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# Alveolar distraction osteogenesis of a fibula free flap in maxillary reconstruction

Alexis Kahn, MD,<sup>a,b\*</sup> Jean-Daniel Kün-Darbois, MD, PhD,<sup>a</sup> Hervé Bénateau MD, PhD,<sup>b</sup> ,  
Alexis Veysseyre MD, PhD,<sup>b</sup>

a Department of Oral and Maxillofacial surgery, CHU d'Angers, 4 rue Larrey, 49933  
ANGERS Cedex - FRANCE.

b Department of Oral and Maxillofacial surgery, CHU de Caen, Avenue Côte de Nacre,  
14033 CAEN Cedex - FRANCE.

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\*Please send all correspondence to:

Alexis KAHN, M.D  
Department of Oral and Maxillofacial surgery  
CHU d'Angers  
4 rue Larrey 49933 ANGERS Cedex – France  
Email : alexis.kahn@chu-angers.fr

## **Abstract**

In maxillary reconstruction, it is challenging to obtain satisfactory maxillary projection and to optimize the implant-prosthetic rehabilitation. We report a case of sagittal distraction of a fibula free flap used to reconstruct maxilla after a ballistic trauma.

Distraction began seven days after implantation of the device. The distraction protocol was 0.9 mm per day during a total period of 2 months. Cone beam computed tomography (CBCT) acquisitions were performed at 3 months after the end of the distraction. The distractor device was removed 5 months after the end of the distraction protocol to allow bone consolidation. A satisfactory total distraction of 7 mm was obtained with an esthetic **variation** of the projection of the upper lip and closure of the nasolabial angle.

## **Keywords:**

Alveolar distraction; fibula free flap; maxillary reconstruction; intraoral device

## **Introduction**

The reconstruction of maxillary defects resulting from tumor resection or trauma is challenging. Nowadays, the fibula free flap is considered as the gold standard for mandibular reconstruction. It seems also to be an ideal approach for maxillary reconstruction [1–3]. The reconstruction of the maxilla must achieve three objectives: anatomical, functional and aesthetic. It should allow to isolate the oral cavity from the nasal cavity and maxillary sinuses. It must also restore all functions, especially the masticatory function, using implants for dental rehabilitation. It shall also achieve aesthetic objectives such as the restoration of the labial projection and the sagittal position of the maxilla [4]. Furthermore, flap positioning is often challenging due to the presence of numerous scars with retraction of the soft tissues.

The authors report a case of sagittal distraction, with an intra-oral device, of a fibula free flap used to reconstruct maxilla after a ballistic trauma.

## **Case report**

### *Case*

A 50-years-old patient presented centro-facial loss of substance secondary to a ballistic trauma. The maxillary defect was classified M1M3 according to the classification of Benateau et al. [5]. Examination showed a class III malocclusion according to Angle classification. It was due to maxillary retro-positioning and relative mandibular prognathism associated with deep nasolabial folds mimicking premature aging (Fig. 1A.B). The reconstruction of the maxilla had already been performed previously with a fibula free flap and the nasal reconstruction using a frontal flap with bone graft. The patient had significant soft tissue retraction, which did not allow positioning of the flap in the ideal position based on aesthetic and implant criteria. A CT scan was performed for preoperative assessment (Fig. 2A.C). It was decided to achieve maxilla reconstruction by performing a sagittal distraction of the premaxilla.

### *Surgical technique*

An incision between the skin paddle and the vestibular mucosa was used followed by minimal dissection in a subperiosteal plane to conserve maximal blood and tissue supply for the fibular bone. Intra-oral alveolar distractor was used (TRACK Distractor 1.0 mm, Art. 51-525-15-09, KLS Martin Group, Gebrüder Martin GmbH, Tuttlingen, Germany) with its recommended screws (Fig. 3). The device was positioned before performing the osteotomy to check the good congruence between the distractor and fibular bone. The osteotomy was performed frontally in order to obtain a splint between the anterior part of the fibular bone, considered as the premaxillary region, from the posterior part. It was performed using a VarioSurg piezotome (NSK Europe GmbH, Eschborn, Germany). The fragment was carefully mobilized to minimize periosteal injury. The activation of the device was performed immediately after osteosynthesis to check the amplitude of displacement and the vector of distraction. The fibular fragment was repositioned to achieve bone-to-bone contact until the site is ready for active distraction. A tight suture closure using absorbable thread (Vicryl™, Ethicon, Johnson and Johnson, Issy les Moulineaux, France) was performed after washing the operative site. A section of suction tubing around the distraction activation screw was positioned, to protect the lip from any trauma. An antibiotic treatment with amoxicillin-clavulanic acid associated with appropriate oral hygiene measures, including mouth washing, was set up. The distraction rate was 0.3 mm per day during the first week and 0.9 mm per day during the following weeks. Activation of the device lasted for a total period of two months. The cleansing was performed before each activation and during the consolidation period until distractor removal. Weekly follow-up to check good healing was performed. Distraction began seven days after implantation of the device. Cone beam computed tomography (CBCT) acquisitions were performed at 3 months after the end of the distraction.

Partial disunion of the scar occurred two weeks after surgery with spontaneous healing obtained within a week. Exposure of the device was noticed five months after surgery (i.e. three months after the end of the distraction protocol).

An esthetic variation was also obtained with better projection of the upper lip and closure of the nasolabial angle after the sagittal distraction and deepening of the oral vestibule (Fig. 1C).

A satisfactory total distraction of 7 mm was obtained and satisfactory bone callus in ossification phase was observed on the CBCT acquisitions (Fig. 2B,D). The distractor device was thus removed 5 months after the end of the distraction protocol. Unfortunately, the implants have not been set up for a financial problem.

## **Discussion**

The maxilla is the major structure of the midface, it is essential for esthetic and functions of the midface. It is a tooth-bearing area, a supporting structure for midfacial soft tissues and a separating barrier between oral and sinonasal cavities [6]. Maxillary reconstruction must restore all the bone, skin and mucosal structures. In case of maxillary loss of substance with delayed rehabilitation, the presence of scarred soft tissues is an obstacle to surgical reconstruction [7]. Fibular free flap has become the choice of many surgeons for reconstruction of major maxillary defects since it was described by Hidalgo in 1989 [8].

Distraction osteogenesis is a surgical technique used for generating new bone between bone segments gradually stretched [9,10]. It was originally developed for the lengthening of long bones and applied to the human maxillofacial region for the first time in 1992 by McCarthy et al. [11]. In addition to bone apposition, distraction osteogenesis leads to a simultaneous expansion of the soft tissues: vessels, nerves, mucosa, skin, and periosteum [12]. The regeneration of dentoalveolar support with distraction osteogenesis is called alveolar distraction

osteogenesis (ADO). Many studies reported applications of ADO in reconstructed mandibles and maxillae [10,13,14].

To our knowledge, no description of sagittal distraction osteogenesis of fibular free flap for maxillary reconstruction using intraoral device can be found in the international literature. Only one paper describing the same technique with the use of external device can be found [7]. The authors describe two cases of multiplanar distraction osteogenesis of fibular free flap with a rigid external distraction device with miniplate-based anchorage on the fibula and a head frame retained with titanium pins to the outer table of the skull [7].

In the present case only the anterior part of the fibular free flap, corresponding to the premaxillary region, was distracted. It allowed the preservation of the periosteum of the posterior parts of the flap which is considered as essential for vascular supply [10].

No standardized protocol for vertical alveolar distraction concerning its latency, rhythm and consolidation period is described in the literature [10]. In the present case, a latency period of 7 days was observed before starting the activation of the distractor. The latency period is usually comprised between 7 to 10 days for vertical alveolar distraction in reconstructed jaws [10]. It is usually shorter (4 to 5 days) in cases of maxillary advancement [9]. But immediate activations are also described [15]. This latency length is usually considered as necessary to obtain a good wound healing of the intraoral incision [9].

In the present work a supplementary precaution was taken with the use of a small distraction rate during the first week of distraction (0.3mm per day) to promote mucosal healing. Then the distraction protocol was performed with a standard distraction rate (0.9mm per day) for a total period of 2 months. This is in accordance with the distraction rates usually described which range from 0.5 to 1mm per day for reconstructed or native jaws [10].

In the present case a consolidation period of five months was observed after the end of the distraction protocol. A shorter consolidation period of 3 months is usually found in comparable

cases in the literature[9,10]. A longer consolidation period has been awaited in the present work since bone consolidation had not been observed at the 2 months CBCT imaging.

Sagittal alveolar distraction osteogenesis of a fibular free flap is a simple and reliable surgical technique to obtain good rehabilitation of a loss of substance of the maxilla and the corresponding soft tissues.

### **Disclosure of interest**

The authors declare that they have no conflicts of interest concerning this article.



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## Captions to illustrations

Figure 1: A. Photograph in frontal view of the patient; B. Photograph in profil view showing class III malocclusion according to Angle classification by maxillary retro-positioning; C. Photograph in profil view showing an esthetic variation with better projection of the upper lip and closure of the nasolabial angle after sagittal distraction and deepening of the oral vestibule

Figure 2: Imaging reports. A. preoperative CT scan in axial section; B. preoperative CT scan in sagittal section; C. CBCT 3 months after the distraction in axial section; D. CBCT 3 months after the distraction in sagittal section.

Figure 3: Intraoperative view of internal alveolar distractor TRACK 1.0 of KLS-Martin after osteosynthesis and preliminary activation of the device





