AMPUTATION IN HAND SURGERY

P. C. LEUNG

When referring to amputation, the immediate association tends to be amputation related to trauma. There is little doubt that injury is by far the commonest cause of amputation, but one must not forget that babies might also be born with amputations of the upper limb. This latter group of amelia composes the various types of congenital amputations.

TRAUMATIC AMPUTATION: LIMB OR DIGITAL PRESERVATION

Traumatic amputation, being one of the most often performed operations, must involve no excessive tissue wastage and leave no complication in the amputated stump. In this era of microsurgery, the first stage of planning before surgery will include the consideration, whether it is worthwhile re-establishing the circulation by doing a replant or revascularisation, instead of performing a simple amputation.

The indications for replantation or revascularisation include: thumb, multiple fingers and metacarpal injuries, undamaged distal segments, young age and occupational need.[1]

For degloved type of ring injury when the full thickness skin has been avulsed whilst the skeletal part of the finger is intact and viable, although successful microvascular revascularisation of the avulsed flap has been reported and various types of flap coverages are possible, usually it is far better amputating the finger because the functional results of any other forms of treatment is not satisfactory.

P. C. Leung, MBBS, MS, FRACS, FRACS(E)
Department of Orthopaedics & Traumatic Surgery
Faculty of Medicine
The Chinese University of Hong Kong
Shatin, New Territories
Hong Kong

PLANNING

Length Preservation

Finger functions are related to their nomal length. After a traumatic amputation, except in the case of replantation, maintenance of the normal length is impossible. Surgical means of supplying the skeletal core and then covering with a skin flap to create a new 'finger' have all been shown unsatisfactory. Therefore, there is no indication for over-energetic attempts to preserve length. Nevertheless, digital lengths should never be sacrificed unnecessarily.

Under special circumstances, local or distant skin flaps may be raised to preserve digital lengths.

Thus for finger tip injuries, V-Y advancement flaps are always alternatives to amputation closure.[2] Cross finger flap coverage is indicated when the individual cannot afford an extra half centimetre loss of length. The Gillis flap is an useful technique for maintaining the length of amputated thumbs at interphalangeal joint levels (Fig. 1).[3] The groin flap may be used effectively in multiple finger losses to preserve the basal stumps of the proximal phalanges or metacarpal heads so as to restore the basic pincer component for the normal thumb.

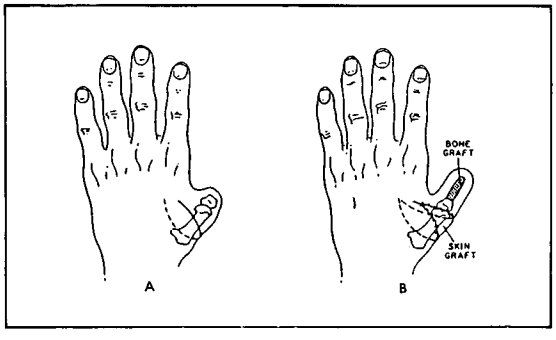

Fig. 1 Gillis operation.

Functional Preservation

When the amputation is at metacarpal phalangeal joint level, a wide gap is left through the clenched fist. This produces functional as well as cosmetic embarrassments. As a means of better functional preservation, a metacarpal ray may be shifted to its neighbourhood partner to eliminate the gap or to create a better functioning position. Figures 2 and 3 show the possibilities of such metacarpal shifts.[4]

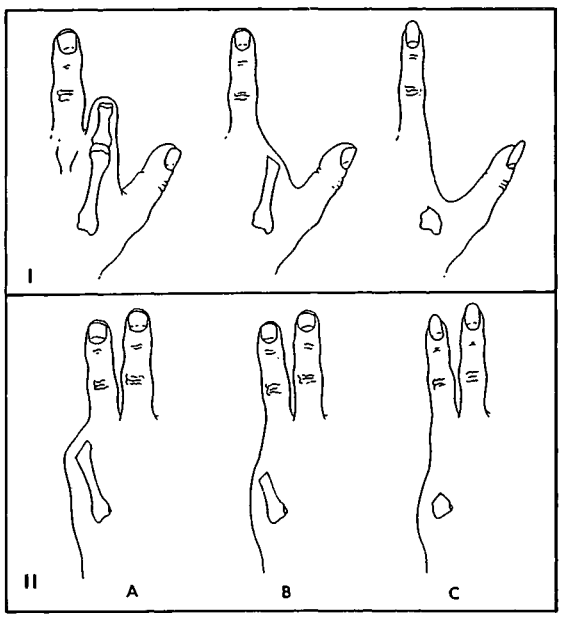

Fig. 2 Possibilities of metacarpal shifts.
I: metacarpal osteotomy for second ray.
II: metacarpal osteotomy for fifth ray.

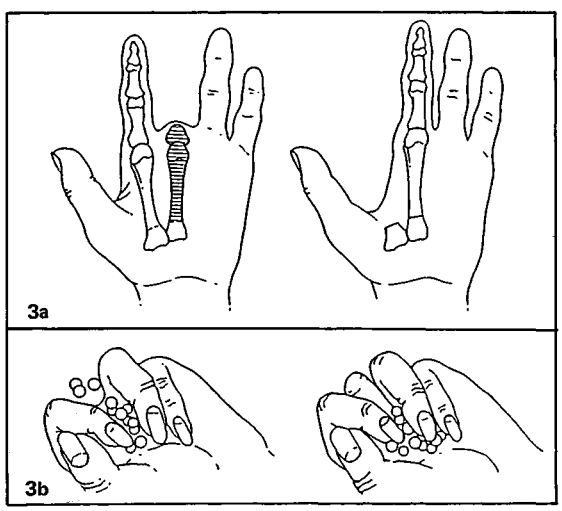

Fig 3 a. Amputated finger creates a gap in the grip.
b. Second ray shifted to the third ray to eliminate gap.

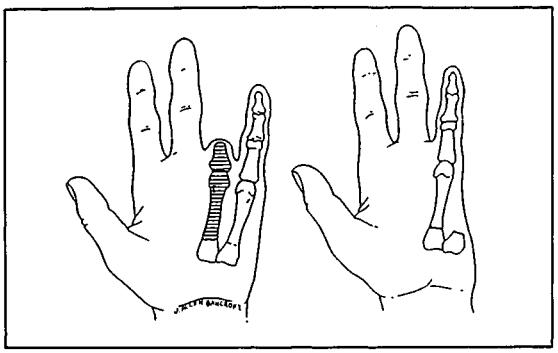

Fig 3c: Fifth ray shifted to the fourth ray.

Cosmetic Preservation

For girls and special individuals, metacarpal shifts may be performed for pure cosmetic reasons. Simple slanting osteotomy for the second metacarpal may be done for the same purpose when only the index finger is amputated.

TECHNIQUES

The techniques involved in amputation should be such that the resulting stump will have a painless, small scar and pressure does not induce tenderness. To achieve this goal, firstly, thorough debridement and surgical lavage are necessary. All dust, sand granules or other foreign-bodies should be meticulously removed because they might be the cause of stump pain and tenderness. The skin flaps are planned for adequate closure. Equal size anterior and posterior flaps are ideal, but under special circumstances, uneven flaps or sagital flaps may be used. The tendons are preferably not taken with the skin because the added thickness will not give more security but the resulting bulkiness may produce tension over the suture site.

The bone end needs to be trimmed just adequately so that flap closure is comfortable and yet there is no excessive loss of length. Tendons should not be stitched around the bone end for reasons just described. They should be just cut at the same level of the bone end. When the amputation is just at the level of the nail bed, the nail bed should be totally removed so as to prevent the regrowth of nail which will be beaked and be the cause of a pinful stump. Digital arteries should either be tied or diathermised. Digital nerves are pulled out, then cut at the most proximal level so that proximal retraction of the nerve ends would ensure their secure burial within soft tissues, and neuroma pain is not so likely.

Stitching is preferably done after the release of the tournequet so that viability of the skin flaps is ensured. Loose stitching is very much encouraged to allow a free escape of blood collected within the surgical wound.

Firm stump dressing in the form of finger stocking may be best recommended.

COMPLICATIONS

Stump breakdown

Stump breakdown should never happen if bone trimming is adequate and skin flaps are properly raised and checked for viability. However, if skin necrosis does occur, unless the area is not wider than 2-3 mm, otherwise proper revision is indicated. A common mistake is to take a sit-and-wait policy and eventually doing skin grafting to make up for the skin defect. Such practice is not only a waste of time but the resultant stump will tend to be tightly scarred and painful. Lengthy procedures to save the length of stumps are only justified under rare circumstances, like partial thumb amputations.

Painful stump

Painful stumps after finger amputations are very common, but the pain is usually of mild nature so most often it escapes the surgeon's notice. Such painful stumps may be caused by a number of factors which include: foreign bodies, painful scar, bone spike, abnormal nail, neuroma, sympathetic hyperreflexia or causalgia.

Foreign bodies are diagnosed clinicaly, sometimes radiologically, and their adequate removal gives relief of stump pain. Small painful hypertrophic scars need to be excised and resutured, bigger ones might warrant a stump revision. If the painful scar is due to tightness of the skin, soft tissue or bone trimming need to be done. Bone spikes need to be removed by bone trimming and painful beaked or abnormal nails may do well by excising the whole nail bed.

Neuroma at the stump should be dissected free; then the digital nerve is traced proximally and cut to produce nerve retraction. For a neuroma resistant to treatment of the nature just described, the free distal end of the nerve may be buried into a muscle gap created at the distal portion of the palm (lumbricles or interosseous muscles).

Both sympathetic hyperreflexia and causalgia produce cold, sensitive stumps with trophic changes and tenderness on palpation. X-ray examination demonstrates the classical Sudeck's osteodynstrophy. For the average case, persistent physiotherapy on the hand (joint movement training and stump desensitisation) gets rid of the trouble gradually. For the resistant cases, intravenous quanethedine or TENS (transcutaneous electrical nerve stimulation) may be useful. Acupuncture has also been tried and has been shown to give satisfactory results.[5]

PROSTHESIS

Functional prostheses are available for the whole hand, not for individual fingers. The commonest mechanical prosthesis consists of a split-hook which is controlled *via* a cable operated *via* a shoulder harness. For social activities, the hook is removed and a plastic glove replaced.

This prosthesis is cheap and simple, but it has its problems. In a study on upper limb amputees done in Hong Kong, 70% amputees used their prostheses during working hours whilst only 30% used them in their household. The problems lie in the weight of the gadget, difficulties in fitting and enduring, special skin and hygienic problem.[6]

The myoelectric upper limb prosthesis – using a small local motor drive triggered off by muscle activities which are detected *via* small transcutaneous electrodes – is a great invention. But the cost prevents many patients from attaining one and this electronic device is very prone to damage and the mechanical effects are never as efficient.

Cosmetic prostheses made locally are either too heavy or too artificial. The French man, Mr. Pillet, is capable of making finger prosthesis which matches the intact ones. If the cost may be omitted these cosmetic replacements are very useful for those who have one to two fingers missing.[7]

Congenital Amputation

Amelia is a general term used for the conditions of total absence of the upper limb, forearm and arm. Hemiamelia is the absence of the forearm, and acheiria, absence of the hand alone. When a good prosthetic service is available, early fitting of prosthesis with prolonged training is indicated. Fitting has to be early because utilisation of the diseased side encourage growth of the amputated stump and structures proximal to it. Another reason lies in the fact that given some years which are devoid of experience in using the diseased upper limb, future training on the utilisation of that limb will be very difficult.

For the acheiria type of congenital amputation, instead of fitting the prosthesis, the Krukenberg operation creates a pair of chopsticks-like forceps (separate radius and ulnar) capable of a good range of functional activities.[7]

CONCLUSION

Considered one of the simplest operations on the hand, amputations of the fingers are taken as routine measures that do not require any planning. However, when not properly done, the amputated stumps form sources of prolonged problems. Therefore, not only should there

be more planning with valid principles, but the awareness of the rich armamentarium of alternatives in solving different problems, will be able to bring much benefits to the suffering patients.

REFERENCES

1 Leung P C. An analysis of complications in digital replantation. *The Hand* 1980; 12(1):25–32.

2 Kutler W. A new method for finger tip amputation. *JAMA* 1947; 133:29.

3 Gillis H, Millard D R, Jr. *The principles and art of plastic surgery.* Boston : Little Brown & Co., 1972.

4 Carroll R E. Transposition of the index finger to replace the middle finger. In DePalma A F, (ed) *Clinical Orthopaedics.* Philadelphia: J B Lippincott Co., 1959.

5 Leung P C. Painful hand syndrome – treatment by acupuncture. In Boswick J (ed) *Current concepts in hand surgery.* Philadelphia: Lea & Febiger, 1983.

6 Chan K M, Lee S Y, Leung K K, Leung P C. A medico-social study of upper limb amputees in Hong Kong – a preliminary report. *Orthotics & Prosthetics,* November, 1983.

7 Pillet J. Cosmetic prosthetics. In Boswick J (ed) *Current concepts in hand surgery.* Philadelphia: Lea & Febiger, 1983.

8 Chan K M, Ma G F Y, Cheng J C Y, Leung P C. The Krukenberg procedures – early results in the management of unilated amelia of the upper limb. *Journal of Hand Surgery* 1983.