First Web-Space Reconstruction by the Anterolateral Thigh Flap

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Four patients with severe contracture of the first web space were treated with an anterolateral thigh perforator flap. The flap size ranged from 10 to 13 cm in length and from 7 to 8 cm in width. The donor site was closed directly and thinning of the flap was performed in all cases. All flaps survived and there were no re-explorations. Web space opening was maintained over the follow-up period. There was an average postoperative increase of the angle of the first web space of 61°. The thinned anterolateral thigh flap provides a pliable vascularized tissue for resurfacing the skin after release of severe contracture of the first web space and represents a reliable alternative to other flaps. (J Hand Surg 2006;31A:640–646. Copyright © 2006 by the American Society for Surgery of the Hand.)

Key words: First web space, anterolateral thigh flap, microsurgery, perforator flaps.

The presence of an adequate first web space is essential for thumb and prehensile hand function. The web contracture may be the result of damage to the skin, muscles, tendons, nerves, or bones of the first 2 rays, generally as a consequence of trauma, burn, infection, and neoplasia. If there is a severe adduction of the thumb it is necessary to perform a wide release of all contracted deep first-web structures, which results in a skin defect on both sides of the hand. In this situation a local flap is inadequate[1] and it is necessary to perform distant flap,[2–5] island flap,[6–13] or a free-tissue transfer.[14–17] With the recent development of perforator flaps some investigators have described the application of the anterolateral thigh (ALT) flap for reconstruction of the hand and upper extremity.[18–22] In these studies the ALT flap often was used in its entire thickness, leaving bulkiness that was unsuitable for particular areas of the hand such as the first web space.

This article describes the advantages of using the thin ALT flap for treating severe contracture of the first web space and compares this flap with commonly used techniques.

Surgical Technique

The ALT flap first was described by Song et al[23] in 1984 as a septocutaneous flap based on the descending branch of the lateral femoral circumflex artery. The lateral circumflex femoral system originates from the deep femoral vessels, passing transversely between the rectus femoris and the vastus intermedius muscles. The system is composed of 3 main branches: the ascending, transverse, and descending branches. The descending branch passes downward between the rectus femoris and the vastus lateralis muscles and sends several muscular and cutaneous branches to the anterolateral skin of the thigh.[24–26] These cutaneous perforators can be classified in septocutaneous vessels, which run in the intermuscular space between the rectus femoris and the vastus lateralis muscles or the musculocutaneous perforators that penetrate the vastus lateralis muscle after arising from the descending branch.[27,28] In the majority of cases the flap was supplied by musculocutaneous perforators; septocutaneous perforators supplied the flap in a small percentage of cases.[28–30] A suitable skin vessel usually is present; during 672 dissections Wei et al[28] reported only 6 cases of an absence of adequate musculocutaneous perforators or septocutaneous vessels, most of which presented during the early part of the learning curve.

A line is drawn between the anterior superior iliac spine and the superolateral border of the patella on the donor thigh with the patient in the supine position.[24,26] This line represents the muscular septum between the rectus femoris and the vastus lateralis

muscles.[30] The locations of the cutaneous perforators are mapped by a color Doppler examination.[31,32] The perforators usually are located in the midpoint of the line connecting the anterosuperior iliac spine with the superior lateral border of the patella.[30–33] The majority of skin perforators are located within a circle with a 3-cm radius centered at this midpoint[24,30]; the flap is designed over the presence of these perforator vessels and its long axis usually is parallel to that of the thigh, which facilitates skin closure and also includes the perforators. If a septocutaneous vessel arising from the descending branch is present then the flap can be harvested as a septal perforator flap.

If the septocutaneous vessels are absent, however, then the flap can be elevated as a muscle perforator flap with intramuscular dissection of the perforators. During this procedure care must be taken not to injure the tiny perforator; leaving a small cuff of vastus lateralis muscle attached to the perforator helps to protect it from damage.[34] The elevation of a muscle perforator flap requires meticulous dissection, which is different from the elevation of a septal perforator flap.[35]

The flap can be thinned to 3 to 4 mm almost uniformly over the entire flap except for 2.5 to 3 cm around the entry of the main perforator to the flap,[26,36] with the removal of a considerable amount of fatty tissue. Partial flap necrosis may be caused by an excessive defatting procedure.[34,37,38] Thinning should be performed before the vascular pedicle is separated.[39] The length of the pedicle is 8 to 16 cm, with a vessel diameter of greater than 2 mm, and the pedicle artery usually is associated with 2 concomitant veins.[28] A defect of less than 8 to 9 cm in width can be closed primarily at the donor site. The dissection time depends on the type of flap (septal perforator or muscle perforator) and surgical experience and ranges from 70 to 100 minutes; the flap is dissected with loupe magnification

Release of the severely contracted web space starts by incising the skin dorsally in a zigzag manner or with straight-line incisions. The fascial contractures are released and the origin of the first interosseous muscle from the first metacarpal is incised. The origin of the adductor pollicis from the third metacarpal also can be released to decrease the contractures[1]; tenotomy of the insertion of the adductor pollicis should be avoided because this procedure will weaken adduction considerably. A complete opening of the first web space is obtained to allow 90° of abduction of the thumb. To hold it in complete abduction we use, as suggested by other investigators,[14,40,41] 1 or 2 transverse K-wires inserted into the first and second metacarpals. In our practice the use of K-wires (usually 2 K-wires) does not produce any additional damage to the muscle[42] but we generally prefer to remove the wires after 3 weeks. A postoperative splinting program also helps to achieve a successful result. The splint is worn at night and is held in position for 3 months.[42] Once the web space has been released a pattern of the flap is prepared and this should be centered over the lateral aspect of the contralateral thigh where the perforators are located. When 2 teams work together the flap is harvested while the web space is being created simultaneously. The flap then is transferred from the donor site to the defect and it is inserted completely into the first web space, leaving only the area of the snuff box open in which to perform the anastomoses. The lateral femoral circumflex artery is anastomosed end-to-end to the dorsal branch of the radial artery and 1 venae comitans to the cephalic vein; vessel anastomoses were performed with an operating microscope.

Discussion

After release of severe contracture of the first web space the skin is deficient on both aspects of the hand: dorsal and volar. To cover this defect a flap (6 × 11 cm) is necessary to fill the web-space depth.[14,42] Different flaps have been described for resurfacing this defect, ranging from local to distant flaps.

The radial forearm flap[6–8] can be used as an island flap only when the palmar arch is intact. When the cause of web space contracture is direct trauma to the web or the palm of the hand then the palmar arch often is damaged. Moreover the poor aesthetic donor site outcome and the sacrifice of a major vessel preclude its use, particulary in female patients.

These problems can be solved partially by the retrograde fascia-fat forearm flap (which removes only the fascia and fat layers of the forearm tissue and leaves the radial artery and the forearm skin intact[43]) or by a prefabricated radial fascial flap (in which the skin graft is applied over the vascularized fascia 2 weeks before its transfer[9]). Nevertheless fasciocutaneous flaps are preferred in patients with defects involving the first web space[44]; the use of skin graft over the fascial flap could be a cause of secondary retraction.[42]

The posterior interosseous pedicle island flap has some advantages over the radial forearm flap: it is thinner, there is less morbidity at the donor site, and the major artery is preserved.[10–13] The greatest dis-

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