Rehabilitation of edentulous mandible with tilted implants followed by immediate functional loading: A Case Report.

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Introduction:

The presence of atrophied alveolus in the posterior parts of a completely edentulous patient poses a major concern while placing dental implants. The augmentation surgery conducted for the alveolar atrophy is associated with higher chances of complications in the patients. A novel concept, described initially by Paulo Malo and his associates in 2003, is the “All-on-Four” principle. This concept encompasses the utilization of four implants restored with straight as well as angled multiunit...
abutments, which support a fixed, provisional, and instantaneously loaded, full-arch prosthesis positioned on the same day of surgery. This treatment option has been introduced to avoid such unfavorable posterior regions, by allowing the usage of tilted implants for an improved spread of the dental implants, both anteriorly and posteriorly. Some retrospective studies have been conducted which have shown that “All-on-Four” principle can have successful outcomes. However, there is a dearth of Indian scientific evidence with regards to the outcome of this novel technique in the Indian patients. Here, we present a case report showing the successful usage of tilted implant on similar principles.

**Case History:**

A 55-year old female came to the Department of Prosthodontics, Terna dental College, Nerul, Navi Mumbai with the chief complaint of replacement of missing teeth. She had a past medical history of anemia for 2 years, without a history of any other chronic illness. She had a history of dental extraction (16, 36, 37, 46) which was done 1 month back. Her serum calcium report showed a level of 5.98 mg/dl, and she was on a fixed drug combination (FDC) medication comprising of vitamin K2, calcium carbonate (elemental calcium) and calcitriol.

The treatment options which were discussed for this patient was a set of complete dentures, Implant supported overdentures or an implant supported mandibular denture opposing maxillary complete denture. The patient opted for placement of implants in mandible opposing maxillary denture.

After taking the pre-operative photographs and orthopantomogram (OPG), the teeth were then extracted completely. Due to the less dense bone in posterior region, option of tilted implants was carried out. (Figure 1,2) The primary and the definitive impressions
were taken, followed by analysis of the vertical dimension both at rest and at occlusion, as well as the Facebow recording. (Figure 2) The try in and denture fabrication was completed. The relining and attachment of the radiographic markers were done before cone-beam computed tomography (CBCT), which was then super imposed for accurate placement of implants. (Figure 4). The Dio-Navi Implant Planning was done for fabrication of surgical guide for pre-determined implant positions. (Figure 5). The DIO NAVI implant system (Digital Implant system, India) was used with starter kit with all the drills from initial to final. The surgical phase started with the placement of the surgical guide affixed with screws. (Figure 5). The tissue punch was then conducted at the implant site followed by a bone flattening drill. (Figure 6) The guide drill was initially done with the help of a guide tube which acts as a stopper preventing over-drilling of bone. The protocol from initial to final drill was followed. (Figure 7) The abutment profile drill was then conducted which followed by the placement of the implants with torque of 50rpm (Figure 8). The surgical guide was then removed carefully, following which the placement of the gingival formers was done in regions 42, 32, and 34 along with graft placement in region 44 (Figure 9).

In the prosthetic phase, the polyvinyl siloxane impression was made with the denture to get an accurate position of the temporary cylinders. These cylinders were picked up using bisacrylic composite (Luxatemp, DMG America) and denture was converted as provisional hybrid prosthesis for immediate loading. (Figure 10)
Discussion:

Recently, a shift in the management practices has been adopted by dentists worldwide to decrease the costs for treatment with minimal complications, providing the best outcomes to the patients. The “All-on-Four” treatment principle came to the fore keeping these dental practices in mind, as a treatment choice for rehabilitation of edentulous patients with better quality outcomes.\(^4\)

In this novel treatment concept, the two posterior implants are placed in front of the mental foramina at a tilt to avoid any kind of injury to the inferior alveolar nerve. This reduces the cantilevers, which allows the growth of the polygonal area for a completely fixed prosthesis and gives suitable support to the molars.\(^5,6\)

This treatment principle also helps in improving the primary stability as well as the cortical anchorage, which helps in the usage of longer implants.\(^6\) It also eliminates the bone grafts in the edentulous mandible as well as the maxilla in most cases. Various studies which are published on this principle in the western countries have found that the survival rates of the implants placed using the “All-on-Four” treatment principle is between 92% to 100%.\(^2,8\)

In this case, the loading was done immediately at the end. It has been suggested that there is early osseointegration of the immediately loaded implants with enough strength, on condition that the implant micromotion and the forces are in control. However, while performing this technique, care should be taken about the cantilever length in the prosthesis, as it cannot exceed a limit. Also, free-hand random placement of implants is not possible with this technique as it is totally driven by prosthesis.

Various approaches have been used till date in case of patients with completely edentulous arches. These include the use of short implants (6 mm in length, 3 mm or even...
less in breadth), guided bone generation, alveolar distraction osteogenesis, wedge shaped implants, trans-mandibular staple implants as well as the use of intra and extraoral autogenous bone grafts. 

In the year 1990, Dr. Malo clinically documented via his retrospective study a method which involves the tilting posterior implants to improve the anchorage of bone, to improve the prosthesis support and avoid bone grafting procedure using “all-on-four concept”. In this study, 44 patients were treated and placed with 176 immediately-loaded implants, positioned in the anterior region, providing support to fixed complete arch mandibular prostheses. Five immediately-loaded implants were lost in five of the treated patients prior to the 6-month follow up, amounting to total survival rates of 96.7 and 98.2% respectively for development and routine groups. The prosthesis survival rate was found to be 100%, and the average bone resorption was extremely low. Thus, Dr. Paulo Malo developed, standardized and systematically analyzed the rehabilitation technique of completely edentulous ridges by “All-On-4 concept”. This concept includes the process of placing four implants, 2 anteriorly axially and 2 posteriorly tilted to an angle of 30 to 45 degrees. This implant tilting will enable the usage of implants with longer length, which helps in improved cortical engagement as well as better stability. This also helps in avoiding the necessity for bone augmentation procedure, trauma to the anatomical structures lying underneath, and improved stress distribution. Following this, a temporary, fixed and instantly loaded, full-arch prosthesis is positioned on the same day of surgery. This will lead to reduction in the post-operative pain and discomfort to the treated patient.

In the year 2007, Zampelis et al. conducted a study to assess whether tilting of splinted implants impacts the distribution of stress in
the bone present around the implant cervix, and to evaluate whether the usage of tilted implants like distal abutments is biomechanically better compared to distal cantilevers, with the usage of two dimensional finite element analysis. The authors mentioned in the limitations that distal tilting of implants splinted by fixed restorations does not lead to elevated bone stress in comparison to the vertical and normally placed implants. Thus, the authors proclaimed biomechanical advantage in the usage of tilted distal implants instead of the distal cantilever units.11

Computer assisted surgery includes the incorporation of All-on-four technique and usage of template made digitally, thus helping in a more accurate positioning of distal implants and protection of the vital anatomical structures like maxillary sinus or the mandibular nerve. This would help in obtaining a more expectable implant survival rate and improved stress distribution by the prosthesis. Computer assisted surgical guide is fabricated using the OPG, CBCT scans as well as casts.12

Thus, in this case, the tilted implant technique allows:

- Placement of longer implants which increases implant-to-bone interface and thus, gives primary stability to the implants
- A wider distance is created between the anterior and posterior implants which results in better distribution of load and decreased stress on implants, thereby increasing the longevity of prosthesis.
- The need for cantilevers is eliminated in prosthesis by distal tilting of implants and the need for bone augmentation is also removed.
- The positioning of implants is more precise, which reduced
chance of trauma to adjacent anatomical structures. Instantaneous loading of prosthesis, thus decreasing the post-operative distress to the patient.

**Conclusion:**

The tilted implants placement principle is an able alternative for rehabilitation of edentulous jaws in comparison to the advanced surgical methods, sans the use of removable prosthesis. It is a cost-effective technique, reduces the treatment period as well as complications, and gives a better quality of life to the patient.

**References:**


5. Sertgöz A, Güvener S. Finite element analysis of the effect of cantilever and


FIGURE 1. PRE-EXTRACTION INTRA-ORAL PHOTOGRAPHS

FIGURE 2. POST EXTRACTION INTRA-ORAL PHOTOGRAPHS
FIGURE 3. UPPER AND LOWER PRELIMINARY AND FINAL IMPRESSIONS FOLLOWED BY FACEBOW
FIGURE 4. RADIOGRAPHIC MARKERS ATTACHED TO LOWER DENTURE

FIGURE 5. DIO-NAVI IMPANT PLANNING FOR PLACEMENT OF IMPLANTS IN 32, 34, 42, 44 REGION
FIGURE 6. PLACEMENT OF SURGICAL GUIDE INTRAORALLY

FIGURE 7. TISSUE PUNCH AND BONE FLATTENING DRILL

FIGURE 8. INITIAL TO FINAL DRILL BEFORE PLACING IMPLANT
FIGURE 9. ABUTMENT PROFILE DRILL FOLLOWED BY IMPLANT PLACEMENT

FIGURE 10. SURGICAL GUIDE REMOVED, GINGIVAL FORMERS PLACED, GRAFT AND PLACEMENT OF MEMBRANE WITH 44 REGION
FIGURE 11: PROVISIONAL DENTURE CONVERSION PHASE