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Arterial supply and anastomotic pattern of the infraspinous fossa focusing on the surgical significance

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Summary The clinical significance of the muscular branch of the circumflex scapular artery (CSA) has been underestimated during surgery involving the scapular osteocutaneous free flap, while the suprascapular artery (SSA) is vulnerable to damage during internal fixation of a scapular fracture. This study aimed to provide navigational guidelines for the positions of the suprascapular and circumflex scapular arteries at the infraspinous fossa and to identify the anastomotic pattern. Scapulae were carefully dissected following injection of liquid silicone into the suprascapular and circumflex scapular arteries. The artery diameters and the distances between landmarks were measured. Scapulae were classified according to the anastomotic morphology of the arteries. The suprascapular and circumflex scapular arteries had mean diameters of 1.7 and 2.1 mm, respectively. The mean horizontal distance from the root of the spine to the suprascapular artery was 90.3 mm, and the mean distance between the suprascapular and circumflex scapular arteries was 45.5 mm. The circumflex scapular artery was positioned along the lateral border at 68.7% from the inferior angle. Practical navigational guidelines for the positions of the suprascapular and circumflex scapular arteries have been provided, with the anastomotic pattern classified into two types and two subtypes. The results

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of the present study will help reduce donor-site morbidity and damage to these arteries during surgery in the scapular region.

Introduction

The suprascapular artery (SSA) and circumflex scapular artery (CSA) supply the infraspinous fossa of the scapula region. Briefly, the SSA enters the infraspinous fossa passing through the great scapular notch (also called the spinoglenoid notch), and the CSA winds around the lateral border of the scapula. The cutaneous branch of the CSA passes through the triangular space and supplies the skin over the scapula, and the muscular branch of the CSA runs deep into the infraspinatus muscle and supplies the periosteum of the lateral border and the infraspinous fossa and muscles inserting into these regions.[1,2] It is also well known that the CSA is associated with the SSA by collateral circulation via the ascending branch of the CSA as well as the dorsal scapular artery (DSA) at the infraspinous fossa.[3–5]

The scapular osteocutaneous free flap has been widely used when reconstructing serious maxillary or mandibular defects. The flap is harvested from a donor site as a combination of the skin paddle over the scapula and the lateral border of the scapula as a bone graft including the vascular pedicles, the cutaneous and muscular branches of the CSA, respectively. The composite flap can be positioned at the recipient site in different three-dimensional spatial relationships.[1,2,6,7]

In order to design the optimal flap and reduce donor-site morbidity, numerous anatomical and clinical studies of the cutaneous branch of the CSA have investigated its branching pattern, vascular territory, and surface marking of the emerging point.[8–11] However, the clinical importance of the muscular branch has been overlooked, with few reports available on the detailed topographic anatomy of the muscular branch at the lateral border and the infraspinous fossa of the scapula. Although postoperative complications such as donor-site morbidity are infrequent, vascular variations of the muscular branch as well as the cutaneous branch are a potential risk factor for donor-site complications such as topographic ischemia. In addition, iatrogenic damage to the SSA and CSA is often reported during other types of surgery in the scapular region, such as open reduction and internal fixation of a scapular fracture.[5,12,13]

The present study aimed to identify the detailed arterial supply and anastomotic pattern of the infraspinous fossa focusing on the SSA and CSA and to provide navigational guidelines for surgery in the scapular region.

Materials and methods

Fifty-nine scapulae (30 right and 29 left sides) were obtained from 31 formalin-fixed cadavers (22 men and 9 women; mean age 72 years). The origin of the SSA and CSA was dissected, and liquid silicone (MICROFIL, MV-130 Red, Flow Tech, MA, USA) was injected into the two arteries after tying their origin to prevent retrograde silicone flow into the subclavian and axillary arteries. After allowing 6 h for the silicone to harden, the scapula was separated from the cadaver by detaching the glenohumeral and acromioclavicular joints to make the dissection and measurements more convenient. The belly of the infraspinatus and teres minor muscle was carefully removed using sharp forceps, whereas the periosteum of the infraspinous fossa was preserved such that the positions of the intact SSA and CSA could be observed (Figure 1A). The following dimensions were measured:

- Diameters of the SSA and CSA
- Distances between landmarks (Figure 1B)
  - #1, Root of spine (RS)—Point of SSA (PS)
  - #2, Point of SSA (PS)—Point of CSA (PC)
  - #3, Inferior edge of glenoid cavity (IG)—Point of CSA (PC)
  - #4, Inferior angle (IA)—Point of CSA (PC)
  - #5, SSA—Point on the lateral border (PL)

The point of SSA and CSA indicated the point immediately after where the SSA passes through the great scapular notch and the point where the CSA winds around the lateral border of the scapula, respectively. The point on the lateral border was defined as the point closest to the SSA. The diameters of the SSA and CSA were measured at the point of SSA and CSA, respectively. The measurements were performed using a digital caliper (CD-15CPX, Mitutoyo, Kanagawa, Japan). Specimens in which fracture or distortion of the arterial position occurred during the dissection were excluded from the measurements. Independent-sample t-tests between both sides and sexes were performed using SPSS statistical software (version 19, IBM, NY, USA). The cutoff for statistical significance was set at $p < 0.05$. Images of the dissected scapula were superimposed to analyze the positional variations of the SSA and CSA using computer software (Sqirlz Morph 2.0; this software can be downloaded free from http://sqirlz-morph.en.softonic.com). In addition, the arterial distribution of the infraspinous fossa was classified according to the anastomotic pattern of the SSA and CSA. This study was performed in accordance with the principles outlined in the Declaration of Helsinki.

Results

The measurements did not differ significantly between the two sides; hence, their values were pooled. The diameter of the CSA was slightly larger than that of the SSA, but the