CME

Homodigital reconstruction of the digits: The perspective of one unit

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ABSTRACT

Over a period of twelve years, a strategy of reconstruction of digital injuries has been evolved in our unit which now allows us to reconstruct most defects of the digits with more predictable and, hopefully, better results than in the 1980s. This policy includes much of the philosophy and techniques of earlier and contemporary surgeons, with local modifications which we believe are improvements of the earlier techniques and a few new procedures. Wherever possible, the extraordinary capacity of the digital skin to regenerate has been exploited and homodigital techniques of reconstruction are used to limit the total injury of the trauma and reconstruction to the damaged digit. The techniques which we currently use are summarised in this article.

KEY WORDS

Digital Reconstruction, Homodigital, Flaps.

INTRODUCTION

It is important to remind ourselves frequently of the aims of our surgery when faced with any injury of the hand requiring reconstruction. The primary goals of digital reconstruction are to preserve digital length and maintain full mobility of the digit while providing adequate protective cover of the deeper vital structures with soft tissue and skin of good quality. The skin must not only be durable but of adequate sensibility for the normal function of that part of that particular digit. Over and above these functional aspects of reconstruction, it is necessary to remember that our hands are used as organs of expression and are also an integral part of our appearance. In respect of appearance, the hand must, at very least, be sufficiently normal as to pass unnoticed. Many reconstructed hands which are a source of pride to the surgeon are doomed by their appearance to remain in the patient's pocket or hidden up a sleeve. The restoration of normal appearance depends, not only on the static appearance and posture of the hand, but also on its ability to move with fluidity, at least within the middle part of its normal range of motion. We can often achieve more aesthetic results in our reconstructions by minor modifications of the same reconstructive techniques, while losing nothing in terms of function.

In attempting to restore the optimum, it is important to recognise those techniques which are likely to prevent one achieving this goal. A shortened and/or stiff digit is usually disadvantaged functionally and cosmetically. In respect of the appearance, loss of the nail complex is a particular disadvantage, as is replacement of the digital skin by skin from elsewhere on the body which is different in colour, texture or thickness. For these reasons, we avoid terminalisation, encourage distal replantation or composite graft replacement, and also look to homodigital reconstruction whenever possible. Since movement is so important to both the function and the appearance of the digits, we avoid techniques of bandaging, splinting and skeletal fixation which prevent immediate mobilisation of the injured hand. In respect of both the appearance and the mobility of digits, time-honoured plastic surgical techniques of skin cover, such as cross-finger, thenar, groin and cross-arm flaps, which necessitate tethering the injured part to another part of the body, are undesirable, although occasionally necessary.

HOMODIGITAL RECONSTRUCTION

Homodigital reconstruction involves rearrangement of the soft tissues of the injured digit to achieve healing without seeking tissue for reconstruction from outside that digit.[1-3] This concept of reconstruction has definite advantages in meeting our goals of digital reconstruction. In particular, it reconstructs 'like with like' and avoids the creation of further scarring and morbidity elsewhere on the hand or body. While homodigital reconstruction is advantageous in these respects, the availability of donor tissues within an injured digit is obviously limited.

Perhaps the single most important and useful technique of homodigital reconstruction is the exploitation of the astonishing ability of the skin of the digits to close defects of considerable size by a combination of wound contraction and re-epithelialisation to give a cosmetic and functional result which cannot be bettered by any surgical procedure. This ability is well recognised and exploited in the management of digital tip injuries.[4-7] In a moist environment, in the absence of infection, this occurs relatively quickly, not only at the tips but also on the other aspects of the digits (Figure 1). Galen recognised this almost two millennia ago and the Smith papyrus describes several hundred means of achieving healing of skin wounds by covering them with mixtures of honey and animal fats, two millennia before Galen. Skin grafting of all defects of the digits has been a particular feature of plastic surgical management of hand injuries during the last fifty years which is often unnecessary and introduces further morbidity and delay of mobilisation. Healing open wounds under dressings avoids the creation of secondary donor sites and the patient can be encouraged to move if the bandaging is reduced to the minimum necessary to provide a moist environment for the raw area and the opportunity of dressing changes is used to encourage movement under water. This is both comfortable and helps debride the wounds. A further advantage of open wound management is that the oedema which is responsible for much of the long-term morbidity of digital injuries is not retained in the digit but leaks out of the open wound during early mobilisation. While the dogma of grafting has been dispelled for digital tip injuries without bone

Figures 1a & b: Loss of the epithelium of the lateral aspect of the middle finger as a result of infection in the hand of a 60 year old man (a), Same digital surface after healing by re-epithelialisation under moist antiseptic dressings for 4 weeks (b) exposure, it is, unfortunately, still common practice in many hand surgery units to graft all skin defects of other parts of the digits. It is sometimes convenient to use skin grafting on the hand, either because of the size of the defect (as in primary and secondary burn surgery) or in particular patients, including children. However, skin grafting demands a delay of mobilisation, and creates a second site of morbidity. Grafting on the palmar surfaces may result in skin cover of inadequate durability, although the experience of Dupuytren's surgery illustrates that skin graft placed on the palmar surface of the hand and fingers is surprisingly durable. Skin grafting onto the extensor paratenon usually results in tendon tethering with loss of digital flexion and also usually gives a poor cosmetic result. Therefore, consideration should be given to the benefits of healing of the skin by secondary intention before automatically moving to harvest a skin graft.

If skin can replace itself under moist antiseptic dressings, then operating to achieve skin cover, per se, is a dubious indication for surgery. However, we do require well-vascularised subcutaneous soft tissue to provide adequate protection of the vital deeper structures and much of our surgical efforts are intended to provide this cover. In most circumstances, we are committed to covering exposed vital structures by moving flaps. However, sometimes, this cover can be achieved by mobilising either the vital structure or the adjacent soft tissue minimally to cover short lengths of exposed tendon, artery or nerve. The fingertip with slight bone exposure lends itself best to this technique. The bone is nibbled back until it is covered by subcutaneous pulp tissue. The skin wound is then healed by secondary intention under moist antiseptic dressings. In doing this, we have accepted very slight digital shortening in exchange for a simple plan of management. In most other circumstances, we are committed to moving flaps. Using flaps is an option which has only been available for a relatively short period in history and sometimes circumstances dictate that we use a more historic approach. The patient illustrated in Figure 2 presented late with a burn of his little finger exposing the flexor tendons. Because his finger was almost completely immobile when first seen by us, our priority of treatment was to mobilise the finger and not to close the skin and soft tissue defect, as this surgery would have created further oedema and might have achieved a healed but uselessly immobile finger. We mobilised the hand aggressively while dressing the wound and, at six weeks, achieved a fully mobile hand with complete healing of the digital wound. Such situations are rare and this can only be done when there is no foreign suture material in the depths of the wound.

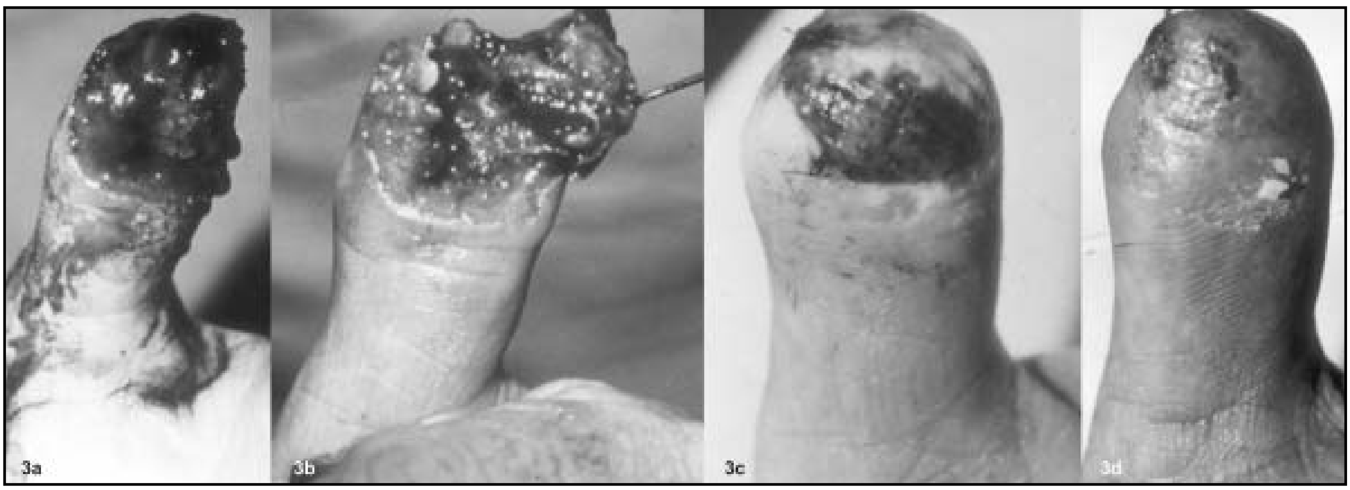
The use of homodigital flaps in digital reconstruction can be divided into reconstructions of tissue loss at the digital tips, on the palmar surface and on the dorsal surface of the digits.

RECONSTRUCTION OF THE DIGITAL TIP

The best option of treatment for complete amputation

Figures 2a & b: Exposure of the flexor tendon following a deep burn of the little finger of a 54 year old man who presented late with an almost totally immobile digit (a), Healing by re-epithelialisation under moist antiseptic dressings was achieved in 6 weeks while mobilisation was continued. A full range of motion of the finger was restored (b) of the tip of a digit is to replace the tip either as a microsurgical replantation or as a composite graft. We have found both techniques to be feasible, useful and economically reasonable under circumstances which vary with the injury and patient.[8-10] Unfortunately, the amputated part is often not available or too badly damaged to replace. As mentioned earlier, tip injuries with only skin loss or those converted to this by minimal bone shortening can be treated with moist dressings and early mobilisation.[4-7] Where the bone exposure is more extensive, flap cover is necessary to maintain digital length. In a ragged injury with significant bone exposure, there may be ragged lengths of soft tissues adjacent to the amputation stump which are adequately vascularised and of sufficient size to provide bone cover: these “opportunist flaps” can be used to convert the tip into a skin wound which can be healed by dressings (Figure 3). It is important when using this technique to ensure that the resulting reconstruction leaves a digital tip of good shape.

Where such opportunity for simple reconstruction of the digital tip does not exist, finger length can be maintained at that of the amputation by the use of flap reconstruction of the stump. The alternative of digital shortening may be expedient, for a variety of reasons, but is not a good operation in terms of hand function. Shortening permanently handicaps the digit, both by virtue of the loss of its length and because the end of the digit will be covered by skin from the digital shaft, which is less sensate than the original skin of the tip. The type of flap reconstruction which is appropriate depends on the extent and configuration of the tip loss. In those amputations which are oblique, the direction and degree of obliquity are also of significance to our choice of flaps. In transverse amputations beyond the mid-nail level and dorsal oblique amputations beyond the proximal nail fold, a Tranquilli-Leali or Atasoy flap works well.[11-12] The skin and the small fibres deep to it are cut and the deep attachments of the pulp to the distal phalanx released. The flap remains vascularised through small vessels, beyond the trifurcations of the digital arteries, within the subcutaneous pulp tissue lateral to the body of the flap. This flap can achieve the slight advancement needed to suture the skin to the nail in such cases. However, with greater losses of finger length and in palmar oblique injuries, even at this level, this flap is too small and cannot advance sufficiently to create a well-rounded digital tip with adequate bone cover. Of the multitude of flaps available for digital tip reconstruction, we favour advancement flaps based on the neurovascular bundles for reconstruction of defects confined to the distal phalangeal segment. Most alternative reconstructions either have no innervation or involve a neurorrhaphy which, in most adults, will create a digital tip with inadequate innervation for fine function. Many of the injuries for which these advancement flaps are being used are Palmar oblique with the amputation removing both skin and subcutaneous soft tissue distally to expose the bone but removing only skin proximally. We do not excise

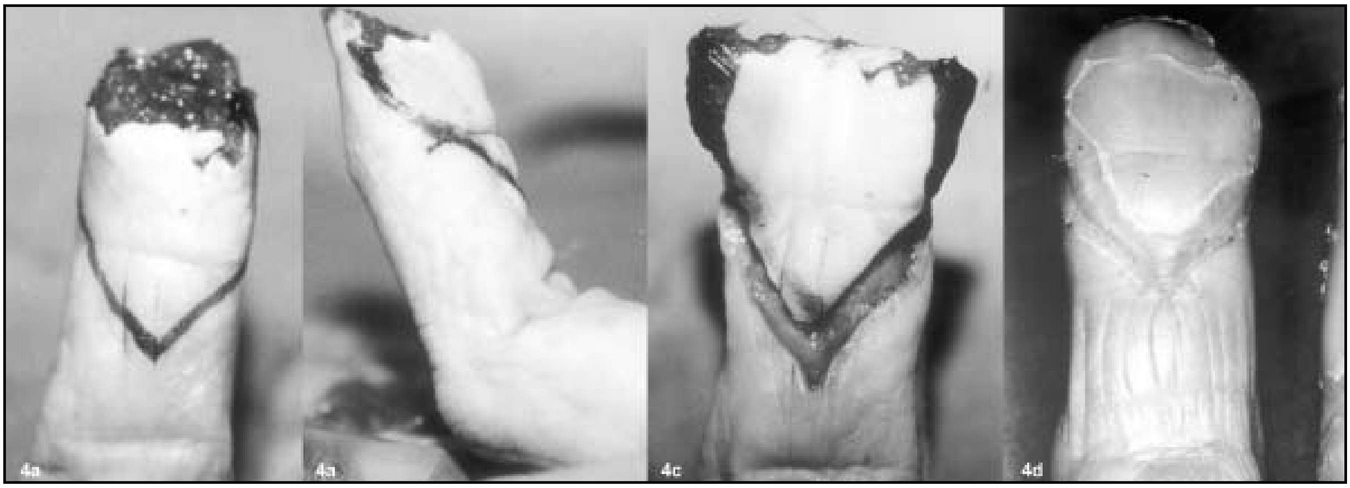


Figures 3a to d: A crush avulsion injury of the left thumb of a 53 year old man (a), The same thumb tip after debridement showing irregular but viable flaps of tissue at the digital tip which were used to achieve bone cover (b), Healing of the thumb under moist antiseptic dressings at three weeks (c), Complete re-epithelialisation of the thumb (d) the pulp which is denuded of skin cover but use it as the leading edge of the advancement flap(s), so lengthening the flap and reducing the extent to which it must be advanced. This technique does not allow direct skin to nail approximation but achieves cover of the distal bone with soft tissue. The digital tip is, thus, converted into an injury which can be epithelialised under dressings. A secondary benefit of this method of using advancement flaps is that the process of epithelialisation helps to round off the digital tips and improves their final appearance. Although all of the advancement flaps we use are designed as a 'V' at their proximal extremity and were conceived to close proximally as a 'Y' after the flap has moved distally, the proximal donor defects are usually left open to close under dressings as closing the vertical limb of the 'Y' tightens the finger proximal to the vascular pedicles of the flaps. Neurovascular advancement flaps are inadequate in size to cover Palmar-sloping tip defects which extend proximal to the distal interphalangeal joint crease into the middle phalangeal segment of the finger or the proximal phalangeal segment of the thumb. In these two segment injuries, which are relatively uncommon, there are many flap options, including the cross-finger flap, the Zancolli flap[13] and the free toe pulp (see below). We now rarely use the cross-finger technique of digital tip reconstruction except in these larger two segment defects for which this flap is usually our first choice. However, it is a two-stage procedure, with consequent slowing of mobilisation which also results in poor innervation of the digital tip, even when re-innervated by suture of its dorsal digital nerve branch to one of the recipient digital nerves. It often also leaves an obvious cosmetic defect on the exposed dorsal surface of the donor finger.

In those palmar and sagittal oblique amputations which have a slope of 30 degrees or less we use a variant of the Tranquilli-Leali flap which we have called the 'Neurovascular Tranquilli-Leali' flap.[14] This flap has the same shape as the original flap but is larger, extending to, or across, the DIP joint crease proximally. It is islanded on both neurovascular pedicles (Figure 4). The incisions of the V cross the distal interphalangeal joint crease at an angle and thus do not cause contractures. When designing the flap one takes the V incisions out almost to the lateral nail folds distally. Having made the flap wide, the leading edge of the flap after advancement is wider than the original finger tip. Unless the lateral corners of the flap are excised, this results in an ugly broad end to the digit. Cutting off the lateral corners and allowing the resulting raw edges and tip to epithelialise not only narrows the digital tip but also rounds it to achieve a good appearance. This flap can be used for stump reconstruction of any length of amputated finger or thumb and we find this version of the Tranquilli-Leali flap much more useful than the original.

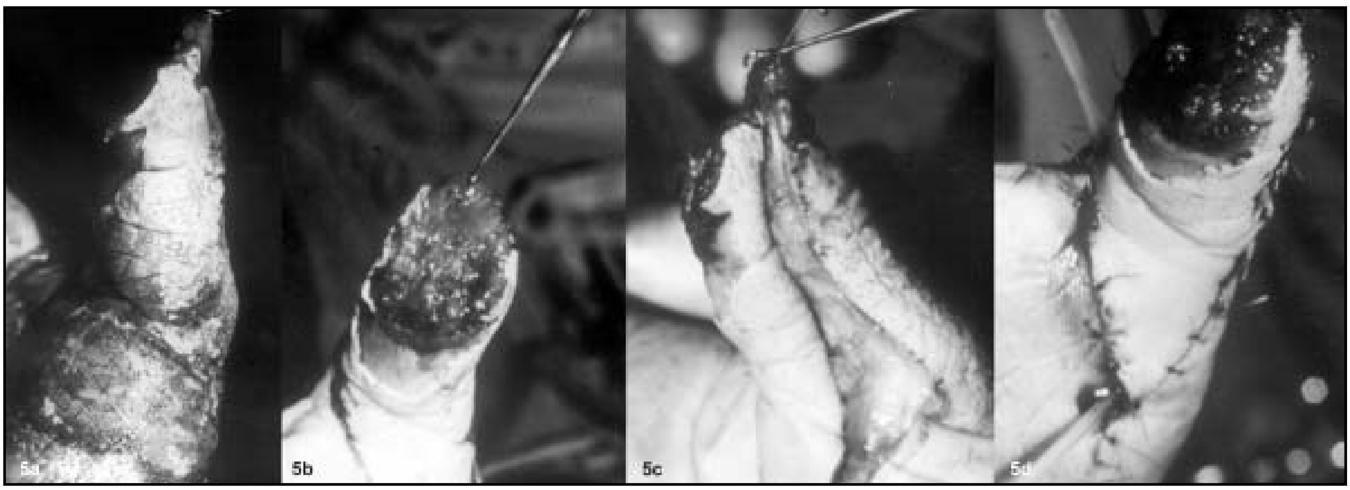
For more sloping palmar oblique defects, we use two alternatives. The first is a longer bipedicle flap. This is, essentially, O'Brien's modification of the Moberg flap[15,16] with the addition of a 'V' tail proximally instead of a skin graft at the base of the thumb (Figure 5).[17-19] This modification appears to have been conceived independently by these three groups of surgeons. As the Hamburg team recorded their first case in 1983, to them must be attributed priority of publication ! There is no danger in raising Moberg-type flaps on the thumb, as the dorsal skin of the thumb has a separate blood supply. However, on the fingers, there is a risk of loss of the dorsal skin if the lateral incisions of the palmar flap cut the dorsal branches of the digital arteries feeding the dorsal skin.[20] More recently, this flap has been re-described by Kojima et al[21] but preserving the dorsal arterial branches, so making it safe for use in the fingers.

An alternative way to increase the pulp advancement for more oblique palmar sloping defects is to use single pedicle lateral flaps. The earliest of these lateral flaps was described by Geissendörfer in 1943.[22] This flap was subsequently popularised by Kutler.[23] It is vascularised by the small vessels beyond the trifurcation of the digital arteries. In our experience, these flaps only ever move significantly in the drawings in textbooks, and we no longer use them. More useful is the lateral flap described by Segmüller[24] and re-described by Biddulph.[25] Each lateral flap is raised as an island on its own neurovascular bundle and has a much bigger volume and reconstructive potential than the Geissendörfer /Kutler flaps. Originally, Segmüller raised the flaps only as far proximally as the DIP joint crease.



Lanzetta et al[26] described the use of a modification in which the flap is extended back to the PIP joint. Independently, we made the same extension and reported the use of this flap in 100 cases (Figure 6).[27] We have also used a similar number of 'Venkataswami' flaps[28] during the same time period. This flap is also islanded on one neurovascular bundle but the leading edge of the flap extends across the palmar surface of the finger. In practice, we find the extended Segmüller flaps to be the more adaptable of these two flaps. One begins by raising one Segmüller flap only on the blind side of the finger. This, alone, may be adequate for the tissue needs of the digital tip; if not, the second flap is raised. Each Segmüller flap carries its own innervation while the advancing edge of the Venkataswami flap furthest from the pedicle is denervated. The Evans flap[29] is a variant of these single neurovascular pedicle flaps.

Figures 4a to e: Pre-operative views of a palmar-facing amputation at nail fold level showing the marking of the neurovascular Tranquilli-Leali flap (a and b), Flap advanced, with the corners of the leading edge marked prior to excision of the corners and suturing (c), Fingertip after completion of epithelialisation (d and e)



Figures 5a to d: Pre-operative views of the thumb of a 47 year old man with a typical crush avulsion of the distal pulp (a), Markings of a V-Y modification of the Moberg flap shown pre-operatively (b), Intra-operative view of the fully mobilised flap (c), Immediate post-operative view with the flap advanced to provide pulp cover of the distal bone (d)

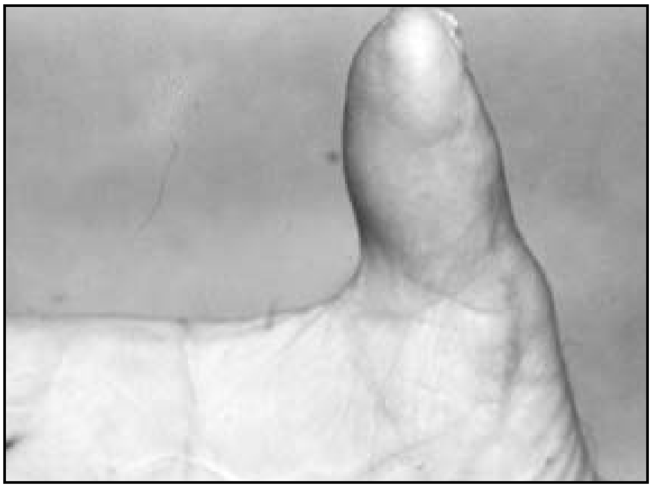
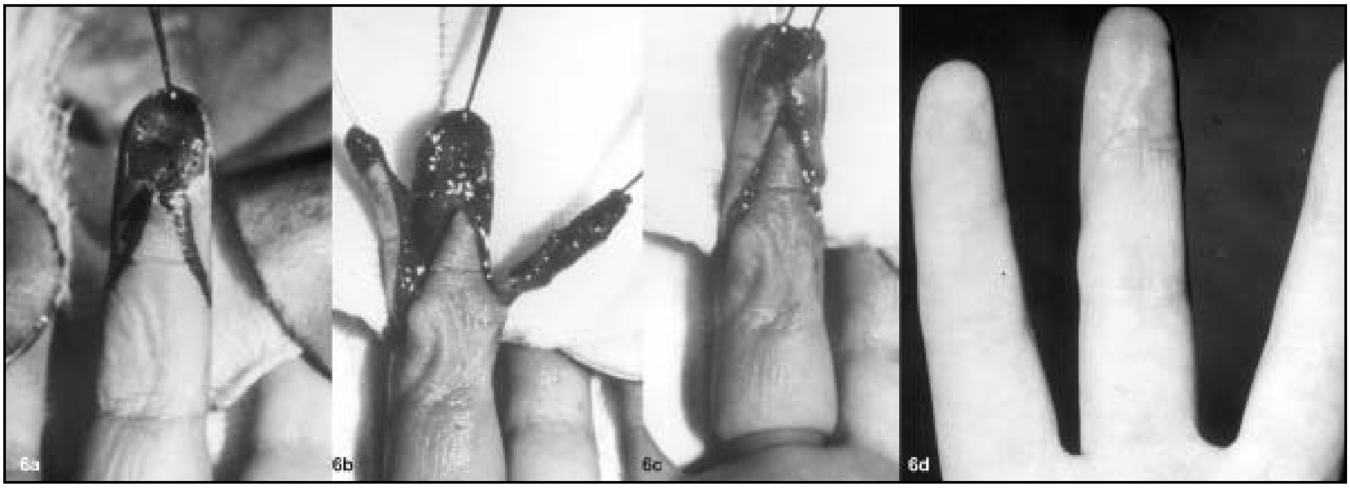


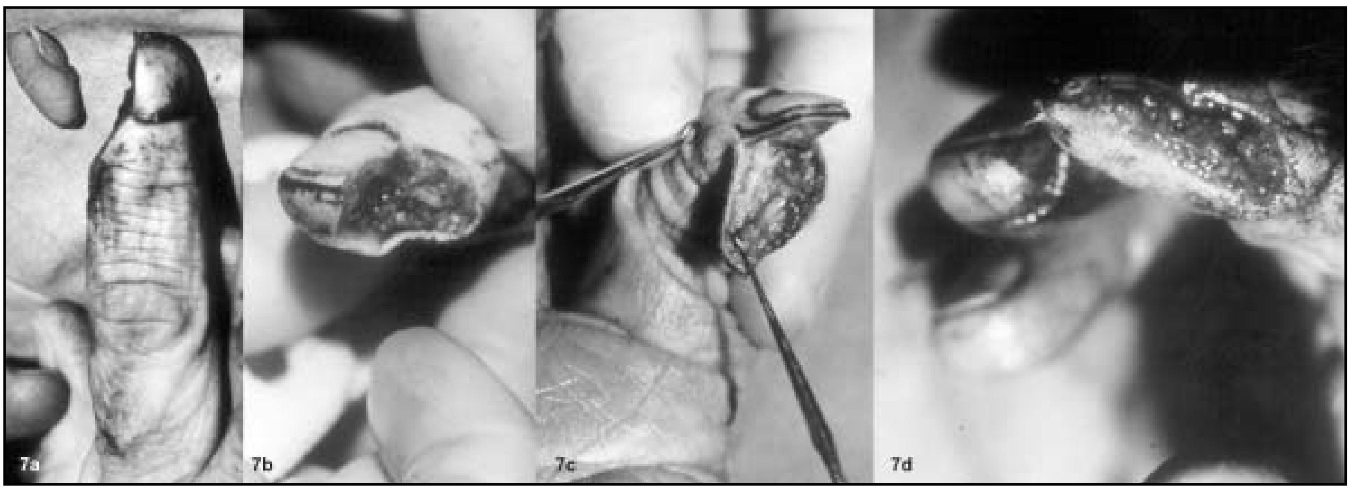
Figure 5e: Final result after epithelialisation of the tip under moist antiseptic Dressings

Because the final position of the Evans flap is predetermined at the drawing stage, we find it less adaptable than the above two flaps and use it rarely.

We devised the lateral pulp flap for losses of the lateral surface of the digital tip with exposure of bone (Figure 7).[30] This flap exploits the excess of pulp in the digital tip. The flap is raised by opening the tip of the finger with a fish mouth incision and freeing the pulp attachments to the bone. The pulp then moves laterally and is lifted over the bone and sutured to the edge of the nail. The deep edge of the pulp - not the superficial edge - is brought up to the nailbed to cover the bone. The pulp is then epithelialised under moist antiseptic



Figures 6a to d: Crush amputation of the tip of the left middle finger of a teenage boy showing a palmar facing coronal oblique amputation with a moderate degree of obliquity exposing the distal phalanx. The finger is marked for reconstruction with two medium-length Segmüller flaps (a), Intraoperative view after mobilisation of the flaps on their neurovascular pedicles (b), Intraoperative view after advancing the flaps to the tip of the finger (c), Late view of the healed finger tip (d)



Figures 7a to h: A slicing defect with loss of the radial lateral pulp, lateral nail fold and nail of the index finger in a 50 year old man (a and b), Dissection to expose the pulp tissue and separate it from the periosteum of the distal phalanx (c), Pulp transposed to cover the distal phalanx (d)

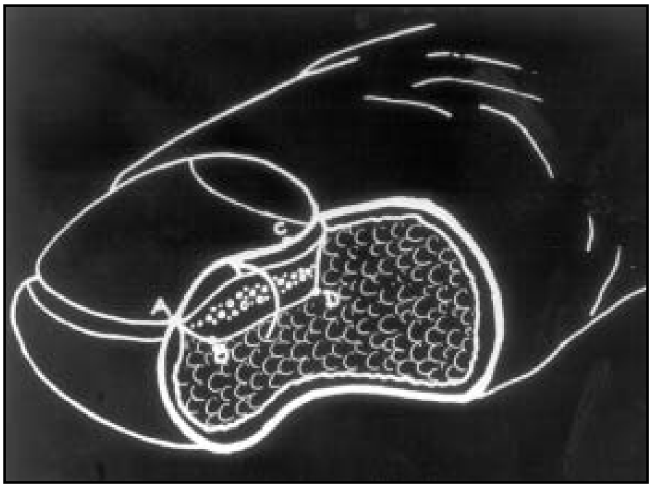


Figure 7e: Diagrams to show the original injury

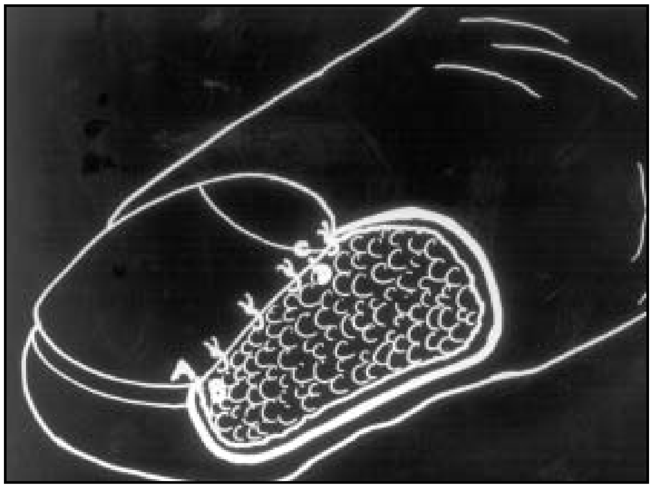
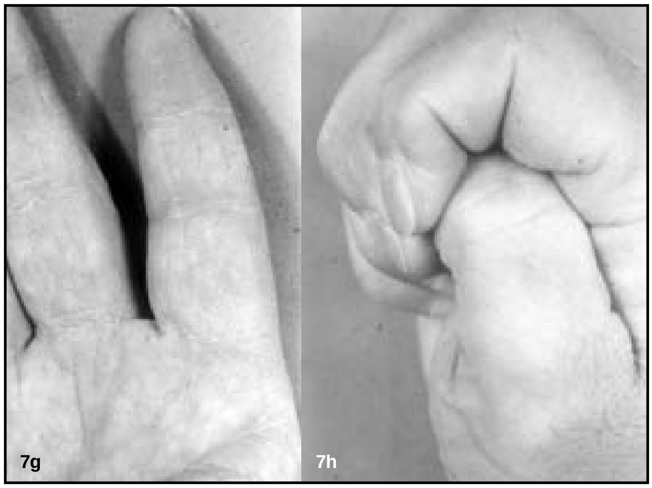


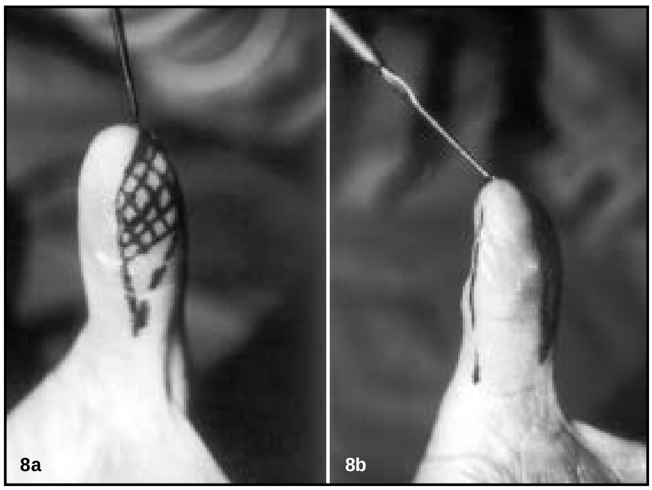
Figure 7f: transposition of the pulp to cover the bone of the distal phalanx

dressings. This reconstruction creates a digital tip which is sensate but has no lateral nail fold. This seems to cause no functional problems and is less obvious than most lateral nail fold reconstructions, as these are usually too bulky. The principle underlying this lateral pulp reconstruction can also be used to cover the bone of an end-amputation, where the bone lies close to the surface.

Side-to-side homodigital switch flaps, which reconstruct or re-innervate one side of a digital tip at the expense of the other side, can be useful to resurface areas of pulp sensibility in the hand which are critical for pinch activity after localised loss of tissue or irrevocable digital nerve injury. Replacement of the radial side of the index or middle finger-tips by a vascularised composite transfer from the ulnar side of the same digit is well established, both as a simple transposition[31] and as an island flap.[2-3] Use of the radial pulp of the thumb tip to reconstruct and/or reinnervate the ulnar side would seem as logical and we recently reported three cases of this switch as a simple transposition flap (Figure 8).[32]



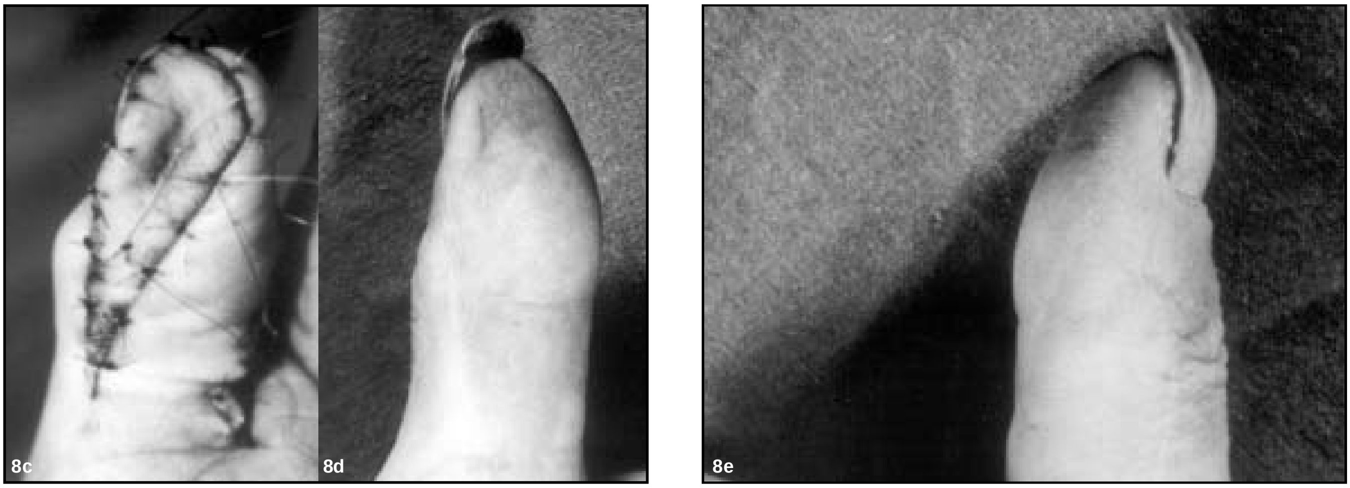
Figures 7g & h: Late views of the reconstruction, one year after the injury (g and h)



Figures 8a & b: Thumb of a patient with irreparable damage to the ulnar digital nerve. A triangle of the denervated ulnar digital nerve territory is shaded, prior to excision down to bone (a), the same thumb showing the pre-operative marking of the radial switch flap (b)

RECONSTRUCTION OF THE PALMAR SURFACE

On the palmar and lateral surfaces of the digits, most small wounds with skin loss only will epithelialise under dressings while one concentrates on mobilisation of the digit. While this technique can be used for larger

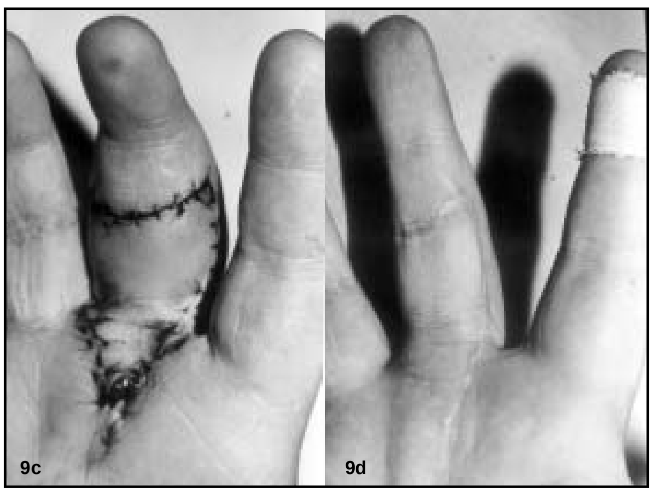


Figures 8c to e: The thumb at surgery, after transposition of the flap and with the graft applied to the donor defect (c), late view of the grafted donor site (d), late view of the switch flap (e)

skin defects, these are often more easily treated by split skin graft reconstruction. When dealing with more extensive defects on the palmar surface of the finger which involve loss of the subcutaneous tissues as well as the skin, one should remember that full thickness skin graft is laid directly onto the neurovascular bundles and tendon sheath in Dupuytren's surgery and creates good functional cover of the vital structures for all but the most heavy industrial workers and may be an appropriate treatment in trauma cases.

In 1966, Hueston described a palmar advancement flap to cover amputation stumps at the PIP and adjacent proximal phalangeal level, with skin grafting of the donor defect at the base of the finger.[33] In 1994, we described a modification of this flap in which a V-Y tail was added to the flap to close the defect at the base of the finger without a skin graft.[34] This technique of advancing the palmar skin and soft tissues of the proximal phalangeal segment up the finger with a V-Y tail can also be used to close round, or almost round, 0.5 – 0.75cm. full-thickness palmar defects at the PIP/IP joint level (Figure 9). In the case illustrated, additional advancement has been achieved by islanding a flap based on the ulnar neurovascular bundle: the skin and subcutaneous tissues have been incised lateral to the neurovascular bundle. Probably our commonest use of this flap is not in dealing with such defects, which are relatively uncommon, but in replantation and revascularisation. With these injuries, elevation of a palmar V-Y flap gives rapid access to both digital arteries as far proximally as the common digital

Figures 9a to b: Right middle finger after excision of a split skin graft reconstruction of the palmar aspect of the PIP joint which had healed with contracture, with a V-Y modification of a Hueston flap incised and dissected (a), The flap being advanced after islanding by division of the skin at its base, to achieve greater advancement (b)



Figures 9c & d: Immediate post-operative view (c), Late views of the reconstruction (d)

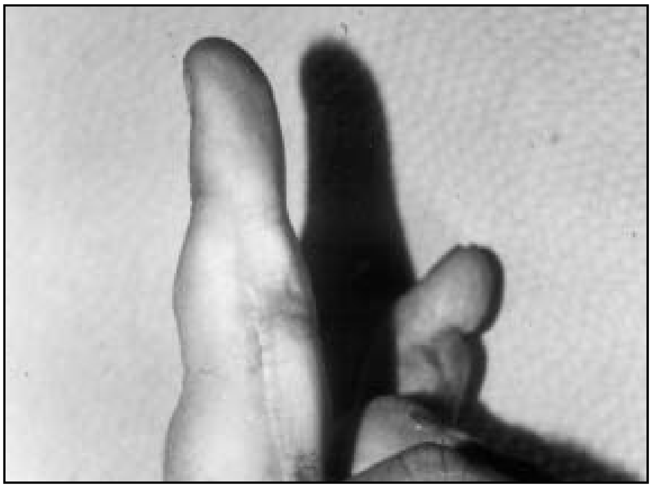


Figure 9e: Late views of the reconstruction

arteries. It then provides a means of skin advancement to cover arterial anastomoses. The advancement also takes tension off the transverse suture line on the palmar side of the finger during post-operative mobilisation. If the skin is particularly badly damaged immediately distal to the suture line, it can be excised and replaced by this advancement flap These flaps are also very useful for multifinger injuries with palmar skin loss and/or a need for revascularisation as they do not risk jeopardising the already damaged neighbouring digits.

The palmar V-Y technique is only suitable for reconstruction of full-thickness defects smaller than one finger segment in length. Fortunately, larger full-thickness defects on the palmar surface of the fingers are not common and are rare on this surface of the thumb. These defects can be reconstructed with cross-finger flaps without the poor sensitivity of this flap being a consideration. However, this technique remains a two-stage procedure and the defect on the dorsum of the donor finger may scar this, the visible part of the finger, significantly. In multifinger injuries, use of cross-finger flaps may also be difficult or impossible without compromise of already injured digits. An alternative which can be used for longer full-thickness palmar defects is the palmar flap described by Zancolli[13] which receives its blood supply by retrograde flow down one digital artery, itself fed from the other digital artery through the transverse communicating vessels. This flap, as originally described, leaves a deep donor defect in the distal palm which requires skin graft reconstruction. We described a method of improving on this unsatisfactory donor site.[35] This flap can be used for defects of two phalanges in length, whether covering the distal and middle phalangeal segments or the middle and proximal phalangeal segments of the finger. We only use this complicated flap when a cross-finger flap is not available or inadvisable.

Where the palmar full-thickness tissue loss is narrow and longitudinal in shape, the defect can be closed simply by moving one or two bipedicle flaps, each of which carries in it one neurovascular bundle, transversely into the mid-line of the finger.[36] The donor defect on the lateral sides of the finger can be skin-grafted or left to epithelialise under moist antiseptic dressings while mobilising the finger. This technique is similar to that described for longitudinal defects on the dorsum of digits later in this paper and in a previous publication.[37]

RECONSTRUCTION OF THE DORSAL SURFACE

On the dorsum of the digits, a very few homodigital techniques of reconstruction suffice to cover almost all full-thickness soft tissue losses except those in which the soft tissue defect of each finger extends to the whole width and most of the length of the finger and more than one finger has lost this degree of tissue.[37] In such cases, syndactylisation and distant flap cover is appropriate, although cover is achieved by this technique at the expense of the ability to mobilise the fingers individually, depending on the specific injuries of each digit. Single finger injuries with this degree of soft tissue loss extending across two or three phalangeal segments of the digit can usually be reconstructed by use of a de-epithelialised cross-finger flap,[38] a reverse dorsal metacarpal artery flap[39-41] or a reverse posterior interosseous artery flap.[42-43] De-epithelialised cross-finger flaps may also be useful for larger proximal-phalanx defects in which injury to the dorsum of the hand precludes the use of the reverse dorsal metacarpal artery group of flaps.

The dorsal skin of the digits is mainly vascularised by dorsal branches of the digital arteries running round the lateral aspects of the digit from the palmar surface.

These vessels will sustain flaps similar in concept to the Hueston flap described for use on the palmar surface of the digit[33] and these are suitable for round or nearly-round defects of the size of the finger nail, or thereabouts. As on the palmar surface, a V-Y tail can be added to these flaps to avoid the need to skin graft the donor site proximally (Figure 10).[44] On this surface of the digits, it is necessary to close the proximal V as a Y to protect the extensor paratenon from desiccation. These flaps are also very useful in replantation, as they allow one to advance the dorsal veins of the proximal part of the finger to the replant and achieve direct vein anastomoses under good skin cover without recourse to either vein grafts or a separate skin cover procedure. Like all other homodigital techniques, a major advantage of these flaps is that they can be used on as many fingers as necessary with each finger remaining independent during post-operative mobilisation . These flaps can be used as far distally as the proximal nail fold, in which case the proximal 'V' is made at, or proximal to, the PIP joint level. Y- closure of the V is facilitated by releasing Clelands ligaments laterally to aid in mobilization of the skin. In a review of 1077 dorsal wounds of digits which we treated over a six-year period, 154 digits required flap reconstruction.[37] The dorsal V-Y flap accounted for 42% of the flaps used and was the commonest skin flap used on this surface of the fingers.

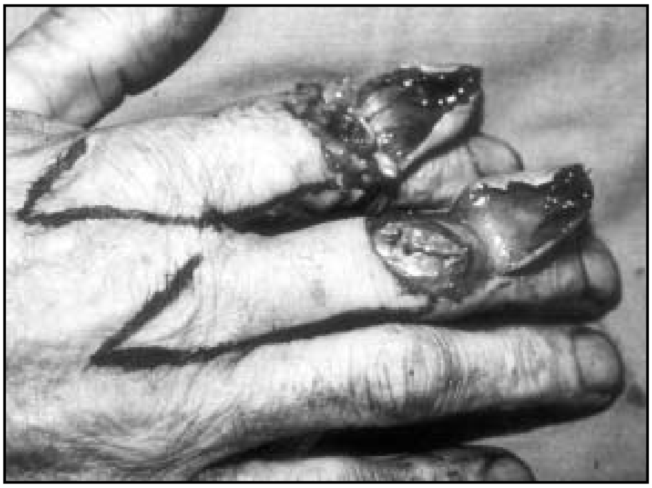
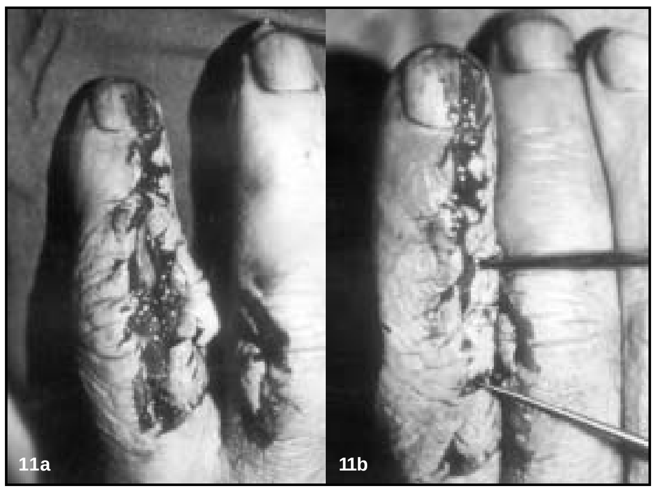


Figure 10a: Dorsal injury to the PIP joints of the right index and middle fingers of a 46-year-old man raising long distally-based flaps. These flaps were not viable. Pre-operative markings of dorsal V-Y flaps are shown

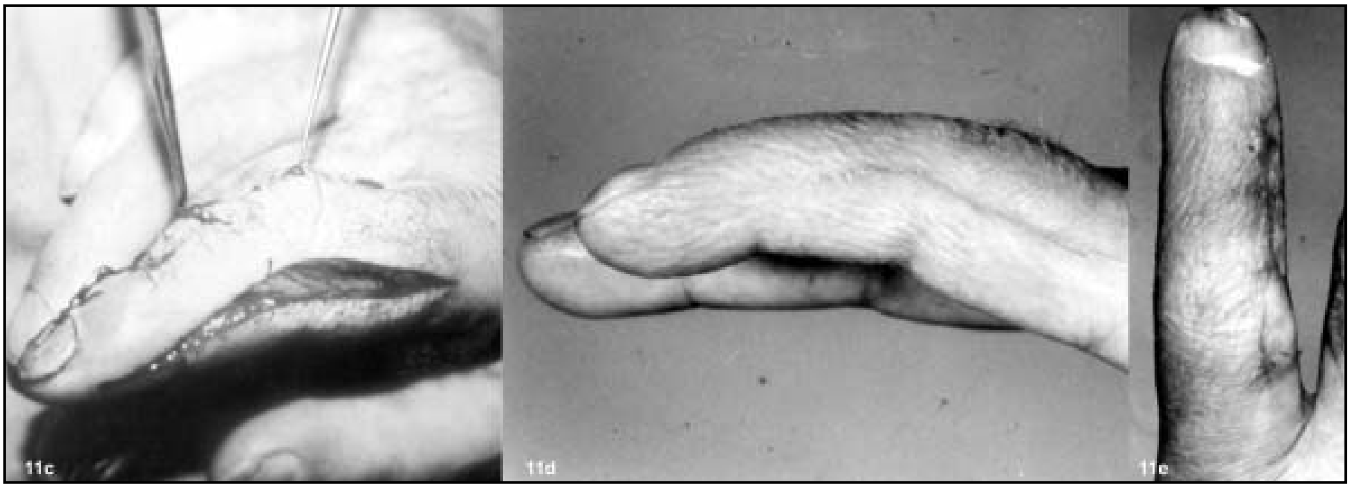
Figure 10b: Late post-operative views of the reconstructions

In the above study, 19% of the defects were reconstructed using a new variant of the old technique of longitudinal bipedicle flaps (Figure 11).[37] These were used specifically for long narrow full-thickness tissue defects, which are not uncommon following injuries to the dorsal digital surfaces by glass and machinery. These flaps can also be used to reconstitute the nail bed in more distal injuries in which a narrow length of the central part of the nail has been removed.

A third homodigital flap completes the compendium of flaps which we use frequently for dorsal finger reconstruction. This flap was described by Tremolada et al[45] and transposes the subcutaneous tissue of the proximal part of the dorsal surface of the digit distally as an island based on one of the same dorsal branches of the digital arteries as those which vascularise the



Figures 11a & b: Dorsal longitudinal defect of the right index finger as a result of an electric saw injury (a), Closure of the dorsal defect with a single (radial) bipedicle strap flap (b)



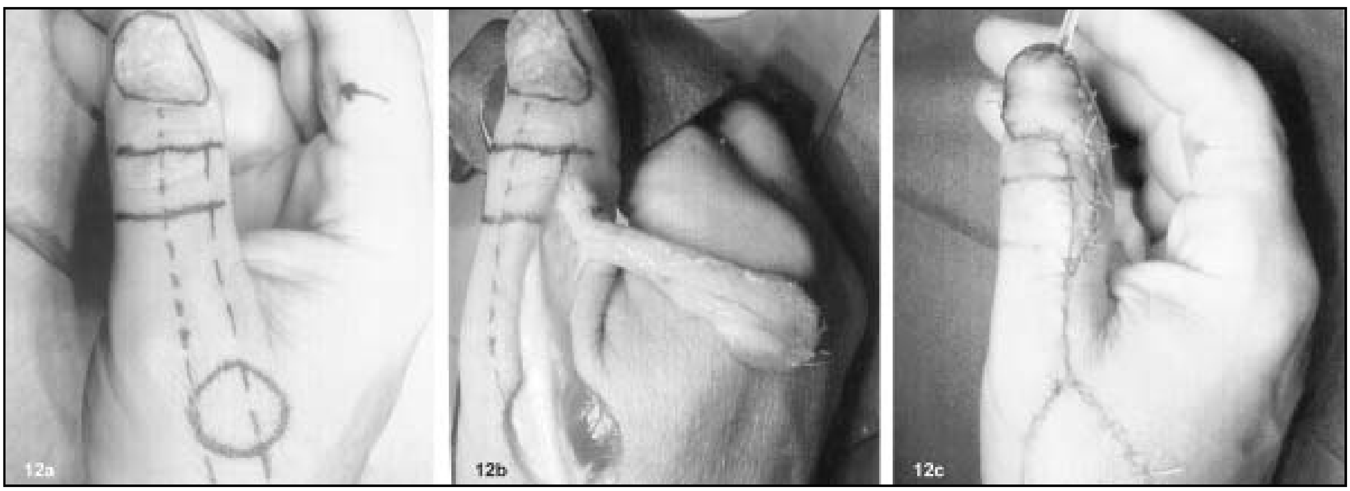
Figures 11c to e: Closure of the dorsal defect with a single (radial) bipedicle strap flap (c), Result at three months. The donor site healed by re-epithelialisation under moist antiseptic dressings over 4 weeks (d and e)

dorsal V-Y flap described above. The subcutaneous tissue transposed requires skin graft cover. Although conceived as a distal transposition of the subcutaneous tissue of the proximal phalanx to reconstruct the dorsum of the middle phalanx, based on a the dorsal branch of the digital artery at the proximal phalangeal joint level, it can also be used to transpose the subcutaneous tissue of the middle phalanx to cover the dorsum of the distal phalanx, based on a the dorsal branch of the digital artery at the distal phalangeal joint level. This variant of the flap is particularly useful for the relatively common fingertip injury which destroys most or all of the nail bed of the finger.

A less common problem is replacement of the nail bed of the thumb and a flap described in Paris by Brunelli and his colleagues is a very easily and quickly raised flap which is useful for reconstruction of this dorsal tip defect (Figure 12).[46,47] This flap has more recently been re-described carrying a segment of vascularised bone from the first metacarpal with it and may prove a very useful means of placing vascularised bone at the tip of the thumb without microsurgical transfer from the foot.[48-50]

CONCLUSION

The strategy described above has proved adequate to reconstruct the many hundred digital defects seen in our practice over the last twelve years. The principle used in these cases has been to capitalise on the enormous healing capacity of digital skin and assist



Figures 11c to e: Closure of the dorsal defect with a single (radial) bipedicle strap flap (c), Result at three months. The donor site healed by re-epithelialisation under moist antiseptic dressings over 4 weeks (d and e)

this, when necessary, by simple local reconstructions. Whenever possible we prefer to use homodigital techniques, although there are upper limits to the size of defects which can be reconstructed by these. For any defect, our choice of flaps is, in part, determined by the size and shape of the defect and, in part, by flap reliability and ease of use. The homodigital flaps described above have proved particularly versatile and reliable in the hands of surgeons of varying levels of experience within our unit, although requiring some familiarity with microsurgical dissection. They are quick to perform, which can be an advantage following lengthy bony or soft tissue reconstructions. They allow early and independent mobilisation of each digit and the use of local tissue respects the cosmetic principle of reconstruction of 'like with like'. Donor site morbidity is also limited to the already injured part. When used for finger tip reconstruction, advancement homodigital flaps cannot achieve the sensibility of the original, but are durable and intrinsically more likely to restore good sensory function in the digital tips than most of the reconstructive alternatives.

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