U-shaped Osteotomy Around the Descending Palatine Artery to Prevent Posterior Osseous Interference for Superior/Posterior Repositioning of the Maxilla in Le Fort I Osteotomy

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Abstract: In maxillary orthognathic surgery, superior repositioning of the maxilla is sometimes difficult, and removal of bony interference, especially around the descending palatine artery (DPA), is very time-consuming in cases of severe maxillary impaction. Posterior repositioning of the maxilla for removal of bony interference between the posterior maxilla and the pterygoid process is also technically difficult. Because the most common site of hemorrhage in Le Fort I osteotomy is the posterior maxilla, this bone removal is a source of frustration for surgeons in DPA injury. When the DPA is injured during bone removal and ligation is performed, aseptic necrosis of the maxilla may occur. Therefore, a simple and safe method for maxillary superior/posterior repositioning is required to remove osseous interference around the DPA. The authors describe here U-shaped osteotomy around the DPA to prevent posterior osseous interference for superior/posterior repositioning of the maxilla in Le Fort I osteotomy.

Key Words: Descending palatine artery, Le Fort I osteotomy, maxillary orthognathic surgery, superior/posterior repositioning, U-shaped osteotomy

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METHOD

Dental local anesthetic (2% lidocaine with 1:80,000 epinephrine) was injected with a dental syringe into the palatal soft tissue around the greater palatine foramen. A used 1.8-mL cartridge of dental local anesthetic was then replaced with indigo carmine (20 mg/5 mL; Daiichi Sankyo, Tokyo, Japan). After conventional Le Fort I osteotomy and downfracture, 3.6-mL indigo carmine was injected with a dental syringe into the palatal soft tissue around the greater palatine foramen. The neurovascular bundle of the DPA running through the maxillary bone could be clearly visualized by indigo blue. Then, U-shaped osteotomies around the DPA are made bilaterally through the nasal floor, the maxillary sinus, and the maxillary tuberosity, extending into the oral cavity (Fig. 1). During
bone removal, the blue-dyed palatal soft tissue can be seen gradually through the thin residual bone. The complete osteotomy can be performed safely without palatal soft tissue injury using a round bur or piezoelectric bone device until the blue-dyed palatal soft tissue is completely exposed (Fig. 2). After bilateral U-shaped osteotomies, the posterior bony interferences are removed. In the case of facial asymmetry, the decanting can be completed easily by unilateral U-shaped osteotomy. Because residual bony interferences are limited to the anterolateral lesion of the maxilla after the U-shaped osteotomy, they can be removed simply, and accurate superior maxillary repositioning is performed using the straight locking miniplate (SLM) technique.7

DISCUSSION

The DPA lies within the greater palatine canal, which is located in the perpendicular plate of the palatine bone and transverses in an anteroinferomedial direction with a mean angulation of 60° to the sagittal plane.3 For superior repositioning of the maxilla, removal of the bony interference around the DPA is necessary in conventional Le Fort osteotomy. The bone removal, however, is associated with the potential risk of DPA injury, and surgeons may inadvertently leave bone contact posterior to the DPA in an attempt to avoid vascular injury because of technical difficulty.3 Therefore, we have been using a simple handmade retractor to protect the DPA during removal of posterior osseous interference for maxillary impaction.5 Although the bony interference around the DPA can be removed safely under good visualization with a rotary round bur and ultrasonic bone device, the removal is time-consuming. With respect to other techniques of removal of bony interference, Johnson and Arnett1 reported pyramidal osseous release around the DPA with a rotary bur and Molt curette or fine chisel for maxillary impaction. In this technique, bone around the DPA is removed completely. Regan and Bharadwaj9 described a modified technique of bony release of the pyramidal process of a palatine bone using spatula osteotomes around the DPA. Although 20 patients underwent this modified technique, the DPA was injured intraoperatively in 1 of 40 sites (2.5%). There is a risk of inadvertent injury to the DPA when bone removal around the DPA is performed with both techniques. In contrast, because the U-shaped osteotomy can be safely performed far from the descending palatine canal, risk of DPA injury is less than methods reported previously. Although >40 dento-facial deformity patients underwent Le Fort I osteotomy with our method, which has potential risks of the tearing of the palatal soft tissue and DPA injury; there were no complications including injury or mechanical bony obstruction of the DPA and postoperative hemorrhage in any patient. The U-shaped osteotomy requires approximately 10 minutes at each side, but surgical time is consequently shorter than conventional methods in severe maxillary impaction cases. The indications of our method are posterior repositioning of the maxilla and maxillary impaction with ≥3 mm. Horseshoe-shaped osteotomy combined with Le Fort I osteotomy (horseshoe Le Fort I osteotomy) has also been performed for maxillary superior repositioning without risk of injury to the DPA during bony interference removal and osseous mechanical obstruction of the DPA.5,10 Compared with horseshoe Le Fort I osteotomy, our method has the advantages of shorter operative time and easy identification of the palatal periosteum by blue dye injection that prevents palatal soft tissue injury during osteotomy.

Maxillary setback is sometimes required to obtain an ideal profile without nasal deformity in cases of maxillary protrusion or asymmetry with a normal maxillary position anteroposteriorly but with horizontal rotation of the maxilla.5 Although removal of the maxillary tuberosity bone or osteotomy of the pterygoid process is required for posterior repositioning of the maxilla,5,11,12 these procedures are challenging because of the possibility of DPA injury or ophthalmological and neurological complications following unfavorable fracture of the pterygoid process. Yoshioka et al13 reported horseshoe osteotomy combined with Le Fort I osteotomy as a safe technique for posterior repositioning of the maxilla without the risk of DPA injury. This technique is more time-consuming, however, than the U-shaped osteotomy around the DPA. Our method enables safe and reliable removal of mechanical bony interference in maxillary setback and impaction (Fig. 3).

It is often difficult to detect the malposition of the maxilla during surgery by means of intraoperative measurements with internal and external reference points. The deflection produced by the bony contact of posterior maxilla induces intermaxillary rotation of the condyle, and can lead to a postoperative anterior open bite.1 Furthermore, surgical splint thickness can affect superior repositioning of the maxilla in some cases.14 Therefore, we reported an accurate maxillary superior repositioning technique named the SLM technique.1 This method does not need any intraoperative measurements using internal and external reference points that can be a source of error in bimaxillary orthognathic surgery.7 In this technique, bilateral SLMs secured to the maxilla and mandible maintain the three-dimensional relation between the mandible and the skull base precisely, such as the incisor pin of an articulator in model surgery. The maxilla can then be accurately moved into the

FIGURE 2. Bilateral U-shaped osteotomy around the DPA to prevent posterior osseous interference after vital staining of the palatal periosteum by blue dye injection. DPA, descending palatine artery.

FIGURE 3. Posterior repositioning of the maxilla after U-shaped osteotomy around the DPA. DPA, descending palatine artery.
planned position identical to that in model surgery. We recommend the combination of the SLM technique and U-shaped osteotomy with the use of staining by blue dye injection when superior/posterior repositioning of the maxilla is needed. Using the combination of these techniques, bimaxillary orthognathic surgery can be simplified and performed safely and accurately even by a less experienced surgeon.

REFERENCES