Lateral Border and Scapular Tip Free Flaps: Old School vs. New School

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ABSTRACT

BACKGROUND: Free tissue transfer from the subscapular system provides a wide array of options for both soft tissue and bony reconstruction. When bone stock is required for head and neck reconstruction, both the lateral scapular border free flap (LSBFF), supplied by the circumflex scapular artery, and the scapular tip free flap (STFF), supplied by the angular artery, are excellent options.

METHODS AND RESULTS: Issues with positioning had previously prevented the widespread use of these bony subscapular system flaps. However, through the use of a Spider Limb positioner, current clinical practice patterns allow for two team approaches in both of these free flaps. The following pictorial essay compares and contrasts the specific positioning and harvesting technique used for both the LSBFF and STFF, while discussing the clinical advantages and drawbacks of each.

CONCLUSIONS: Both the lateral border scapula and scapular tip free flaps provide excellent bone stock for head and neck reconstruction. By positioning with currently available technology, both can of these free flaps can be harvested through a two team approach.

INTRODUCTION

The subscapular system is an important anatomic network for free tissue transfer to the head and neck. Since its first descriptions over 35 years ago, several institutions have used free tissue from this area as a primary means of performing osseous reconstruction.[1,2] Since its inception, the majority of studies focused on the lateral scapular border free flap (LSBFF), supplied primarily from the periosteal perforators of the circumflex scapular artery.[3] Subsequent investigations have described the angular artery as an independent vascular supply to the scapular tip.[4,5] Although this was initially used in some cases to augment the blood supply of the bone stock, the majority of recent reconstructive literature has focused on the scapular tip free flap (STFF) supplied solely by the angular artery.[6,7]

After the adoption of the fibula free flap, the LSBFF was supplanted as the reconstructive option of choice for bony defects. This was largely due to the issues surrounding short pedicle length, limited mobility of the soft tissue component, and need for intra-operative re-positioning. The introduction of the STFF eliminated many of these issues by leveraging the thoracodorsal system to provide a much longer pedicle and independently mobile soft tissue components.[7] However questions remained surrounding optimal positioning and the ability to perform a simultaneous two team approach. Early descriptions for harvest of the subscapular system required sequential surgery with intra-operative repositioning.[8] However, current positioning systems allow for two team approaches to the harvest of both LSBFF and STFF.[9,10] The following pictorial essay describes the positioning pearls, operative technique, and clinical considerations for each of these free flaps. Institutional approval for this study was provided through the University of Michigan with informed consent obtained from all depicted patients.

POSITIONING

First described by Stevens et al,[9] use of the Spider Limb positioner (Smith and Nephew, Andover MA, USA) for harvest of the subscapular system has been adopted at many institutions. This has allowed for two team approaches for a variety of free flaps from this system. However, the majority of these studies do not distinguish between the optimal harvesting position for the LSBFF and STFF. Both require the patient to be on a bean bag in a semi-decubitus position, but differ in terms of the arm positioning used by the Spider Limb.

Lateral Scapular Border

When harvesting the LSBFF, the extent of the semi-decubitus position is dependent on the laxity of the scapula. For younger patients with more skin laxity, the scapular border is generally more easily palpable. **Figure 1A** demonstrates the position of the arm during retraction with the Spider Limb positioner. The forearm and upper arm are extended in parallel, while the entire arm is held approximately 30^0 above the horizontal plane of the patient's body. The thumb is pointed towards the patient to help avoid brachial plexus injury. There is ample room for the ablative team to perform concurrent surgery on the contralateral side of the head and neck. With slight alterations in arm positioning, concurrent surgery on the ipsilateral side is also possible, however this may create some limitations during the posterior cuts of the harvest. **Figure 2A** demonstrates the vantage point of the reconstructive surgeon. The scapular border should be easily palpable in this position. The initial anterior incision is integrated into a vertical parascapular skin paddle, along the posterior border of the latissimus dorsi muscle, encompassing the triangular fossa at its superior aspect.

Scapular Tip

The position of the arm during harvest of the STFF is shown in **Figure 1B**. Using the Spider Limb positioner, the arm is abducted 90^0 from the patient's flank. The forearm is bent at a 90^0 angle relative to the upper arm while being held in a straight vertical position. Here, the thumb is also pointed towards the patient to avoid a brachial plexus injury. This configuration provides the ablative team more space at the resection site compared to the optimal LSBFF harvest position. Here, concurrent surgery can be performed on the ipsilateral side of the head and neck without impediment. **Figure 2B** demonstrates the reconstructive surgeon's point of view. The scapular tip should be easily palpable in this position along with the anterior border of the latissimus dorsi muscle. The initial incision is designed along the anterior border of the latissimus dorsi muscle to allow posterior retraction of the muscle and subsequent exposure of the thoracodorsal system.

OPERATIVE TECHNIQUE

Lateral Scapular Border

First, the triangular fossa, located at the junction between the long head of the triceps muscle, teres major, and teres minor is palpated and marked. As shown in **Figure 2A**, a vertical parascapular skin paddle is designed, overlying the scapular border, the teres major muscle, and encompassing the triangular fossa at its superior aspect. This ensures that the descending cutaneous branch of the circumflex artery, which travels inferiorly from the triangular fossa, is captured within the skin paddle. A vertically oriented paddle is easier to harvest in this position, as the horizontal branch goes quite medial and the exposure is limited. **Figure 3A** demonstrates the relationship of the underlying muscles seen during the parascapular skin paddle elevation. Once the initial anterior skin incision is made, dissection to the underlying muscle is done to

identify the latissimus dorsi and teres major muscles. After identifying the posterior border of the latissimus dorsi, it is reflected anteriorly to reveal the entirety of the teres major muscle and the scapular border. Dissection posteriorly along the teres major reveals the descending cutaneous branch of the circumflex vessels. This is done in a subfascial plane to protect the descending branch and ensure it remains within the overlying soft tissue of the parascapular skin paddle (which is elevated as an axial flap). Once the vascular pedicle of the skin paddle is identified, blunt dissection over the pedicle and into the triangular fossa is done to isolate the teres major muscle and divide it. Remnant teres major muscle at the inferior aspect can be thinned and removed as needed. This provides access to the lateral border of the scapula bone, as seen in **Figure 4**. When soft tissue is desired, back cuts on the parascapular skin paddle can then be made, freeing it off the deltoid, triceps, and teres minor muscles. Small periosteal perforators superior to the junction of the descending cutaneous branch and descending scapular branch of the circumflex vessels are then clipped to free the scapula for bony cuts. Once the desired bone stock is measured, the soft tissue overlying the bone cuts (subscapularis, infraspinatus, teres minor) is dissected away from the lateral scapula border. Bone cuts are then made with a reciprocating saw.

Scapular Tip

The anterior border of the latissimus dorsi muscle is first palpated, approximating the location of the initial anterior incision (**Figure 2B**). Once this incision is created the anterior border of the latissimus muscle is identified and separated from the underlying serratus anterior muscle and chest wall. Once on its medial aspect, the latissimus dorsi muscle is reflected posteriorly (**Figure 3B**). An avascular plane between the latissimus dorsi and the chest wall allows for blunt dissection and quick identification of the thoracodorsal artery. The latissimus

branch of the thoracodorsal artery is then traced proximally to isolate the angular branch that travels to the scapular tip. Continued pedicle dissection reveals the circumflex and subscapular vessels. With this full exposure (seen in **Figure 5**), soft tissue cuts are made to partially transect the teres major at the proximal portion of the desired bone stock. Similarly, distal cuts to separate the serratus anterior at the scapular tip are performed. Medially, soft tissue cuts through the subscapularis are also created down to the medial edge of the desired bone. Once the appropriate bone stock is isolated from the surrounding soft tissue, the bone is freed using the reciprocating saw. If a soft tissue component is desired, back cuts can be made through the latissimus dorsi and its overlying skin. Less commonly, the circumflex scapular branches can be traced and a parascapular paddle can also be elevated.

DISCUSSION

The ability to harvest bone from the subscapular system has made it an important tool in the reconstructive armamentarium. Although there are subtle differences in positioning between the LSBFF and STFF, simultaneous two-team approaches are possible in both cases with the Spider Limb positioner. The orthogonal positioning of the arm during STFF harvest provides the ablative team with ample room on the ipsilateral side of the neck. In contrast, the more posterior access that is needed for the LSBFF is achieved by holding the arm in a more extended and medial position. Although this limits access to the ipsilateral neck, concurrent surgery for a majority of the case is still possible. However, the slight curvature of the LSBFF and orientation of the pedicle make it ideally suited to reconstruct the contralateral mandibular body.[11] This allows full access to the operative field for the ablative team during harvest.

Our group has consistently adopted the Spider Arm for both the LSBFF and STFF, and provides a number of advantages, including the ability to finely reposition, elimination of an assistant to hold the arm, and a two team approach to improve surgical efficiency.[9] Disadvantages include both the cost of the Spider Arm and need to learn new instrumentation, although many institutions already employ this device for orthopedic surgery. Traditional lateral decubitus and semi-lateral approaches using a Mayo stand have been well described in the literature,[2,8,12] and these positioning techniques have no associated device cost. However, these approaches do not allow for a full two team approach while also requiring an assistant to hold the patient during the majority of the dissection. Importantly, it may also require a second prep and draping of the patient during re-positioning.

Positioning aside, there are important clinical considerations when using the LSBFF or STFF. Two of the major limitations of the LSBFF are the short pedicle length and difficult geometry when used in conjunction with a separate skin paddle. The periosteal perforators of the descending scapular branch and axial pattern of the descending cutaneous branch limit orientation options for the parascapular skin paddle. In comparison, the STFF has a much more independent soft tissue paddle and a pedicle length that routinely reaches 15cm.[6,7] However, the thickness of the STFF skin paddle can be limiting in patients with increased body mass index. In these cases, the musculofasciocutaneous latissimus dorsi segment may be too thick to resurface certain oral cavity defects. Thinning these segments is also difficult due to the random location of cutaneous perforators from the latissimus dorsi muscle to overlying skin. The parascapular skin paddle of LSBFF is often thinner and more easily shaped to a given defect. When considering functional outcomes, both the LSBFF and STFF harvest result in some objective

limitations to shoulder movement. However, there is no significant difference between the two sites and in most cases subjective morbidity is limited.[13]

CONCLUSIONS

The LSBFF and STFF are important options for bony reconstruction. The bone stock of the LSBFF may be more robust, but the increased pedicle length and improved soft tissue mobility of the STFF have made it the bony option of choice in the subscapular system. In both cases, widespread adoption had historically been limited by positioning issues. However, recent advancements have allowed both of these free flaps to be harvested using two-team approaches.

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