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The radial forearm flap without fascia and other refinements

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Abstract. The radial forearm flap is generally classified as a fasciocutaneous flap. The skin of the forearm is, however, supplied by branches from the radial artery which pierce the fascia of the forearm to course and branch subcutaneously. We have used the flap as a skin flap in 300 cases over 11 years. It is not necessary to take the fascia with the flap. Two other refinements of the forearm flap, also used over the past 11 years, are described. The venous drainage of the flap is simplified by utilising the usual anatomical confluence of deep and superficial veins at the elbow. Secondly, draping a large loop of pedicle in the neck during intraoral reconstruction enables a larger calibre vein to be used for the anastomosis, thus increasing its reliability.

Key words: Surgical flaps – Microsurgery – Forearm flap – Head and neck neoplasms

Since the introduction of the radial forearm flap by Song [1] it has become established as one of the most frequently employed skin flaps in the microsurgeons' repertoire. Its special place is in the head and neck, where it has become the best and most reliable way to reconstruct intraoral defects after cancer resection [2].

This paper discusses a number of refinements which have been introduced into the method of raising and insetting the flap, serving to make it simpler, quicker and less destructive to the arm.

Methods

The Head and Neck Unit at Princess Alexandra Hospital, Brisbane, Australia has been using the radial forearm flap as the workhorse for intraoral reconstruction since 1983. The senior author (DWR) developed the refinements outlined in the following text within one year of commencing its use. The flap has been raised in this fashion now in 300 cases over 11 years.

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Description of flap elevation and inset

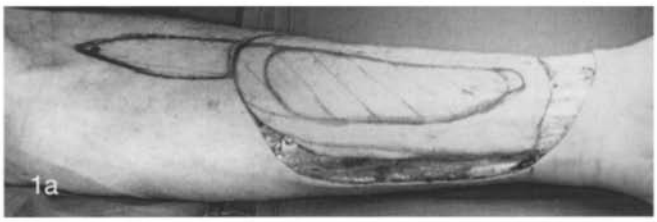
The arm is assessed clinically prior to the surgery for adequacy of the ulnar arterial circulation. At surgery, the flap is drawn out, centred over the distal radial artery. The limb is then completely exsanguinated with a firm elastic bandage, and a padded upper arm standard tourniquet inflated to 250 mmHg.

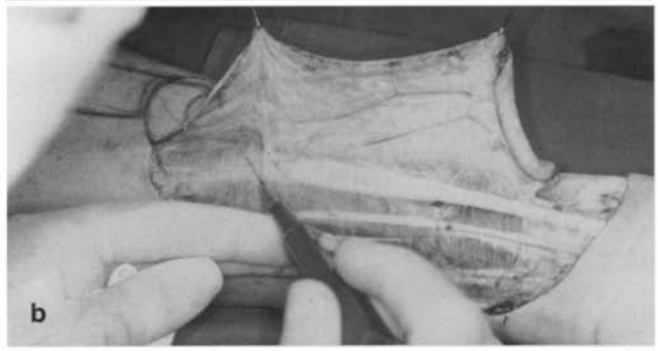
Flap elevation is begun by incising the skin around the flap border (Fig. 1a). A longitudinal incision is made from the proximal flap border to the elbow flexion crease. The flap is then raised in the subcutaneous plane superficial to the forearm fascia, from the lateral and medial sides toward the radial artery. As dissection crosses the flexor carpi radialis on the medial side whilst dissecting in a lateral direction, the fascia is incised at this point, taking care to preserve the paratenon on the underlying tendon (Fig. 1b). Exactly the same method is used on the lateral side. The dissection is superficial to the superficial branches of the radial nerve which are identified but always preserved uninjured. As dissection moves medially toward the radial artery, the brachioradialis tendon is noted deep to the fascia. The fascia is incised longitudinally over the brachioradialis. Next, the radial artery and its venae comitantes are identified at the distal end of the flap, raised and ligated. At this point the septocutaneous vessels running from the radial artery to the subcutaneous tissue are readily seen in the filmy septum between the tendons of flexor carpi radialis and brachioradialis.

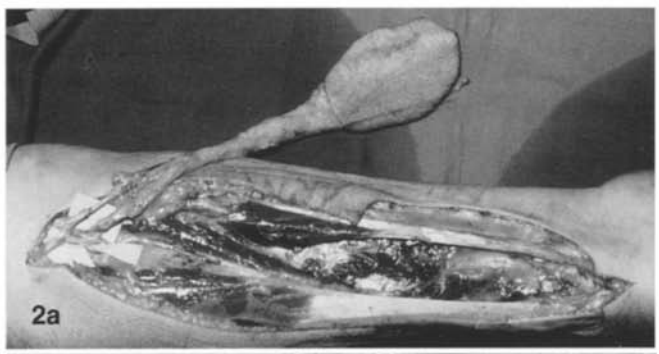
The radial artery lies between the tendons on the surface of flexor pollicis longus. Once divided distally it is easily lifted out with its accompanying veins, carrying the overlying intermuscular septum containing the septocutaneous vessels and the skin flap which has thus been raised as a cutaneous rather than a fasciocutaneous island. The radial vascular pedicle is then developed to the elbow (Fig. 1c).

At the elbow, the origin of the radial artery is identified and prepared for division. Normally the venae comitantes of the radial artery converge here and run into a larger superficial vein. The venous anatomy at the elbow may involve multiple connections between adjacent veins and look relatively complex, however it is always quite simple to trace the small venae comitantes into larger, more superficial vessels and finally into a single vein. If desired, the cephalic vein can also be raised with the flap and traced to the elbow. It is usually possible to trace the converged venae comitantes into this vein meaning that all three potential draining veins of the skin flap converge on and join a single large vein at or just proximal to the elbow [Fig. 2a, b]. Flap elevation is now complete.

The tourniquet is deflated allowing the flap to perfuse, and careful completion of hemostasis of the flap and pedicle is performed with cautery. The radial artery is then divided at its origin. The vein







is divided at its proximal limit of dissection. The flap is now free to be transferred to the intraoral defect.

Closure of the forearm defect is by split skin graft which is sutured into position. A firm bolus dressing is placed over it to apply pressure. The arm is firmly wrapped in layers of bulky cotton dressing and elastic bandage. A backslab is not used. As only the tendons of the flexor carpi radialis and brachioradialis, and the belly of the flexor pollicis longus are exposed beneath the fascia in the skin island defect, it is rational to limit wrist and thumb mobility for one week postoperatively to prevent shearing whilst the skin graft is taking. The fingers may, of course, be allowed to move, preventing stiffness.

The flap is transferred to the neck, where microvascular anastomosis is performed. Usually some form of neck dissection has already been done. In all cases the external jugular vein is preserved, allowing its use as the recipient vein if the internal jugular vein has been taken. The radial artery is usually anastomosed end to end to the facial or superior thyroid vessels. The vein is anastomosed to the common facial, internal or external jugular vein. The anastomoses are done before the flap is inset, which enables variation in positioning of the pedicle for the best view of the vessel lumen during anastomosis.

The flap is then passed to the defect and sutured into place. The pedicle, being long, may drape in a loop, but this will not compromise it. On the contrary, tension free anastomoses of large caliber vessels encourage excellent flow, the key to reliable microsurgery. After skin closure the surgery is complete.

Results

This method has been used in 300 cases over 11 years. Many of the cases have been performed by inexperienced Plastic surgery trainees, under the supervision of the senior author. Only 7 flaps have been lost. Overall flap survival has been 98%.

Donor site healing complications are rare. Occasionally the flexor carpi radialis tendon becomes exposed resulting in a delay in healing.

Discussion

The following modifications in the use of the radial forearm flap are introduced.

1. The flap is a cutaneous flap, not a fasciocutaneous flap (Fig. 1). Leaving the fascia on the forearm has dis-

Fig. 1a A radial forearm flap outlined and incised down to the forearm fascia. **b** The medial aspect of the flap after elevation above the fascia to flexor carpi radialis. The fascia will be incised longitudinally along the lateral edge of the flexor carpi radialis tendon, the plane of dissection then passing deep to the radial vascular bundle. On the lateral side the flap is similarly elevated, the fascia being incised along brachioradialis. All branches of the radial nerve are preserved. **c** The flap elevated. The only fascia taken with the flap is the strip between flexor carpi radialis and brachioradialis

Fig. 2a A radial forearm flap elevated in our usual fashion. **b** A closer view of the venous anatomy at the elbow of the flap pictured in Fig. 2a. Both venae comitantes of the radial artery converge, then course into a superficial vein in common with the cephalic vein (seen on the *left side* in the picture) which has been elevated to contribute to flap venous drainage. The radial artery is seen behind the vein connecting the deep to superficial drainage. This is the usual anatomical situation

tinct advantages. It allows easier preservation of the radial nerve. It covers the muscles and tendon providing a more suitable surface for grafting. The underlying muscles and tendons can also then glide normally under the fascia rather than adhering to the skin graft. Raising the flap is if anything technically easier without the fascia. Whilst dissecting the flap off the fascia it is clear that there are no vessels of significance running from within or deep to the fascia into the skin flap. Timmons [3] clearly showed that the forearm skin is supplied by vessels which run directly from the radial artery into the subcutaneous tissue, the fascia being irrelevant. Classification as a fasciocutaneous flap [4], suggests that this flap may only be reliably harvested with the fascia, but this is not the case. Indeed, this is an inhibiting belief which limits the versatility of the radial arterial pedicle, as the fascia and skin may be elevated as separate leaves of the same flap if both are required for different objectives.

2. All three potential flap draining veins (two deep and one superficial) are followed to the elbow where they become confluent (Fig. 2). This allows a single venous anastomosis in the neck of a large caliber vein which is certain to allow optimal flap venous drainage. The anastomosis is usually technically simple due to the size of the vein. The usual recipient veins are the common facial, the external jugular or the internal jugular. Gottleib et al. [5] reported this technique in 1993, and we can confirm that is has been consistently reliable over the 11 years of its use since its introduction in 1984.

3. The vascular pedicle in the neck is not shortened to "fit". There is no need for this at all, because the great deal of excess length allows it to simply drape in a loose loop. The artery will not kink due to its thick wall and internal pressure. The veins will not kink because they remain attached to the artery by loose areolar tissue. Shortening the pedicle results in the use of smaller caliber vessels for anastomosis, particularly the vein. This misses the point of taking the trouble to follow the venae comitantes into larger vessels near the elbow. The larger the caliber of the vessel, the easier and safer is the microsurgical anastomosis.

If the flap pedicle is cut to "fit", margin for error is reduced both in the vessel size to be anastomosed and in the possibility of making the pedicle excessively short, particularly if any anastomosis needs to be redone.

Conclusion

This method of raising and transferring the radial forearm flap has proven to be rapid, simple safe and reliable in 300 cases over 11 years of use. It is used as a skin flap on a long pedicle with large calibre vessels for anastomosis.

References

1. Song R, Gao Y, Song Y et al (1982) The forearm flap. Clin Plast Surg 9:21–26
2. Soutar DS, Ray AK (1992) The radial forearm flap in head and neck reconstruction. In: Jackson IT, Sommerlad BC (eds) Recent advances in plastic surgery 4. Churchill Livingstone, Edinburgh, pp 88–90
3. Timmons MJ (1986) The vascular basis of the radial forearm flap. Plast Reconstr Surg 77:80–92
4. Cormack GC, Lamberty BG (1984) A classification of fascio-cutaneous flaps according to their patterns of vascularisation. Br J Plast Surg 37:80–84
5. Gottleib LJ, Tachmes L, Pielet RW (1993) Improved venous drainage of the radial artery forearm free flap: use of the profundus cubitalis vein. J Reconstr Microsurg 9:281–284