

CASE REPORT

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Immediately loaded fixed full-arch implant-retained prosthesis: a solution to the extreme defect in zone 2—a case report

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Abstract

Background Implants immediately loaded full-arch prosthesis in maxilla is always a challenge, especially when the zone 2 is extremely defected. To achieve a satisfying result, different therapeutic alternatives have been proposed, such as zygomatic implant, pterygoid implant; however, precise surgical skills limited its application.

Case presentation This study reported a case that an edentulous patient was treated with a new technique, two axial implants and four tilted implants supporting an immediate fixed denture, extruding the cortical bone of the anterior wall of the maxillary sinus to establish the primary stability.

Conclusions Two-year follow-up proves that it is a viable choice. Meanwhile, a reliable method for its saving time and money and low level of discomfort for patients is presented.

Keywords Extremely defected in maxillary zone 2, Maxillary sinus, Immediate dental implant loading, Tilted implant, Case report

Background

The implant placement at the edentulous upper jaw is often challenging because of the poor bone quality and quantity; especially when maxillary sinus pneumatization occurs, the design of the surgery will be harder than

usual (Velasco-Torres et al. 2017). In 2008, Bedrossian et al. described the three zones of maxilla (Bedrossian et al. 2008): The maxillary anterior teeth are considered as zone 1, and the premolar region is designated as zone 2, while the molar region is designated as zone 3 (Fig. 1). It is a useful classification, which can guide the implant design. In this article, we focus on the case when only zone 1 is present.

For a fully implant-supported immediate restoration, enough bone at zone 2 is always considered as a necessary condition. To achieve a satisfying result, different therapeutic alternatives have been proposed, such as long distal cantilevers and short implants; however, the long-term effects of these treatment effects are inevitable.

The long-term effects of tooth loss and the use of complete dentures make it difficult to place implants for edentulous patients. Here are three solutions for immediate restoration when zone 2 is extremely defected: bone grafting, zygomatic implant and pterygoid implant.

For bone grafts, maxillary sinus floor elevation through crestal or lateral approach can lead to a good result. It

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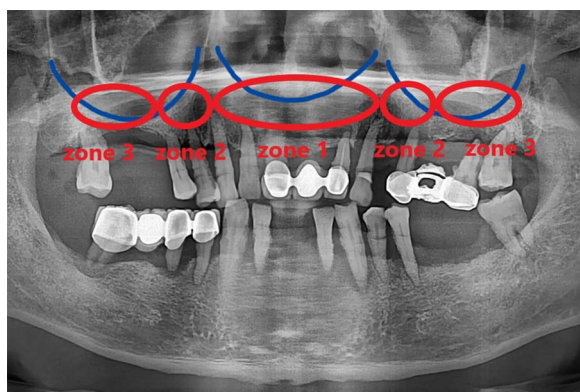


Fig. 1 A schematic of three zones of maxilla

is a pretty proven technology, but in the situation of extremely defected maxillary zone 2, it cannot repair the prosthesis immediately. For edentulous patients, it is important to repair the occlusion immediately. The absence of tooth not only impairs their eating, but also affects their appearance.

The use of zygomatic implants to support dental prostheses was first reported by Branemark in 1988. For severely atrophic maxillary arch like extreme defect in zone 2, the treatment with two zygomatic and two standard fixtures to support an immediate fixed prosthesis could be considered as a viable treatment method (Agliardi et al. 2017). In general, zygomatic implants were used in Cawood class V or VI, or zone 1 lack of enough bone height. Many researches have shown the complications like biologic complication, maxillary sinus infections, peri-implant pathology, etc. These methods are time-consuming and increase the pain and financial burden of patients. Besides, there are some better options to solve the problem of native bone. So if there is a chance to avoid it, it is better to choose another way.

As well as zygomatic implant, pterygoid implant is an alternative option for the patient with atrophic maxilla like Class IV and V of Cawood. Because of the poor vision of the posterior of maxillae, it is difficult to drill a suitable implant bed for pterygoid implant. Rodríguez Xavier calculated the mean position of the pterygomaxillary buttress axis, which was 72.5 ± 4.9 degrees to the distal direction and 81.3 ± 2.8 degrees to the palatal direction relative to Frank-fort plane (Rodríguez et al. 2014). To reach the pterygoid plate, most studies suggested placing an implant at least 13 mm length. In the study of Thomas J., they suggested that increased implant length may be beneficial to the osseointegration, and more cortical bone context with the implant increases primary and secondary stability (Balshi et al. 2013). The length and the special angle of the implant make the surgery difficult; also,

because of the poor visibility of anatomy site, the implant placement is precarious, and the implant may fall into the sinus and cause the medical negligence (Anandakrishna and Rao 2012). Thus, the pterygoid implant needs highly experienced doctors.

Many researchers (Bidra et al. 2013; Panagos and Hirsch 2009) reported the use of pterygoid or pterygomaxillary implants in patients undergoing bilateral maxillectomy; in some way, it is a rescue solution for the patients who have almost all the maxillary defected. It has its own advantages, such as good ability to acquire initial stability and osseointegration (Yates et al. 2014). From a surgical point of view, the zygomatic and pterygoid implants need advanced surgical skills, which limits its application. Thus, we adopted a new method, which could simplify the course of operation and fix the prosthesis immediately.

When the patient is young at 50 s, 6 implants for the edentulous maxillary are safer because it can provide a stronger occlusal force. Once we decided to drill 6 implants, an intractable problem came up that the severe atrophy maxilla cannot provide enough height (always need at least 10 mm after bone reduction) for the implants. The use of tilted implant is an ideal solution. Many researches have proved that the angulation of dental implants does not affect the survival rate nor lead to the marginal bone loss (Chrcanovic et al. 2015; Del et al. 2012). Tiziano Testori reported a technology which got an encouraging result that used a trans-sinus implant and inserted a xenograft to repair an edentulous upper jaw (Testori et al. 2013). It proved that in zone 2, using tilted implants may be a valuable attempt.

VIIV technique was presented in 2008, using four tilted implants and two axially implants to support an immediately full-arch fixed prosthesis without bone grafting procedure. According to the research, cumulative implant survival rate, marginal bone level, esthetic and patient's satisfaction evaluation are considered excellent (Agliardi et al. 2008).

As for severe maxillary atrophy, it is difficult to design the position of the implants. The most important factor to consider when establishing the primary stability is the quality and quantity of cortical bone of retentive bone, such as pterygoid plate and maxillary tuberosity. In this article, implants extruded the cortical bone of the anterior wall of the maxillary sinus to obtain a good initial stability. The surgery design avoids bone graft and thus reduces the injury and total treatment time. Most importantly, enough torque makes immediately loaded fixed full arch possible. This technique is a highly predictable treatment option for edentulism, and the clinical results are satisfactory, practical and worth spreading. At present, few cases of extruding the cortical bone of the

anterior wall of the maxillary sinus have been reported. This study reported a case that an edentulous patient was treated with this new technique and presented a new method when zone 2 is extremely defected.

Case presentation

A 57-year-old Chinese man with an unrestorable remaining dentition due to generalized aggressive periodontitis was presented to our hospital. The patient, who was not a smoker, has no systemic disease. The panoramic radiograph provided all the information we need, such as bone size and volume, conditions of the opposing dentition or jaw. Many teeth were missing because of the severe periodontitis. Maxilla and mandible were severely atrophied, and zone 2 was extremely defected, and the height of the remaining alveolus was less than 3 mm (Fig. 1).

After the assessment and diagnosis of the clinical situation, many different treatment options were proposed, including conventional complete dentures and implant overdentures for edentulous patient.

As the patient chose a fixed prosthesis to restore his tooth, an implant-supported fixed complete denture using the technique of extruding the cortical bone of the anterior wall of the maxillary sinus was suggested: two distal implants by using TPP (tuberosity, pterygoid plate, palatine) technique. Two other tilted implants for the extrusion of the anterior wall of the sinus, being tilted 45 degrees relative to the occlusal plane, and finally two axial implants in the anterior maxilla.

Applying the extruding the cortical bone of the anterior wall on the maxilla can achieve immediately loaded prosthesis without the need of sinus lifting, which also reduces the time of treatment, surgical trauma and price compared to conventional therapy.

Roxithromycin and analgesics were given orally 30 min before surgery. All the teeth were extracted, and then, ecrotic tissues and all inflammatory residues were removed and clearly exposed the alveolar crest, and the alveolar bone crest was modified with bone clippers.

First, a 16-mm implant site was drilled at the posterior wall of the maxillary sinus, angle of about 30–45° relative to the occlusal plane. A direction pin was positioned in order to check the proper axis of the drill. Second, the medial tilted cavity was drilled engaging the anterior sinus wall. Last, cavity was drilled axially in the central incisors position. According to the intended implant diameter, the bone cavity was extended gradually, following the manufacturer instructions 6 implants were placed immediately, and the insertion torque of the plant was between 50 and 60 Ncm. (Use Cortex 3.8*11.5 mm at left and right central incisor. Use Cortex 4.2*16 mm at left first premolar, second molar and right second premolar, second molar). We sutured the flaps with resorbable 4-0

vicryl. A CBCT was taken soon after the surgery (Fig. 2). Panoramic radiograph was taken before and after the surgery.

After the implanting surgery, impressions for fabricating the immediate-loading prosthesis were made. Ice packs were provided, while the temporary prosthesis was made. Four hours after surgery, a 12-tooth acrylic temporary prosthesis was delivered, occlusal adjusted until multi-point attachment was achieved in the intercuspal position. In the meantime, group functional occlusion attachment was achieved (Fig. 3). In case of post-surgical pain, analgesics and anti-inflammatory drugs were prescribed. Patient was suggested to maintain good oral hygiene. The second day, occlusal splints were given to the patient in order to avoid implant damage as a result of bruxism.

No complication about the surgery and the temporary prosthesis was recorded. The definitive prosthesis was fabricated 6 months later. With two-year follow-up, the patient was great satisfied with the esthetics, function and phonetics of his prosthesis (Figs. 4, 5).

Discussion

The result of this article shows that when only the zone 1 of maxilla is present in the upper jaw, extruding the cortical bone of the anterior wall of the maxillary sinus to obtain a good initial stability is a feasible method. By using two axial implants and four tilted implants to support an immediate full arch, we avoid bone grafting and difficult surgery (Fig. 6). Clinical and radiographic outcomes of this method are very encouraging.

There is reliable cortical bone in zone 2, such as the canine buttress, and the wall of sinus cavity. In our technique, coronal and apical part of the implant can be anchored in native bone with a high level of primary stability. The key to immediate function treatment is apical fixation, and the implant uses the canine buttress to achieve stability. The canine region is a strategic area because of the distribution of mechanical stress. The anterior wall of maxillary sinus is also used for implant placement. Agliardi E L (Agliardi et al. 2015) reported three methods with successful cases in which the long implants are extruding from sinus cavity for initial stability. The cumulative success rates are reported as 98%. Thus, fixtures are favorably directed toward the location of cortical bone, and bone grafting can be avoided. The two advantages of anatomy provide theoretical support for our new technique.

The immediate rehabilitation of the maxilla will be difficult if the zone 2 is extremely defected, thus restricting implant position and dimensions in case of bone grafting, and anterior wall of the maxillary sinus always can provide cortical bone for retention.

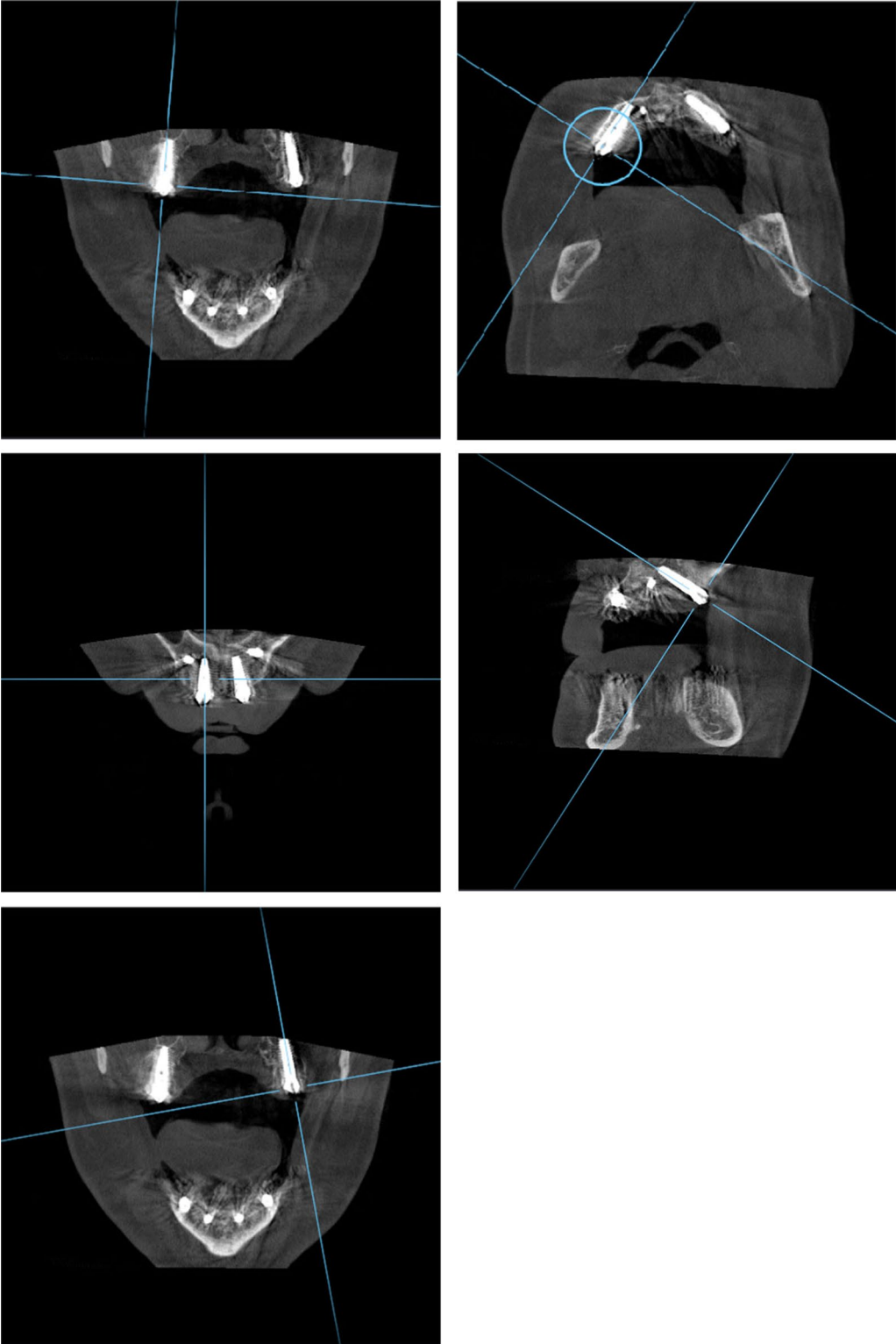


Fig. 2 CBCT scan was taken immediately after implant placement

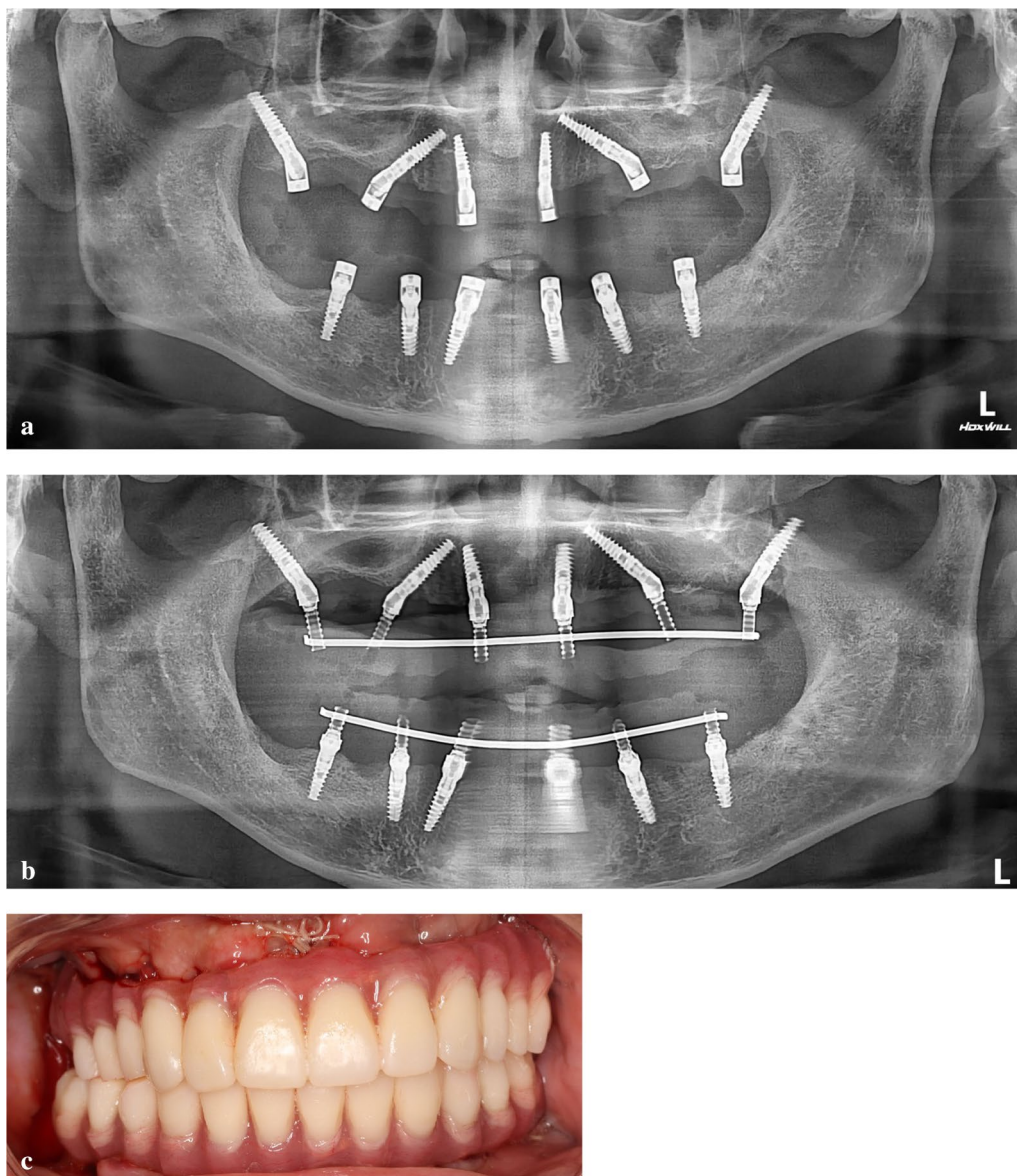


Fig. 3 **A** Panoramic radiograph was taken immediately after implant placement. **B** Panoramic radiograph was taken after transfer copings splinted. **C** Occlusal view

Immediately fixed prostheses have a high success rate in repairing edentulous jaw. The Kaplan–Meier survival estimate method showed that immediate implant and immediate loading decreased the calculating success rate significantly in the maxilla. Disruption happened only to those that suffered multiple implant failure (Testori et al. 2014). Camlog Foundation Consensus Report indicated that there is less marginal bone loss around immediately loaded implants when compared to conventionally loaded implants (Schwarz et al. xxxx). Studies have shown that it functioned well in a 15-year time perspective, bone loss mainly occurred in the first year, and the situation

became stable in subsequent years. Piano Sergio placed eighty-four implants including a half of tilted implant, followed by immediate restoration. Implants were installed tilted mesial to the anterior maxillary sinus wall (Piano et al. 2016). The inclusion criteria indicated that it has a slightly better bone volume than our researches. The encouraging result is that both implant survival rate and prosthetic survival rate after two years are 100%. It suggested that immediate loading of the tilted implants anchored in the anterior wall of maxilla may be a reliable treatment. As time goes on, more problems may arise, so

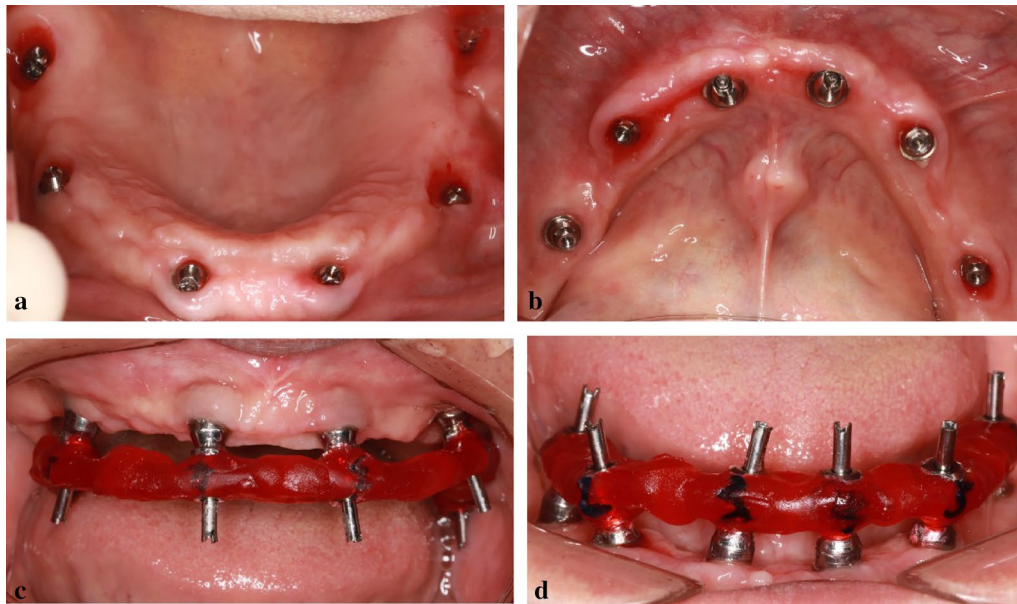


Fig. 4 **A B** Multi-abutments were placed. **C D** Transfer coping were placed

a regular follow-up care should be conducted to find and solve problems in time (Jemt and Johansson 2006).

Based on the previous study, immediately loaded fixed full-arch implant-retained prosthesis is proved to be a reliable method for its saving time and money, and low level of discomfort for patients.

There have been a few studies about the long-term function and complications of immediate-loading prostheses supported by implant extruding the cortical bone of the anterior wall of the maxillary sinus. However, there are many cases reported about treating the edentulous maxilla with tilted implants. Tilting implant is considered as a safe method for the restoration of maxillary edentulous jaw, which can replace maxillary sinus floor elevation. Neither the implant survival rate nor the peri-implant marginal bone loss seemed to be affected by the inclination of implants with respect to the occlusal plane (Casar-Espinosa et al. 2017). The differences in angulation of dental implants in relation to the mesial–distal occlusal plane might not affect the survival of these dental implants nor affect the marginal bone loss (Chrčanovic et al. 2015). At the same time, studies have also shown that the tilted implants in different planting areas affected bone loss. The peri-implant marginal bone loss of angled implants depends on their location in the dental arch; for example, tilted implants substituting premolars suffer higher bone loss than molars, so it still needed a long-term research. The estimated implant loss rate is influenced by the implant location, type of restoration, and implant number. There is no increased

risk of implant loss in immediately loaded full-arch fixed restorations.

Teatori Tiziano et al. reported a solution to extremely defected zone 2 for edentulous maxilla (Testori et al. 2013). They detached the sinus membrane from the anterior wall, placed the tilted implant and inserted a xenograft. While healing, patients used their full denture. Axial and tilted implants crestal bone loss averaged is closed, which convinced that the tilted implants are feasible methods for full arch. The trans-sinus implants did not cause sinus infections, maybe because the reduced trauma compared to a traditional sinus elevation. In our research, we did not insert a graft.

Insertion of fixtures extruded the anterior wall of sinus cavity can obtain higher torque like 50 N·cm, reducing the motion at the bone–implant interface, making the immediately loading possible. The surgery design avoids bone graft and thus reduces the injury and total treatment time. It not only gives the patients a better treatment experiment, but also alleviates their financial burden. Using axial implants united tilted implants can expand the clinical indication, so more edentulous patients with extremely defected zone 2 could get an immediately loading full arch, and the final prosthesis could be wider anteroposterior spread without cantilever.

There are still some limitations of our new technique, and it is difficult to choose the right angle and position because the lack of bone leads to a small operate space, so it requires experienced operator. Good knowledge of implant characteristics and mechanical behavior is also important for the operator. The case described in our

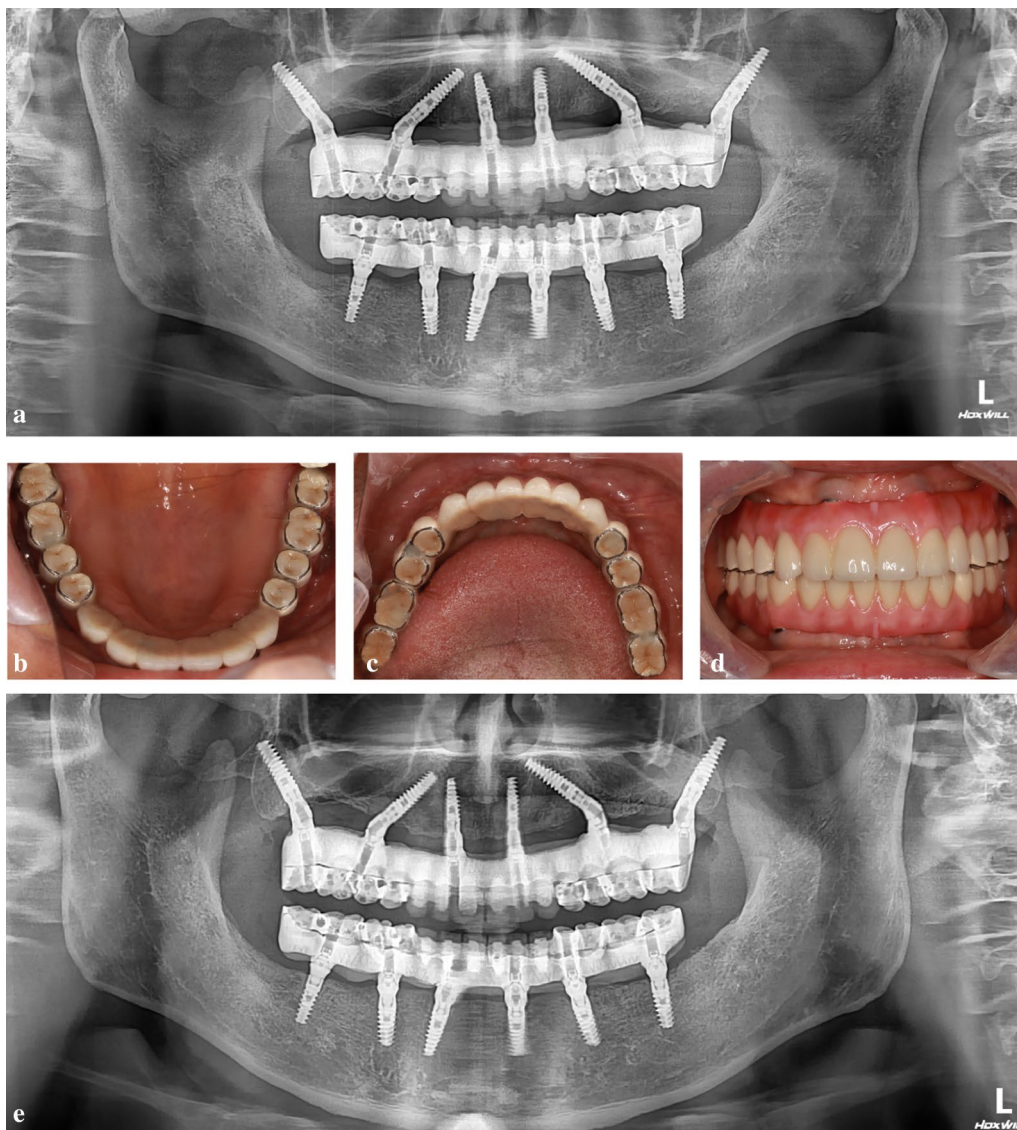


Fig. 5 A B C D Panoramic radiograph and clinical view after 6 months. E A panoramic radiograph after 18 months

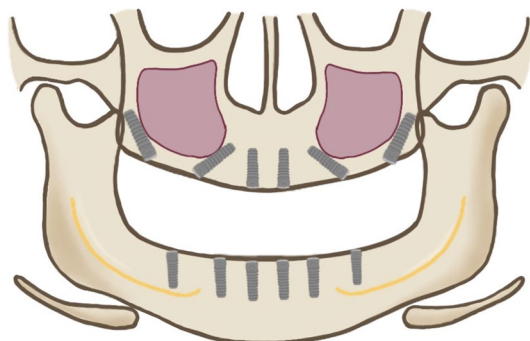


Fig. 6 A schematic of the placement of implant extruding the cortical bone of the anterior wall of the maxillary sinus

article is lack of long-time follow-up. Further prospective studies on larger samples of patients and implants with longer follow-up should be undertaken to confirm the long-time effect of this method.

Nowadays, there are many reports on successful immediate full-arch immediately loading with computer-guided surgery. Using the advanced technology, it might be easier for doctors to determine the appropriate angle and position even for operators who are not very experienced in edentulous treatment. Contemporary implant surgery is performed as guided surgery based on virtual computer-assisted planning, and the implant position was considered based on both anatomy landmark and prosthetic demands.

Computer-aided surgery could minimize the deviation and make the usage scope of our new technique more extensive.

Conclusions

This article introduced a new method which can immediately fix prosthesis for the extreme defect in zone 2 without maxillary sinus elevation. Using two axial implants and four tilted implants to support a full-arch prosthesis, extruding the cortical bone of the anterior wall of the maxillary sinus to establish the primary stability achieved an ideal result.

Abbreviations

TPP Tuberosity pterygoid plate palatine

Acknowledgements

We thanked Xiaoya Lu, Xiaoping Wang, Xiaohui Han, Lihua Hu, Mei Ji, Sheng-feng Li, Shengyun Huang, who have made genuine contributions to the manuscript.

Author contributions

X.P.Wang and X.Y.Lu contributed to the case report design; X.H.Han accomplished the restoration and collected the data; X.P.Wang, L.H.Hu, X.Y.Lu, MJ and S.F.Li contributed to the manuscript drafting; S.Y.Huang was the surgeon and was a major contributor in writing the manuscript; and authors read and approved the final manuscript.

Funding

This research was supported by Shandong Provincial Medicine and Health Science and Technology Development Program (2017WS097); Shandong Provincial Natural Science Foundation(ZR2021MH270); and Jinan Clinical Medical Science and Technology Innovation Plan(202134035).

Availability of data and material

All the datasets and materials used during the current study are included in this published article.

Declarations

Ethics approval consent for publication

This study was approved by the Ethics Committee of Shandong Provincial Hospital Affiliated to Shandong First Medical University, SWYX:NO.2022-403.

Competing interests

The authors declare that they have no competing interests.

Informed consent

Written informed consent for the publication of clinical details was obtained from the patient.

Received: 8 November 2022 Accepted: 17 January 2023

Published online: 25 January 2023

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