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Typically as teeth are lost in the posterior maxilla, the maxillary sinus enlarges (pneumatization) over time. This phenomenon also occurs with aging. Enlargement of the sinus presents challenges to implant placement in the posterior and frequently augmentation of the sinus is required to provide sufficient bone circumferentially around the implant. Sinus augmentation delays loading of the implant as the bone graft needs to mature and increase in density around the implant when placed simultaneously at implant placement. Mesial or distal tipping of a standard implant avoiding the sinus because it requires the fabrication of custom abutments in an attempt to achieve a parallel path of draw for the prosthesis whether a cement or screw retained prosthesis is to be employed. The Co-Axis implant (Keystone Dental, Inc. Burlington, MA), a unique implant incorporates an angle correction in the platform which allows off-axis placement to avoid anatomical features such as the maxillary sinus. The following case report demonstrates use of this implant system.

**KEY WORDS:** Dental implant, maxillary sinus, off-axis, tilting

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INTRODUCTION:

Typically as teeth are lost in the posterior maxilla, the maxillary sinus enlarges (pneumatization) over time. This phenomenon also occurs with aging. Enlargement of the sinus presents challenges to implant placement in the posterior and frequently augmentation of the sinus is required to provide sufficient bone circumferentially around the implant. Sinus augmentation delays loading of the implant as the bone graft needs to mature and increase in density around the implant when placed simultaneously at implant placement.\(^1,2\) This sometimes is not possible when insufficient bone height is present for initial stability of the implant at placement leading to further delays to completing treatment. Additionally, grafting increases the costs associated with treatment.

A SOLUTION TO SINUS AVOIDANCE

Mesial or distal tipping of a standard implant avoiding the sinus because it requires the fabrication of custom abutments in an attempt to achieve a parallel path of draw for the prosthesis whether a cement or screw retained prosthesis is to be employed. Off-axis or “tilted” implant placement has been utilized for many years to work around the patient’s anatomy.\(^3,4\) Implants placed into the pterygomaxillary region were have been used for more than 20 years in an attempt to avoid an enlarged maxillary sinus.\(^6\) These pterygomaxillary implants...
allow for the placement of implants in the posterior maxilla without the use of sinus augmentation procedures or other types of bone grafts. Zygomatic implants have also been proposed to avoid the sinus with placement into the zygoma using very long implants with angle corrections in the implants platform to accommodate the drastic angle these implant need to be placed. Prosthetic platforms of these implants often emerge palatal to the crestal midline complicating restoration and may narrow the arch width with the prosthesis.7

The Co-Axis implant (Keystone Dental, Inc. Burlington, MA), a unique implant incorporates an angle correction in the platform which allows off-axis placement to avoid anatomical features such as the maxillary sinus8,9 (Figure 1). This implant was introduced in Europe in 2003 and approved in 2007 by the FDA for use in the USA. The implant is available with an external hex connector in 4.0, 5.0 and 6.0mm diameter (12 degree

Figure 3: Co-Axis implants placed into the pterygoid area of the tuberosity and angled anteriorly to avoid the enlarged maxillary sinus while maintaining parallel prosthetic axis.

Figure 4: Patient without her maxillary removable partial denture and prior crowns present on the lateral incisors which do not match the shade of the natural central incisors.

Figure 5: CBCT panoramic view with clear surgical guide with markers embedded in the guide.

Figure 6: Clear replica of the patient’s partial denture with gutta percha cones at the sites and an angled cone in posterior to check orientation of the mesial wall of the sinus.
correction) and 5.0 and 6.0mm diameter (24 degree correction). A trilobe connector is available in a 12 degree in both a 4.3mm (platform is a 3.5mm) and a 5.0mm (platform is a 4.3mm). Also an internal octagon (hex) is available in a 5.0mm (platform is a 4.8mm) option.

Surgical placement of this unique implant does require minor modifications to the procedure when placing the fixture. An orientation dimple is found on the fixture mount, which is rotated as the implant is placed to orientate the angled platform. This is performed so that the implants achieve parallelism between the implant platforms regardless which direction the fixture axis is oriented (Figure 2). With proper orientation a screw-retained prosthesis may be utilized with the screw access holes on the occlusal surface of the abutment crowns. If a cemented prosthesis is desired, often stock abutments may be used instead of...
custom abutments lower the restorative costs.

The Co-Axis implant may be placed by tipping the posterior fixture mesially and the anterior fixture distally, bridging the enlarged sinus when adequate bone is available mesial and distal to the sinus (Figure 3). This permits the prosthetic axis of the implants to be parallel, simplifying the restorative phase and eliminating the need for multi-abutments or custom abutments.

**CASE REPORT:**

A 74 year old female presented with the complaint that her maxillary removable partial denture was bothering her with minimal retention and she was interested in a fixed implant bridge bilaterally. Examination noted the only remaining teeth in the maxillary arch were the lateral and central incisors bilaterally. The incisors demonstrated no mobility or bleeding on probing. The laterals had been restored previously by another dentist with
PFM crowns which were much whiter than her natural teeth. The patient expressed she was not interested in changing the crowns to a shade matching the central incisors and indicated she wished the bridges to be fabricated to match the shade of the two crowns (Figure 4). A panoramic radiograph was taken to access available bone and the maxillary sinus (Figure 5). Radiographically, fully impacted 3rd molars bilaterally were identified. Due to the lack of pathology and the patient’s age it was decided to not treat the 3rd maxillary molars and keep them under observation.

A replica of the current maxillary removable partial denture was created using a Lang denture duplicator (Lang Dental Manufacturing Co, Wheeling, IL) and clear Jet Tooth Shade™ acrylic (Lang Dental Manufacturing Co.). Gutta percha cones were luted to the clear denture replica at the canines and the 1st molars bilaterally. A 24 degree guide pin was placed into site #3 to check parallelism with the prosthetic axis of implant at site #6 (Figure 15) and osteotomy was completed for site #3 to accept a 5.0mm diameter 24 degree Co-Axis implant (Figure 16). The implant was inserted with the handpiece into site #3 (Figure 18).
Figure 19: Occlusal view of the right quadrant following implant placement with fixture mount on both implants showing the orientation of the fixture and the corrected prosthetic axis.

Figure 20: Hand drivers engaging the implants at sites #3 and #6 demonstrating parallelism of the prosthetic axis.

Figure 21: 24 degree 5.0mm Co-Axis implant placed at site #3 skirting the mesial wall of the maxillary sinus.

The patient was scheduled for implant surgery and a local anesthetic (4% Septocaine with 1:100,000 epi) was administered at the appointment using local infiltration. The clear replica which had parallel holes drilled at the canine and 1st molar locations through the acrylic bilaterally was inserted and a pilot hole just penetrating the crestal bone was made with a 2.0mm pilot drill at the two sites in the right quadrant (Figure 7). The surgical guide was removed and the osteotomy at site #6 was corrected to a 12 degree orientation with tipping the site to the palatal (Figure 8). The osteotomy at site #3 was oriented at 24 degrees tipping the site to the distal to skirt the mesial wall of the sinus to a depth of 4mm. A 12 degree guide pin was placed into site #6 and a 24 degree pin inserted into site #3 and periapical radiographs taken to check the initial osteotomies in relation to the mesial sinus wall and other anatomy (Figures 9 - 11). A mid-crestal incision was made with a vertical releasing incision distal to the lateral incisor and a full thickness flap was reflected.

Sequential osteotomy drills were utilized to prepare site #6 to accommodate a 5.0mm x 11.5mm implant (Figure 12). A 12 degree Co-Axis implant with an external hex connection was
carried to the mouth on the fixture mount in the handpiece (Figure 13) and inserted at 20 rpm until the surgical motor reached 45 Ncm (Figure 13). Final insertion was made with a hand wrench until the implant was seated and the orientation dimple was centered on the mid-facial orienting the prosthetic axis to the vertical axis (Figure 14). The 24 degree guide pin was placed into site #3 to verify that the orientation would be parallel with the prosthetic axis of the implant at site #6 (Figure 15). The osteotomy was completed at site #3 to accommodate a 5.0mm x 13mm implant (Figure 16). A 24 degree Co-

Axis implant with an external hex connector with a fixture mount attached was placed into a handpiece (Figure 17) and inserted into the osteotomy to full depth (Figure 18). The orientation dimple was placed at the distal to orient the prosthetic axis to be parallel with the implant at the canine site (Figure 19). Hex wrenches were inserted into both implants to verify parallelism (Figure 20).

A periapical radiograph was taken of the implant at site #3 which demonstrated the implant placement paralleled the mesial sinus wall without perforating the sinus during placement (Figure 21). A radiograph was taken of the implant...
at site #6 to verify placement (Figure 22). Cover screws were placed and the site was closed with interrupted sutures. The surgical guide was reinserted and the procedure was repeated in the left quadrant. Periapical radiographs were taken of the implant at site #11 (Figure 23) and site #14 (Figure 24) demonstrating placement of the molar implant avoided the left mesial wall of the sinus. The quadrant was again sutured to close the flap. All implants were treated in a two stage
Figure 28: Radiograph verifying the fit of the prosthetics in the upper left quadrant to the Co-Axis implants that have been platform switched.

Figure 29: Buccal view of the screw retained zirconia bridges on canine to 1st molar bilaterally matching the shade of the patient’s current crowns on the lateral incisors.

protocol. The old partial was relined with a soft silicone denture liner (GC RELINE™ Ultra Soft, GC America) to avoid premature loading of the implants during the healing phase of treatment.

Following four months of healing, a new CBCT scan was performed to check integration of the implants (Figure 25). Local anesthetic (4% Septocaine with 1:100,000 epi) was administered and a mid-crestal incision was made and the soft tissue reflected to expose the cover screw on each implant. The cover screw was removed and a 4mm tall healing abutment was inserted and full seating verified by radiograph. It was noted that the healing abutment at site #6 was not seated fully and it was removed and the bone was recontoured on the mesial aspect to allow the healing abutment to completely seat and a new radiograph was taken. The 5.0mm diameter implants were platform switched to a 4.0mm restorative platform. Sutures were placed adapting the soft tissue around the healing abutments and the patient was dismissed.

A week later the patient presented and sutures were removed and the tissue was allowed to further mature for 2 additional weeks. At this appointment, the healing abutments were removed and open tray impression abutments were inserted into each implant and seating was verified radiographically. A Miratray Advanced impression tray (Hager Worldwide, Hickory, NC) was filled with Aquasil Ultra heavy superfast set VPS (Dentsply Caulk, Milford, DE) was dispensed from an automix cartridge into the tray and Aquasil LV superfast set VPS (Dentsply Caulk) was syringed around the gingival aspect of each of the impression abutments intraorally. The tray was seated until the long pins on the impression abutments pierced the clear plastic on the occlusal aspect of the Miratray and allowed to set. Upon setting, the pins were unscrewed and the tray was removed. The healing abutments were reinserted and an interocclusal record was taken with
Regisil® Rigid bite registration VPS (Dentsply Caulk) with the patient occluding with her anterior natural maxillary incisors in contact with the lower anterior teeth. A counter full arch impression was taken and sent to the lab for fabrication of the prosthetics. A shade had been selected to match the crowns present on the maxillary lateral incisors per the patient’s request. The existing partial denture was relieved to allow the removable prosthesis to seat fully without contact on the healing abutments. Permasoft™ (Dentsply Prosthetics, York, PA) soft denture reline material was mixed to a thicker consistency and placed into the saddle area bilaterally and the partial denture was reseated and patient instructed to occlude. Upon setting the relined prosthesis was removed and excess material trimmed with a scalpel. The provisional partial denture was reinserted and checked for comfort and occlusion.

The lab created a soft tissue model of the maxillary arch utilizing the open tray impression after analogs had been attached to the impression abutments within the impression. The case was mounted with the provided interocclusal record. A scanning base (Glidewell Labs, Newport Beach, CA) specific to each implant were inserted into each implant analog and the model was scanned to create a virtual model. Upon that a full contour bridge was created in the computer and sent for milling. The milling center milled the zirconia full contour bridges and returned them to the lab. The lab removed the soft tissue from the model and inserted a titanium base (Glidewell Labs) on each analog. The interior of the zirconia bridge where it would contact the titanium base was cleaned by means of blasting with Al2O3. Monobond Plus (Ivoclar Vivadent Inc., Amherst, NY) was applied on the clean bonding surface of the zirconia and to the titanium base and allowed to react for 60 seconds then air dried. The screw access hole in the titanium base was blocked by wax to prevent resin from occluding the screw and a thin layer of Multilink® Hybrid Abutment resin cement (Ivoclar Vivadent Inc.) was applied from the automix syringe directly to the bonding surfaces of the base and the ceramic structure. The parts are lightly pressed together in the correct relative position of the components and held together for 5 seconds. Glycerine gel was applied on the cementation joint to prevent the formation of an inhibition layer and the cement was allowed to auto polymerize for 7 minutes. After auto-polymerization completed, the glycerine gel was rinsed off with water. Any cement in the screw access hole was removed as well as the wax and the bridge was removed from the model. The cementation joint was then polished with rubber polishers at a low speed (< 5,000 rpm) to avoid overheating and the bridges were returned to the dentist for insertion (Figure 26).

The bridges were returned and the healing abutments were removed on the right quadrant. The right side bridge was inserted and two titanium fixation screws specific to the Co-Axis implants where tightened by hand. Radiographs were taken to verify complete seating of the bridge with the implants (Figure 27). The fixation screws were tightened to 30Ncm with a torque wrench. The process was repeated for the left quadrant (Figure 28). A piece of teflone (plumbers) tape was made into a ball and inserted into each of the bridges screw access holes. GRADIA® DIRECT LoFlo (GC America, Alsip, IL) a light-cured, high viscosity flowable microfilled hybrid composite was injected to fill each screw access hole to the occlusal level and then light-cured. Occlusion was
checked and adjusted as needed (Figure 29). The patient returned at 1-week post insertion to check the occlusion. At this time she indicated she was comfortable and reported no issues with the prosthetics. No occlusal adjustment was needed after verification with articulating film.

**CONCLUSION:**

Utilization of angled implants to bypass the need for sinus augmentation has been shown to decrease the treatment needed as well as the time required to complete treatment and costs involved. Yet, prosthetic complications can result in restoring the case as the prosthetic axis matching the fixture axis may preclude a screw retained prosthesis due to emergence of the screw hole at the buccal/facial leading to esthetic issues or the distal making it difficult to insert the wrench. Multi-abutments can be utilized but this increases the cost of treatment and decreases the available interarch space available for the prosthetics.

The Co-Axis implant circumvents these potential issues with its 12 or 24 degree angle correction incorporated into the implant platform. This allows angled placement of the implant with proper positioning of the prosthetic axis in the ideal position of the occlusal or lingual surfaces. This provides a simpler prosthetic fabrication with maximized esthetics and lower treatment costs to the patient.

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**References:**
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The Keyless Partially Guided Implant Placement Protocol: Success Rate and Complications

Amr Hosny Elkhadem, DDS, MSc

Abstract

Background: to describe the concept and use of a simplified keyless guided implant placement system in partially and completely edentulous patients.

Methods: 89 implants were placed in 23 patients (7 complete, and 16 partial cases) using the universal simple guide kit. After CBCT and virtual implant planning, surgical guides with c-shaped sleeves were constructed. The implants were placed using flap or flapless approach according to the need for soft or hard tissue augmentation. The intra-operative complications, post-operative complaints and implant survival rate were reported.

Results: All implants demonstrated insertion torque values greater than 30 Ncm. Only few post-operative complications were reported. 98.9% of the placed implants integrated.

Conclusions: The keyless partial guidance using the simple guide kit and c-shaped sleeves is a promising economic alternative to conventional guided approach. Further investigations are required to evaluate its accuracy and long term success rates.

KEY WORDS: Computer-aided Implantology, surgical guide, open sleeve, tolerance

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INTRODUCTION
The use of CT scans combined with computer software to plan implant cases has been proposed since the 1990s. The technique aims to provide correlation between the bone anatomy and the desired tooth position allowing for predictable aesthetic and functional outcomes. Many authors refer to guided implant placement as a protocol that enhances the accuracy and safety of implant placement. Moreover, it allows for the minimally invasive flapless technique in many situations, which minimizes the intra-operative time, postoperative pain and postoperative complications.

Despite the aforementioned advantages the techniques is not popular among implant practitioners. This might be attributed to the higher cost and time required to plan the cases and fabricate the guides. Expensive guided implant kits with complex assortment are also mandatory. Additionally, the control over implant direction is usually achieved with a closed circular configuration with small drill tolerance. Using the relatively longer drills for guided systems through such closed configuration was always associated with accessibility problems in the posterior region for dentate patients. Such a small tolerance is mandatory to provide accuracy, yet it is thought to block the passage of the irrigation and might cause increased incidence of implant failure in dense bone and deep osteotomies.

Moreover, there is an uprising question related to the accuracy imposed by the mechanical tolerance of the machined components. To provide adequate precision of the guided systems, a small gap of approximately 20 microns is provided between the main sleeve fixed in the guide and the removable, diameter specific, keys. A similar tolerance gap is designed between the removable keys and the drills. The friction during repeated use of the keys and the drills increases the gap obviously which might contribute to increases linear and angular deviation with these guided systems.

When weighing the merits and demerits of these systems, one must consider both the benefits and the drawbacks. The guided implant technique offers the potential for improved accuracy, predictability, and safety compared to traditional implant placement. However, the cost and time considerations, as well as the accessibility issues, must be taken into account. Further research and development in this area could help address these limitations and make guided implant placement more accessible and feasible for a wider range of practitioners and patients.

Figure 1: The simple guide kit. (a) cortical drill, (b) 2.3 mm starter drill, (c,d,e) 2.2 mm pilot drill with variable lengths, (f) 2.8 mm intermediate drill.

Figure 2: Surgical guide with c-shaped sleeve establishing 3 mm facial openings for side approach of the drills.
its of conventional guided systems one can understand why such protocol is not so popular. Hence, there is a great need to provide modification in the concept and design of guided surgical approach to overcome the drawbacks and maximize the benefits.

**MATERIALS AND METHODS**

The technique utilizes a simplified universal kit design (Simple guide kit, Dentis Co.-Ltd, Daegu, South Korea) and a modified C-shaped main sleeve. The kit design eliminates the removable keys used in conventional guided kits, and adopt the concept of guidance for the pilot and intermediate drills only. For all cases, the final drilling is done after removing the surgical guide using the conventional non-guided final drills.

The design and sequence of the simplified kit is different from the regular guided implant drills (Fig 1). All drills are composed of cutting flutes and a smooth guiding shaft that is compatible in size with the main sleeve of the surgical guide with no removable key in between. The drilling sequences starts with a pointed drill for penetration of the cortical bone. A starter drill (2.3x8mm) is used to create an initial osteotomy inside the bone. This is followed by the use of pilot drills (2.2mm in diameter). The pilot drills have variable lengths according to the desired implant to be placed. As the pilot drill diameter is smaller than the initial osteotomy created by the starter drill, it will snap into the osteotomy engaging 8 mm of vertical bone height and part of its guiding shaft will engage the main sleeve of the guide. In all scenarios, a 2.8x8mm intermediate drill is used afterwards to prepare the coronal

![Figure 3: Virtual implant planning for an edentulous case. Implants were placed in relation to the required prosthetic position guided by the radio-opaque scan appliance.](image-url)
8 mm of the osteotomy. As the osteotomy path is shaped the surgical guide is removed and the final drill of the conventional kit is used to create the final osteotomy shape. This is followed by inserting the implant in the conventional non guided fashion. Additionally, the surgical guide is designed with a c-shaped metal sleeve with a facial opening (Fig 2). The opening allows for side approach of the drills and unrestricted access of the coolant. In this report, 23 cases were operated. 89 implants were installed in 7 completely edentulous and 16 partially edentulous cases.

**COMPLETELY EDENTULOUS CASES**

37 implants were installed in 7 completely edentulous cases (two mandibular and 5 maxillary) using this technique. Preparation started by duplicating the patient denture into radio-opaque scan appliance (Barium sulphate to acrylic resin 1:4). Holes were prepared in the tooth centre of the proposed site to facilitate its identification on the CT scan. Double scan technique was performed. The first scan was done with the patient wearing the scan appliance and biting on cotton rolls allowing for teeth separation. The second scan was made for the scan appliance alone. Virtual planning was performed using Blue sky Plan (Bluesky Bio, LLD – USA). The virtual implants were placed in the required anatomical sites after correlating them to the desired tooth positions (Fig 3). 3D superimposition of the scan appliance was done over the patient CT scan using a point registration technique (Fig 4). After defining the diameter, height and offset of the guiding tubes the software generated the virtual guide by binding the scan appliance to the guiding...
tubes. The STL file of the guide was fabricated using additive manufacturing. C-shaped sleeves were fixed in the surgical guide and the guiding tubes were opened facially opposite to the sleeve openings (Fig 2). The guide was fixed in the patient mouth with 3 fixation screws and the suggested drilling sequence was applied.

PARTIALLY EDENTULOUS CASES

52 implants in 16 partially edentulous cases (7 mandibular and 9 maxillary) were placed. Patient scanning protocol differed according to the number of missing teeth and the presence of metallic restorations. In cases with few missing teeth and few or no metallic restoration, the patient received a CBCT with no scan appliance. The patient model was scanned using a laser scanner. When the patient had multiple missing teeth and/or numerous metallic restorations a scan appliance with radiopaque markers was first prepared. The patient had a CBCT wearing the scan appliance. Afterwards, a CBCT for the patient model with the scan appliance was made for superimposition purposes. Virtual planning was done after correlating the prosthetic position to the underlying bone anatomy. When no scan appliance existed virtual tooth setting was utilized. When designing the guide, extension over the adjacent teeth as well as part of the palatal and lingual mucosa was required to assure proper stability. All cases not requiring grafting were done in a flapless manner (Fig 5). In cases requiring bone grafting a flap was first raised and the guide was then used for implant placement (Fig 6). When extra security was required to fix the guide in place light-cured flowable composite was used to temporarily bond the guide to the supporting teeth.

RESULTS

No major intra-operative complications or problems were reported in either flap or flapless cases. In few cases the c-shaped sleeves were detached off the guide when contacting the drills. The sleeves were replaced and the procedure completed. All implants demonstrated acceptable implant stability at inser-
tion (more than 30 Ncm). There was no reports of postoperative infections among all participants. Only 4 patients reported postoperative pain that lasted more than one week after the surgery. The rest of the patients reported no postoperative pain or mild pain for few days. Only two case (one flap and one flapless) reported transient post-operative oedema. At the second stage, only one maxillary implant failed with overall success rate of 98.9%.

**DISCUSSION**

The keyless partially guided technique seems to offer numerous advantages. First, the elimination of the removable keys together with the open shaped sleeves allowed for better accessibility during surgery especially in the posterior region up to the maxillary tuberosity. The open guiding sleeves allowed also for unrestricted access of the irrigation during drilling.

The proposed simplified approach did not compromise the control over osteotomy preparation at all stages of drilling. The use of a short starter (2.3x8mm) drill created an initial osteotomy channel that accommodated the smaller pilot drill. This assured dual guidance of the pilot drill by engaging the initial osteotomy apically and the guiding sleeve coronally. The path created by the pilot and intermediate drill is so definite that it guides further drilling with minor possibilities of introduce a change in the osteotomy direction or depth. Final drills with blunt non cutting tip are usually preferred because they seem to be safer.

By eliminating the removable keys only one mechanical tolerance is present instead of the two gaps in the conventional guided approaches. Theoretically, this will reduce the mechanical tolerance error to the half. Minimizing the error introduced by the bur sleeve gap is thought to be a crucial factor in reducing the intrinsic errors imposed by guided surgery.

As the majority of cases were flapless, the incidence of post-operative pain and complications were less. As the guide are based on 3D implant planning on CBCT, direct expo-
sure of bone was not utilized unless soft and/or hard tissue augmentation was required. Moreover, conservative transmucosal drilling was used. Tissue punch was not used as there is no proven clinical advantage or impact on the implant success rate when compared to transmucosal drilling. On the contrary, the increase in the size of the punched tissue is thought to increase the probing depth and crestal bone loss around implants.12

A debate exist about the accuracy of partial guidance in comparison to classical fully guided systems. While some practitioners might believe that guided final drilling and insertion significantly affect the accuracy others believe that guidance of the initial osteotomy provides sufficient guidance to the rest of the procedures. The clinical data regarding the survival rate and accuracy of partial versus full guidance is still sparse.13 Kuhl et al.14 evaluated the accuracy of half versus fully guided techniques on cadaver model. They found no statistical significant difference between the two protocols. Yet, there is a need to conduct more clinical trials to evaluate the accuracy of both systems.

CONCLUSION
The use of the simplified partially guided keyless approach seems to be a promising alternative to conventional guided surgery. The technique allowed easy access to the posterior region with efficient delivery of the irrigation during drilling. The use of a small economic universal kit might encourage many practitioners to utilize guided surgery. Further studies are required to compare the accuracy and success rate versus the conventional guided techniques and manual techniques.

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Case courtesy of Dr. Mariano Polack and Dr. Joseph Arzadon, Gainesville, VA
One of the problems encountered with immediate implant placement is insufficient soft tissue to achieve a tension free primary closure. In this case report a simple and recent approach was performed to provide sufficient primary closure at time of immediate implant placement. A 38-year-old nonsmoking medically fit female patient presented to Prosthodontics Department, Faculty of Dentistry, Cairo University with a history of endodontic treatment in the maxillary left lateral incisor and repeated post fracture. The condition ended up with insufficient tooth structure to support a post core restoration. Hence, it was decided to replace the tooth with an endosseous implant. Oral examination revealed that the remaining supra-gingival portion of the broken lateral incisor could hinder adequate primary closure at time of immediate implant placement. Therefore, it was decided to reduce the root 2mm below gingiva, leave it for 3 weeks to allow the exposed area for growth of the soft tissues and thereby providing adequate soft tissue for primary closure after implant placement. This approach provides a tension free primary closure of the socket after immediate implant placement. This protects the healing site from the oral environment.

**KEY WORDS:** Immediate implant placement, soft tissue coverage, case report

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INTRODUCTION
With the continued impact of esthetics on dental treatment, the desire for patients to maintain their dentition is critical. Immediate implants are a 1-stage surgical procedure designed to successfully place a dental implant after tooth extraction and site preparation, reducing the time spent between tooth loss and final restoration placement. Clinical studies have demonstrated that successful osseointegration and optimal esthetics can be achieved with implants placed in fresh extraction sockets.\textsuperscript{1-3}

One of the problems encountered with the immediate implant placement is insufficient soft tissue that could achieve a tension free primary closure. This is particularly the case in the aesthetic zone where stabilization of the soft tissue profile becomes even more critical.\textsuperscript{4}

![Figure 1: Initial presentation.](image1)

![Figure 2: CBCT scan of endodontically treated maxillary lateral incisor.](image2)

![Figure 3: Maxillary lateral incisor is reduced 2mm subgingivally.](image3)

![Figure 4: Soft tissue coverage of reduced lateral incisor after 3 weeks.](image4)
A 38-year-old nonsmoking medically fit female patient presented to Prosthodontics Department, Faculty of Dentistry, Cairo University with a history of endodontic treatment in the maxillary left lateral incisor and repeated post fracture (Figure 1). The condition ended up with insufficient tooth structure to support a post core restoration. Hence, it was decided to replace the tooth with an endosseous implant. Oral examination revealed that soft tissue around the remaining supra-gingival portion of the broken lateral incisor was deficient, so that adequate primary closure could be hindered at time of immediate implant placement. The CBCT scan showed a retained left lateral incisor root with previous endodontic treatment and a prepared post channel with an absence of radiolucency around root.

**CASE REPORT**

A 38-year-old nonsmoking medically fit female patient presented to Prosthodontics Department, Faculty of Dentistry, Cairo University with a history of endodontic treatment in the maxillary left lateral incisor and repeated post fracture (Figure 1). The condition ended up with insufficient tooth structure to support a post core restoration. Hence, it was decided to replace the tooth with an endosseous implant. Oral examination revealed that soft tissue around the remaining supra-gingival portion of the broken lateral incisor was deficient, so that adequate primary closure could be hindered at time of immediate implant placement. The CBCT scan showed a retained left lateral incisor root with previous endodontic treatment and a prepared post channel with an absence of radiolucency around root.
After giving infiltration anesthesia, the retained root was reduced 2mm below gingiva by round bur at low speed and high torque under coolant with cold normal saline (Figure 3). The patient was instructed to use chlorhexidine mouth wash three times daily and was followed weekly for observation of soft tissue healing. After three weeks, the soft tissue totally covered the surgical area (Figure 4).

Once soft tissue coverage was achieved at the site of the reduced root, immediate implant placement was planned. Preoperative antibiotics were given orally 1 hour prior to surgery (amoxicillin, 2 g). Following local anesthesia, a crestal incision was done (Figure 5) and extraction was performed using periotomes (Figure 6) with appropriate precautions to ensure that the labial plate of bone was not traumatized. The extraction socket was carefully examined for dehiscences and fenestrations and debrided of residual periodontal fibers using curettes. A self-tapping tapered implant of 4.1 mm diameter and 12 mm length (DENTIS, Korea) was placed after preparing an osteotomy along the palatal wall of the socket and 3 mm beyond the apex of the socket to ensure a palatal orientation of the implant (Figure 7). The insertion torque achieved was 40 Ncm and the gap between the implant crest and the labial plate in

Figure 9: Final master impression.

Figure 10: Final implant restoration.

Figure 11: Patient is happy with the final implant restoration.
addition to fenestrated buccal plate apically were filled with Bio- Oss (Geistlich, Switzerland). The flap was replaced so that tension free closure of the implant and augmented site was achieved with 3.0 suture (Figure 8). The patient instructed to use chlorhexidine mouth wash three times daily. One week after the sutures were removed.

After 4 months of healing, a crestal incision was performed and healing abutment was placed. An open tray impression with pick-up coping was performed using addition silicone (Elite, Zhermack) (Figure 9). The finished porcelain fused to metal crown was inserted (Figure 10) with a good aesthetic result (Figure 11).

**DISCUSSION**

Immediate implant placement become an increasingly popular treatment modality particularly with teeth of poor prognosis in an otherwise healthy setting of the anterior maxilla. The most common complication with immediate implant placement is the soft tissue dehiscence and early exposure of the implant site. In this novel approach (by getting adequate soft tissue covering before immediate implant placement) the surgical site is protected by sufficient soft tissue that could achieve a tension free primary closure.

**Disclosure**

The authors report no conflicts of interest with anything mentioned in this article.

**References**

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Background: There is little evidence about the factors that influence patients’ decisions to undergo recommended periodontal treatment. This study investigated these factors in patients seeking treatment at a private periodontal practice.

Methods: One hundred twenty patients who completed treatment at a private periodontal practice were included. They were 17 to 93 years old (mean: 54.8 y); 53.3% were men and 46.7% were women; and 43% were Caucasians, 28% African Americans, 18% Hispanic or Mexican Americans, and 9% Asians. An additional 18 patients declined the treatment. A written questionnaire assessed various factors influencing patients’ decisions to approve the recommended treatment, including opinions on the treatment duration and options, office environment, available resources, financial issues, outcomes, roles of various team members, efficacy of diagnostic/educational tools, pain and anxiety control, and ease of scheduling.

Results: Average treatment cost per patient was US $8,030 (range: US$980–US$37,200). Patients cited the availability of suitable appointments (98%), good doctor communication (99%), perception that pain and anxiety control during treatment would be adequate (98%), and conviction that the treatment plan would yield the desired outcome (99%) most frequently as factors that led them to approve and complete treatment. Also important for >90% of patients were positive staff behaviors, strong clinical skills, and the provision of education/communication throughout treatment. When asked to rate these factors, the likelihood that treatment would be effective (94%) and cost (71%) were rated “very important.”

Conclusions: Effective treatment plans, a good office environment, adequate communication with the doctor and staff, and constant motivation and education of patients are key to treatment acceptance. The study also suggests that certain demographics may influence the rate of treatment plan acceptance.

KEY WORDS: Treatment plans, treatment acceptance, patient questionnaire, periodontal treatment
INTRODUCTION

The attainment of a treatment plan relies to a large extent on acceptance of the plan by the patient and diligent follow-through by both the patient and the treating office staff. The phrase “treatment acceptance” has been mentioned over and over again in a broad spectrum of all-encompassing medical/dental procedures.\(^1\)

And conceivably, this is of utmost importance in the dental field, as there is less of a focus on, and understanding of, the correlation between oral health and an individual’s overall well-being.

It has been suggested that certain variables, including office design, insurance coverage, payment methods, the constituents of the treatment plans offered, supporting materials, interactions with the office staff, and the doctor’s presentation of the plan can significantly influence patient acceptance.\(^2, 3\) It has also been postulated that effective presentation of treatment plans, including communication, imaging, and payment options, can lead to a higher rate of case acceptance. Another postulate is that the front desk staff are an important factor in treatment acceptance and satisfaction, as they communicate with patients and play other roles, such as “shock absorbers, educators, translators, and psychologist” to meet the needs of patients.\(^4\)

Successful treatment acceptance is critical for increasing practice production and developing a more rewarding and fulfilling business at a dental practice. However, there is scarce evidence-based information about the factors that promote treatment acceptance. The aim of this study was to investigate patients’ opinions about the characteristics that may influence their acceptance of recommended periodontal plans at a private periodontal practice.

MATERIALS AND METHODS

This study sample included patients seeking periodontal treatment at a private periodontal specialty clinic in Maryland, USA. The patients were either referred by another dentist or attended the clinic on their own, usually because they were advised by their dentist to seek periodontal treatment with a specialist. The inclusion criteria included patients 18 years of age and older who attended our clinic during a 3-year period (2012-2014), consented to participate in this study and to complete a questionnaire about the patient’s opinion regarding a treatment plan recommended by the treating periodontist. One-hundred-thirty-eight (138) patients participated in this study. Their age ranged between 17 and 93 years (mean 53.8 years), and included 65 females and 73 males.

Patients who completed the recommended treatment plan were interviewed at the end of the treatment phase. Data regarding the type of treatment performed, number of treatment visits, and the cost of treatment were obtained from patients’ charts. We developed a questionnaire form to gather demographic and other information not covered in the chart and to assess patients’ opinion about the factors that may have played a role in their decisions to approve and pursue the periodontal treatment plan recommended by the periodontist. The questionnaire form consisted mainly of closed-end questions. The questions and statements used in the questionnaire were developed based on earlier interviews and discussions with five patients not involved with this study. The survey was designed as follows:

- In the first part, patients reported demographic information, such as age, sex, ethnicity, educational background, income level, method of referral, and payment information (insur-
ance coverage, and method of payment if they held no dental insurance or their insurance plan did not cover the treatment in full).

- The next part of the questionnaire consisted of a series of statements about the office environment, their perception of the treatment and its outcome, and financial aspects. Patients were instructed to mark each statement as true or false. Examples include: “The demeanor and behavior of the staff played a role in my decision to receive treatment here,” “It was fairly easy to get appointments at times that would work with my schedule,” “Communication with the doctor and staff was easy,” “I was offered several different options for treatment and rationales for each,” “My fears regarding my treatment were adequately addressed,” “The costs of the various treatment options were presented clearly,” and “I was pleased with the outcome of treatment.”

- The next part of the questionnaire inquired about the importance of each of several factors for the patients in accepting a treatment plan. These included the time it would take to complete treatment, options available for controlling pain, treatment cost, and convenience of appointment times. Respondents were instructed to mark each item as “very important,” “somewhat important,” or “not important.”

- Finally, the survey asked patients which staff member(s) (assistant, front office staff, hygienist, doctor) and what part of the treatment-planning process (photos, x-rays, study models, previous patient images, information from staff) was(were) most helpful in the decision to accept treatment. Patients were also asked about how easy or difficult the financing of their treatment had been.

Additional space was provided for free-form comments at the end of the survey.

Patients included in this study signed a consent form that described the purpose of the study and the methods. The data were tabulated and presented as frequency tables.

**NONRESPONSE ANALYSIS**

We used the t-test and the Mantel-Haenszel test to test the hypothesis that there are no significant differences in age, gender, or ethnicity between subjects who accepted the recommended periodontal treatment plan and completed a full questionnaire, and those who declined the plan for any reason. Of the 138 patients who participated in the study, 18 declined treatment and were therefore not available for an interview. The analysis showed that patients who declined treatment were younger in age ($p<0.05$), of similar gender, but had a significantly different ethnicity profile ($p=0.0008$) compared to patients who approved the recommended treatment plan and completed the treatment (Table 1).

**RESULTS**

One-hundred-twenty patients who underwent treatment completed our survey. Patient age ranged from 17 to 93 years (mean: 54.8 years). Sixty-four patients (53.3%) were men and 56 (46.7%) were women. With respect to ethnic background, 42.5% of respondents were Caucasian, 28.3% African American, 18.3% Hispanic or Mexican American, 10.8% “other” (Table 1). Eighty-one percent had an American Society of Anesthesiologists (ASA) health status of I or II. Only one patient did not have a college education; all others had completed college or postgraduate studies. Ninety-four percent of patients
rated their economic status as “average.”

Treatments performed included nonsurgical methods, crown lengthening, osseous surgery, soft tissue grafting, periodontal tissue regeneration, alveolar ridge augmentation, implant placement or treatment of implant-related complications, extractions of teeth, and/or preprosthetic surgery. Ninety-five percent of patients completed treatment in 7 or fewer visits. The cost of treatment ranged from US$890 to US$37,000. Most patients had some insurance coverage but were still financially responsible for a substantial portion of treatment. On average, insurance covered only 28.3% of the treatment cost. Eighty-six percent of the patients had been referred by general dentists.
Effect of office environment on treatment plan acceptance

The vast majority of respondents agreed that staff behavior (88%), staff skills (91%), the availability of suitable appointments (98%), and doctor communication skills (98%) were important factors in leading them to accept treatment. Also important in treatment acceptance for at least 90% of patients were the initial visit to discuss treatment (93%), education from (90%) and answers to questions (90%) by staff during regular visits, answers regarding concerns about treatment and pain control (93%), and the provision of clear information regarding the expected length and outcome of treatment (95%). Ninety percent of the patients felt that the treatment was effective, 91% were pleased with the outcome, and 93% would refer a friend or family member to the treating office. In free-form comments, patients frequently mentioned the positive attitude of the staff and their professionalism in carrying out their work, as well as the quality of information given during treatment and the interest of the entire staff in patients’ well-being.

Most important factors in accepting a treatment plan

When asked which factors were “very important” in leading to treatment acceptance, 93% of patients cited the likelihood that the treatment would be effective. The cost of treatment was very important (71%) or somewhat important (24%) for 95% of patients, and most patients felt that financing their treatment was “easy” (39%) or “fair” (50%). Somewhat fewer patients agreed that the following factors were “very important” in their treatment decision: options for pain control (51% very important, 38% somewhat important), the presentation of several treatment options (63% very important, 26% somewhat important), and the availability of convenient appointments (67.5% very important, 25% somewhat important).

For 96% of respondents, the doctor was the most significant person in the office in helping them decide on treatment. Among the tools made available during diagnosis and treatment planning, the willingness of staff to answer questions was the most influential (51%); x-rays (50%) and photos (40%) were also fairly helpful in bringing patients to make a decision. Other tools, such as computed tomography (13%), guru animated treatment films (4%), models (8%), and previous patient slides (8%), were important for only a few patients in helping them decide to proceed with treatment.

Forty-four percent of the patients reported that the office Web site was helpful, and 13% did not visit the Web site.

DISCUSSION

Dentists’ clinical training and experience have a strong influence on their patients’ choice of treatment,[5, 6] as the dentist is expected to have adequate professional competency and knowledge of the treatment need of the patient and what would work. However, it seems clear from this and other studies that doctors and their staff members can increase patient satisfaction and treatment acceptance by striving for quality communication with patients and among themselves. This includes direct and indirect communication, such as the appearance of the staff and doctors, cleanliness of the office, total wait time, quality of dental care, and the
manner in which care is given. Most patients do not understand, nor are they able to evaluate, the clinical skills of a dentist; therefore, they usually rely on other criteria, such as communication with the dentist and the dentist’s interactions with the entire staff to help them choose one office over another. Other studies also found that good communication between dentists and patients led to greater treatment acceptance and patient satisfaction.\[7, 8\]

Dilatush and Horrocks\[3\] stated that patients use four criteria to select a dentist: price, technology, convenience, and public relations. Their findings are consistent with the results of our survey, in which over 90\% of our patients stated that their treatment decision was influenced by factors such as good communication with the office staff, the availability of convenient appointments, cost of treatment, the relative ease of paying for treatment, and confidence that the dentist could produce the desired outcome.

One barrier to effective communications is language. A dental office staff that is reflective of the demographics of the patient population helps to reduce barriers to good communication. For instance, approximately a third of our patients speak Spanish, and we have made sure that at least one member of our staff is bilingual. The presence of Spanish-speaking staff helps bilingual patients better relate to the office and understand that the doctor went the extra mile to help patients. Any language barrier can manifest itself in a negative way in scheduling, providing medical and dental history, consenting to treatment, and following the dentist’s instructions during or after procedures.

Levin\[6,9\] recommended building better relationships with patients to help a practice grow and emphasized an “internal marketing program” for the entire office staff. Interpersonal relationships are a critical component of “internal marketing,” and practice success and the entire referral process depend on the quality of interpersonal relationships. Effective internal marketing, from this point of view, consists of necessary staff training to use the right wording in a warm and vivid way to establish a strong bond between the patient and the office, which eventually leads to increased patient flow. It is also recommended that questions from patients be encouraged.\[10\] McInnes,\[2\] working in the field of cardiology, echoed these sentiments, noting that involving the patient in treatment planning, paying attention to patient needs, making frequent contact with the patient, setting clear goals, and sticking to a clear treatment plan resulted in better patient acceptance of and compliance with treatment.

Seidel-Bittke\[11\] noted that many patients simply do not realize the importance of treatment, especially regular preventive care. Plenty of education based on good research and a plethora of good materials to present to patients can help convince and motivate patients to undergo and complete treatment. Rosedale and Strauss\[12\] used a diabetes patient-screening program to emphasize the impact of overall health on dental health, and vice versa. In the present study, the patients felt they were given adequate knowledge about the benefits of treatment on their general and dental health.

Many authors noted the influence of treatment costs on the acceptance of treatment plans. Levoy\[4\] recommended that dentists make third-party financing available. Seidel-Bittke\[11\]
also recommended that dentists make many payment plans available to patients, in addition to stressing to patients that the choice to spend money to improve their health is valid. In our study, 89% of patients stated that the financing of their treatment was “easy” or “fair.”

Dilatush and Horrocks\cite{3} recommended creating a dominant Internet presence for the dental office by means of a Web site that features user-friendly navigation/organization, well-written words, and clear pictures; is not overly clinical; has a “meet the dentist” page; and has good management with regard to search engine optimization and connections with social media. Levoy\cite{4} emphasized that a dentist’s Web site needs to be patient friendly and not overly complicated or overloaded with technical wizardry. In this study, 44% of the patients deemed the office Web site helpful.

Interestingly, although about half the patients in this study stated that photographs and radiographs did help them decide to proceed with treatment, relatively few patients were swayed by the so-called “high-tech” tools such as computed tomography (13%) or guru animated treatment films (4%), although 94% of these patients used these tools. It would be useful to learn more about what was lacking in these devices that minimized their influence on patient acceptance in this study.

This study has some limitations. First, we used a novel, opinion-based questionnaire to gather our data. Patient opinions will, of course, always be subjective and qualitative by their very nature, but a stronger approach would have been to use a previously validated questionnaire regarding patient treatment acceptance. To our best knowledge, there are no such validated surveys in the peer-reviewed literature on treatment acceptance in periodontics, although many commentaries and editorials have been written by experienced clinicians on patient acceptance of dental treatment. A pilot study of the ACCEPT questionnaire\cite{13} studied patient acceptance of the use of prescribed medication. A fully tested and validated survey would be preferable, and it would provide a more complete picture regarding the reasons that patients accept or refuse treatment. Our survey included only 120 responses from a particular patient population at one periodontal practice. To generalize the findings, a larger and more representative sample of patients and practices may be required. Populations with a broad range of demographics, including representative socioeconomic status, education, and ethnic/racial makeup, may have answered the survey differently. On the other hand, the inclusion of multiple practices might have created other issues. For example, different practices may have different procedures for communication with patients, treatment planning, etc., and these differences would inevitably influence the responses to the survey. Another limitation of this study is that responses from patients who did not accept the treatment plan and did not follow through with the treatment were not included. These responses may provide useful information not observed in this study.

In addition to having adequate clinical skills, a successful dentist/periodontist must also be a good communicator. To be a good communicator, the dentist needs to be a good listener. A patient’s chief complaints should be taken into consideration when developing a treatment plan. Furthermore, the clinician should
educate, motivate, and address the questions and concerns raised by the patient. With good communication from the doctor and staff, patients will have confidence in the treatment plan and be motivated to follow through with the recommended treatment. In addition, patients appreciate sufficient information about the cost of treatment, the duration of procedures, methods for pain control, the availability of alternative treatment options, and the predictability of the outcome of treatment. Generally, the treatment outcome should be the restoration of function and/or esthetics, and it should be stable and reasonably predictable.

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Disclosure
The authors report no conflicts of interest with anything mentioned in this article.

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The purpose of this review was to test the null hypothesis of no difference in the implant failure rate, marginal bone loss, and postoperative infection for patients being rehabilitated by tilted or by axially placed dental implants, against the alternative hypothesis of a difference.

**KEY WORDS:** Dental implants, tilted, off-axis, review, analysis

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BACKGROUND
The purpose of this review was to test the null hypothesis of no difference in the implant failure rate, marginal bone loss, and postoperative infection for patients being rehabilitated by tilted or by axially placed dental implants, against the alternative hypothesis of a difference.

MATERIALS AND METHODS
An electronic search without time restrictions was undertaken (and last checked) in July 2014 in the following databases: PubMed, Web of Science, and the Cochrane Oral Health Group Trials Register. The following terms were used in the search strategy on PubMed: (((dental implant) OR oral implant)) AND (((tilted) OR angulated) OR axial) OR upright) [all fields]. The following terms were used in the search strategy on Web of Science, in all databases: (((dental implant) OR oral implant)) AND (((tilted) OR angulated) OR axial) OR upright) [topic] The following terms were used in the search strategy on the Cochrane Oral Health Group Trials Register: (dental implant OR oral implant AND (tilted OR angulated OR axial OR upright)) A manual search of dental implants-related journals was also performed. The reference list of the identified studies and the relevant reviews on the subject were also scanned for possible additional studies. Moreover, online databases providing information about clinical trials in progress were checked (clinicaltrials.gov; www.centerwatch.com/clinical-trials; www.clinicalconnection.com). Eligibility criteria included clinical human studies, either randomized or not, interventional or observational, comparing implant failure rates in any group of patients receiving tilted or axially placed dental implants. Zygomatic implants were not considered. For this review, implant failure represents the complete loss of the implant. Exclusion criteria were case reports, technical reports, animal studies, in vitro studies, biomechanical studies, finite element analysis (FEA) studies, and reviews papers. The following primary outcomes were measured: 1) implant failure rate: implant failure represents the complete loss of the implant; 2) Progression of the marginal bone loss; 3) postoperative infection.

RESULTS
The search strategy resulted in 44 publications. A total of 5029 dental implants were tilted (82 failures; 1.63%), and 5732 implants were axially placed (104 failures; 1.81%). The difference between the procedures did not significantly affect the implant failure rates (P = 0.40), with a RR of 1.14 (95% CI 0.84–1.56). A statistically significant difference was found for implant failures when studies evaluating implants inserted in maxillae only were pooled (RR 1.70, 95% CI 1.05–2.74; P = 0.03), the same not happening for the mandible (RR 0.77, 95% CI 0.39–1.52; P = 0.45). There were no apparent significant effects of tilted dental implants on the occurrence of marginal bone loss (MD 0.03, 95% CI _0.03 to 0.08; P = 0.32). Due to lack of satisfactory information, meta-analysis for the outcome ‘postoperative infection’ was not performed.

DISCUSSION
The use of tilted implants to support prostheses for the rehabilitation of compromised atrophic edentulous jaws can be considered a predictable technique, with an excellent prognosis in the short-medium term. However, there is lack of randomized long-term trials to determine the efficacy of this surgical approach. In atrophic edentulous jaws, tilting of the implants may represent a feasible treatment option to overcome placement of implant in specific
anatomical areas, such as the pterygoid region, the
tuber, or the zygoma or bone-grafting procedures
which demanding surgical procedures and can be
associated with complications, morbidity, and high
costs. Moreover, implants of conventional length
can be placed, allowing engagement of as much
cortical bone as possible, thus increasing primary
stability.\textsuperscript{1} Tilting of the implants may allow using
longer implants that may engage greater quan-
tity of residual bone, which may be beneficial to
implant stability. Moreover, a more even distribu-
tion of stress around implants is achieved when
implants with longer lengths are used.\textsuperscript{2,3} Regard-
ing This meta-analysis, No RCTs were included.
The forty-four included articles were twenty-five
prospective studies and nineteen retrospective
analyses. Thirty-six studies were of high quality,
and eight of moderate quality. Quality assess-
ment of the studies was achieved according to the
Newcastle-Ottawa scale (NOS).\textsuperscript{4} All the meth-
odology procedures of this Meta-analysis review
were performed starting from clear focus answer-
able question and extensive systematic search to
proper meta-analysis performance. As well as data
interpretation were done with caution due to the
presence of uncontrolled confounding factors in
the included studies, none of them randomized.

The aim of this review was to test to com-
pare the survival rate of dental implants, post-
operative infection, and marginal bone loss
of tilted and axially placed dental implants.

The results of this review indicate that, the
insertion of dental implants in a tilted position
did not statistically affect the implant failure rates
in relation to axially placed implants. This sug-
gests that tilted implants may achieve the same
outcome as implants placed in a straight man-
ner. In addition the study did not find an appar-
ent significant effect of tilted dental implants
on the occurrence of greater marginal bone
loss in comparison with axially placed implants.

CONCLUSIONS

It is suggested that the differences in angulation
of dental implants might not affect the implant sur-
vival or the marginal bone loss. The reliability and
validity of the data collected and the potential for
biases and confounding factors are some of the
shortcomings of the present study. There is lack
of strong evidence to recommend the placement
of tilted implants as an alternative option for reha-
bilitation of atrophic edentulous jaws. Hence,
well performed pragmatic randomized controlled
trials are still needed to evaluate the benefit or
harm of this treatment option in comparison
with axially placed implant with bone grafting.

Disclosure
The authors report no conflicts of interest with anything mentioned in this article

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