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Reconstructive

Tips to Virtually Plan Your Free Scapula Flap

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Summary: The use of virtual surgical planning (VSP) and computer-aided design and manufacturing to assist in osseous reconstruction has become the standard of care in head and neck reconstruction. The use of the free fibula flap with VSP remains the most common flap for osseous reconstruction, and as such, it is well described in the published literature. The scapular free flap (SFF) based on the angular branch has not yet garnered the same attention. The popularity of the SFF osseus head and neck reconstruction is increasing due to the flaps' inherently different properties and indications it can fulfill; the natural curvature of the bone, the reduced incidence of atheroscelerosis in the donor vessels and the earlier postoperative mobilization of the patient. In the preoperative planning process, the SFF presents several unique challenges and considerations that differ from the free fibula flap. It is important for surgeons already using, or considering using the SFF, that VSP is used correctly to achieve optimal outcomes. The authors aim to describe and clarify aspects of VSP use in SFF reconstruction in the head and neck area with a specific focus on: (1) The perforator-like vascular anatomy of the scapula; (2) How to maximize the shape of the scapula to minimize osteotomies; (3) Fine-tuning of scapula osteotomies on side table; (4) How to plan cutting guide placement and fit on the scapula. The authors hope that this article will help reconstructive microsurgeons plan and perform the SFF in conjunction with VSP.
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CONCISE PRESENTATION OF UNIQUE IDEA, INNOVATION, OR TECHNIQUE

There are anatomical points of the scapular free flap (SFF) that must be considered during virtual surgical planning (VSP). The descending branch of the circumflex scapula anastomoses with the angular branch of the thoracodorsal artery, which supplies the scapula tip.[1] There is some variability in the subscapular system, but the entry point of the angular artery is consistently located on dorsal surface of the inferior angle of the scapula tip,[2] which must be included in the planned area of bone harvest. The lateral scapula is composed of thick corticocancellous bone, and is preferred over the thin, cortical medial bone.[3] The SFF and fibula free flap (FFF) have an average bone height exceeding the minimum 7 mm for safe dental implantation.[4] The bone quality in the scapula is spongy in comparison with the cortical nature of the fibula.[5] This has implications for bone healing and dental implantation. Herein, we describe four relevant aspects to be considered when using VSP to plan an SFF, with an emphasis on the differences with the FFF.

The angular branch enters the scapula tip like a perforator entering the skin. The pedicle is not tethered to an adjacent fascia or septum. This means there are few limitations to the movement and position of the pedicle relative to the bone, unlike the FFF. The pedicle can be mobilized and moved freely to suit the reconstructive requirements.[6] In the SFF, the vascular pedicle travels in a perpendicular direction relative to the scapula bone and enters the bone along its lateral edge (Fig. 1). In the FFF, the peroneal pedicle travels in a parallel direction to the bone and must be carefully separated off the shaft of the fibula at the proximal osteotomy location. The accompanying skin paddle can be rotated over or under the bone due to the thin septum which permits this to happen, but its movement is limited by the tethering of the septal attachment.

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As a result of this perforator-like anatomy, the preoperative decision regarding which scapula to use as a donor is based on the shape of bone required rather than pedicle constraints.[7,8]

The SFF has a gentle concavity, which mimics the shape of the curved mandibular body. (**See figure, Supplementary Digital Content 1,** which displays a postoperative photograph of the scapula mimicking the mandibular body. **http://links.lww.com/PRSGO/D519**.) To recreate this angle with an FFF typically requires one osteotomy. Using the scapula tip to create this angle, osteotomies can be avoided. For mandibular reconstruction, the ipsilateral scapula is typically used. The flap should be planned to lie in a vertical position with the lateral edge of the scapula facing toward the neck (Fig. 2). This ensures the harvested pedicle will drape freely toward recipient vessels. The SFF can be used for short linear defects up to 8 cm.[9] The lateral border of scapula can be placed up to 9 cm without breaching the glenoid joint.[9]

Takeaways

Question: How to use virtual surgical planning to plan a scapula tip free flap.

Findings: The article presents useful tips and tricks for reconstructive surgeons.

Meaning: This article will be useful for those looking to start doing scapula tip free flaps.

For maxillary reconstruction, the SFF can be placed horizontally or vertically according to defect requirements. For hard palate defects, the SFF can be fixed in the horizontal position with the tip replicating the curve of the anterior alveolar crest. A separate latissimus dorsi muscle or a cuff of muscle attachment on the anterior surface of the scapula can be left to mucosalise, recreating the oral mucosa. For anterior maxilla defects involving both the orbital floor and the hard palate, the contralateral SFF is recommended so the tip can replace the most prominent point of the maxilla, (Fig. 3). An additional benefit is that the donor vessels can easily reach either the facial vessels or superficial temporal vessels.[10]

A distinguishing feature of the SFF VSP process is the application of the cutting guides on the bone. When harvesting the FFF, it is common practice to apply the cutting guides, perform the osteotomies and attach the reconstructive plates with the pedicle still intact. When harvesting the SFF in the supine position,[10] it is very difficult to apply the cutting guides in a tight space between the scapula and posterior chest wall with the pedicle still attached to the subscapular artery. The osteotomies are made without the cutting guides. We use a sterilized three-dimensional printed model of the desired scapula bone flap as a reference before cutting the scapula bone. It is recommended to harvest slightly more scapula than needed, which can be resected at final osteosynthesis relative to the native maxillary bone. After pedicle division,

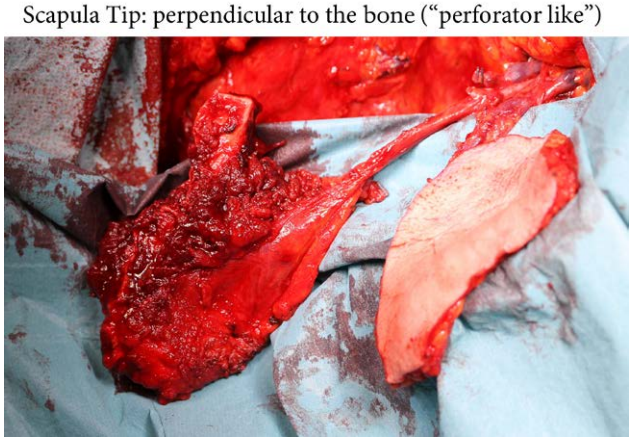

Fig. 1. Location of the vascular pedicle in relation to the bone.

Fig. 2. Ipsilateral scapula tip with lateral border of scapula placed caudal to the neck vessels.

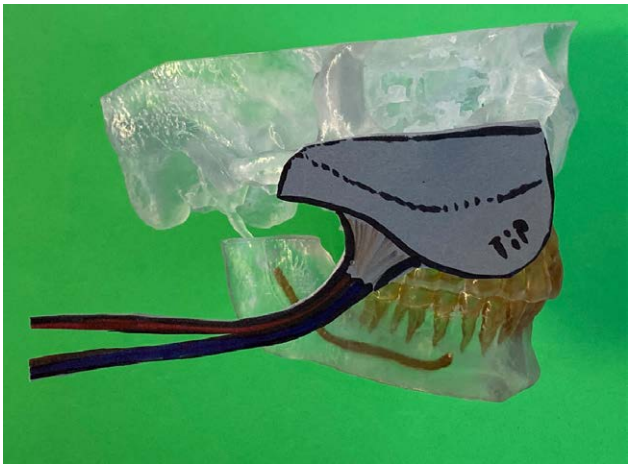

Fig. 3. Contralateral scapula tip to maxillary defect with vessels caudal to the neck.

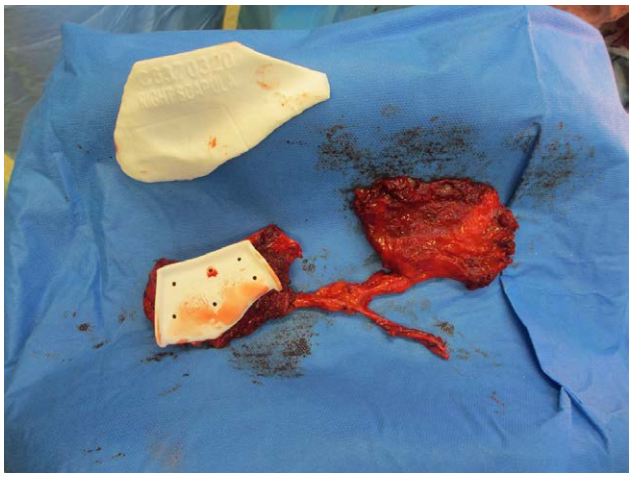

Fig. 4. Cutting guides and plating on the side table with slightly more bone taken than needed.

the guides can be applied to the bone on a theater side table for further fine-tuning osteotomies (Fig. 4).

The scapula has several muscle attachments, which must be divided, preserving a cuff of muscle to protect the periosteum. The teres minor and major attach superiorly. The serratus anterior attaches to the scapula tip. The subscapularis attaches on the anterior surface of the scapula and along its lateral margin. Due to this bulky muscle attachment on the scapula surface, in our institution, we use an offset between 3 and 5 mm so that the guides fit the bone snugly. (**See figure, Supplemental Digital Content 2,** which displays a photograph of the cutting guide. **http://links.lww.com/PRSGO/D520**.)[11] There is no offset routinely needed for the osteotomy guides on the FFF.

DISCUSSION

The SFF, based on the angular branch, is our first line osseous flap for bone defects less than 8 cm, where we can use the natural curvature of the scapula to avoid osteotomies. The SFF can be used for patients with significant comorbidities where significant soft tissue reconstruction is needed and in nonunion cases. The disadvantages of this flap are that it is difficult to achieve as accurate an osteosynthesis as with the FFF, due to the difficulty applying the cutting guides at the correct location and because of the soft tissue attachment along the scapula's lateral edge. The bone in the scapula is less cortical compared with the fibula. This fact needs consideration for achieving dental implant stability. There is no free flap that offers a perfect solution to all reconstructive requirements, but we believe this article will assist surgeons in maximizing the capabilities of this flap.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

1. Van Thienen CE, Seneviratne S. The angular branch of the thoracodorsal artery and its blood supply to the inferior angle of the scapula: an anatomical study. *Plast Reconstr Surg.* 2000;106:222–224.
2. Seneviratne S, Duong C, Taylor ID. The angular branch of the thoracodorsal artery and its blood supply to the inferior angle of the scapula: an anatomical study. *Plast Reconstr Surg.* 1999;104:85–88.
3. Moscoso JF, Keller J, Genden E, et al. Vascularized bone flaps in oromandibular reconstruction a comparative anatomic study of bone stock from various donor sites to assess suitability for enosseous dental implants. *Arch Otolaryngol Head Neck Surg.* 1994;120:36–43.
4. Nguyen S, Tran KL, Wang E, et al. Maxillectomy defects: virtually comparing fibular and scapular free flap reconstructions. *Head Neck.* 2021;43:2623–2633.
5. Lanzer M. Gander T, Grätz K, et al. Scapular free vascularised bone flaps for mandibular reconstruction: are dental implants possible? *J Oral Maxillofac Res.* 2015;6:e4.
6. Nishimura T, Furukawa M, Koshima I. A targeted problem and its solution scapular bone flap harvests of patients in a supine position. *Laryngoscope.* 2004;114:1130–1132.
7. Al Deek NF, Tsao CK, Wei FC. The surgeon's fist with the thumb up to guide the design and inset of the osteoseptocutaneous fibula flap in mandibular reconstruction. *Plast Reconstr Surg.* 2017;140:1259–1262.
8. Kusumoto J, Hashikawa K, Sakakibara A, et al. Strategy for preventing skin paddle necrosis in mandibular reconstruction with free fibula osteocutaneous flap. *Microsurgery.* 2022;42:451–459.
9. Dowthwaite SA, Theurer J, Belzile M, et al. Comparison of fibular and scapular osseous free flaps for oromandibular reconstruction a patient-centered approach to flap selection. *JAMA Otolaryngol Head Neck Surg.* 2013;139:285–292.
10. Gomez-Martinez de Lecea C, Schweizer R, Thor A, et al. Five-step scapula tip flap harvesting for oromaxillofacial defects reconstruction. *Plast Reconstr Surg.* 2022;150:416e–418e.
11. Kass JI, Prisman E, Miles BA. Guide design in virtual planning for scapular tip free flap reconstruction. *Laryngoscope Investig Otolaryngol.* 2018;3:162–168.