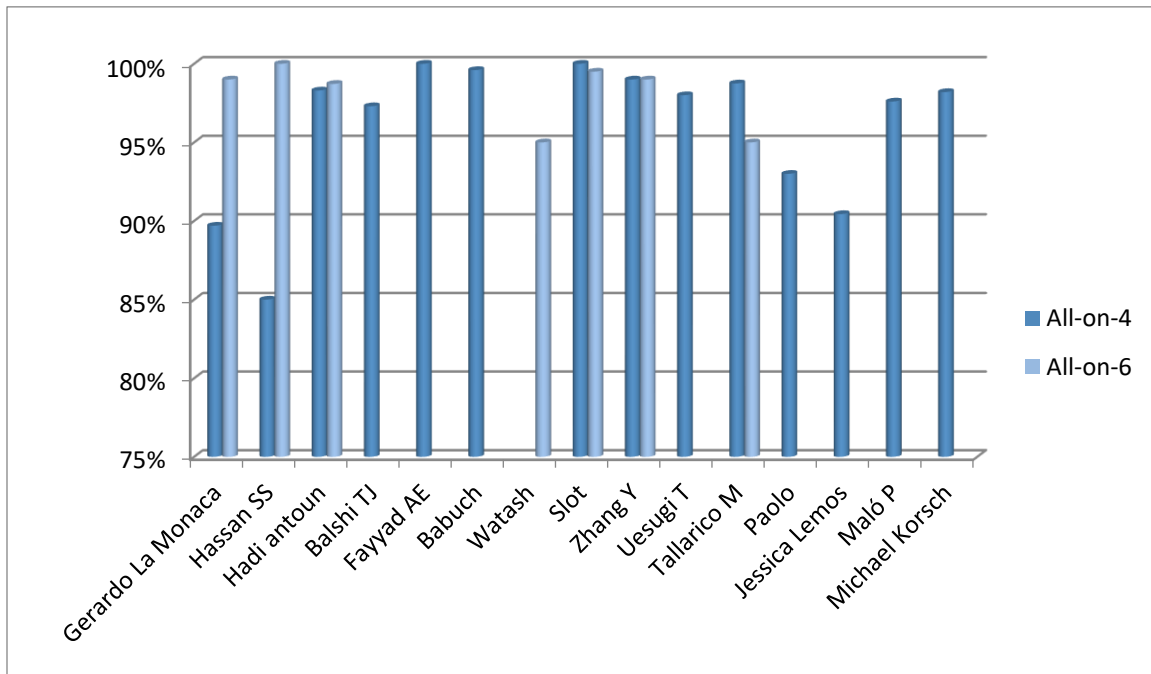


Figure 4. Implant survival according to the studies.

Prosthetic Survival Rate

Prosthetic survival is excellent, often approaching 100%, although “success” without any repairs is lower. For All-on-4, survival can reach up to 100%, while for All-on-6 it ranges from 95% to 100% (Figure 5). La Monaca G nuances these results, showing that although survival is 88.2%, the strict success rate (prosthesis without any modification) is only 51.5% [7].

No significant difference in prosthetic survival is generally observed between the All-on-4 and All-on-6 concepts. However, prostheses on splinted implants show higher reliability (66.7% without complications) compared to non-splinted implants (0%) [2].

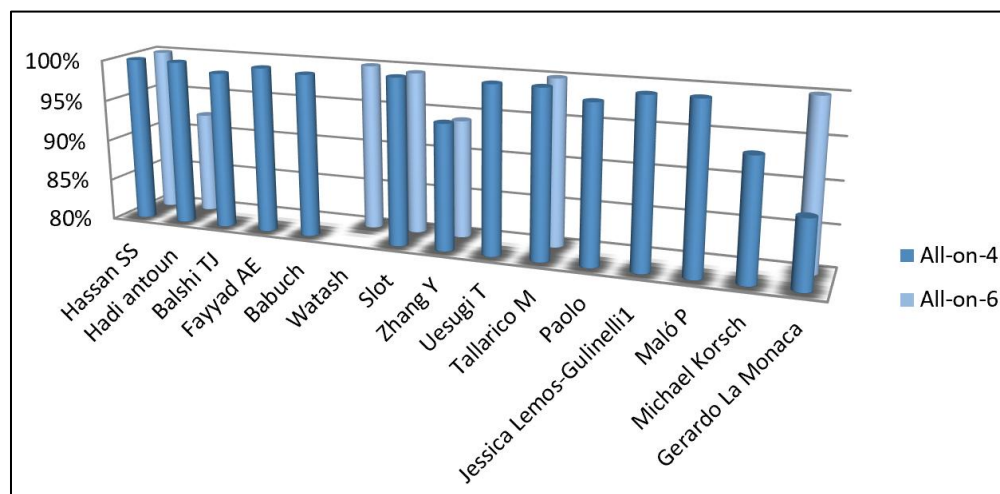


Figure 5. Prosthetic survival rates of All-on-4 vs. All-on-6 according to the studies.

Biological Complications

The incidence of biological complications appears higher in configurations with fewer implants. One study reported 10.3% complications for the All-on-4 group compared to only 1.0% for the All-on-6 group [7]. No biological complications were observed during post-treatment follow-up with the All-on-6 technique, according to Minas [2]. Complications reported include mucositis, peri-implantitis, and suppuration, often associated with poor oral hygiene or posterior maxillary location. Smoking and a history of implant failures significantly increase the risk of biological complications (OR up to 5.56) [3].

Comparative studies show a higher frequency of complications in All-on-4 (All-on-4: 17.3% to 19%; All-on-6: 10.3% to 18.8%). Overall, All-on-6 exhibits slightly lower rates, suggesting reduced mechanical stress due to the presence of two additional implants.

Marginal Bone Loss (MBL)

Marginal bone loss is a phenomenon observed in the majority of studies, but it generally remains within clinically acceptable limits. It is influenced by the number of implants and local factors and typically ranges from 0.9 mm to 1.7 mm in the medium to long term.

Regarding the comparison of concepts, La Monaca G reported significantly lower marginal bone loss for All-on-6 (approximately 0.9 mm) compared to All-on-4 (approximately 1.23 mm) [14]. However, some authors found no statistically significant difference in MBL between All-on-4 and All-on-6 configurations [15, 16]. As for aggravating factors, the presence of natural antagonist teeth, thin buccal bone, and smoking are correlated with greater bone loss [6]. Hassan SS reported a direct correlation between bone loss and clinical signs of inflammation (plaque, gingivitis) [7]. The highest bone losses were observed in the study by Tallarico, while the lowest were reported in the studies by Wim Slot and Zhang. The general trend indicates that All-on-6 results in less bone loss, likely due to better distribution of occlusal forces.

Mechanical Complications

Mechanical complications are primarily technical in nature and generally do not result in implant loss. Reported mechanical complications in the studies ranged from 1.9% to 4.2% of implants. Prosthetic complications were more frequent in All-on-4, without affecting overall survival. These included screw loosening, reported in 2.5% to 3.4% of implants [4,8], prosthesis fractures occurring in 2% to 4.2% of cases [12,15], and wear or fracture of prosthetic components, observed in 2% to 2.8% of implants. [11,2].

These incidents are generally reversible with simple replacement or adjustment, without compromising function or patient satisfaction, confirming the reliability of All-on-4 and All-on-6 protocols in the medium term. In one study, 10 chips or tooth fractures were reported [7]. Implant splinting appears to reduce complications. Fayyad AE demonstrated the importance of splinting: the “splinted” group presented significantly fewer total complications (33.3%) compared to the “non-splinted” group (100%) ($p = 0.001$) [17].

Patient Satisfaction

Although patient satisfaction is an essential clinical outcome, it was rigorously evaluated in only six of the sixteen analyzed studies. Both protocols, All-on-4 (86–92% satisfaction) and All-on-6 (92–97% satisfaction), demonstrate a significant improvement in patients' quality of life. While a slight superiority of the All-on-6 protocol is observed in terms of overall satisfaction, the clinical differences between the two techniques remain minimal.

One study reported a notable improvement in quality of life and masticatory function, with no significant differences observed between the 4-implant and 6-implant groups [10]. Another study noted that clinicians prefer All-on-6 in more complex cases (low bone density, bruxism), which contributes to predictability and, consequently, final satisfaction [15]. Fayyad AE also reported that patient satisfaction was higher in the splinted implant group, attributed to increased prosthetic stability and improved phonetic comfort, even when complications occurred [17].

Despite the heterogeneity of the included studies in terms of design, follow-up duration, and evaluated outcomes, a general trend emerges from the analyzed results. Both All-on-4 and All-on-6 protocols demonstrate high implant survival rates, generally exceeding 90%, with no consistent or statistically significant differences across studies. However, the available data suggest a slight advantage of the All-on-6 protocol in terms of implant stability, reduced marginal bone loss, and lower incidence of biological complications, likely due to a more favorable distribution of occlusal forces.

Prosthetic survival rates are also comparable between the two techniques, with values approaching 100% in most studies, although strict success rates (without complications) show more variability. Mechanical complications, while present, remain relatively low and do not compromise treatment outcomes, with similar frequencies observed in both protocols. Finally, patient satisfaction is high in both groups, with a slight tendency in favor of the All-on-6 protocol in some studies, although without clinically significant differences.

Overall, the findings suggest that both protocols represent reliable and predictable treatment options for full-arch rehabilitation, with a potential biomechanical advantage of the All-on-6 approach in certain clinical situations. However, due to the heterogeneity of the included studies and the predominance of observational designs, no definitive conclusion can be drawn regarding the superiority of one protocol over the other.

4. DISCUSSION

The objectives of this review were to compare implant survival rates, clinical outcomes, complications, and patient satisfaction between the All-on-4 and All-on-6 protocols, while identifying the most appropriate technique. While the results confirm that both techniques are reliable therapeutic options for full-arch rehabilitation, they also highlight notable differences regarding biomechanical behavior, complication profiles, and specific clinical indications.

Study Selection and Level of Evidence

Most of the studies included in this review were retrospective observational cohorts, with a smaller number of randomized clinical trials (RCTs) and one case report. This distribution reflects a common challenge in surgical implantology, where conducting randomized protocols for complex full-arch rehabilitations is often difficult. While findings from retrospective cohorts provide valuable insights and reflect real-world clinical practice, they represent a lower level of evidence compared to RCTs. This methodological variability should be considered when interpreting the results, particularly for direct comparisons of implant survival rates between the two techniques.

Follow-up Period

Long-term studies provide robust information on implant and prosthetic survival, whereas short-term studies mainly validate initial osseointegration, early complications, and the initial performance of implants. In contrast, only long-term studies (such as those by Maló or La Monaca) allow assessment of material fatigue and bone response to prolonged mechanical loading. While All-on-4 demonstrates excellent early outcomes, mechanical complications and bone loss may progress over time, suggesting that All-on-6 could offer more durable stability in the very long term. The variability in follow-up durations, however, hinders synthesis and direct comparison of results.

Techniques Studied

All-on-4 continues to be the most documented and historically prevalent technique, as it is faster, less invasive, more cost-effective, and frequently performed without grafting. All-on-6, often viewed as an evolution of the protocol, is less frequently studied in isolation. Comparative studies indicate that All-on-6 appears to offer improved load distribution and lowers the risk of overload, although overall survival differences between the two approaches are generally minimal under favorable anatomical conditions.

Most Studied Outcomes

Osseointegration Rate : Osseointegration appears comparable between the two techniques, with reported rates ranging from 94.6% to 100%, indicating that the number of implants does not significantly affect the initial biological healing phase, as long as primary stability is ensured. Early failures are generally associated with bone quality (particularly in the posterior maxilla) or systemic factors (such as smoking), rather than the technique itself, emphasizing the need for precise surgical planning and careful monitoring during the initial post-implantation period. Nevertheless, All-on-6, by increasing the number of anchorage points, may provide greater overall primary stability, further safeguarding the critical phase of immediate loading.

Implant Survival Rate : Implant survival is generally high for both concepts (>94%), but it varies according to location and the number of implants: it is slightly lower in the maxilla, especially during the first years. Some studies (Hassan S.S) report an advantage for the All-on-6, particularly in high-risk situations (low bone density, bruxism, long cantilevers) [14], while others (Tallarico et al., Zhang et al.) find no statistically significant difference at mid-term [15,16]. It appears that survival differences are more closely related to bone quality (maxilla vs. mandible) than to the number of implants, with the atrophic maxilla remaining a major risk factor identified in several cohorts [11]. These data suggest that implant survival depends not only on the protocol but also on biological and anatomical factors specific to each patient.

The superiority of the All-on-6 in the maxilla, as suggested by some studies, can be explained by the lower bone density (type D3/D4), which requires a larger bone-implant contact area to dissipate forces.

Prosthetic Survival Rate : prosthetic survival is generally excellent, often nearing 100%, regardless of the technique employed; however, distinguishing between “survival” (the prosthesis remains in place) and “success” (no intervention needed) is essential. Rigid splinting of implants has been confirmed as a critical factor for success [17]. All-on-6 may provide increased rigidity of the prosthetic arch, which can help minimize micromovements and potentially reduce material fatigue. In this context, for definitive prostheses fabricated from rigid materials (e.g., zirconia), the All-on-6 configuration may offer a more stable foundation and could contribute to a lower risk of fatigue-related fractures [4].

Biological and Prosthetic Complications : the analysis of complications reveals an interesting divergence. Regarding biological complications, the All-on-4 configuration appears more prone to peri-implantitis and mucositis (10.3% vs. 1% in La Monaca’s study) [7]. Two hypotheses may explain this observation: first, more difficult hygiene maintenance due to inclined implants and a ridge-lap transition profile that favors plaque retention by limiting access for cleaning; second, occlusal overload, since with only four implants, the forces per unit are higher, potentially leading to micro-damage of the crestal bone and promoting marginal bone loss. Concerning prosthetic complications, prosthesis fractures and screw loosening are reported in both groups, but are often repairable. As mentioned in the prosthetic survival section, rigid splinting significantly reduces these complications. Furthermore, the All-on-6 configuration, with its two additional implants, enhances arch stability and limits material stress [4, 17].

Marginal Bone Loss (MBL) : marginal bone loss (MBL) is a key indicator of stress at the bone–implant interface. The literature indicates a favorable trend for All-on-6, which often exhibits lower MBL [14]. From a biomechanical perspective, the addition of two implants allows a widening of the support polygon, which reduces lever arms and bending moments, particularly in distal extensions (cantilevers). It also enables a better distribution of occlusal forces; by reducing the load per implant, the All-on-6 configuration better preserves crestal bone, especially in patients presenting occlusal risk factors such as bruxism or low bone density (D3/D4 type). In contrast, All-on-4 relies on the distal inclination of implants to reduce the prosthetic cantilever. While effective in avoiding anatomical grafting, this strategy generates more complex mechanical stresses at the implant neck, which may explain the slightly higher bone resorption rates observed in some All-on-4 studies.

Patient Satisfaction : the high level of patient satisfaction observed with both protocols seems closely linked to their success rates, which benefit from mechanical stability and fewer complications. In more complex cases, All-on-6 is considered more predictable, improving the overall patient experience. This indicates that satisfaction arises from the combined effect of esthetics, function, and biomechanical reliability.

Clinical Indications and Decision-Making

Based on these data, the choice between All-on-4 and All-on-6 should not be arbitrary but guided by a clinical decision matrix. All-on-4 remains the technique of choice for cases with severe posterior bone atrophy where avoiding the sinus or inferior alveolar nerve is a priority to reduce surgical risks (avoiding grafts). It is a "surgically oriented" solution. All-on-6 appears as the "biomechanically oriented" solution. It should be preferred when bone volume allows, and especially in patients with high biomechanical risk: bruxers, natural antagonist teeth, or low bone density (maxilla).

Limitations of the Review and Perspectives

Interpretation of these results must consider certain limitations. Most included studies are retrospective, with heterogeneous follow-up durations (from less than one year to 17 years). Additionally, variability in protocols (implant types, prosthetic materials) sometimes complicates direct comparisons. Long-term (>10 years) randomized controlled trials (RCTs) using strictly standardized protocols, particularly for the definitive prosthesis, are necessary to isolate the biomechanical effect in All-on-4 vs. All-on-6 comparisons. Stratification by age, sex, bone density, and bruxism would allow the formation of homogeneous groups and guide protocol selection according to the patient profile.

Furthermore, the interpretation of the results should take into account the heterogeneity of patient characteristics across the included studies. Factors such as age, systemic comorbidities, smoking habits, bone quality, and parafunctional activities (e.g., bruxism) may significantly influence implant survival rates, marginal bone loss, and the incidence of complications. However, these parameters are not consistently reported or standardized across the analyzed studies, which limits the ability to adjust comparisons between All-on-4 and All-on-6 protocols according to patient profiles. This variability represents an important limitation and should be considered when interpreting the findings.

5. CONCLUSION

Both All-on-4 and All-on-6 appear to be reliable approaches for implant-supported rehabilitation of complete edentulism. The All-on-4 concept remains widely used due to its surgical simplicity, lower cost, and reduced need for bone grafting procedures. However, some studies suggest that it may be associated with higher biomechanical demands on individual implants and a slightly increased incidence of prosthetic and biological complications, although these findings are not consistently reported or statistically significant across the literature. The All-on-6 protocol may offer a more favorable distribution of occlusal forces and enhanced biomechanical stability, which could be beneficial in complex clinical situations such as low bone density, long cantilevers, bruxism, or high occlusal loads. Nevertheless, the available evidence remains heterogeneous, and results reported in the literature vary between studies. Therefore, the choice between All-on-4 and All-on-6 should be guided by a patient-centered and risk-based clinical decision, taking into account anatomical conditions, functional demands, and individual risk factors, rather than assuming a clear superiority of one technique over the other.

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REFERENCES

1. Thomason JM, Feine J, Exley C, et al. Mandibular two implant-supported overdentures as the first choice standard of care for edentulous patients: the York Consensus Statement. *Br Dent J.* 2009;207:185-186. doi:10.1038/sj.bdj.2009.728.
2. Elsyad MA, Elgamal M, Askar OM, Al-Tonbary GY. Patient satisfaction and oral health-related quality of life of conventional denture, fixed prosthesis and milled bar overdenture for All-on-4 implant rehabilitation: a crossover study. *Clin Oral Implants Res.* 2019;30(11):1107-1117. doi:10.1111/clr.13524.
3. Hasani Jebelli MS, Yari A, Nikparto N, et al. Tissue engineering innovations to enhance osseointegration in immediate dental implant loading: a narrative review. *Cell Biochem Funct.* 2024;42(2):e3974. doi:10.1002/cbf.3974.
4. Maló P, Rangert B, Nobre M. The "All-on-Four" immediate-function concept with Brånemark System implants for completely edentulous mandibles: a retrospective clinical study. *Clin Implant Dent Relat Res.* 2003;5(Suppl 1):2-9. doi:10.1111/j.1708-8208.2003.tb00010.x.
5. Singh AV. *Clinical implantology.* New Delhi: Elsevier India; 2013. 688 p.
6. Antoun H, Belmon P, Cherfane P, Sitbon JM. Immediate loading of four or six implants in completely edentulous patients. *Int J Periodontics Restorative Dent.* 2012;32(1):e1-e9. PMID: 22254222.
7. La Monaca G, Pranno N, Annibali S, et al. Immediate flapless full-arch rehabilitation of edentulous jaws on 4 or 6 implants according to prosthetic-driven planning and guided surgery: a retrospective study up to 10 years. *Clin Implant Dent Relat Res.* 2022;24(6):831-844. doi: 10.1111/cid.13134.
8. Babbush CA, Kutsko GT, Brokloff J. The all-on-four immediate function treatment concept with NobelActive implants: a retrospective study. *J Oral Implantol.* 2011;37(4):431-445. doi 10.1563/AAID-JOI-D-10-00133.
9. Korsch M, Walther W, Hannig M, Bartols A. Evaluation of the surgical and prosthetic success of All-on-4 restorations: a retrospective cohort study of provisional vs definitive immediate restorations. *Int J Implant Dent.* 2021;7(1):48. doi: 10.1186/s40729-021-00330-1.
10. Slot W, Raghoobar GM, Vissink A, Meijer HJ. A comparison between 4 and 6 implants in the maxillary posterior region to support an overdenture: 1-year results from a randomized controlled trial. *Clin Oral Implants Res.* 2014;25(5):560-566. doi:10.1111/clr.12118.
11. Uesugi T, Shimoo Y, Munakata M, et al. The All-on-four concept for fixed full-arch rehabilitation of the edentulous maxilla and mandible: a longitudinal study with 3–17-year follow-up and risk factors for survival rate. *Int J Implant Dent.* 2023;9(1):43. doi:10.1186/s40729-023-00511-0.
12. Balshi TJ, Wolfinger GJ, Schlauch RW, Balshi SF. A retrospective analysis of 800 Brånemark System implants following the All-on-Four protocol. *J Prosthodont.* 2014;23(2):83-88. doi:10.1111/jopr.12089.
13. Lemos-Gulinelli J, Pavani R, Nary-Filho H, et al. Incidence of surgical and prosthetic complications in total edentulous patients rehabilitated by the All-on-Four technique: a retrospective study. *Int J Interdiscip Dent.* 2020;13(2):76-79. doi:10.4067/S2452-55882020000200076.
14. Hassan SSM, Emarah AABM. All-on-4 versus All-on-6 implant concepts for rehabilitation of edentulous maxilla: short-term randomized clinical and radiographic study. *Egypt Dent J.* 2020;66(1):659-670. doi:10.21608/edj.2020.79138.
15. Zhang Y, Li S, Di P, et al. Comparison of 4- or 6-implant supported immediate full-arch fixed prostheses: a retrospective cohort study of 217 patients followed up for 3–13 years. *Clin Implant Dent Relat Res.* 2023;25(2):381-397. doi:10.1111/cid.13170.
16. Tallarico M, Meloni SM, Canullo L, Caneva M, Polizzi G. Five-year results of a randomized controlled trial comparing 4 vs 6 implants with guided surgery. *Clin Implant Dent Relat Res.* 2016;18(5):965-972. doi:10.1111/cid.12380.
17. Fayyad AE. Prosthetic complications in immediately loaded All-on-Four mandibular prosthesis using titanium wire reinforcement versus non reinforced temporary framework: a randomized clinical trial. *Egypt Dent J.* 2022;68(1):885-892. Doi 10.21608/edj.2021.106662.1872
18. Minase DA, Sathe S, Bhojar A, et al. Prosthetic rehabilitation of All-on-Six implant-supported prosthesis: a case report. *Cureus.* 2024;16(1):e51946. doi:10.7759/cureus.51946.

19. Maló P, Nobre MA, Lopes A, Ferro A, Botto J. The All-on-4 treatment concept for rehabilitation of the completely edentulous mandible: a longitudinal study with 10–18 years follow-up. *Clin Implant Dent Relat Res.* 2019;21(4):565-577. doi:10.1111/cid.12769.
 20. Wentaschek S, Hartmann S, Walter C, Wagner W. Six-implant-supported immediate fixed rehabilitation of atrophic edentulous maxillae with tilted distal implants. *Int J Implant Dent.* 2017;3(1):35. doi:10.1186/s40729-017-0096-0.
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