

Graftless Implant Concept – A Review Literature

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Abstract

All on 4 concept is documented as alternative to conventional implant treatment options in highly atrophic ridges for clinically significant success rates. The all on 4 technique, aids in avoiding bone augmentation procedures, bypasses anatomical structures, reduces cantilever length there by reducing the stress and provides better stress distribution. The purpose of this study is to compile the clinical and research articles regarding all on 4 concept, to determine various surgical techniques and basic principles of this concept.

Keywords

All on Four Implants, Graftless Implants.

Introduction

Tooth loss results in atrophy of alveolar ridge and mucosa, decreased resiliency of tissues and muscle tone followed by poor adaptive capacity and its severity increases over time in edentulous jaw¹. Management of atrophic ridges has always posed a challenge to the prosthodontists for years to provide a stable denture. Various prosthetic options to provide successful treatment for atrophic ridges are complete denture fabrication with detailed impression to provide denture stability, removable implant retained prosthesis or fixed implant – supported prostheses². Implants being a fixed treatment option improves masticatory efficiency, patient satisfaction and doesn't hasten the bone loss like dentures^{3,4}.

According to Literature the successful prostheses are made using 6-8 implants in maxilla and 6 implants in mandible and applying posterior cantilever extension where ever necessary⁵.The presence of maxillary sinuses and inferior alveolar nerve in close proximity with alveolar crests in excessively resorbed ridges restricts the implant placement in the posterior region^{6,7}. Bone grafts, Pterygoid implants or zygomatic implants can be used in such situations⁸. So, despite the advantages to achieve sufficient bone support to place standard implants in severely atrophic jaw, an extensive surgical bone augmentation procedure is often necessary to avoid or prevent invasion of anatomical landmarks. These grafting procedures may cause potential complications such as graft rejection, loss of graft material⁹.

To utilize preexisting bone in the most effective way, all on four concept is a documented alternative with a clinically significant success rates as they avoid the bone augmentation procedures, anatomical structures, reduces cantilever length there by reducing the stress and provides better stress distribution^{10,11}. The purpose of this review is to evaluate different surgical techniques in all on four concept.

Materials and Methodology

In this review, studies involving applications of the various techniques of all on four concepts in maxillary and mandibular arches, its advantages, osseointegration and clinical variations were examined. In the review performed in Pubmed and Medline between 2000 and 2018 publications keywords like full arch implant supported prosthesis, implants in atrophic ridges, tilted implants, osseointegration were used

together and searched. 40 articles from the review were evaluated with respect to the subject examined.

The inclusion criteria for articles were: (1) articles that were related to the all on four concept, and (2) abstracts that were obtained when full text could not be obtained.

Articles about conventional full arch implant usage for edentulous arches were excluded from the review.

Results and Discussion

40 articles were compiled in the Pubmed and Medline review. 25 of these articles were found to be suitable for the inclusion criteria. Of these, 12 were review literature, 11 were clinical studies and 2 were case reports.

Evaluation of Various Surgical Techniques

Pre-surgical radiographic examination is important for planning of implant treatment as it gives detailed information on the morphology of the alveolar ridge, quantity and quality of the available bone and potential area for implantation¹².

Periapical and panoramic radiographic images are widely used in preoperative planning of implant placement.

A clinical study states that, the American Academy of Oral and Maxillofacial Surgery recommended CBCT as the best option. It provides cross sectional images that demonstrate the height and width of the alveolar bone providing a tool to evaluate the quantity through accurate measurement and allows assessment of the bone quality regarding density of the remaining bone and precise localization of adjacent anatomic structures including the nasal fossa and

maxillary sinuses in the upper jaw and the inferior alveolar nerve canal in the mandible¹².

Conventionally, after assessing the bone quality and quantity by CBCT scan data, local anesthesia is administered and flap is reflected. If required alveoloplasty is done and osteotomy site preparation is carried out for implant placement.

Use of cantilevered implant-supported fixed dental prostheses has been suggested as an alternative in posterior regions where placing additional implants possess a challenge due to lack of bone height and/or crest width. However, the biomechanical performance of such prostheses has been associated with low survival rates and frequent biologic complications. Posterior cantilever in mandibular ISFPs should be 1.5 to 2 times A-P-spread of implants.

Krekmanov L et al study reported that axial implants posed a challenge in the reconstruction of the atrophic ridges mainly due to crestal bone resorption and anatomical limitations such as the maxillary sinus and nerve approximation¹³. These two often required bone augmentation procedures for positioning of implant.

Testori T et al in a prospective clinical study mentioned short implants (8 mm or less) could be a possible option, but a minimum amount of at least 7 mm of vertical bone height must exist. Moreover, adequate bone quality is critical for achieving success with short implants¹⁴.

Rosén A and Aparicio C in their follow up study reported the use of pterygoid and zygomatic implants as an alternative to bone grafting procedures in the rehabilitation of the posterior atrophic maxilla with

74% to 99% success rate for zygomatic implants^{11, 15}.

However, the placement of such type of implants is very technique-sensitive and presents with a high rate of biological complications.

Four to six vertical implants are used in the anterior region of the edentulous maxilla and mandible cantilevered to obtain a full-arch fixed prosthesis in “All-on-4” technique. To improve implant position and decrease the cantilever length, the concept of tilted distal implants was studied. The use of these tilted implants has been proposed by several authors within the past decade as a viable treatment option for the prosthetic rehabilitation of the severely atrophic posterior jaws

Advantages of the All-on-4 concept¹⁶: Angled posterior implants avoid anatomical structures, allow longer implants anchored in better quality bone, reduces posterior cantilever, eliminates bone grafts in the edentulous maxilla and in most of the cases mandible has high success rates, good biomechanics, immediate function and aesthetics, final restoration can be fixed or removable and reduced cost due to less number of implants. There are various types of surgical protocols in All on 4 concept like flap or flapless surgery, guided or free-handed surgery and also surgical techniques like quad zygoma, all on four-shelf, all on four-v4, conventional or long implants, different implant position and angles, types of implants.

The Anatomical Landmarks for All on four Surgical Approach are

V- point¹⁷: It is the surgical aiming point for implant placement in the maxilla when the treatment plan involves a 4-implant scheme in the presence of reduced bone stock at the lateral pyriform rim. It is the point of maximum bone mass in the midline of the maxilla, typically above the base of the nasal fossa within the nasal crest near the junction of the vomer. (Fig:1)

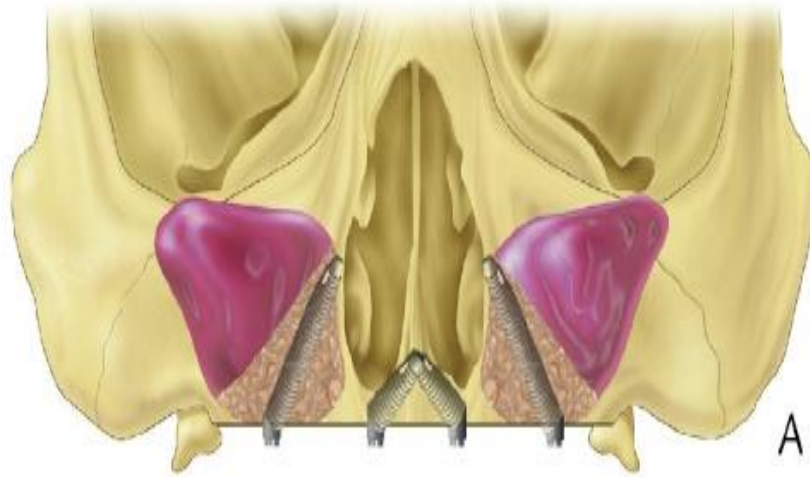


Fig 1: V-point

M- point¹⁷: Denotes the maximum bone available at the pyriform rim just above the nasal floor.(Fig:2)



Fig 2: M-point

N- point¹⁷: It is a radiographic based location used as an aiming point, usually 2 mm anterior to the anatomical point. It is the most anterior deflection of the inferior alveolar nerve in mandible as the nerve emerges from the mental foramen. (Fig: 3)

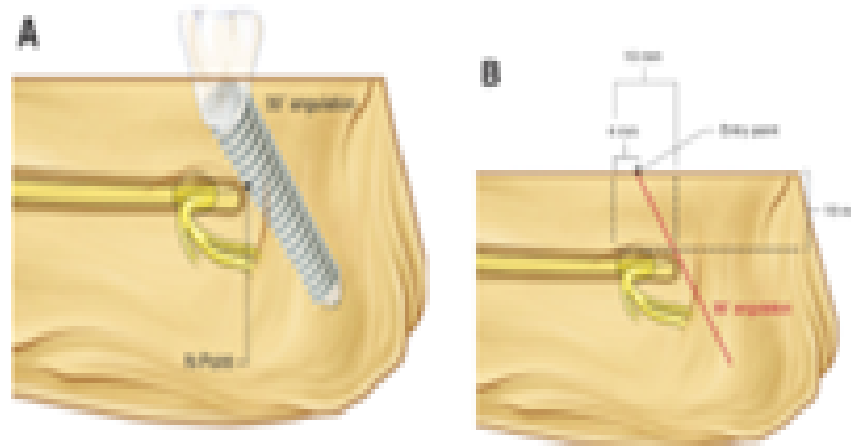


Fig3: N-point

S- point¹⁸: The most anterior point of the anterior wall of maxillary sinus. This is the most anterior inferior projection of the sinus where implants must bypass not to traverse the sinus cavity and where no load-bearing bone is present posteriorly. The amount of available vertical alveolar bone from Point-S to the alveolar plane of All-on-4 shelf, this determines how far posteriorly the implant can be placed.(Fig:4)

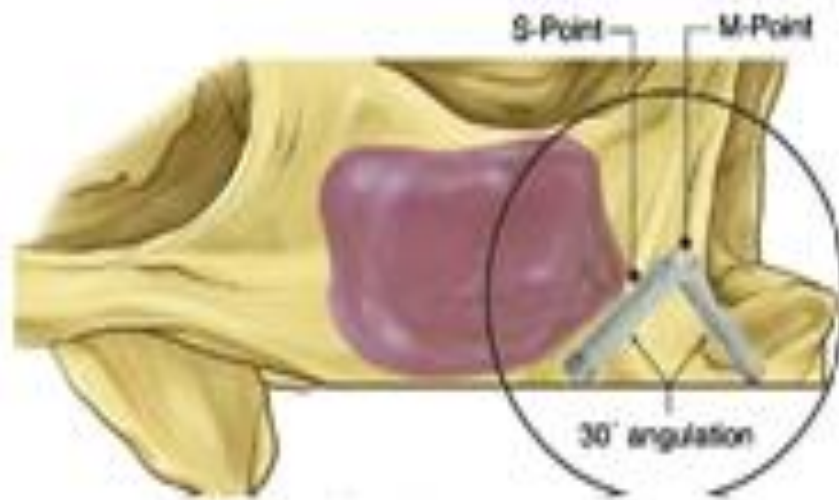


Fig 4: S-point

Various surgical techniques in all on four concepts are: Quad zygoma, all on 4 “V-4”, pterygoid implants, all on 4 “M-4” (piriform rim proximation), all on 4 shelf.

All-on-4: zygoma implants and quad zygoma¹⁹ (Fig: 5)

According to Branemark zygoma implants were used for 3 primary reasons (1) maxillary defect with post cancer (CA) resection, (2) trauma, (3) severe maxillary atrophy.

According to the concept of zygoma implants, when there is insufficient bone in premolar and molar regions leaving only the anterior premaxilla available, the zygoma implants are indicated to engage the available bone at distant site. Babbush C, Hahn J, Krauser J, et al advocates that the apex of the implant gets engaged within the body of the zygoma, transversing the maxillary sinus and emerging from the first molar position at a 45degrees angle.

According to Bedrossian the maxilla is divided radiographically into 3 zones: zone 1 = premaxilla, zone 2 =premolar, zone 3 = molar.

The implant placement involves 2 axial implants in the anterior position bilaterally and 2 zygoma implants in the posterior region at 45 – 60 degree angle.

Bedrossian E. reported a graft less solution for atrophic maxilla. when there is absolutely no available bone in the maxilla, the Quad Zygoma uses 4 zygomatic implants to support a full-arch prosthesis.

Long-term prospective studies with the conventional 2-stage and immediate loading approaches document high success rates with minimal complications. Zygoma implants showed a success rate of 96% after 12 years.



Fig 5: Quad zygoma

Complications

Sinusitis is the most common complication associated with zygomatic implants. Diagnosis and evaluation of the sinus pre-surgically also as extra-sinus surgical approach and immediate loading of the implants seem to scale back this complication.

Infraorbital nerve paresthesia, orosinusual fistula and perforation of the orbit²⁰ are the other

complications reported during and after the insertion of zygoma implants.

All on 4 “V-4”²¹:

Jensen and Adams in 2009 described case reports of “All-on-4” concept called “V-4” and how these implants are primarily placed in V form in maxilla and anterior mandible. It is indicated in patients with

severe mandibular atrophy with 5 to 7 mm of remaining native bone. These 4 implants are placed at a 30-degree angle to support a full-arch prosthesis. Jensen presented in his article that V point is the surgical aiming point for

implant placement in the maxilla when the treatment plan involves a 4-implant concept in the presence of reduced bone stock at the lateral pyriform rim. (Fig: 6)



Fig 6: All on 4- v4

Pterygoid Implant^{22, 23}:

An implant is placed into the pterygomaxillary suture at the posterior maxilla and angled forward about 30 degrees to provide for posterior implant support when bone is not available in the molar and sometimes premolar sites.(Fig:7)

The average success rate for pterygoid implants is 90.7%. Moreover there's an insufficient data about implant failures that occur beyond the first year of load, thus making it difficult to draw conclusions about long-term survival rates of these implants.

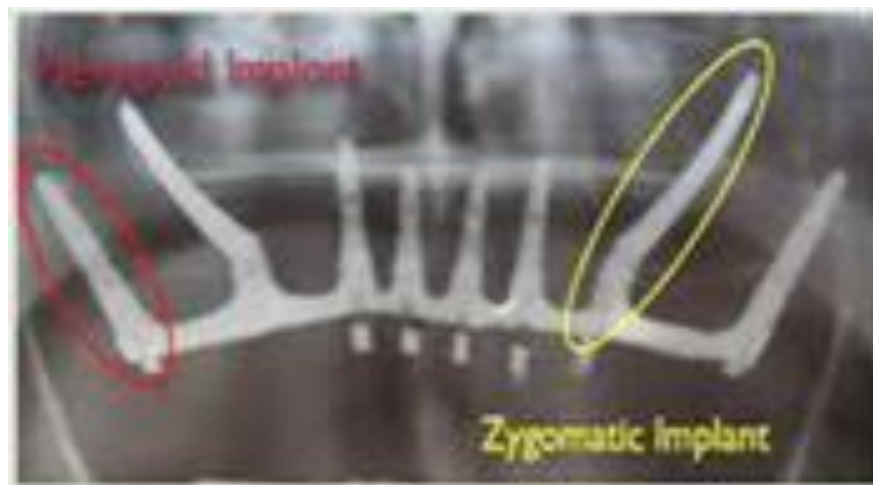


Fig7: Pterygoid and zygomatic implants.

Complications

Insertion of implants at the extent of the pterygoid plate are often related to bleedings (from the pterygoid plexus or the anterior maxillaris)²⁰. lack of primary implant stability is the other complication which can be solved with under preparation drill protocols and innovative implant designs.

Vomer Implant²²:

A concept in which, angled implants that pass into the nasal crest of the anterior midline maxilla, sometimes extending superiorly into the vomer junction. vomer implants are apically anchored to nasal crest.

All on four shelf^{18, 24}

Ole T. Jensen et al in 2010 and in 2011 described the all on four shelf for maxilla and mandible as a pre-prosthetic procedure. The shelf approach is to determine the precise implant position and angulation. The shelf facilitates the anterior-posterior (A-P) extent by identifying the anterior sinus wall and lateral nasal wall.

In this technique the alveolar topography is recreated by bony reduction, allowing implant placement within premaxilla such that when it is viewed from the frontal aspect it is visualized in an "M" configuration. The thin crestal bone reduction helps to place implants in thicker basal bone. This technique also allows for proper interocclusal distance of 22 mm which is required for the final prosthesis. Apically tilting the anterior and posterior implants in a 30° angulation engages the bone for maximal anchorage.

The only contraindication for the All-on-4 Shelf: Maxilla is, if there is an indistinction between the

nasal fosse and the maxillary sinus, making it one continuous cavity, the alternative treatment option will be zygomatic implants.

In 2011 Jensen and colleagues described All-on-4 Shelf: Mandible with the same strategy in which bone reduction rather than bone augmentation is used to rehabilitate the edentulous arch²⁴. A minimum of 20mm interarch space and flat alveolous ridge, are required for the mandibular arch. All on 4 shelf design is identical to Malo's "All-on-4" design, with 2 deviations in regards to the posterior implants. the First point is 1:1 ratio represents the available bone height from alveolar bone to N point and the distance gained by tilting the posterior implant in a 30° angle. The second key point is when sufficient bone is present in mental foramen region the posterior implant can be positioned behind the mental foramen, unspecified by the authors, for better A-P spread the implants can be placed above the inferior alveolar nerve from buccal to lingual with engagement to the lingual cortex via a transalveolus fashion.

Jensen et al described about the angulation of the posterior implant and anterior-posterior spread in their clinical study. The All-on-4 shelf clearly shows the maximum posterior position where the posterior implant can be placed as the shelf reduction usually exposes the sinus membrane, so that it is directly visualized for placing the implant just anterior to the anterior sinus wall. When the sinus is not visualized or exposed, a lateral punch hole into the sinus is made at the most anterior inferior extent of pneumatization to serve as a guide for implant placement and angulation. This point is called S-Point (sinus point).

Piriform Rim Proximation¹⁷

When there is alveolar crest atrophy, vertical height of the bone may still be present with a decreased width of the bone. Reducing the height of the bone will give a wider bone and move the alveolar plane closer to the piriform rim, which is the most desirable site for implant placement using an M-4 placement strategy.

Overview on Prosthetic Procedures

Depending upon the density or quality of bone, the loading protocol is chosen which is either immediate loading or delayed loading. Implant level impressions are made by placing transfer or impression copings on either multi-unit abutments or castable abutments.

Rigid splinting of impression copings is required for an accurate transfer of relationship of multi-unit abutments and implant position from mouth to master cast. This assures an accurate fit of one-piece implant framework. An open tray impression is made using elastomeric impression material. After the cast is poured, one-piece implant framework is either milled or casted using titanium or PEEK material in the form of a bar with retentive pins as in hybrid prosthesis or an anatomical framework as in Malo's bridge.

The passive fit of implant framework is evaluated by Sheffield test²⁵. After confirming the accurate fit of the framework, jaw relations are recorded. The superstructure is then fabricated with either acrylic or porcelain fused to metal or zirconia. The final prosthesis can be either screw retained or screw-cement retained which are completely fixed. It can also be a fixed-removable prosthesis as in Marius bridge.

Conclusion

The all on four variations can be used as a potential treatment option in atrophic edentulous jaws. It is necessary to further increase long term follow-up studies.

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