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The All-on-4 Dental Implants: A Comprehensive Review

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Abstract

The clinical success rate of dental implants is primarily influenced by the mechanical environment which functions as an independent units. Factors such as the number, design, and positioning of implants are determined by the patient's systemic condition, bone availability, bone quality, and the treatment plan devised by the dentist. In cases with poor bone quality or limited bone volume, strain on the residual alveolar bone can be minimized by increasing the anteroposterior spread of the implants, using longer implants, and placing a greater number of implants in biomechanically compromised situations.The severely atrophied maxilla restricts implant placement mainly in the posterior region when using conventional techniques. The All-on-Four concept is a treatment modality commonly used for completely edentulous patients. The patient also benefits from the immediate rehabilitation of edentulous arches, which helps in preserving the self-confidence and enhances the quality of life.

Keywords: All on four concept , rehabilitation, edentulous jaw, severe atrophy, tilted implants.

INTRODUCTION:

Edentulism has been shown to have significant social and psychological effects, negatively impacting facial and oral aesthetics, masticatory function, and speech abilities. These factors collectively lead to a substantial decline in patients' quality of life. Immediate implant placement is a complex surgical procedure that demands meticulous treatment planning and precise surgical techniques. Various prosthetic solutions have been developed for the rehabilitation of severely atrophic maxillae and mandibles, including conventional complete dentures, implant-supported removable prostheses, and implant-supported fixed prostheses. However, implant- supported prostheses may not always be feasible due to factors such as proximity to vital anatomical structures and insufficient bone quality and quantity.(1)

The All-on-4 implant concept emerges as an alternative to conventional implant techniques, designed to optimize the use of available residual bone in atrophic jaws. This approach enables immediate function while eliminating the need for regenerative procedures, which can increase treatment costs, patient morbidity, and the risk of associated complications (Malo et al., 2000).

HISTORICAL ASPECTS:

All on 4 is not the invention, but rather a treatment technique that has developed and evolved over time.

The "All-on-4" technique has its roots in the work of **Brånemark and his colleagues** in 1977, where they utilized four to six vertical implants placed in the anterior segment of the edentulous maxilla and mandible to support a full-arch fixed prosthesis through a cantilevered design. While their 10-year study demonstrated favorable success rates—approximately 80% for the maxilla and 91% for the mandible—the extended cantilever remained a challenge, as it had to compensate for the lack of posterior dentition.(2)

Earlier concepts resembling the All-on-4 approach can be traced back to Mattson and colleagues in 1999. They treated 15 patients with severely resorbed edentulous maxillae by placing four to six implants to avoid sinus augmentation, selecting sites with at least 10 mm in alveolar ridge height and a minimum horizontal width of 4 mm. Their approach successfully restored patients with a fixed prosthesis containing 12 teeth supported by a framework,

with only one implant failure and 100% prosthetic stability over a follow-up period of 3 to 4.5 years.

In **2000, Krekmanov and his team** further advanced the technique by demonstrating the effectiveness of posteriorly tilted implant-supported prostheses. By increasing the anterior-posterior (A-P) spread and reducing cantilever length, they enhanced implant stability and cross-arch stabilization, making the biomechanical outcome comparable to traditional axially loaded implants. The angulation of the implants also allowed for the placement of longer fixtures, shifting implant support further posteriorly and improving load distribution.(3)

This concept uses 2 vertical anterior implants in conjunction with 2 distally tilted inclined implants with their apices positioned anterior to the sinus wall or mental foramen. It involves the use of straight and angled multiunit abutments, which

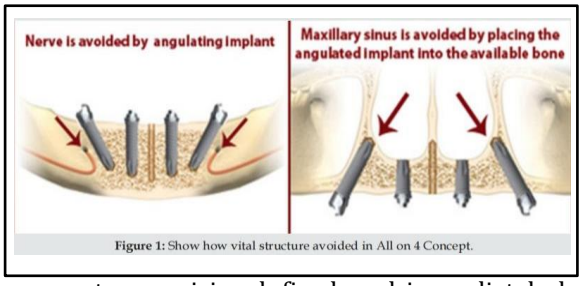


Figure 1: Show how vital structure avoided in All on 4 Concept.

support a provisional, fixed, and immediately loaded, full arch prosthesis. It has been developed to maximize the use of available bone and allows immediate function [4] .

The two anterior implants are positioned in alignment with the jaw anatomy, while the two distal implants are tilted at a 45° angle (Figure 1). Numerous long-term studies and published data on the All-on-4 concept have reported cumulative survival rates ranging from 92.2% to 100%.(5) The concept of **immediate loading** was further developed, formalized, and systematically analyzed in 2003 by dentist **Paulo Malo and his colleagues** through a retrospective study focused on the mandible. Their findings were highly promising, demonstrating high short-term success rates for both implants and prosthetic outcomes.

KEY CONSIDERATIONS FOR ALL ON FOUR:

1. The ability to achieve primary implant stability within a torque range of 35–45 Ncm is essential. (6)

2. Patients should not exhibit severe parafunctional habits such as excessive clenching or grinding.

3. For an edentulous maxilla:

- A minimum bone width of 5 mm is required.
- The bone height between the canines must be at least 10 mm.

4. For an edentulous mandible:

- A minimum bone width of 5 mm is necessary.
- The bone height in the interforaminal region must be no less than 8 mm. (7,8)

5. To minimize cantilever forces, the posterior implants can be placed at an angulation of up to 45°.

6. If the implant angulation is 30° or greater, the tilted implant must be splinted for additional stability (8,9).

7. The All-on-Four technique does not require a greater mouth opening compared to conventional implant procedures, due to the angulated positioning of the tilted implants.

8. If remaining or compromised teeth require extraction, the extraction sockets must be thoroughly

cleaned and debrided, ensuring that implants are positioned within the interdental bone between the sockets [9].

9. For tilted posterior implants, the distal screw access holes should be planned to emerge at the occlusal surface of the first molar, second premolar, or first premolar for optimal prosthetic integration.

INDICATIONS:

1. The implant procedure should be performed with good oral hygiene to prevent the onset of systemic diseases. [10]

2. The interforaminal bone length must be at least 10 mm for successful implantation. [11]

3. The interforaminal bone width should measure a minimum of 5 mm in applicable cases. [12]

4. In the anterior maxillary region, the available bone length must be at least 10 mm. [13]

5. The anterior maxillary sinus region should have a minimum bone length of 10 mm for implant placement.

6. The bone width in the maxillary region should not be less than 5 mm **(Boyaci, 2015).**

7. Primary stability of the implants must be ensured for a successful procedure **(Menini et al., 2012**).

8. Implants should remain completely immobile to facilitate immediate loading **(Menini et al., 2012**).

9. The interarch distance should be at least 20 mm to allow for proper prosthetic support **(Menini et al., 2012).**

CONTRAINDICATIONS:

1. Patients who have contraindications to traditional implant placement are not suitable candidates **(Menini et al., 2012).**

2. Individuals with systemic health conditions that prevent surgical implant placement should be avoided.**(Menini et al., 2012; Boyacı, 2015).**

3. Cases where bone reduction is required due to a high smile line in the maxilla may not be ideal candidates **(Menini et al., 2012).**

4. Patients with an irregular or thin bone crest may not have sufficient structural support for implants **(Menini et al., 2012).**

5. Inadequate bone volume can make implantation unfeasible **(Menini et al., 2012).**

6. The presence of remaining teeth or root fragments that interfere with implant planning may necessitate alternative approaches. **(Menini et al., 2012).**

7. Patients with restricted mouth opening of less than 50 mm, which limits surgical instrumentation access, may not be suitable for this procedure **(Menini et al., 2012).**

SURGICAL PROTOCOL:

I. surgical protocol

Step 1: Selection of case satisfying the inclusion criteria

Step 2: Planning implant placement using All-On-4 Guide (Preferred)

Step 3: Location of Maxillary Antrum and Mental Foramen with All-On-4 Guide.

Step 4: Implant placement done following the protocols

i. A 2 mm deep osteotomy (bone preparation site) is created along the central axis of either the maxilla or mandible.

ii. A surgical guide with a titanium band is carefully positioned within this prepared site.

iii. The titanium band is contoured to match the curvature of the opposing dental arch. In the mandible, the guide also functions to retract the tongue, creating additional working space.

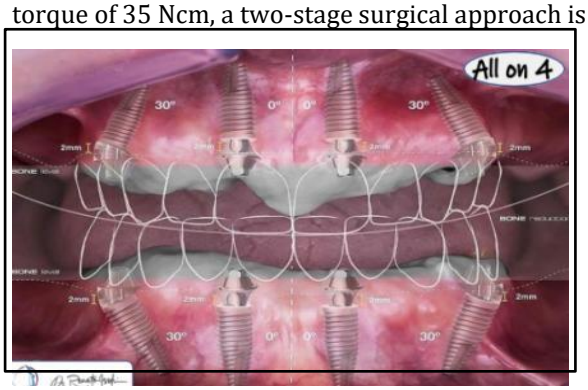
iv. Vertical reference markers on the guide assist in maintaining the correct angulation while drilling, ensuring an accurate implant trajectory that does not exceed a 45º tilt.

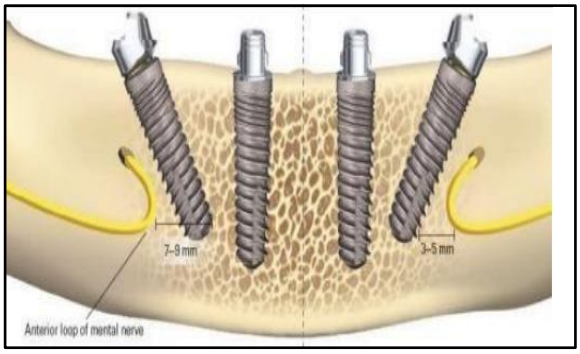
v. Additional positioning aids, such as angulated guide pins and a denture template, may be used to facilitate optimal implant placement.

vi. The anterior implants are aligned to follow the natural anatomical inclination of the jaw. However, in cases of severe mandibular bone resorption, a lingual tilt may be necessary.

vii. The posterior implants are placed just anterior to the mental foramina or maxillary sinus, positioned at an angled trajectory of approximately 30º–45º relative to the occlusal plane.

viii. Each implant is inserted with a torque exceeding 35 Ncm. If at least three implants fail to achieve a torque of 35 Ncm, a two-stage surgical approach is recommended instead of immediate loading.[14]





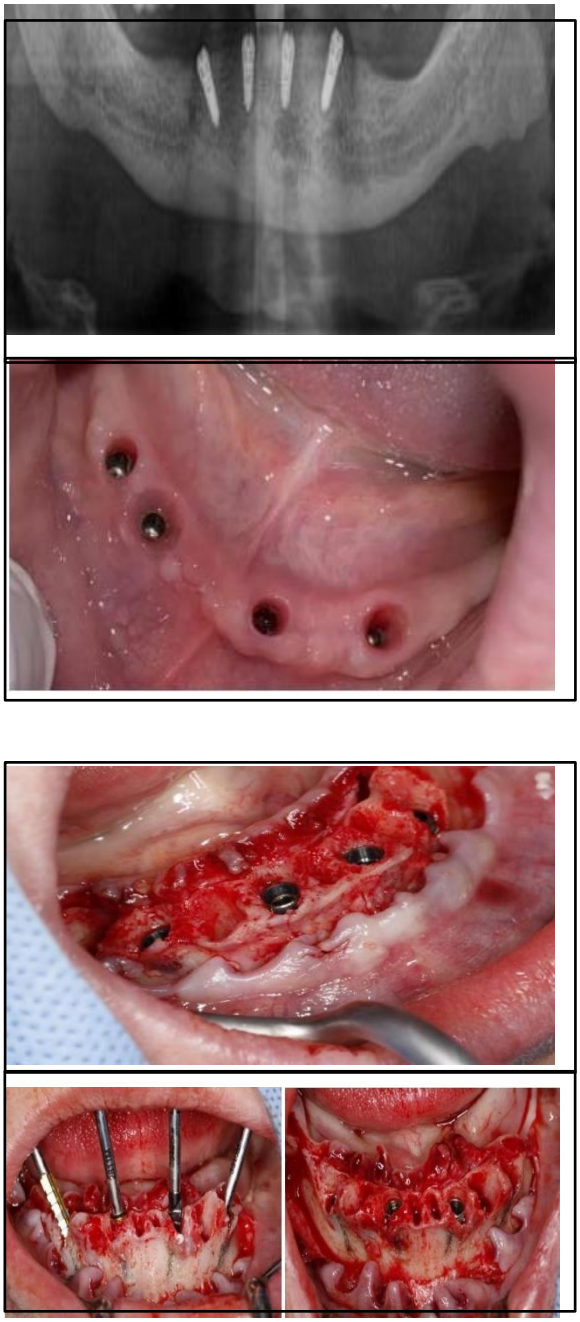


Fig 3 Surgical techniques of All on four implant

POST OPERATIVE CARE:

1. Postoperative medications are amoxicillin 500 mg four times daily or clindamycin 150 mg three times daily for 1 week, as well as an analgesic as needed.

2. A chlorhexidine rinse in a 0.12% solution is used every day at bedtime during the 6-month osseointegration period.

3. Patients are advised to maintain a soft diet, with foods of a consistency no harder than well-cooked chicken or fish.

4. The patient's occlusion is checked at the 1-week postoperative appointment.

5. Group function with bilateral, equal centric occlusion is the goal for the next 6 months during the osseointegration period.

6. Patients are advised to call immediately if they feel that they are biting more heavily on one

side than the other.

7. They are also advised to report any swelling, pain, or mobility of the prosthesis encountered at any time after surgery.

II. prosthetic phase

i. Multiunit abutments with 17º and 30º angulations, along with straight abutments of varying collar heights, are secured onto the implants.

ii. These abutments ensure optimal access, facilitate relative parallelism, and allow for a passively fitting rigid prosthesis.

iii. Approximately 2–3 hours post-surgery, the fabrication of a temporary prosthesis begins.

iv. To achieve this, impression copings are attached to the multiunit abutments and reinforced using quick-setting resin and wire bars.

v. This method guarantees a precise and stable impression, preventing any unintended displacement of the impression copings.

vi. During the provisional prosthesis construction, healing caps are placed over the abutments to protect them.

vii. The temporary screw-retained acrylic prosthesis is torqued to 15 Ncm, with patients advised to consume only soft foods.

viii. After 4–6 months, when the final prosthesis is planned, the implant stability is evaluated.

ix. If the implants are deemed stable, the provisional restoration is removed, and the patient's bite is recorded.

x. Laboratory analogs corresponding to the multiunit abutments are attached to the provisional prosthesis, which is then positioned on an articulator against a counter model.

xi. The prosthesis is indexed using putty material, followed by the fabrication of a resin model in separate sections, which are then assembled intraorally.

xii. This resin pattern is scanned, and the definitive framework is designed using CAD/CAM technology.

xiii. Once the framework trial is successfully completed, the final prosthesis is fabricated and delivered to the patient.

The definitive prosthesis may be either:

✓ A metal-acrylic resin prosthesis, consisting of a titanium framework with acrylic resin dental prosthetics.

✓ A metal-ceramic prosthesis, featuring a titanium framework with fully ceramic zirconia crowns. (15)

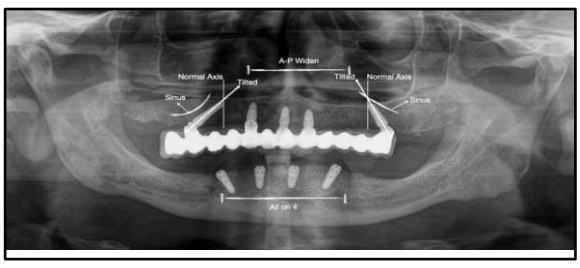


Fig 4 Fixed prosthetic restoration over the concept All on four

A-P SPREAD [16-17]:

i. According to Rangert, the anteroposterior spread of the prosthesis (the distance between the most anterior and most posterior implant) should be 10 mm, allowing for a cantilever length of 20 mm, following the 2:1 ratio of anteroposterior spread to cantilever length.

ii. According to English, the anteroposterior length of the cantilever for a mandibular implant-supported fixed prosthesis should be 1.5 times the anteroposterior spread.

iii. As per English, this guideline results in a cantilever length of 10–12 mm for a mandibular implant-supported fixed prosthesis. In the case of a maxillary implant-supported fixed prosthesis, the cantilever length should be reduced to 6– 8 mm due to the lower bone density in the maxillary posterior region.

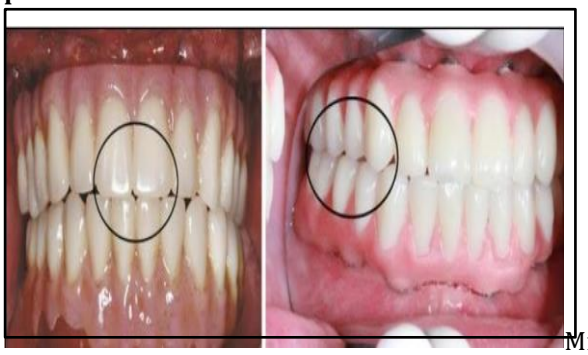
OCCLUSAL SCHEME(18-19):

The goal of any prosthetic procedure should include the foundation of a functional occlusion.

i. Bilateral, identical intercuspal contacts should be maintained when the jaws are in a stable position.

ii. The occlusal scheme should incorporate **"freedom in centric."**

iii. ·There should be no interference between the **maximal intercuspal position** and the **retruded position**.



Minimal tooth contact should be allowed during free mandibular movements in lateral and protrusive directions

Fig 5 Simultaneous bilateral point contacts on canine and posterior teeth and grazing contacts on incisors(20).

OCCLUSAL SCHEME FOR IMMEDIATE LOADING , ALL ON FOUR :

1. The cantilever length should always be kept to a minimum.

2. Bilateral, simultaneous contact should be maintained across all teeth, except for those positioned distal to the implant emergence.

3. During lateral movements, either group function or guidance should be established with **flat linear pathways and minimal vertical superimposition**, excluding teeth in the cantilever region.

4. In protrusive movements, guidance should be provided across all anterior teeth (canine to canine) with **flat linear pathways and minimal vertical superimposition**.

5. No balancing contacts should be present when an **implant-supported fixed prosthesis occludes with a removable prosthesis**.

OCCLUSAL SCHEME FOR DEFINITIVE PROSTHESIS FOR ALL ON FOUR (21):

1. Simultaneous bilateral contact should be achieved on cuspids and posterior teeth, with slight grazing contacts over the incisors.

2. When opposing natural dentition, canine guidance should be provided in lateral movements.

3. When opposing an implant-supported bridge in the posterior region, group function occlusion should be established with flat linear pathways and minimal vertical imposition.

4. If an implant-supported fixed prosthesis occludes with a removable partial denture, complete denture, cast partial denture, or implant-supported overdenture, the distal- most tooth should be slightly out of occlusion, and during excursive movements, one or more balancing contacts should be introduced.

5. The inclination of the cuspal planes should be less than the condylar path inclination.

ADVANTAGES:

1. Cost-effective treatment option.

2. Enhances posterior primary stability. (22)

3. Temporary acrylic prosthesis allows for immediate function (immediate loading).(23)

4. Reduces the need for sinus lifting, bone grafting, mandibular nerve repositioning, and minimizes surgical invasiveness. (24)

5. Ensures natural aesthetics and sufficient masticatory function. (Spinelli et al., 2013)

6. Utilizes longer posterior implants (≥13 mm) to enhance bone anchorage and achieve high primary stability in an optimal biomechanical position. (Menini et al., 2012; Spinelli et al., 2013)

7. Incorporates computer-assisted planning and guided implant surgery to improve success rates and ensure proper occlusal force distribution. (Spinelli et al., 2013)

8. Limits the cantilever extension to 9.3 mm in the maxilla and 6.6 mm in the mandible. (Spinelli et al., 2013)

9. Provides a comfortable post-surgical recovery with fewer complications. (Spinelli et al., 2013)

10. Suitable for rehabilitating atrophic edentulous jaws. (Spinelli et al., 2013)

11. Jaw type, gender, and implant placement location does not affect the treatment plan. (25)

12. Relatively high success rate. (26)

DISADVANTAGES:

1. The cantilever length is restricted and cannot be extended beyond predetermined limits.

2. The technique is highly sensitive and requires a pre-surgical splint to ensure precise implant

placement at the correct position and angulation. (Francetti et al., 2016)

3. Freehand, arbitrary implant placement is not always feasible, as implant positioning is entirely prosthetically driven. (27)

ALL ON FOUR DENTAL IMPLANT TREATMENT FAILURES: BIOLOGICAL COMPLICATIONS [28-30]

These include soft tissue dehiscence, peri-implant bone loss, peri-implant mucositis, inflammation beneath the fixed prosthesis, and soft tissue hypertrophy or hyperplasia.

TECHNICAL COMPLICATIONS [28-30]

These involve issues such as screw loosening or fracture, veneering material fracture, wear or complete replacement of acrylic resin teeth, framework fracture, loss of screw access filling material, fracture of the opposing restoration, implant fixture fracture, conversion of an implant-supported fixed prosthesis to a complete denture or overdenture, and patient dissatisfaction.

DISCUSSION :

A recent shift in practice paradigm has been to minimize treatment costs and patient morbidity while providing the most satisfying patient-centered treatment outcomes according to the state of the art of dental practice. **Drago et al (2018)** focused on the relationship between cantilever lengths (CL) and anterior-posterior (A- P) spreads in definitive hybrid full-arch, screw-retained prostheses.The study involved 130 patients with 193 edentulous arches (112 maxillary and 81 mandibular). A total of 774 implants were placed, with most arches restored using four implants. Drago indicated cantilever length should not exceed one tooth size while the final prosthesis must have cantilever length/anterior posterior spread ratio less than 1 (CL/AP ratio

<1). When keeping ratio at 0.9, he reported less than 1% complication rate with only one denture base fracture(31). **Sanchez-Monescillo A et al (2019)** described the photogrammetric technique for full-arch, all-on-four rehabilitation of a 68-year-old patient with an implant-supported fixed restoration in the mandible. The photogrammetric technique has proven to be a successful digital alternative to conventional printing of multiple implants. Aesthetics and function remained stable during a 1-year follow-up period. No biomechanical or biological complications were observed.(32) **Sharma et al (2020)** explored the recent advancements in the All-on- Four protocol, such as the integration of 3D imaging, computer-guided surgery, and novel implant materials and noted the improvement in precision and predictability of the procedure (33). **Dario V et al (2023)** analyzed the distribution of stresses in 3D Finite Element (FE) models at the bone, implant, and structure level of different designs for implant supported fixed prostheses in completely edentulous patients, comparing results in entire and partially resected jaws using the all-on-four .It was observed that the tensions on the implants are greater in the entire mandible than in the resected mandible, the tensions of the structure and the cancellous bone are comparable in all cases, in the resected mandible, the maximum tension levels at the cortical bone/implant interface are greater than in whole jaw rehabilitation. In the resected mandible, the all-on-four configuration was biomechanically superior to parallel implants, considering the radial stresses on the implants and cortical bone. A design with four parallel implants minimizes stress on a resected jaw while, across the entire jaw, all-on-four rehabilitation is superior at all levels (bone, implant, and structure) (34). **Maranini et al (2024)** -The all-on-four configuration proved to be biomechanically superior to parallel implants, considering the radial stresses on the

implants and cortical bone. It was found that Chewing stress can also be minimized to a greater extent and lowest stress was observed in both lateral and vertical loads in the peri implant region (35).

LIMITATIONS OF ALL ON FOUR CONCEPT(2):

1. Good general health and acceptable oral hygiene.

2. Sufficient bone for 4 implants of at least 10mm in length.

3. Implants attain sufficient stability for immediate function.

CONCLUSION:

The **All-on-4** technique presents a modern approach in restoring edentulous jaws, offering a solution that moves away from complex surgical procedures and removable prostheses. This method is cost-effective, shortens treatment time, reduces morbidity, and significantly improves patients' quality of life. Previous attempts to address severe resorption in the maxilla and mandible with dental implants had limited success. However, the introduction of the All-on-4 protocol represents a breakthrough, providing a promising advancement in the rehabilitation of fully edentulous and severely compromised jaws. It is rapidly emerging as a preferred treatment option and a gold standard for managing patients with extensive dental compromises.(36)

REFERENCES:

1. Maló P, Rangert B, Dvärsäter L. Immediate function of Brånemark implants in the esthetic zone: a retrospective clinical study with 6 months to 4 years of follow-up. Clin Implant Dent Relat Res. 2000;2(3):138-46.
2. Shakhawan M Ali, Zanyar M Amin, Rebwar A Hama, Hawbash O Muhamed, Rozhyna P Kamal And Payman Kh Mahmud. All on 4 treatment concept in dental implants: a review articles. March 2019; 10.32474
3. Krekmanov L, Kahn M, Rangert B, Lindström H, (2000) Tilting of posterior mandibular and maxillary implants for improved prosthesis support. Int J Oral Maxillofac Implants 15(3): 405- 414.
4. Sharma S, Luthra R, Makkar M, Singh P, Pathania P, (2017) All-on-4 treatment concept - a review. J Pharm Biomed Sci 7 (3): 53-56.
5. Thumati P, Reddy M, Mahantshetty M, Manwani R, (2015) "All-On-4/ DIEM 2" A concept to rehabilitate completely resorbed edentulous arches. J Dent Implant 5(1): 76-81.
6. Pankaj P. Singh, A.Norman Crainin. Atlas of oral implantology textbook 3rd edition; pg275
7. Dr Paulo Malo. The all on 4 and all on 4 with nobelguide clinical solution booklet 2003; pg7
8. Taruna M, Chittaranjan B, Sudheer N, Tella S, Abusaad M. Prosthodontic perspective to all-on-4® concept for dental implants. J Clin Diagn Res. 2014;8(10): Ze16-Ze19.
9. B. Anandh, B.Lokesh, Vijay Ebenezer, S.Jimson And J.Parthiban. All on four - the basics. Biomedical & Pharmacology Journal Sept 2015;
10. Malo P, de Araujo Nobre M, Lopes A. 2007.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. J Prosthet Dent;97:26-34.
11. Menini M, Signori A, Tealdo T, Bevilacqua M, Pera F, Ravera G, et al. 2012.Tilted implants in the immediate loading rehabilitation of the maxilla: A systematic review. J Dent Res;91:821-7.
12. Malo P, Rangert B, Nobre M. 2003 .''All-on-Four'' immediate-function concept with Branemark System implants for completely edentulous mandibles: A retrospective clinical study. Clin Implant Dent Relat Res
13. Boyacı BK. 2015.Evaluation of stress distributions occuring on titanium implants placed with the use of 'all-on-four' concept by different framework materials with finite element analysis (Ph.D. thesis) Gazi University İnstitute of Health Sciences,. ;5:2-9.•
14. Sharma S, Luthra R, Makkar M, Singh P, Pathania P, (2017) All-on-4 treatment concept - a review. J Pharm Biomed Sci 7 (3): 53-56.
15. M.Taruna, B.Chittaranjan, N.Sudheer, Suchita Tella, Md.Abusaad. Prosthodontic perspective to all-on-4® concept for dental implants. October 2014journal Of Clinical And Diagnostic Research 8(10):Ze16-Ze19
16. Bo Rangert, et al. All-on-4® Immediate-Function Concept with Brånemark System Implants for Completely Edentulous Maxillae: A 1-Year Retrospective Clinical Study. Clinical Implant Dentistry and Related Research. 2005;7(1):S88–94.
17. Purcell Ba, Mcglumphy Ea, Yilmaz B, Holloway Ja, Beck Fm. Anteroposterior spread and cantilever length in mandibular metalresin implant-fixed complete dental prostheses: a 7- to 9-year analysis. Int J Prosthodont. 2015 Sep-Oct;28(5):512-8.
18. Verma M, Nanda A, Sood A. Principles of occlusion in implant dentistry. J Int Clin Dent Res Organ 2015;7, Suppl S1:27-33607/Ijp.4172. Pmid: 26340012.
19. Parekh Rb, Shetty O, Tabassum R. Occlusion in implant prosthodontics. J Dent Implant 2013; 3:153-648.

20. Dr. Shreya H. Mantri, et. al. "The New Alternative to Conventional Dentures- All On 4 Dental Implant Treatment Concept: A Review Article." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), 20(03), 2021, pp. 26-37.

21. Singh R, Sharma S, Sultan K, Dadwal R, Kaushal A, Mongra A. Concept of all on four for dental implants: A review. IP Int J Maxillofac Imaging 2020;6(4):93-96.

22. Menini M, Signori A, Tealdo T, Bevilacqua M, Pera F, Ravera G, et al. 2012.Tilted implants in the immediate loading rehabilitation of the maxilla: A systematic review. J Dent Res;91:821-7.

23. Krekmanov L, Kahn M, Rangert B, Lindstrom H. Tilting of posterior mandibular and maxillary implants for improved prosthesis support. Int J Oral Maxillofac Implants. 2000;15(3):405–14.

24. Spinelli D, Ottria L, De Vico G, Bollero R, Barlattani A, 44 Bollero P. 2013. Full rehabilitation with Nobel clinician ® and 45 procera implant bridge ®: Case report. Oral Implantol (Rome) 46;6:25-36.

25. Balshi TJ, Wolfinger GJ, Slauch RW, Balshi SF.2014.A retrospective analysis of 800 Brånemark system implants following the All-on-FourTM protocol. J Prosthodont ;23:83-8

26. Ferreira EJ, Kuabara MR, Gulinelli JL. 2010.All-on-four" concept and 54 immediate loading for simultaneous rehabilitation of the atrophic 55 maxilla and mandible with conventional and zygomatic implants.

27. Anandh B, Lokesh B, Ebenezer V, Jimson S, Parthiban JJ. All on Four - The Basics. Biomed Pharmacol J. 2015;8.

28. Carlos Parra and Stephen K. Harrel. Treatment planning strategies for dental implant procedures, August 2019

29. Chee, W., Jivraj, S. Failures in implant dentistry. Br Dent J 202, 123–129 (2007). Doi:10.1038/Bdj.2007.74

30. Dan Holtzclaw. All-on-4® implant treatment: common pitfalls and methods to overcome them. July 2016 the Compendium of Continuing Education In Dentistry 37(7):458-465

31. Drago C. Ratios of cantilever lengths and anterior-posterior spreads of definitivehybrid full-arch, screw-retained prostheses: results of a clinical study.J Prosthodont 2018;27(5):402–8.

32. Sanchez-Monescillo A, Hernanz-Martín J, González-Serrano C, GonzálezSerrano J, Duarte S Jr. All-on-four rehabilitation using photogrammetric impression technique. Quintessence Int. 2019;50(4):288-293. doi: 10.3290/j.qi.a42098.

33. Sharma, P., & Kapoor, S. (2020). Advancements in All-on-Four implant protocols: A systematic review. International Journal of Oral Health and Clinical Research, 7(4), 209-215.

34. Dario V, Michelangelo-Santo G, Roberto B, Fabio F. Is All-on-four effective in case of partial mandibular resection? A 3D finite element study. J Stomatol Oral Maxillofac Surg. 2023 Oct;124(5):101463.

35. Maranini, C. B., Souza, J. P. A. F. de M., Cicareli, A. J., & Kassis, E. N. (2024). Major characteristics and clinical results of the all-on-four technique in implant dentistry: a systematic review. MedNEXT Journal of Medical and Health Sciences, 5(S1)

36. Soyfer V. Review Article on the All-On-Four Treatment Concept in Dental Implants. Arch Surg Clin Res. 2023; 7: 019-023.

37.