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CLINICAL TECHNIQUE

Tilted Implant Concept for Full Mouth Immediate Loading Restoration

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ABSTRACT

Conventional techniques of full arch/full mouth implantation works on placement of implants and leaving them undisturbed for subgingival healing until they get osseointegrate into the jaw bone. These implants are uncovered after the subgingival healing of 3 to 6 months depending on various factors, such as bone density, implant dimensions, occlusal load, etc. and restored in function once the soft tissue has healed in next 3 to 4 weeks. The vertical ridge loss along with maxillary sinus pneumatization restrict the clinician to place adequately long implants into posterior maxilla without performing sinus augmentation procedures. Further, many patients who have the chronic sinus pathologies do not qualify to receive the sinus graft and refused by the dentists for the fixed implant prosthesis. Uncontrolled diabetics are also not good candidates for the sinus grafting. In the implant dentistry, such patients have simply been treated with the implant over dentures by avoiding posterior maxilla. In the similar fashion, the vertically resorbed posterior mandible has also been a big challenge for the implant dentists in the cases where the dentist find insufficient bone dimensions to place even shortest available implants above the mandibular canal. In implant dentistry, various procedures, such as onlay block grafting, nerve repositioning, etc. have been advocated to manage the resorbed posterior mandible. Such procedures are more invasive, require multiple surgical steps, elongate the treatment time and also cause the tissue morbidity to some extent. Moreover, the full mouth work is not very simple in most cases because most of edentulous patients do not step in with adequate bone dimensions in all four parts of the jaws to place implants with adequate dimensions. Conventional way of treating edentulous patients with full mouth implant supported fixed prosthesis may require placement of multiple number of implants, bone augmentation procedures, longer treatment span and multiple number of surgical steps. Thus, such techniques are not always comfortable and also affordable to the patients. In comparison to the posterior segments, anterior parts of the jaws offer the bone with larger volume and higher density which enables the dentist to place longer implants with higher initial stability by stabilising implant apices into the opposing cortices/basal bone (nasal floor, mandibular symphysis).

In this tilted implant concept, the back implants are slanted distally to place the implant head at the second premolar or first molar position which enables to place longer implants, stabilizing their apices into the anterior higher density bone, and reduces the distal cantilever of the prosthesis. Total four implants are used in this technique where two straight implants are placed close to the midline and rest two implants are placed anterior to the maxillary sinus (in maxilla) or mental foramina (in mandible) which are slanted distally to reach the second premolar or first molar position. A 10 to 12 unit screw-retained metal to plastic (hybrid) splinted prosthesis is placed over these implants. Hence, it is a graft less implant placement procedure for restoring the edentulous jaws by tilting posterior implants for utilizing maximum amount of bone and stabilizing them into highest possible bone density. This facilitates an optimal support for an acrylic prosthesis that can be immediately fixed over the inserted implants to restore the esthetics and functions within few hours after the implant insertion surgery. This paper aims to explain the graft less approach for full arch immediate rehabilitation on 4 to 6 implants placed in one arch by smartly tilting the back implants to avoid vital structures, such as maxillary sinus and mandibular canal and stabilizing into the high density bone. This clinical study was done on total 80 implants to evaluate their success under the tilted positioning and immediate load conditions. The technique was performed on both diabetic and nondiabetic patients and no variation was found on the success rate between both the groups. None of the tilted implant got failed in 3 years follow-up but four implants got failed at anterior positions which immediately replaced with new implant placed at the adjacent position and restored in function. The mean values of bone loss relative to the implant platforms at 1 year follow-up were 0.8 mm for the maxilla and 0.5 mm for the mandible. The average bone loss for the maxilla and mandible respectively, at 3 years of follow-up were 1.3 mm. Thus, very promising results were found in this clinical study. Hence, the conclusion is that the tilted implant immediate function concept for completely edentulous patients has proven to be clinically effective technique, patient pleasing and applicable in various clinical situations where otherwise more invasive, complicated and expensive bone augmentation procedures would have been indicated.

Keywords: Tilted implant concept, Dental implant, Graft less approach for full arch implant restoration, Multiunit abutment, All-on-4, All-on-6, Immediate loading.

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INTRODUCTION

Edentulism affects patients in various ways such as reduced chewing efficiency, inadequate intake of nutritious diet, declined self confidence, and premature aging appearance

and many of them live the life as a 'dental cripple'. Complete edentulism can be the result of various factors and diseases such as periodontitis, dental caries, trauma, intentionally removed or lost post surgical or after radio therapeutic dose in oral carcinoma cases, etc. The most common cause of teeth loss is periodontitis specially in underdeveloped and developing countries. Hence, a growing no. of population in India and many other similar countries has the terminal dentition and are being restricted to get the full mouth rehabilitation due to inadequate no. of natural teeth abutments and the financial burden. The most affordable option for such patients, which has conventionally been advocated by the dentists, is the complete denture. But, complete dentures are not very comfortable for most of such patients due to several problems related to these dentures, such as inadequate retention, stability, soft tissue erosions, gagging, diminished oral sensory functions, inadequate mastication ability, improper speech and many more. Such problems with the dentures are even more profound in the patients who have lost their teeth due to advanced periodontitis, because such patients loose most of the vertical ridge dimensions, which is utmost requirement to retain these dentures, due to periodontitis. Fabrication of the simple soft tissue supported dentures with poor retention further lower down the self esteem of such patients and keep them away from living a quality life.

In recent times, dental implant supported prosthesis (implant over dentures) has offered several advantages such as improved retention and support, reduced size prosthesis, better speech, and enhanced mastication ability when compared to the conventional dentures[1,2] but in the today's world of comfortable life, most of the patients express desires to have the fast and fixed prosthesis which should appear and work as the natural teeth.

Conventional techniques of full arch/full mouth implantation works on placement of implants and leaving them undisturbed for subgingival healing until they get osseointegrate into the jaw bone. These implants are uncovered after the subgingival healing of 3 to 6 months depending on various factors such as bone density, implant dimensions, occlusal load, etc. and restored in function once the soft tissue has healed in next 3 to 4 weeks.[3,4] Moreover, the full mouth work is not very simple in most cases because most of edentulous patients do not step in with adequate bone dimensions in all four parts of the jaws to place implants with adequate dimensions. Patients with long time edentulism or loss of teeth because of advance periodontitis, often presented with the insufficient bone dimensions specially in the posterior parts of the jaw. The vertical ridge loss along with maxillary sinus pneumatization restrict the clinician to place adequately long implants into posterior maxilla without performing sinus augmentation procedures.

The sinus augmentation again need skilled approach and quality bone graft materials to regenerate the new bone into the sinus. Further, sinus augmentation procedure not only add the no. of surgical procedures to the implant treatment but also extend the time to place and restore the implants, often to the complete year.[5,6] Further, many patients who have the chronic sinus pathologies do not qualify to receive the sinus graft and refused by the dentists for the fixed implant prosthesis. Uncontrolled diabetics are also not good candidates for the sinus grafting. In the implant dentistry, such patients have simply been treated with the implant over dentures by avoiding posterior maxilla.

In the similar fashion, the vertically resorbed posterior mandible has also been a big challenge for the implant dentists in the cases where the dentist find insufficient bone dimensions to place even shortest available implants above the mandibular canal. In implant dentistry, various procedures such as onlay block grafting,[7] nerve repositioning,[8] etc. have been advocated to manage the resorbed posterior mandible. Such procedures are more invasive, require multiple surgical steps, elongate the treatment time and also cause the tissue morbidity to some extent.

As discussed earlier, conventional way of treating edentulous patients with full mouth implant supported fixed prosthesis may require placement of multiple number of implants, bone augmentation procedures, longer treatment span and multiple number of surgical steps. Thus, such techniques are not always comfortable and also affordable to the patients. In comparison to the posterior segments, anterior parts of the jaws offer the bone with larger volume and higher density which enables the dentist to place longer implants with higher initial stability by stabilising implant apices into the opposing cortices/basal bone (nasal floor, mandibular symphysis).

TILTED IMPLANT CONCEPT

Tilted implant concept was first described by Paulo Malo, Lisbon, Portugal in his state of art All-on-4^{TM} concept. The back implants are slanted distally to place the implant head at the second premolar or first molar position which enables to place longer implants, stabilizing them into the anterior higher density bone, and reduces the distal cantilever of the prosthesis. Total 4 implants are used in this technique where two straight implants are placed close to the midline and rest two implants are placed anterior to the maxillary sinus (in maxilla) or mental foramina (in mandible) which are slanted distally to reach the second premolar or first molar position. A 10 to 12 unit screw retained metal to plastic (hybrid) splinted prosthesis is placed over these implants.[9] Hence, it is a graft less implant placement procedure for restoring the edentulous jaws by tilting posterior implants for utilizing maximum amount of bone and stabilizing them in highest possible bone density. This facilitates an optimal support for

an acrylic prosthesis that can be immediately fixed over the inserted implants to restore the esthetics and functions within few hours after the implant insertion surgery.[10]

To perform this technique, total four implants are inserted with the back implants tilted up to 45°, often in close approximation to the inferior and anterior wall of maxillary sinus in upper jaw and superior and anterior to the inferior alveolar nerve and mental foramina in mandible, to take maximum advantage of existing bone by inserting long implants and firmly stabilizing their apex into high density anterior bone. A fixed standardized surgical guide is used to correct implant placement. Both flap and flapless (guided) approaches are compatible with the technique. Special components are developed to correct the prosthetic angulations of the tilted implants as well as to immediately restore the implants into function.[11] If necessary, a cantilever can also be added to the final prosthesis. Skilled approach of tilting the posterior implants avoid the expensive, time taking, and more invasive grafting procedures like sinus grafting, block grafting, nerve repositioning, etc.

Though 10 to 12 unit prosthesis placed on four implants is adequate enough for chewing, to achieve an optimal maxillofacial prosthesis and is well accepted by the patients but in couple of patients the anterior extension of maxillary sinus does not allow the optimal distal tilting of back implants to reach the second premolar and few patients do not feel 10 to 12 unit prosthesis adequate enough. In such patients, two additional implants are inserted posterior to the sinus into the tuberopterygoid bone in maxilla,[12] and in mandible two short and wide implants are inserted into the buccal self region to support 14 unit fixed prosthesis (All-on-6 Concept). Addition of these two implants offers several advantages, such as addional support to the anterior four implants, avoidance of any distally cantilevered prosthesis, allows fixing of complete arch prosthesis, and improved maxillofacial prosthesis. Few disadvantages with this All-on-6 concept are problems in hygiene maintenance in the back part of the prosthesis, difficulty in placing and prosthetic handling of implants into tuberopterygoid region because of area of less access and visibility.

This paper aims to explain the graft less approach for full arch immediate rehabilitation on 4 to 6 implants placed in one arch by smartly tilting the back implants to avoid vital structures such as maxillary sinus and mandibular canal and stabilizing into the high density bone.

MATERIALS AND METHODS

In this approach, minimum four implants are used to support a 10 to 12 unit fixed prosthesis. The concept benefits from posterior tilting of the two distal implants, which offers a minimum of 10 to 12 unit immediately placed prosthesis. For complete arch 14 unit prosthesis, total 6 implants are used into each arch. For this clinical study, tapered, variable thread design implants with SLA surface were used. Total 17 arches were restored in total 11 patients with tilted implant concept. Total 6 arches were restored by placing 6 implants in each arch (All-on-6 concept) while 11 arches were restored by placing 4 implants in each arch. Six patients received the prosthesis for both arches while in five patients single arch was treated with tilted implant concept opposite to the natural teeth or fixed prosthesis. For this study, total 80 implants were used. Out of 80 implants, 46 implants were tilted mesially or distally up to 45°. Out of 46 tilted implants 12 implants were placed into the tuberopterygoid bone. Out of 80 implants, 48 implants were placed into the maxilla and rest 32 implants were placed in the mandible. In all cases, a provisional prosthesis was fixed over the implants on the day of implant surgery. In the anterior segments, 3.5 to 3.75 mm diameter implants were used and all of them were stabilized into the nasal floor either by open or crestal approach nasal floor elevation procedure.[10,11] The lengths of anterior implants were 13 to 16 mm. The all slanted implants placed anterior to the sinus or mental foramina were either 3.75 or 4.2 mm in diameter and 16 to 18 mm in length. These implants were also stabilized into the nasal floor and base of anterior mandible. Most of the implants placed into the tuberopterygoid bone were 3.75 to 4.2 mm in diameter and 16 mm in lengths. when required, the short and wide (5 mm wide and 6-8 mm long) implants were used into the distal mandible (buccal self). All implants except which placed into buccal self region, were placed with the bicortical engagement anchorage to obtain the adequate initial stability for immediate functional loading. The head of the implants is stabilized into the crestal bone (first cortex) while the apices of the implants were stabilized into the basal bone (second cortex), such as nasal floor, mandibular symphysis or pterygoid bone. In all cases, a moldable surgical guide (Nobel Biocare, India) was used for controlled tilting of the implants. All distal implants were tilted at 45°. After the implants placement, straight,17° or 30° multiunit abutments were inserted on top of anterior implants while always 30° multi unit abutments were inserted on top of the distal implants to correct the prosthetic angulation. This enables easy and passive insertion of splinted prosthesis over the all multiunit abutments. In all cases, a prefabricated all acrylic prosthesis or patient's old dentures were modified and immediately fixed over the implants using titanium cylinders.

Inclusion/Exclusion Criteria

All the patients were medically evaluated and investigated for systemic problems such as diabetes, thyroidism, heart problems, osteoporosis, hypertension, etc. Out of 11 patients, three patients were controlled diabetic (HbA1c <6-8%) while two patients were uncontrolled diabetics (HbA1c >10%)[13,14]

and rest were nondiabetic. All 16 patients were above the age of 40 years with the mean age value of 56 years. Six patients were male and 5 were females. Out of 11 patients, two female patients were suffering with moderate osteoporosis but none of them was receiving bisphosphonates[15,16] therapy. For the osteoporotic patients neither specific medication was used nor specific modification was done in the technique except placing longest possible implants and maximally stabilizing into the cortical bone. For the uncontrolled diabetics, those patients first sent to the diabetologist to get their sugar level down (fasting blood sugar level <160) in couple of days using regulated dose of insulin. Once the sugar level got controlled, all those patients underwent the implant surgeries with the systemically administered antibiotics (Inj- Taximax 1.5 gm 8 hourly and Inj Amikacin 500 mg 12 hourly) started 1 hour before the implant surgery and same medication continued for minimum 5 to 7 days until soft tissue primarily got healed to reduce the chances of postimplantation infection. The blood sugar level was regularly monitored for next 6 weeks in such patients and kept in control until the implants got primarily integrate with the bone.

TREATMENT PLANNING

After the medical evaluation, all patients undergone panoramic radiographs (Fig. 1), and dental CT evaluation to evaluate the bone dimensions and bone quality (Fig. 2). All cases were planed three dimensionally using 'Implant 3D' implants simulation and CT planning software[17] (Figs 3A and B). Out of 11 patients, only one patient was treated flap less using soft tissue supported surgical stent, rest 10 patients were treated with the open approach. For the maxilla, anatomical inclusion criterion was bone ridge minimum of 6 mm wide and height minimum of 10 mm and also the anterior-inferior wall of the sinus should not extend anterior to the first premolar. That means it should allow to place implants in such a manner that their head, by distal tilting of implants, can be reached minimum to the second premolar region. For mandible, minimum 5 mm ridge width and 10 mm ridge height should be available. Further, the position of mental foramina should allow the distal tilting of posterior implants in such as way that their heads can be reached minimum to the first premolar position. Patients on the bisphosphonates (oral or intravenous), patients with liver cirrhosis or severe heart problems were excluded from the treatment.

SURGICAL PROTOCOL

Medication

All implants were placed under local anesthesia, local infiltrations were used for maxilla while inferior and lingual nerve blocks were given for mandibular implants. LOX 2%-Lignocain hydrochloride with adrenalin (1:200000) was used as the local anesthetics in all cases. All patients were sedated with diazepam (Valium 5 mg) 1 hour before surgery. Antibiotics (amoxicillin 875 mg and clavulanic acid 125 mg, Augmentin) were prophylactically given to all patients 1 hour prior to surgery and daily for 7 days thereafter. As mentioned earlier, the uncontrolled diabetic patients were kept on inject able form of antibiotics. Steroid injection (inj. Dexona) and analgesic injection (inj. Dynapar) was given to all patients just after the surgery to reduce postsurgery pain and swelling.[18] Thereafter, analgesics with serretiopeptidase (tab Supar-s 1tab BD) were given to the patients for next 7 days along with antacid (Pentoprazole 40 mg OD).

Implantation Surgery

For maxilla, a 'hockey stick' releasing incision over the tuberosity was initiated and carried full thickness over the maxillary ridge to the opposite tuberosity. A full thickness flap was elevated to expose the bony ridge, anterior and lateral wall of maxilla, maxillary tuberosity (if tuberopterygoid implants were planned to be placed) and nasal

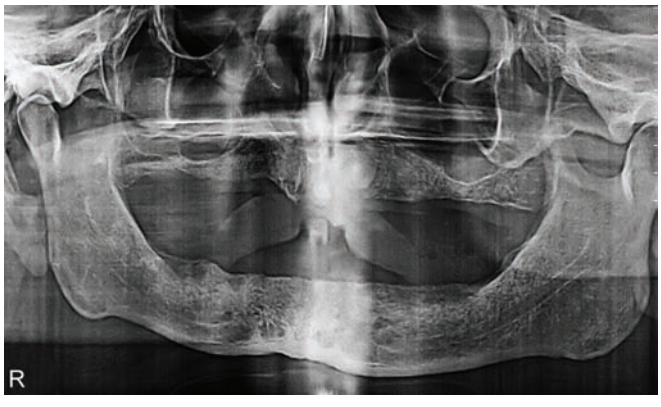
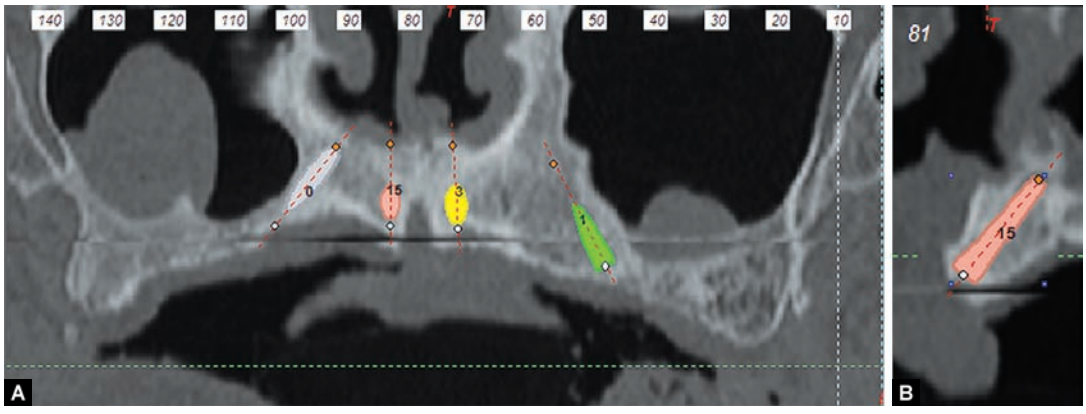


Fig. 1: The panoramic radiograph is mandatory for the full arch implant prosthesis with the tilted implant concepts. It shows the various details such as bone height, path and positions of vital structures like maxillary sinuses, nasal floor, mandibular canals, etc.

Fig. 2: CBCT provides the accurate and detailed information about the bone volume, bone density, bone angulations, and about the vital structures



Figs 3A and B: Accurate 3D planning can be done using 3D planning and implant simulation software. It helps to choose the correct implant dimensions and their 3 dimensional placement simulation into the jaw bone. Various views of jaw bone such as axial, panoramic, cross-sections, and 3D are created using this software. It provides the detailed information about the bone and vital structures. The panoramic view of CT of the same case as its panoramic radiograph shown in Figure 1. The panoramic view is showing bilateral sinus pathologies which contradict the sinus grafting in this case. Thus, tilted implant technique looks the best and only option to offer fixed full arch implant prosthesis in such cases

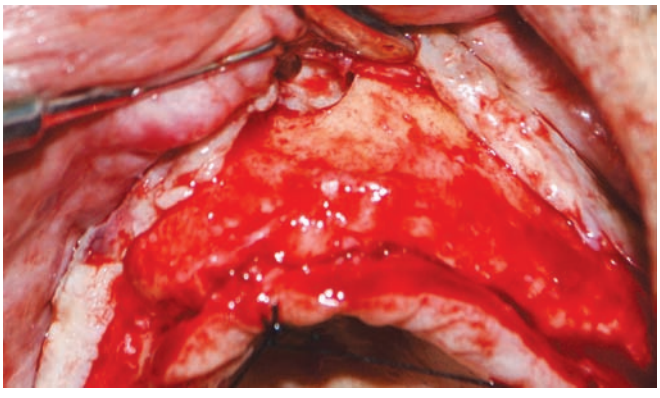


Fig. 4: Mucoperiosteal flap is elevated to uncover the bony ridge, and lateral walls of the sinuses. The flap is further elevated to reach the inferior cribriform rim and nasal spine and nasal epithelium is carefully elevated using the sinus curettes

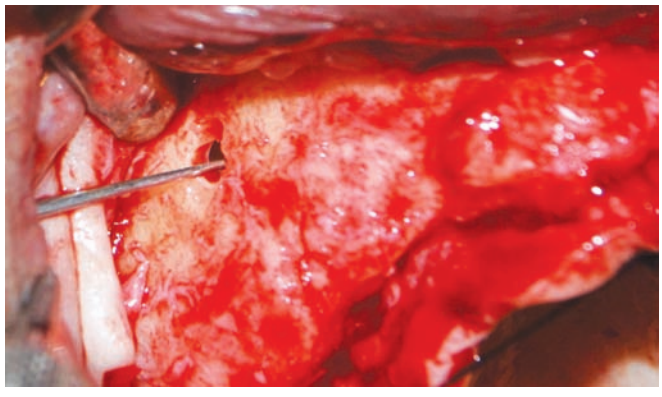


Fig. 5: Taking the reference from the panoramic X-ray, a small opening is created into the lateral wall of sinus, posterior to the anterior wall of sinus, using small round bur. A blunt probe is then used to explore the location and path of anterior wall of sinus

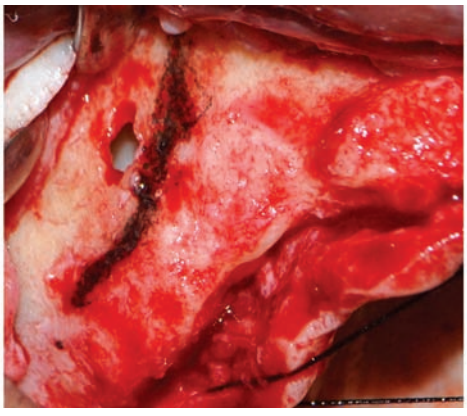


Fig. 6: The path of the sinus wall can be drawn using a surgical pen or sterile HB pencil

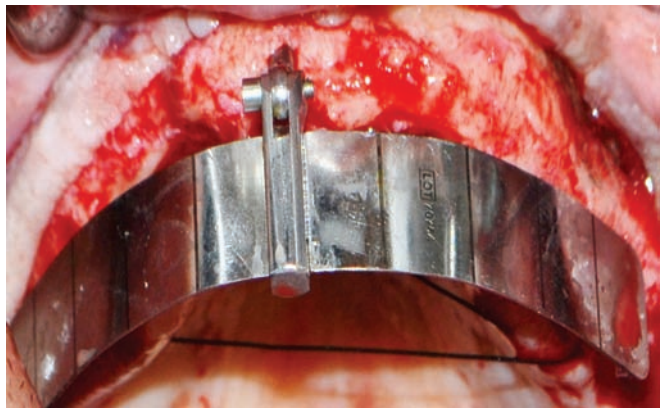


Fig. 7: A small osteotomy is prepared into the mid line using 2 mm diameter pilot drill and pin of the surgical guide is seated

floor (if implants into the nasal floor are planned). Vertical ridge reduction was done using the bone rhonger and carbide trimmers to make a flat platform and also to carry the future denture base-ridge transition line under the lip so that it does not get visible when patient smiles. Then nasal floor epithelium was carefully elevated using sinus curettes (Fig. 4). A small hole into the lateral wall of sinus was prepared using a small round bur taking the reference from the panoramic radiograph for the position of anterior wall of sinus. A small blunt probe was then used to explore the location and path of anterior wall of the sinus (Fig. 5). The path of the sinus can be drawn over the exposed ridge

using a surgical pen or sterile HB pencil (Fig. 6). A small osteotomy was prepared in the midline using pilot drill and surgical guide pin was seated into it (Fig. 7). The guide was then molded to the ridge shape. Keeping the path of anterior wall of sinus in mind, the osteotomy for the distal implants was began as posterior as possible and directed interiorly almost at 45° toward the nasal floor and minimum 2 to 3 mm anterior to the anterior wall of sinus (Fig. 8). The osteotomy is deepened until the nasal floor has been perforated while protecting the elevated nasal epithelium using sinus curette.[19,20] Once two distal implants have been placed and slanted at 45°, two implants were placed in the anterior maxilla which were also stabilized into the nasal floor (Fig. 9). For all-on-6 cases, the osteotomy was prepared for tuberopterygoid implants. The osteotomy was begun at very slow speed (500-600 rpm) at tuberosity (keeping in mind the distal wall of sinus) little from buccal side and drilled right up to the medial pterygoid process of sphenoid bone. With the minimal drilling, the long implants were placed to stabilize them with higher stability into the pterygoid bone. Once all the implants were correctly placed (Fig. 10), appropriate multiunit abutment were selected and placed over each implant to correct the prosthetic angulations. Straight, 17° or 30° multiunit abutments can be placed on the anterior implants while for the distal implants 30° multiunit abutments are placed (Figs 11 and 12). Once the multiunit abutments had been placed, the connection screws of multiunit abutments were tightened at 20 Ncm using mechanical driver and healing caps were placed on top of the multiunit abutments and flap was primarily sutured back using 4-0 Ethicon suture material (Fig. 13).

For mandible, the mucoperiosteal flap was elevated to expose the ridge and mental foramina. The surgical guide was placed in the similar fashion as in the maxilla. The

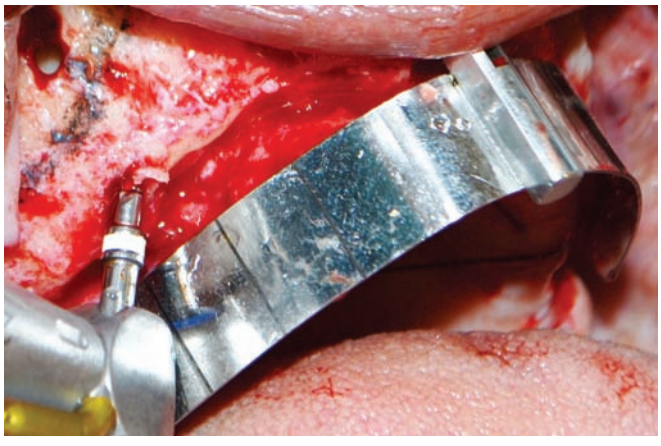


Fig. 8: Taking the guidance from the surgical guide, the osteotomy for the posterior implants is began far posterior from the anterior wall of the sinus (at second premolar or first molar positions) and directed anteriorly to place the implants anterior and along the anterior wall of sinus. In this way, the distal implants are finally seated with their head distally tilted up to 45° to reach the second premolar or first molar position

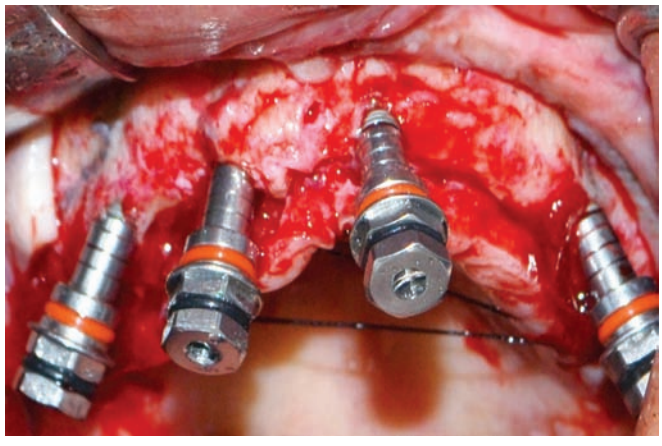


Fig. 9: All four implants in position, two distally tilted back implants and two straight anterior implants

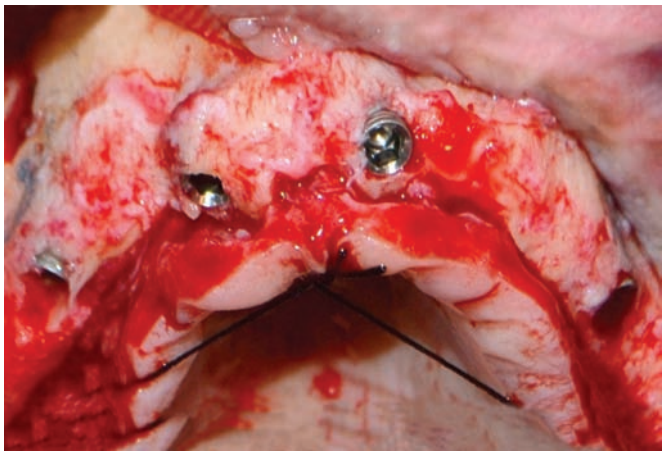


Fig. 10: All four implants at final positions after removing the mounts

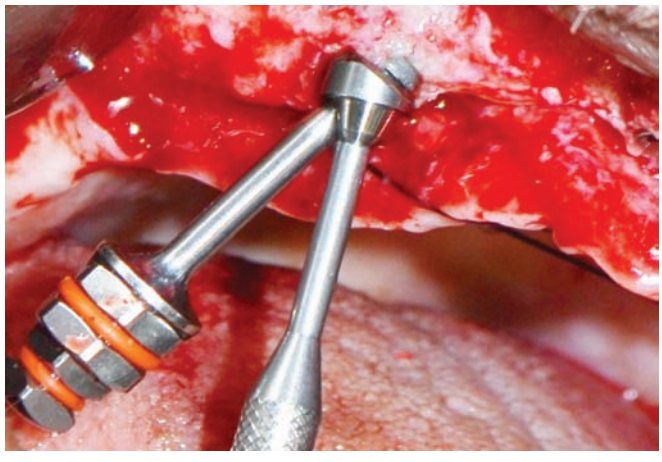


Fig. 11: A 30° multiunit abutment is being screwed on the top of distal implant to correct the prosthetic angulations

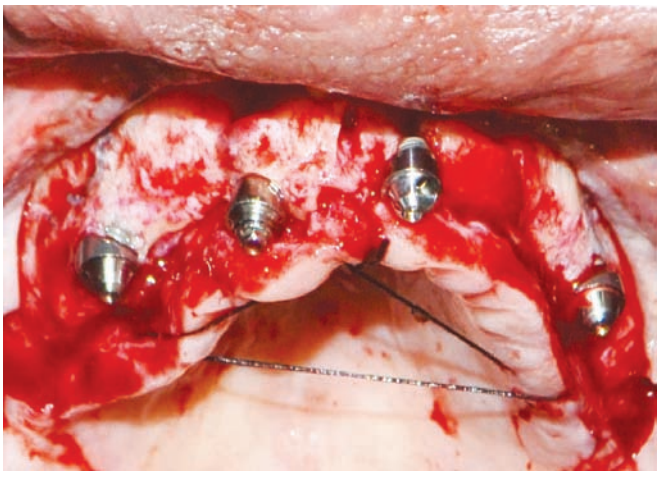


Fig. 12: Appropriate multiunit abutments paced on top of all four implants

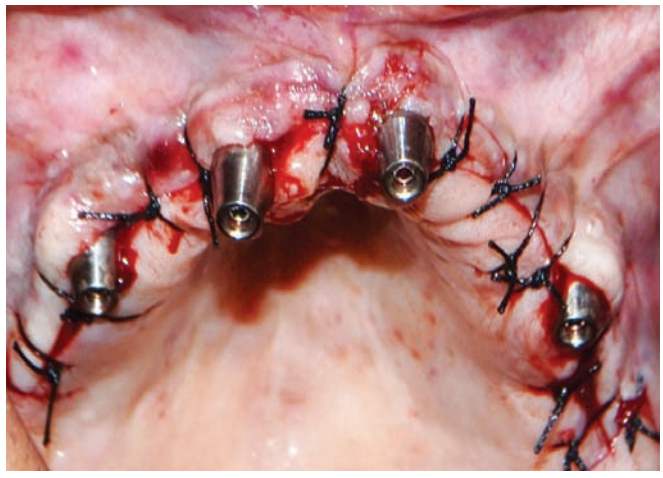


Fig. 13: Covers/healing abutments are placed on top of the multiunit abutments and flap is sutured back

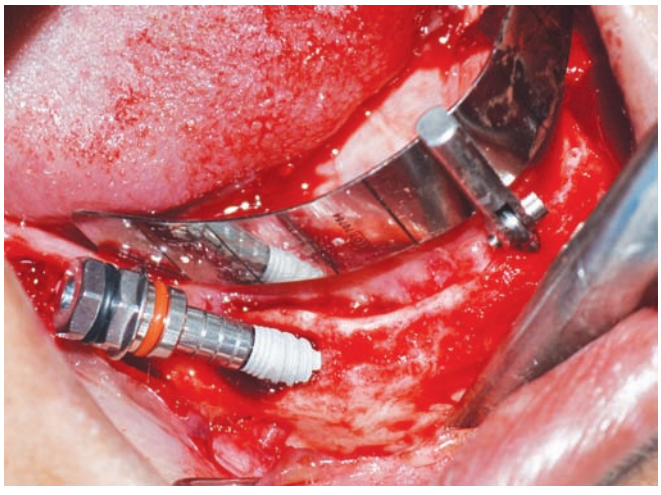


Fig. 14: In the mandible, the distal implants are slanted at 45° anterior and superior to the mental foramen

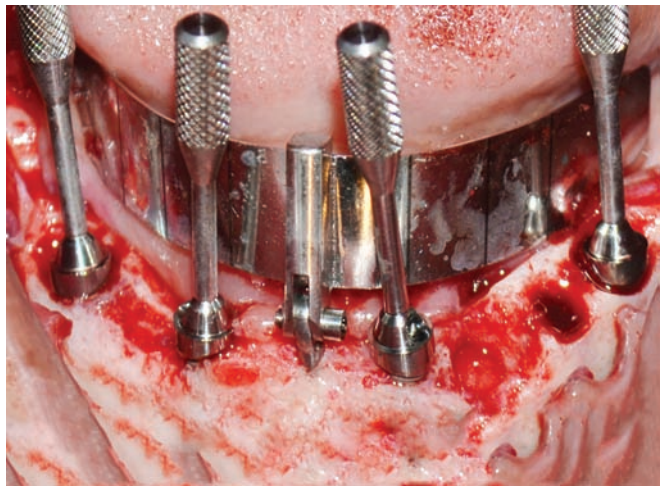


Fig. 15: All four correctly placed implants and multiunit abutments in mandible

Fig. 16: All four implants with connected multiunit abutments after removing the surgical guide

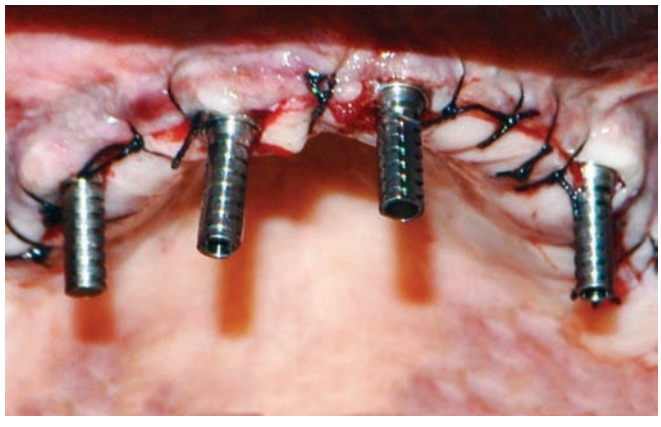


Fig. 17: Healing abutments are replaced with the titanium cylinders

osteotomy preparation of the distal implants was begun at the ridge, posterior to the mental foramina and directed toward the anterior mandible keeping the drill 3 to 4 mm. Anterior to the mental foramina or anterior loop of mandibular canal, to reach the basal bone. Preferably, 4.2 mm diameter and longest possible implants were placed and distally tilted at 45° to reach the first or second premolar position (Fig. 14). Two straight implants were placed into the anterior mandible (Figs 15 and 16). For All-on-6, two short and wide implants are placed at the distal mandible, preferably at buccal self region, where the mandibular canal runs little down and lingual. Once all implants were correctly placed, the

appropriate multiunit abutments picked up and placed on top of the implants and cover screw were placed on top of the multiunit abutments. Flap was sutured back using 4-0 suture to achieve the primary closure.

IMMEDIATE PROSTHESIS

Patient's old denture or prefabricated new denture was used to make an immediate and fixed provisional prosthesis. The putty/wax indices were recorded into the tissue surface of the dentures to mark the abutments positions. The holes were prepared using carbide trimmers through the dentures at the marked positions. Then, cover screws were removed from the multiunit abutments and replaced with the titanium cylinders (Fig. 17). The dentures were seated in mouth to check the passive and complete seating in the mouth while titanium cylinders passively emerging out of the denture holes (Fig. 18). With the denture correctly and completely seated in mouth, the fast setting self cure resin was used to adhere the titanium cylinders with the denture. After the acrylic had set in mouth, it was screwed out from the multiunit abutments along with the titanium cylinders. The part of titanium cylinders emerging out of the denture was reduced and the prosthesis was reduced in size by removing the flanges and palatal extension (Fig. 19). The prosthesis was finished, polished and screwed on top of the multiunit abutments immediate after the implant placement surgery (Fig. 20). Hence, all treated patients left the clinic, on the day of surgery, with fixed provisional prosthesis and allowed to chew the soft to regular stuffs (Fig. 21). All patients instructed to avoid hard stuffs, which can cause the undesired trauma to the healing implants, minimum for next 6 weeks.

FINAL PROSTHESIS

Final prostheses was delivered to all patients after minimum 3 months healing of the implants. If the provisional prosthesis was accurately and passively seated, then no impression posts were used but the same prosthesis was used for transferring the positions and orientations of multiunit abutments from

Fig. 18: Prefabricated denture or patient's old denture is used to make the immediate fixed provisional prosthesis. The holes are drilled through the denture and connected with the cylinders using fast setting self-cure acrylic in the mouth

Fig. 19: The long flanges and palatal extension of the denture are removed

Fig. 20: The denture is fixed over the four immediately placed implants

Fig. 21: Upper and lower provisional prosthesis fixed over the implants on the same day of implants insertion surgery

mouth to the working models (Fig. 22). If the soft tissue recession under the prosthesis was noticed then impression was taken using the same prosthesis by screwing the prosthesis in mouth and injecting the light body addition silicon or polyether into the spaces between the denture base and receded ridge tissue. Once the impression material got set, the dentures were screwed out from the mouth and assembled with the analogs. The impression was poured in the hard stone plaster. Before removing the dentures from the model, a putty index was created for the teeth setting for the final prosthesis at similar positions. If provisional prosthesis anyhow was not suitable to be used to transfer the abutment positions, the open tray impression transfer abutments were used to make the open tray impression using putty and light body. The impression abutments were splinted together using pattern resin in mouth to avoid any movement in respect to each other during impression transfer (Figs 23 to 25).

Over the models, using the castable plastic sleeves, a metal framework was fabricated in the cast metal or titanium. That metal framework was checked in mouth for its complete and passive seating over the multiunit abutments. Using the putty index, the readymade acrylic teeth were used to fabricate a metal to plastic (hybrid) prosthesis keeping the patency for the screw holes (Fig. 26). This final hybrid prosthesis was finally screwed over the multiunit abutments in mouth, the screws were tightened using torque ratchet at the 25 Ncm and screw holes were closed using the Gutta-percha and composite over that (Figs 27 to 31).

Alternative to the hybrid prosthesis, Porcelain fused to metal or zirconium prosthesis (milled zirconium prosthesis with veneered ceramic over that) can also be used. Out of total 17 arches, hybrid prosthesis was delivered for 12 arches while porcelain fused to metal screw retained prosthesis was delivered to the rest 5 arches. Full zirconium prosthesis was used in none of the cases. The hybrid prosthesis looks better in appearance (because readymade teeth are used), gives better support to the perioral tissues, is light weight, more resilient and so act as the shock absorber and does not transfer the occlusal forces/trauma directly and immediate to the implants, hence, preferred over the ceramic prosthesis. Only problem with hybrid prosthesis is, often any of the front tooth popped out on traumatic biting which can be easily repaired in mouth. The prosthetic restoration of All-on-6 was done in the similar fashion with two more multiunit abut-

Fig. 22: In case of accurately seated provisional dentures, these dentures can also finally be used to transfer the multiunit abutment positions to the working models. Provisional dentures are connected with the analogs to transfer the positions and orientations of the multiunit abutments to the working casts for the fabrication of final prosthesis

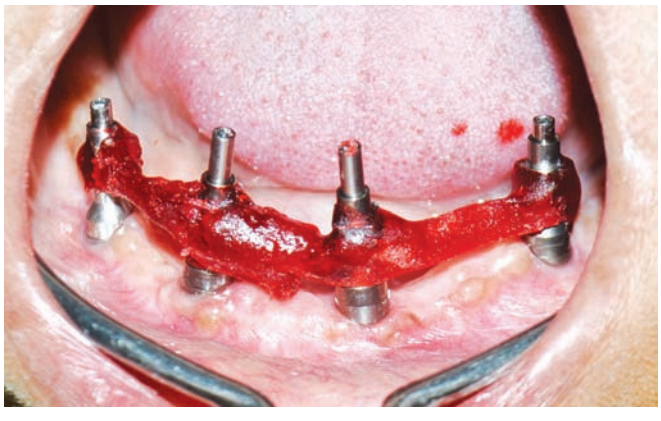


Fig. 23: Open tray impression posts splinted together using pattern resin for accurate impression transfer

Fig. 24: The holes are prepared through the impression tray and its complete seating is checked into the mouth

Fig. 25: An accurate abutment level open tray impression is made using the addition silicon material

Fig. 26: Final metal to plastic prosthesis (hybrid prosthesis) ready to fix over the implants

Fig. 27: The multiunit abutments with nicely healed soft tissue around, ready to receive final prosthesis

Fig. 28: Closed view of angled multiunit abutment showing the connection screw on its lateral side which connect the multiunit abutment to the implant. Another screw hole can be seen on top of this to receive the connection screw of the prosthesis

Fig. 29: Upper and lower final prosthesis is fixed over the implants

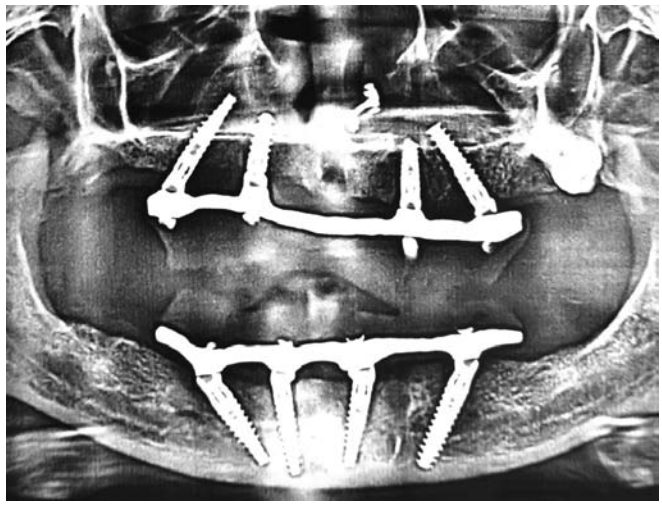


Fig. 30: Radiograph at 2 years follow-up. Distal tilting of posterior implants along the anterior wall of sinus in maxilla and anterior to the mental foramen in mandible can be seen in radiograph

Figs 31A and B: Improved maxillofacial prosthesis and raised confidence in smile can be noticed in before and after pictures of patient (Permission was taken from this patient to publish her pictures)

ments on most distal implants (Fig. 32). Though rarely, but often the accurate placement of tuberopterygoid implants result in the mesiaobuccal tilting of implant head even more than 45°. For that situation, a 'flat connection abutments' can be used. However in all our tuberopterygoid implants we did not require flat connection abutments but used only multiunit abutments.

RESULTS

Out of 80 implants used in 11 patients, 3 implants got failed under the provisional prosthesis in maxilla before receiving the final prosthesis while 1 implant got failed in the similar fashion in the mandible. Out of 4 failed implants, 3 were from the straight implants while one implant failed at pterygoid position. For all 3 failed anterior implants, failed one was removed and immediately new implant was placed at adjacent position and proceeded for final prosthesis. For the tuberopterygoid implant, the failed implant was removed, provisional prosthesis is reduced from distal to the anterior tilted implant (second premolar) and waited for 2 months until the site got healed. Then patient undergone for the dental CT again to see the bone availability after healing at tuberopterygoid position. A new implant was reinserted into the pterygoid and we proceeded for the final prosthesis. After final prosthesis is loaded, none of the implant got failed till the 2 years follow-up in 7 cases and 3 years follow-up for rest 4 cases. Three implants (2 in maxilla and 1 in mandible) showed the crestal bone loss of more than 2 mm at 2 years follow-up. Out of total 4 failed implants, only one implant (in mandible) belonged to the one of uncontrolled diabetic patients. When the crestal bone loss with implants was compared in diabetic and nondiabetic patients, not a noticeable deference was found.

The mean value of bone loss relative to the implant platforms at 1 year follow-up were 0.8 mm for the maxilla and 0.5 mm for the mandible. The average bone loss for the maxilla and mandible respectively at 3 years of follow-up were 1.3 mm.

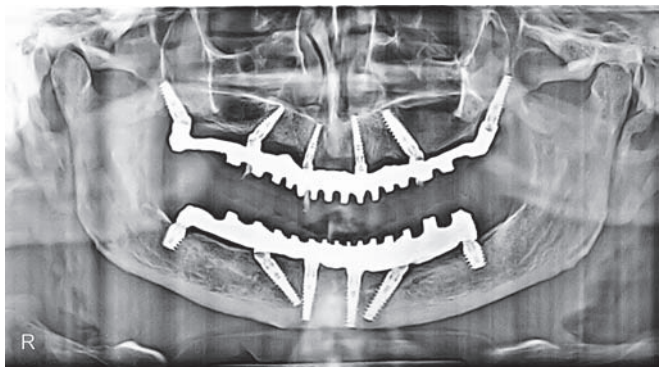


Fig. 32: Radiograph showing All-on-6 procedure in maxilla as well as in mandible. Most posterior implants in maxilla have been placed into tuberopterygoid bone while the short and wide implants are placed into posterior mandible. The apices of all anterior implants can be seen placed into the opposing cortices/ basal bone (into the nasal floor in maxilla and mandibular symphysis)

DISCUSSION

Though long-term multicenter study with more no. of cases is required to further proven the higher success rates of the tilted implant concept using tapered implants but the results from this study indicate that immediate restoration of resorbed maxilla and mandible over the tilted implants can be highly predictable treatment concept which can be landed up with the higher success rate of the implants and low marginal bone loss under the immediate load. The well engineered multiunit abutments and its all components enables the clinician to nicely correct the angulations problem on the tilted implants and proving the optimal prosthetic base for predictable restorations. Tilting the implants provide widely spread anterior-posterior prosthetic base for the prosthesis. Tilting enables the clinician to place the longer implants and

anchoring into the high density bone. Tapered implants with self-cutting/self-tapping thread design at the apex enables the clinician to place these implants with the minimal drilling and achieve higher anchorage into the opposing cortices. Their condensing body laterally condense the low density bone to achieve higher stability. The implants with common platform and platform switch design also allows the clinician to work with more freedom (mix and match prosthetic inventories) and minimize the crestal bone loss problem.

CONCLUSION

The tilted implant immediate function concept for completely edentulous patients has proven to be clinically effective technique, patient pleasing and applicable in various clinical situations where otherwise more invasive, complicated and expensive bone augmentation procedures would have been indicated. This concept can be adopted by the implant dentists as a standardized treatment procedure and can be routinely performed to most of the edentulous patients to deliver a short treatment procedure and an immediate functional full arch prostheses in place on the day of implants insertion surgery.

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