Direct Drilling and GBR for Implant Placement in Anterior Maxilla with Horizontal Bone Defect: a Step-by-step Correcting Direction Drilling Technique

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Abstract Objective: To describe a simple drilling technique to simultaneously place implant in horizontally deficient anterior maxilla.

Study design: A horizontal bone defect was noticed in a 20-year-old male with two missing maxillary middle incisors. We used a step-by-step drilling technique to prepare the implant site, during which the drill preparing directions was corrected step by step to the final ideal direction. Then the implants were placed and bone grafting materials were used in undercut for guided bone regeneration. After 6 months the implants was restored and followed for 2 years by cone beam CT.

Results: Clinical and radiograph evaluation revealed new bone formation at the labial side of anterior maxilla. Final crowns were restored and the new bone formation demonstrated a stable situation during the 2 year follow-up.

Conclusion: This step-by-step correcting direction technique can be used as an alternative procedure to overcome the horizontal bone defect in anterior maxilla.

Keywords Dental implants; Alveolar augmentation; Case report

Introduction Dental implant placement in anterior maxilla is often a challenge due to limited bone and high esthetic requirement. After maxillary anterior tooth lost for a long time, bone resorption is often occurred, especially in the labial-lingual bone. Bone defect in anterior maxilla has been classified by several researchers according to bone quantity and quality and bone defect direction (El-Ghareeb, Moy, & Aghaloo, 2008; Wakimoto, et al., 2012). Many reasons contributed to this bone loss, like removable denture, labial muscle’s pressure, loss of periodontium. The facial plate of alveolar bone is lost or remodeled to a greater extent than the labial-palatal bone after tooth loss, probably because the labial bone over natural teeth is usually much thinner than its palatal counterpart. Loss of labial-palatal dimension of ridge further necessitates calls for additional procedure to receive optimum implant borne prosthesis.

Bone splitting technique, bone-expansion (bone-condensing) techniques, and guided bone regeneration (GBR) with bone grafting materials have proved to be successful in highly resorbed ridges to achieve bone augmentation in horizontal and vertical dimension (Chiapasco, Abati, Romeo, & Vogel, 1999). Several ridge split techniques have been developed in past few decades and includes split crest ostectomy and numerous modification techniques (Anitua, Begona, & Orive, 2012; Khairnar, Khairnar, & Bakshi, 2014). However, bone splitting often caused bone fracture, loss of primary stability or delaying of implant placement (cannot be placed simultaneously). In addition, patients often have severe post-operation reaction like severe pain, swelling due to the severe damage to the bone.

Some operators advocated use of osteotome progressively increasing diameter to create implant bed due to maxillary bone is softer in quality (Summers, 1994a, 1994b). The use of osteotome allows manipulation and compaction the peri-implant bone to achieve excellent primary stability without losing any bone. However, some authors claimed certain bone loss associated with use of osteotome to
One hour prior to surgery, the patient received antibiotic prophylaxis (1 g amoxicillin) and continued to take for 7 days (500mg three times a day) after the surgical procedure. Surgery was performed under local anesthesia (articaine 4% with epinephrine 1: 100,000, Sanofi-Aventis, Meyrin, Switzerland). A midcrestal incision and a small vertical release incision in the labial surface were used for flap elevation. The surgical procedure was conducted as follows:

1) Use a round bur to mark a point at the implant site (Figure 1 b).

2) Use a small diameter guide drill to perform a first hole within the bone, without considering the correct drill correction (Figure 1 c, Figure 3 b,c).

3) Use a little big diameter twist drill to prepare the implant site, and at the same time adjust the drill direction when up and down the drill to make the hole more adjacent to the final direction. During this step, the cortical bone in the labial side maybe perforated, since there is an undercut. Just leave the perforation in there and do nothing (Figure3 f,g).

4) Use an even bigger twist drill to prepare the implant site, and at the same time adjust the drill direction when up and down the drill to make the hole more adjacent to the final direction. During this step, the cortical bone in the labial side maybe perforated, since there is an undercut. Just leave the perforation in there and do nothing (Figure3 f,g).

5) Use the final drill and correct the drill’s direction when drilling up and down. Make sure the direction is the same as the final implant placement direction (Figure 1 d, Figure 3 h,i).

6) Use the shape drill to make the final shape of the implant site and check the final direction. Some the bone can be condensed out of the implant site through the perforation area. It’s better to leave it there because it could cover the implant surface and promote bone regeneration (Figure 1 e).

7) The implants (3.5*11 mm Ankylos implant) were placed by the insert instrument (Figure 1 f, Figure 3 j).

8) The bone grafting material was placed in the undercut area and coved by a collagen membrane (Figure 1 g,h, Figure 3 k).
9) The wound was sutured by absorbable suture and keep it clean by Listerine for two weeks (Figure 1 i,j).

Six months after implant placement, second stage surgery was taken as usual and a healing abutment was placed. Two weeks later, an implant level indirect impression was taken with a closed tray technique after placing of an implant transfer post. Impressions were taken with a polyvinyl siloxane impression material using an individual impression. When the final crowns were finished, abutments were screwed onto the dental implants and were tightened with a 15 Ncm torque. Permanent restorations were placed (Figure 2). This case was followed for two-years by cone beam CT.

Figure 2 Restorations after the step-by-step technique in anterior maxilla

2 Results
No adverse events were recorded during the healing period in this patient. There were no signs of infection. Minor swelling of the gingival mucosa was present in the first days after surgical procedures, but no mucositis or flap dehiscence with suppuration was found. The primary stability of all implants was more than 15 Ncm. There was suitable wound healing around healing abutments with a fine adaptation to the final restoration.

The patients maintained stable implant prostheses during their final prostheses. After 6 months of implant placement, the new bone formation can clearly be seen at the labial surface (Figure 4.c, d). The post-operative cone beam CT after 1 year showed no bone loss, even a little bone gains the crest (Figure 4.e,f). During the two years follow-up, the labial bone is stable and even a little bone gain was obtained (Figure 4 g,h). The CT scan revealed the new cortical bone formed at the labial surface.

Figure 3 Sagittal view of the step-by-step drilling technique in anterior maxilla
drill to enlarge the implant hole, and in the meantime, to correct the direction of implant path by putting the drill to the lingual side and slowly drilling up and down for several times. The slowly up and down drilling skill can also enlarge the bone hole to make the third drill more easily put in and reduce the damage to the surround bone. 3) The third point is using an even larger drill (usually the final drill to continue correcting the direction and make sure the final implant correct is correct. 4) The implant surface is usually exposed at the undercut area, therefore, using the bone grafting materials is necessary, which is based on the principle of GBR.

In this case, it is usually treated by bone splitting technique, which required at least 1 mm of trabecular bone sandwiched between the cortical plates and the labial plate is easily fracture at the undercut due to the less labial-palate bone. Instead of bone splitting, we used the first small guide drill without correct direction, because there is an undercut in the labial surface and the cortical bone is hard to remove if the drilling according to the normal direction. To achieve this, the first drill should be as thin and sharp as possible. During the first drilling, we avoid the hard cortical bone and remove it during the following drilling by correcting the drill direction (usually put the drill toward the lingual side step by step). Though this technique, the implant bed can be prepared and the cortical bone in the undercut can be removed step by step with the least bone loss.

The implant surface is exposed often in this severe bone undercut and we used normal GBR technique to gain new bone formation. Since there is an undercut, all the bone grafting materials were surrounded by the natural bone except the mucous membrane surface. In this situation, the bone growth factors can moved into the bone grafting materials and promote the bone regeneration. This is demonstrated by the cone beam results during the two-year follow-up.

This technique is based on the concept that the palatal bone is stable and can resists bone resorption. It should be performed only when there is at least 3.5 mm of labial-palatal ridge width at the crest level. If there is severe bone loss on the palatal surface or the vertical bone, this technique is not suitable for implant placement. In that situation, it is important to obtain

3 Discussion
This article introduced a step-by-step correct direction drilling technique for treating patient with severe labial-lingual bone loss, during which the drills were used slowly to correct the implant direction step by step. The advantage of this technique is avoiding the disadvantage of bone splitting like bone fracture, loss of primary stability or delaying of implant placement. During this technique, the implant can be simultaneously placed with ideal primary stability. The outcome and follow-up clearly showed the success of this technique.

The main technique and key points of this method are: 1) Using the first small diameter guide drill to gain access within the alveolar bone without considering the direction, in the aim of providing a path for the following drill. 2) The second step is using another

Figure 4 Cone beam CT images in sagittal plane at different time point. a), b) before surgery; c,d) 6 months after implant placement; e,f) one year after restoration; g,h) two year after restoration
palatal bone or vertical bone firstly, in order to constitute a better bone volume and achieve final esthetic outcome.

In conclusion, this technique is easy to master for dentists and make the patients feel more comfortable during the surgery or post-surgery. This step-by-step drilling technique, by virtue of simplicity, conserving and patient comfort, combining with guided bone regeneration, will optimize the final result of dental implant in anterior maxilla with horizontal bone defect.

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