SCIENTIFIC ARTICLE

Vascular Perfusion of a Flexor Carpi Ulnaris Muscle Turnover Pedicle Flap for Posterior Elbow Soft Tissue Reconstruction: A Cadaveric Study

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Purpose The use of a pedicled flexor carpi ulnaris (FCU) muscle proximal turnover flap has been described previously for soft tissue reconstruction at the posterior elbow. Whereas consistent arterial supply to the FCU has been reported, the reliability of distal flap perfusion has not been confirmed. This study evaluated the vascular perfusion of an FCU turnover flap, based on the most proximal primary vascular pedicle that would permit a proximal turnover flap reconstruction to include the olecranon tip.

Methods In 12 fresh-frozen, proximal humeral human amputation specimens, the FCU flap was elevated from distal to proximal, preserving the most proximal primary vascular pedicle to the muscle belly that would permit flap coverage of the olecranon tip. The axillary artery was injected with India ink after ligation of radial and ulnar arteries at the wrist. After injection, each specimen was sectioned transversely at 0.5-cm increments to assess vascular perfusion of the muscle using loupe magnification.

Results The distance from the olecranon tip to the distal FCU muscle belly was 25.9 cm. The primary vascular pedicle that would facilitate creation of a proximal turnover flap was, on average, 5.9 cm distal to the olecranon tip. Perfusion of FCU muscle as measured distal to this primary pedicle was present in 50% to 100% of the muscle belly at an average of 8.9 cm beyond the pedicle. Perfusion of 25% to 50% of the FCU muscle belly was present at an average of 11.1 cm beyond the pedicle. Perfusion became less consistent (<25%) within the muscle belly at an average distance of 11.6 cm.

Conclusions Use of a proximally based, pedicled FCU muscle turnover flap provides a reliable option for soft tissue reconstruction at the posterior elbow. We observed consistent arterial perfusion of the muscle flap when preserving a proximal vascular pedicle 5.9 cm distal to the olecranon tip. *(J Hand Surg 2011;36A:246–251.*

Key words Flexor carpi ulnaris, flap, soft tissue reconstruction, elbow, olecranon.

Successful treatment of soft tissue deficits at the elbow presents many challenges. Complex wounds, particularly those involving exposed bone, tendon, or hardware along the posterior aspect of the elbow, may require local or distant flap coverage. Traditional methods of posterior elbow soft tissue reconstruction involve the use of rotational flaps including the anconeus, brachioradialis, and extensor carpi radialis muscles[1–6]; fasciocutaneous flaps[7–11]; regional flaps such as a radial forearm flap, posterior interosse-

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ous artery flap,[5,7,9–13] or a latissimus dorsi flap[12,13]; and free tissue transfer such as a gracilis muscle flap.[5] These fascial or muscular flaps may be difficult to mobilize and may involve potential morbidity including partial or complete loss of the flap and inconsistent soft tissue coverage of the olecranon.[5]

Recently, the flexor carpi ulnaris (FCU) muscle was assessed in a cadaver model as a proximal turnover pedicle flap to provide soft tissue coverage of the posterior olecranon with consistent coverage of wounds observed 2 to 4 cm in width proximally at the olecranon tip.[14] The FCU is superficially located, which makes it easily accessible for flap harvest, with minimal donor morbidity.[15] The muscle belly lies within the ulnar arterial angiosome and is perfused by both the ulnar and posterior ulnar recurrent arteries. These vessels provide several vascular perforators to the muscle belly; however, the dominant arterial supply based on pedicle size comes from the ulnar artery.[16] The posterior ulnar recurrent artery consistently provides 2 to 3 pedicles to the muscle within the proximal third of the muscle, whereas the ulnar artery consistently provides 2 major pedicles, proximal and distal, to the muscle belly. The more proximal pedicle enters the muscle at the junction between the proximal and middle third of the muscle belly.[16] The distal pedicle consistently enters the muscle belly at the musculotendinous junction.[16] Despite these studies of vascular anatomy, however, we are unaware of previous studies that have evaluated the distal extent of arterial perfusion of the FCU muscle when used as a proximally based turnover flap for coverage of the posterior elbow, as described in the anatomical study by Wysocki et al.[14] Confirmation of the preservation of distal muscle perfusion after flap dissection and elevation is critical to validate its use in soft tissue reconstruction for defects over the olecranon, because this distal muscle is reflected proximally to cover the proximal portion of the soft tissue defect. Our purpose was to identify the primary pedicle as the most proximal arterial perforator within the proximal muscle belly that would perfuse the muscle sufficient to permit the muscle to be elevated from its insertion at the pisiform and turned over proximally to provide complete coverage of the olecranon.

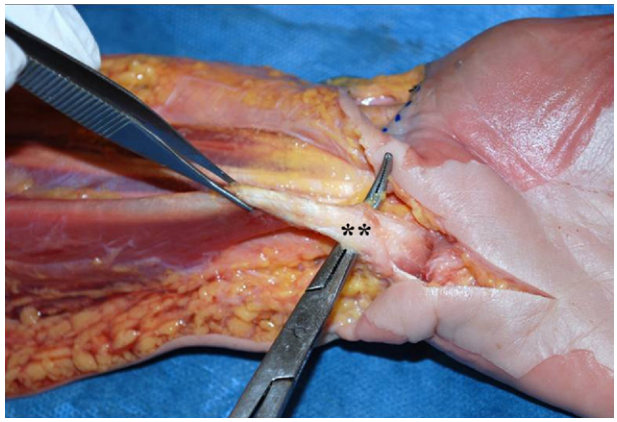

FIGURE 1: Dissection of the FCU tendon (asterisks) at its insertion. The distal extent of the FCU muscle belly may be appreciated here.

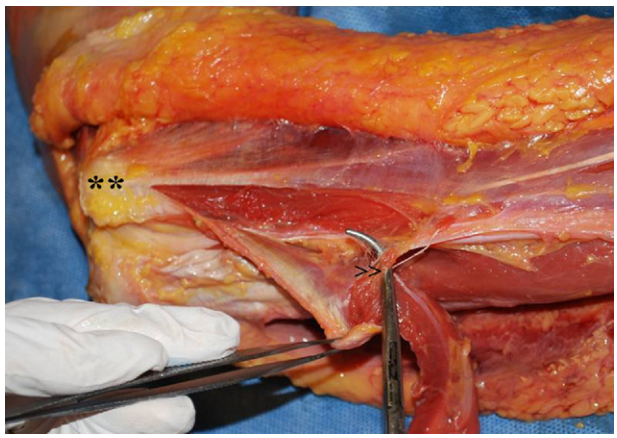

FIGURE 2: During distal to proximal elevation of the FCU, the most proximal primary pedicle to the FCU was identified (arrowheads), which permitted coverage of the posterior olecranon tip. The FCU origin is identified (asterisks).

MATERIALS AND METHODS

We obtained institutional review board approval for this study and used 12 fresh-frozen, transhumeral cadaveric amputation specimens. These specimens had no evidence of prior upper extremity trauma or surgical scars. The average age of the specimens was 68.3 years (range, 51–87 y) and specimens consisted of 7 right and 5 left extremities. Before use, the specimens were thawed to room temperature (21°C); all preinjection dissection and injection portions of the study were completed on the same day. We completed all dissections using 3.5× loupe magnification.

In each specimen, we exposed the FCU at its insertion at the pisiform (Fig. 1) and elevated it from distal to proximal along the medial aspect of the forearm; we did not carry out flap elevation proximal to the identified primary vascular pedicle (Fig. 2). This primary pedicle was identified by elevating the muscle belly from ulnar to radial, exposing the vascular pedicles from the ulnar artery and the posterior recurrent ulnar artery to the FCU. We examined pedicles that perforated the FCU and identified the largest, most proximal pedicle that permitted the creation of a proximal turn-