

# All On Four Implants - A Review

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**Abstract:** *This article systemically reviews all the literature available online on the "All-on-four" concept from the perspective of its advantages, disadvantages, advancements and limitations for patient. The comparison in this review is based on published clinical study of "Tilted versus NonTilted Implants", "Flap versus Flapless Surgery Concept", "Immediate Function Concept" and "Patient Related and Financial Outcomes Analysis".*

**Keywords:** All-on-four, NobelActive, Brånemark System, Nontilted implant, full arch edentulism

## 1. Introduction

The All-on-four concept that has gained popularity in full arch edentulism cases in recent years was first presented as a modern technique in implant-denture rehabilitation by Malo for the first time in year 2003 and began to be used in atrophic full arch mandibular region along with maxillary region in the year 2005. Implants are positioned in the pre-maxillary region of the maxilla as median and in the interforaminal region of the mandible. Implants are placed in different regions according to anterior and posterior implant sites. Anterior implants are placed to the lateral incisor sites or canine/first premolar region, posterior implants are placed to the second premolar or first molar region (R & P, 2017).

Two implants that are orthogonally placed to the occlusal plane in the anterior region and two implants that are placed in the posterior region with a mesial angle of 30-45° in edentulous maxillary and / or mandibular jaws. The survival rate of implant was 98% for the maxilla and 98.1% for the mandible after 5 to 10 years of follow-up (M, B, N, Tella, & Abusaad, 2014). The use of tilted and longer implants increases primary stability, allows cantilever decrease with excellent prosthetic support, and maximizes the use of available bone (Malo, Nobre, & Lopes, The use of computer-guided flapless implant surgery and four implants placed in immediate function to support a fixed denture: Preliminary results after a mean follow-up period of thirteen months, 2007).

### Advantages of the All-on-4® concept

- Angled posterior implants avoid anatomical structures
- Angled posterior implants allow longer implants anchored in better quality bone
- Reduces posterior cantilever
- Eliminates bone grafts in the edentulous maxilla and mandible in majority of cases
- High success rates
- Implants well-spaced, good biomechanics, easier to clean
- Immediate function and aesthetics
- Final restoration can be fixed or removable
- Reduced cost due to a smaller number of implants and avoidance of grafting in most cases.

### Disadvantages of the All-on-4® concept

- Free hand arbitrary surgical placement of implant is not always possible as implant placement is completely prosthetically driven.
- Length of cantilever in the prosthesis cannot be extended beyond the limit.
- It is very technique sensitive and requires elaborate pre-surgical preparation such as CAD/CAM, surgical splint. (Bellini, et al., A finite element analysis of tilted versus non tilted implant configurations in the edentulous maxilla. , 2009)

### Limitations of the All-on-4® concept

- Good general health and acceptable oral hygiene;
- Enough bone for 4 implants of at least 10mm in length; and
- Implants attain enough stability for immediate function.

### Tilted versus Nontilted implants

Sr No	Article	Study	Result
1.	A finite element analysis of tilted versus non tilted implant configurations in the edentulous maxilla.	To evaluate stress patterns at the bone-implant interface of tilted versus Nontilted implant configurations in edentulous maxillae using finite element models of two tilted and one Nontilted configuration	The tilted configurations showed a lower absolute value of compressive stress compared with the nontilted, indicating a possible biomechanical advantage in reducing stresses at the bone-implant interface. (Bellini, et al., A finite element analysis of tilted versus non tilted implant configurations in the edentulous maxilla. , 2009)
2.	Comparison of tilted versus nontilted implant-supported prosthetic designs for the restoration of the edentulous mandible: a biomechanical study.	The study was to evaluate the stress patterns induced in cortical bone by three distinct implant-supported prosthetic designs. The first two models consisted of a prosthesis supported by four implants, the distal two of which were tilted, with different cantilever lengths (5 mm and 15 mm). The third design consisted of a prosthesis supported by five conventionally placed implants and a 15-mm cantilever.	No significant difference in stress patterns between the tilted 5-mm and the nontilted 15-mm configuration was predicted. The tilted configuration with a 15-mm cantilever was found to induce higher stress values than the tilted configuration with a 5-mm cantilever (Bellini, et al., 2009).

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Sr No	Article	Study	Result
3.	Biomechanical comparison of axial and tilted implants for mandibular full-arch fixed prostheses.	This study was to examine the effect of the inclination of the two distal implants according to the All-on-Four concept on the stress distribution within the supporting structure.	Within the limitations of this photo elastic stress analysis, the use of tilted implants reduced the maximum stress in the distal crestal bone of the distal implant by approximately 17% relative to the axial implants.(Kim, Kim, Bae, & Cho, 2011)
4.	Marginal Bone Loss Around Tilted Implants in Comparison to Straight Implants: A Meta-Analysis	Clinical human studies have reported marginal bone loss in tilted and straight implants at 12-months follow-up or longer were included. Mean marginal bone loss and the number of implants that were available for analysis was extracted from original articles for meta-analyses.	No significant difference in weighted mean marginal bone loss was found between the tilted and straight implants in the short and medium terms.(Monje, Chan, Del Amo, Moreno, & Wang, 2012)
5.	The fate of marginal bone around axial vs. tilted implants: a systematic review.	This review compares the crestal bone level change around axially placed vs. tilted implants supporting fixed prosthetic reconstructions for the rehabilitation of partially and fully edentulous jaws, after at least 1 year of function.	Tilting of the implants does not induce significant alteration in crestal bone level change as compared to conventional axial placement after 1 year of function. The use of tilted implants to support fixed partial and full-arch prostheses for the rehabilitation of edentulous jaws can be considered a predictable (Fabbro & Ceresoli, 2014) technique, with an excellent prognosis in the short and mid-term.
6.	Immediate rehabilitation of the completely edentulous jaw with fixed prostheses supported by either upright or tilted implants: a multicenter clinical study.	This study was to assess the treatment outcome of immediately loaded full-arch screw-retained prostheses with distal extensions supported by both upright and tilted implants for the rehabilitation of edentulous jaws and to compare the outcomes of upright versus tilted implants.	The clinical results indicate that immediately loaded tilted implants may achieve the same outcome as upright implants in both jaws.(Capelli, Zuffetti, Fabbro, & Testori, 2007)
7.	Bone level changes around axial and tilted implants in full-arch fixed immediate restorations. Interim results of a prospective study.	This prospective study was to assess clinical outcomes and peri-implant bone level changes around tilted and axial implants supporting full-arch fixed immediate rehabilitations up to 60 months of loading.	The use of tilted implants in the immediate rehabilitation of fully edentulous jaws is safe and is not associated to a higher marginal bone loss as compared to axially placed implants(Francetti, Romeo, Corbella, & Taschieri, 2010)
8.	Straight and tilted implants for supporting screw-retained full-arch dental prostheses in atrophic maxillae: A 2-year prospective study.	The study evaluates, over a 2-year period, the treatment outcomes for maxillary full-arch fixed dental prostheses (FDPs) supported by a combination of both tilted and axially-placed implants and to compare the marginal bone loss (MBL) and implant survival rates (SR) between tilted and axial implants.	Based on the results of this retrospective clinical study, full-arch fixed prostheses supported by a combination of both tilted and axially placed implants may be considered a predictable and viable treatment modality for the prosthetic rehabilitation of the completely edentulous maxilla.(Collar, et al., 2018)
9.	Partial Rehabilitation with Distally Tilted and Straight Implants in the Posterior Maxilla with Immediate Loading Protocol: A Retrospective Cohort Study with 5-Year Follow-up.	The purpose of this study was to compare the outcome of fixed partial prostheses in the posterior maxilla with two axially placed implants or one implant placed distally tilted and one axially placed implant following an immediate loading protocol.	No significant differences were found between both groups in survival, complications, or marginal bone resorption.(Queridinha, Almeida, Felino, & Nobre, 2016)

Immediate function concept

S. No	Article	Study	Result
1.	All-on-Four" immediate-function concept with Brånemark System implants for completely edentulous mandibles: a retrospective clinical study.	The purpose of this study was to develop and document a simple, safe, and effective surgical and prosthetic protocol for immediate function (within 2 hours) of four Brånemark System implants supporting fixed prostheses in completely edentulous mandibles: the "All-on-Four" concept.	The high cumulative implant and prostheses survival rates indicate that the "All-on-Four" immediate-function concept with Brånemark System implants used in completely edentulous mandibles is a viable concept.(Malo, Rangert, & Nobre, 2003)
2.	All-on-4 immediate-function concept with Brånemark System implants for completely edentulous maxillae: a 1-year retrospective clinical study.	The purpose of this study was to evaluate a protocol for immediate function (within 3 hours) of four implants (All-on-4, Nobel Biocare AB, Goteborg, Sweden) supporting a fixed prosthesis in the completely edentulous maxilla.	The high cumulative implant survival rate indicates that the immediate function concept for completely edentulous maxillae may be a viable concept.(Malo, Rangert, & Nobre, 2005)
3.	A pilot study of complete edentulous rehabilitation with immediate function using a new implant design: case series.	The aim of the present study was to retrospectively evaluate the clinical performance of a novel implant design in the rehabilitation of completely edentulous jaws and in combination with an immediate function protocol.	The results of the present pilot study indicate that fully edentulous jaws with various types of bone can be treated with high success and good aesthetics using immediately loaded implants with the presented design, and that favourable marginal bone levels can be maintained.(Malo, Nobre, Wigren, & Petersson, 2006)

S. No	Article	Study	Result
4.	"All-on-Four" immediate function concept and clinical report of treatment of an edentulous mandible with a fixed complete denture and milled titanium framework.	This clinical report describes a method of restoring an edentulous mandible with the "All-on-Four" immediate function concept and a milled titanium framework.	No discernible clinical and radiographic changes were noted around the dental implants. To date, there have been no prosthetic complications.(Khatami & Christopher, 2008)
5.	"All-on-four" concept and immediate loading for simultaneous rehabilitation of the atrophic maxilla and mandible with conventional and zygomatic implants.	The simultaneous rehabilitation of an edentulous patient with a hybrid (zygomatic and conventional implants) all-on-four implant-supported prosthesis for the maxilla and a standard (conventional implants) all-on-four implant-supported prosthesis for the mandible. The transfer impression was made with a multifunctional guide and the upper and lower prostheses were placed 24h postoperatively.	Clinical and radiographic examinations showed no infection or bony resorption 2 years later. Simultaneous maxillary and mandibular rehabilitation with all-on-four immediate loading is a viable, fast and effective option for edentulous patients.(Ferreira, Kuabara, & Gulinelli, 2010)
6.	The all-on-four immediate function treatment concept with NobelActive implants: a retrospective study.	The All-on-Four treatment concept provides patients with an immediately loaded fixed prosthesis supported by 4 implants. This single-centre retrospective study evaluated the concept while using the NobelActive implant (Nobel BioCare, Gothenburg, Sweden).	Seven hundred eight implants placed in 165 subjects demonstrated a cumulative survival rate of 99.6% (99.3% in maxilla and 100% in the mandible) for up to 29 months of loading. The definitive prosthesis survival rate was 100%.(Babbush, Kutsko, & Brokloff, 2010)
7.	Immediately loaded mandibular fixed implant prostheses using the all-on-four protocol: a report of 183 consecutively treated patients with 1 year of function in definitive prostheses.	This study was done to evaluate a specific protocol using four implants to support immediately loaded fixed prostheses to restore edentulous and partially edentulous mandibles and report on the outcome after 1 year of function with the definitive prostheses.	Radiographic evaluation revealed no major bone loss around dental implants. Based on this retrospective study, the following conclusion can be drawn- this technique appears to provide a highly predictable implant performance(Butura & Galindo, 2012)
8.	Implanting the edentulous jaws with "All-on-4" immediate reconstruction: a preliminary clinical observation	To evaluate the treatment outcome of the "All-on-4" immediate loading protocol via survival rate of the implants, survival rate of the prosthesis, marginal bone, postoperative complications and patient satisfaction.	The present preliminary data of the short-term observation suggest that the "All-on-4" immediate loading protocol is a viable treatment modality for the edentulous jaws.
9.	Marginal Bone Stability Around Tapered, Platform-Shifted Implants Placed with an Immediately Loaded Four-Implant-Supported Fixed Prosthetic Concept: A Cohort Study.	This study longitudinally evaluates marginal bone remodelling around tapered, platform-shifted implants placed for total arch rehabilitation with fixed hybrid prostheses.	It was concluded that the use of tapered, platform-shifted implants for total arch rehabilitation with the use of the All-on-Four protocol yields very favourable radiographic outcomes, at least after a minimum of 12 months in function.(Babbush, Kanawati, & Kotsakis, Marginal Bone Stability Around Tapered, Platform-Shifted Implants Placed with an Immediately Loaded Four-Implant-Supported Fixed Prosthetic Concept: A Cohort Study., 2016)

Flap verses flapless surgery concept.

S. No	Article	Study	Result
1.	The use of computer-guided flapless implant surgery and four implants placed in immediate function to support a fixed denture: preliminary results after a mean follow-up period of thirteen months.	This study was done to report on the preliminary clinical outcomes of survival and bone loss for prosthodontic rehabilitation using computer-guided flapless implant surgery and 4 implants placed in immediate function to support a fixed denture.	The results of this study indicate that, within the limitations of this preliminary study, this treatment modality for completely edentulous jaws is predictable with a high survival rate.(Malo, Nobre, & Lopes, 2007)
2.	Double Guided Surgery in All-on-4@ Concept: When Ostectomy Is Needed.	The study reports a technique with double guided surgery for bone reduction and implant placement with the All-on-4 concept.	The results of our study indicate that this treatment is predictable with an excellent survival rate allowing excellent results even when bone reduction is mandatory.(Tonellini, Vigo, & Novelli, 2018)
3.	Prosthetically driven, computer-guided implant planning for the edentulous maxilla: a model study.	To analyse computer-assisted diagnostics and virtual implant planning and to evaluate the indication for template-guided flapless surgery and immediate loading in the rehabilitation of the edentulous maxilla.	The use of a computer program for prosthodontically driven implant planning is highly efficient and safe. Thus, a protocol that combines a computer-guided technique with conventional surgical procedures becomes a promising option, which needs to be further evaluated and improved.(Katsoulis, Pazera, & Stern, 2008)
4.	Implant treatment software planning and guided flapless surgery with immediate provisional prosthesis	The study evaluates the clinical outcome of fully edentulous patients in the maxilla, who were treated with immediately loaded	The study concluded that software- and computed tomography-guided surgical planning for completely edentulous arches

S. No	Article	Study	Result
	delivery in the fully edentulous maxilla. A retrospective analysis of 15 consecutively treated patients.	implant-supported cross-arch bridges using computer-aided implant surgery.	provides reliable results with high success rates.(Meloni, Riu, Pisano, & Cattina, 2010)
5.	Application of the "All-on-Four" concept and guided surgery in a mandible treated with a free vascularized fibula flap.	In this article, they have described the first case in the literature in which 3D computer-assisted treatment planning and guided surgery enabled a patient affected by extreme Para physiologic mandibular bone atrophy to be treated with a free vascularized fibula flap and, after a period of healing, the flapless installation of 4 immediately loaded dental implants. The computer-fabricated surgical guide allowed placement of the implants according to the "All-on-Four" concept	The use of a fibula flap makes it possible to create greater bone thickness while computer-assisted treatment planning and guided surgery provide several advantages over the traditional technique.(Nocini, Castellani, Albanese, & Zanotti, 2012)
6.	Computed tomography-guided implant surgery for dental rehabilitation in mandible reconstructed with a fibular free flap: description of the technique.	In this article they have describe the possibility of using CT-guided implant surgery with a flapless approach and immediate loading in mandibles reconstructed with fibular free flaps.	With CT-guided surgery the implants are positioned exactly where planned virtually. Precise prosthetic guidance of the positions of the implants is achieved with little room for error when the computer-generated template is seated correctly(Riu, Pisano, Miloni, & Masarelli, 2010)
7.	Surgical Templates for Dental Implant Positioning; Current Knowledge and Clinical Perspectives	In this article the authors attempted to review the evolution and clinical applicability of surgical templates used in the placement of dental implants.	Computer-aided planning and image-guided surgery can be carried out, when implant positioning is to be precisely executed, and when safe positioning of implants with optimal use of available bone.(kola, 2015)
8.	Accuracy of implant treatment planning utilizing template-guided reformatting computed tomography.	To evaluate the magnitude of error in transferring the planned position of implants from reformatting CT scans to a surgical template.	The transfer errors detected in this investigation are not clinically relevant. Other factors involved in transferring positional and angular measurements from reformatting CT to the surgical site may result in more significant errors.(Besimo, Guindy, & Lambrecht, 2000)

Advancements in all on four treatment concepts.

A new approach to the All-on-Four treatment concept using narrow platform NobelActive implants.

Although several approaches to implant-supported restoration of severely atrophic maxillae and mandibles have been developed, most of these treatments are costly and protracted. An exception is the All-on-Four concept, which uses only 4 implants to support an acrylic, screw-retained provisional prosthesis delivered on the day of implant placement, followed by a definitive prosthesis approximately 4 months later. After the introduction of a new implant design in 2008, a new protocol was developed for provisionally treating patients with severely atrophic jaws using the All-on-Four concept and 3.5-mm-diameter implant. This article describes that protocol and reports on the results of 227 implants after 1 to 3 years of follow-up. The cumulative survival rate was 98.7% at the end of 3 years, with a 100% prosthetic survival rate. Combining the 3.5-mm-diameter Nobel Active implants with the All-on-Four concept promises to become a new standard of care for severely compromised patients.(Babbush, Kanawati, & Brokloff, 2013)

Patient-Related and Financial Outcomes Analysis of Conventional Full-Arch Rehabilitation Versus the All-on-4 Concept:

## A Cohort Study

### a) Background

Patient-related variables such as cost of treatment, length of the treatment period, and comfort provided by the interim prosthesis when treatment planning for full-arch rehabilitation are often neglected in dental publications.

### b) Methods

Two patient cohorts were followed up longitudinally in this study: the "All-on-4 treatment concept group" and the "historical group." The number of implants, total treatment time, number of surgical procedures, number of sinus grafts, necessity for immediate provisional implants, adjusted cost associated for treatment in each group, and the quality of interim prosthesis were compared.

### c) Results

The total adjusted cost for patients receiving All-on-4 treatment concept averaged at \$42,422 ± 3860 (€31,392 ± 2856), whereas the mean total adjusted cost for the historical group was \$57,944 ± 20,198 (€42,879 ± 2113) (P = 0.01). The difference in cost had a mean value of \$7307 (€5407) per jaw. Factors associated with complexity of treatment and patient comfort, such as the quality of interim prosthesis, number of surgeries, and duration of treatment time, all significantly favoured the All-on-4 treatment concept group in comparison with conventional treatment modalities.

### d) Conclusions



When implant rehabilitation of the total jaw is sought, the All-on-4 treatment concept should be considered the least costly and least time-consuming treatment option. (Babbush, Kotsakis, Kanawati, & Hinrichs, 2014)

## 2. Conclusion

Placement of dental implants previously in attempts to treat the severely resorbed maxilla and mandible has had only limited success. But the rehabilitation of completely edentulous, atrophied maxilla and mandible by the placement of implants using the All-on-Four protocol gives new hope for a perceivable success, while becoming a promising treatment method of choice and standard in the care for severely compromised patients. (B, B, Ebenezer, & Jimson, 2015)

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