The Serratus Anterior Scapular Flap –
A New Osteomuscular Unit*

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Summary. Dye and contrast studies of 32 scapular regions have demonstrated a reliable blood supply of the scapula based on a terminal branch of the serratus anterior artery. This artery, called the “angular branch” in our paper, provides the vascular supply of a new osteomuscular flap. The anatomical study also illustrated the relationship between this angular branch and the circumflex scapular and dorsal scapular arteries. The features of this flap are as follows: 1) a constant and long pedicle based on the subscapular-thoracodorsal axis; 2) the possibility of a bony shape similar to the anterior part of the mandible and the hard palate, the maximum length being 22 to 26 cm; 3) the malleable muscular component, suitable for cover of adjacent defects alone or in combination with other regional flaps. The use of the flap for partial reconstruction of the hard palate is described.

Key words: Serratus anterior muscle – Scapula – Myo-osseous flap – Head and neck reconstruction

Cadaver dissections with dye and contrast studies were carried out in order to demonstrate the vascular relationships between the muscle and bone. Anatomical findings and a clinical application are presented.

Materials and Methods

Thirty-two scapular regions were dissected in sixteen fresh cadavers (11 males, 5 females, aged 2 months to 87 years). The cadavers were turned on their side with the arm abducted, a curved incision was made from the axilla to the angle of the scapula. The thoracodorsal and serratus anterior vessels were identified. Methylene blue was injected into the thoracodorsal artery after ligature of the branch to the latissimus dorsi. X-ray films were obtained after injection of 50% barium sulphate suspension.

The muscles were removed from the scapula and the length and thickness of the axillary and medial borders and the inferior angle were measured. These measurements were then related to the age and sex of the cadaver.

Results

The Scapular Bone

The scapula is a thin triangular bone with costal and dorsal surfaces, three borders (superior, medial and axillary) and three angles (superior, inferior and lateral). The bone dimensions vary according to sex, the scapula of the male being larger in all aspects, (Table 1). Cancellous bone is present at the medial and axillary borders as well as at the inferior angle. The midportion of the bone is formed by very thin compact cortical bone.

The Serratus Anterior Muscle

The serratus anterior is a thin fan shaped muscle, arising from the outer surface of the anterior part of the first eight to ten ribs and inserting on the scapula at different levels: some fibers reach both...
Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Length</th>
<th>Thickness</th>
<th>Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axillary border</td>
<td>13.4 cm (12-14.5)</td>
<td>10.6 mm (8-12)</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>12.4 cm (11-14)</td>
<td>8.4 mm (6-10)</td>
<td>F</td>
</tr>
<tr>
<td>Medial border</td>
<td>11.1 cm (10-12)</td>
<td>2.9 mm (2.2-4)</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>10.9 cm (10-12)</td>
<td>2.5 mm (1.5-4)</td>
<td>F</td>
</tr>
<tr>
<td>Inferior angle</td>
<td>7.7 mm (6.5-10)</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.2 mm (6-9.5)</td>
<td>F</td>
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Angular degree

42° (38°-46°) M

36° (35°-40°) F

sides of the inferior angle, while others insert onto the costal aspect of the medial border of the scapula and the superior medial angle.

The blood supply is provided by the serratus anterior branch of the thoracodorsal artery. Accessory vascularization from the dorsal scapular artery can also be found. The motor innervation is by the long thoracic nerve (Bell’s nerve). The function of the muscle is to hold the scapula against the thoracic wall and to allow full abduction of the arm. It is also an accessory respiratory muscle.

The Vascular Supply

The serratus anterior artery was always found to be a division of the thoracodorsal artery: as one branch only in 75% (24/32) of the cases and two branches in 25% (8/32). The artery arises 3 to 6 cm lower than the latissimus dorsi branch. It then runs subfascially on the anterolateral surface of the muscle, parallel to the long thoracic nerve, and gives two or three terminal branches. One of these runs towards the axillary border and inferior angle of the scapula. This branch has a mean length of 5.8 cm (2.8 to 8 cm) and a diameter of 1 mm. The artery is always accompanied by two veins (Figs. 1 and 2).

The distance between the entrance of the branch into the Teres Major muscle and the inferior angle of the scapula varies from 3 to 5 cm.

This branch, called the “Angular branch”, provides the blood supply to the Teres Major, the Subscapularis and the Serratus Anterior muscles, and participates in the anastomotic arch of the lower part of the scapula, with the circumflex scapular artery at the axillary border and the dorsal scapular artery at the medial border (Fig. 3). This vascular network lies deeply in the muscles at the periosteal level and gives the blood supply to the bone by multiple small perforating arteries.

Surgical Technique

The patient is turned on his side with the arm abducted at 90°, a curved incision is drawn from the axilla over the inferior angle of the scapula to the spine. A fasciocutaneous flap is elevated over the scapula and the infraspinatus, rhomboid major and teres major muscles are identified.

The upper border of the latissimus dorsi is located. Some of the muscle fibers, inserting on the inferior angle of the scapula, are cut.

With the latissimus dorsi and the overlying skin retracted, the thoracodorsal vessels and their branches are easily identified.

After ligature of the branch to the latissimus dorsi, the serratus anterior artery is dissected out.

Flap elevation includes mobilization of the Serratus Anterior muscle, transection of the rhomboid muscle, 2 to 3 cm away from the medial border of the scapula, in order to preserve the descending branch of the dorsal scapular artery, and horizontal section of the infraspinatus and teres major muscle covering the bone. The bone surface is exposed and the bone cut.

The subscapularis and serratus anterior muscles are then transected.

After ligation of the branch to the latissimus dorsi, the serratus anterior artery is dissected out.

The inferior angle of the scapula is now totally free and the pedicle can be dissected proximally up to the subscapular artery.

The length of the pedicle can be 15 to 17 cm (Fig. 4). After transfer of the flap the donor site is repaired: the muscle bellies are sutured together over the free edge of the scapula and the skin is closed.

Case Report

A 57-year-old patient (Fig. 5) was admitted for hard palate reconstruction, 5 years after resection of the nose, upper lip.

Fig. 1. Cadaver dissection showing the scapula (SC) with teres major (T) and infraspinatus (I), serratus anterior (SA), latissimus dorsi (LD), long thoracic nerve (TH, N), thoracodorsal pedicle (TH, D), terminal branches for the serratus anterior muscle (the angular branch (AB) indicated with an arrow)

Fig. 2.