

Claw Finger Correction in Leprosy—Newer Approaches

G. N. MALAVIYA

Central Jalma Institute for Leprosy, Agra-India.

A better understanding of the biomechanics of finger clawing has helped to develop improved surgical procedures for correction of claw finger deformity and restore function of paralysed fingers. Four such procedures which are in current practice have been reviewed for their merits, demerits and effectiveness to define proper indications for their use.

Clawing of fingers because of intrinsic muscle paralysis is the most common deformity seen in leprosy patients. Ulnar nerve paralysis results in a number of cosmetic and functional problems which an affected hand has to face. These are:

1. Loss of abduction and adduction of fingers.
2. Instability of metacarpophalangeal joint (MCPJ).
3. Flattening of distal transverse metacarpal arch.
4. Flattening of ulnar half of the hand.
5. Hollowing of intermetacarpal and thumb web space.
6. Anaesthesia of the ulnar half of hand.

The overall effect is a poor grip due to unstable MCP joint; poor grasp due to inadequate opening of hand and poor pinch due to unstable MCP joint of index finger and thumb.

Biomechanically there is loss of equilibrium anteroposteriorly and independent control of MCPJ and proximal inter phalangeal joints (PIPJ). The equilibrium can be restored if both MCPJ and PIPJ or at least one of them is stabilised. The aim of claw finger correction therefore is to restore a stability of proximal phalanx in each digit so as to correct the internal balance of digits during prehension. The appearance has to be restored so that the patient can be socially accepted and restoration

of functional capabilities to help him in carrying out various activities effectively.

Successful restoration of function involves erasing of adaptive movement patterns, pre-operative muscle exercises to increase power in the muscle to be transferred and postoperative learning of new movement patterns to integrate the transferred muscle into its new place.

Timing of surgery

The patients can be operated if their disease is stable i.e. they should have at least six months of anti-leprosy treatment with good clinical response and freedom from exacerbations and reactions for six months. Risks of reaction after surgery is very little and reactions, if occur, can be easily controlled with available antireaction drugs.

Ideally patients should have a 'cured' disease but this means that number of years will lapse before the patients are deemed fit for surgery. During this waiting period, adaptive movement patterns get deeply ingrained and are difficult to get rid off later. The soft tissues and joints also undergo changes and contracture making subsequent corrections very difficult. However the paralysis should be stable i.e. of one year or longer duration. During this period the hands can be adequately managed with regular oil massage and exercises.

Condition of the hand

All the finger joints should be fully mobile passively. Long flexors and extensors of fingers should preferably have normal power. However, one can afford to have only moderate power in flexors of ring and little finger and normal in index and middle fingers for better pinching. The extensors should have a normal power, if not, power should be restored in these prior to finger correction.

Bourrel's MCP Joint stabilisation test is of much help in selecting the cases as it brings out the extensor deficiencies and long flexor contractures. Absence of secondary deformities is desirable. If these are present and likely to interfere with the postoperative results (viz. pseudoboutonniere deformity) those should be corrected pre-operatively in order to get satisfactory results. All the four fingers require correction because interossei are paralysed for all fingers and MCP Joints are unstable. If thumb is also paralysed, it can be operated along with the fingers in the same sitting or separately at a later date. Choice of operation involves a consideration for disease status, condition of the hand, extent of paralysis, age, occupational needs and socioeconomic background. Many of the operations require some re-education specially those which involve a muscle tendon unit transfer. These patients have to learn as to how to activate the transfer and calls for active cooperation of the patient. Re-education is difficult in older patients, in cases with long standing paralysis and in patients of low intelligence.

The key joint is MCP Joint which needs to be stabilised and a balance between flexors and extensors at this joint needs to be restored. The corrective operations practised in the past tried to mimic lumbrical muscle action as evident by insertions made into lateral bands in number of procedures described^{2,3,4}. These operations provide additional power to the extensors which are otherwise normal. This extra force leads to

over correction in about 20% cases where PIP joint goes into hyperextension making fist closure difficult which is a serious disability. The possibilities of over correction are enhanced if flexor digitorum superficialis is removed from finger for transfer to thumb and fingers. These procedures should be reserved for cases where extensor apparatus requires some mending in addition to claw correction.

The improvement in function and correction of deformity can be obtained either by muscle substitution to replace the paralysed intrinsic muscles or by redistribution of the available forces to restore balance at MCP and PIP joints.

Procedures where existing forces are redistributed

(a) Extensor diversion procedure⁵

Here the over action of long extensors on MCP joint is prevented by diverting part of the forces volarly through a tendon graft attached to long extensors proximally and to lateral bands distally, passing volar to deep transverse metacarpal ligament. As a result, MCP Joint is prevented from hyperextending when the hand is opened up (Fig. 1).

Isolated finger movements are possible but significant increase in grip and pinch strength are lacking. Normal sequence of finger closure is not achieved and clawing recurs when lumbrical position is attempted. The reversal of distal transverse metacarpal arch can also get exaggerated.

However no re-education is required and operation does not involve any dissection in deep tissues. It is simple to perform and can be undone if needed. It is useful for active cases who opt for surgery due to cosmetic reasons and also in cases with extensive paralysis where other muscles are not available for transfer.

(b) Dermadesis and pulley advancement⁶

The MCP joint, if maintained in 5 to 10° volar flexion, can be flexed actively by existing

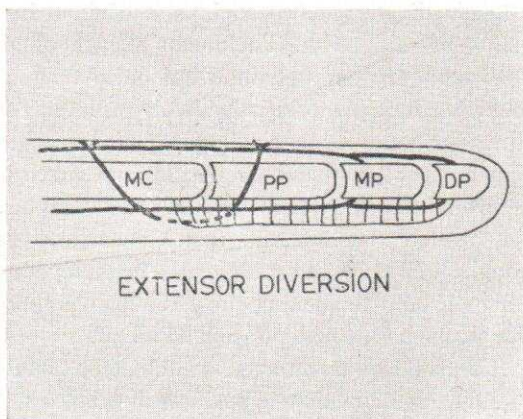


Fig. 1. Extensor diversion procedure.

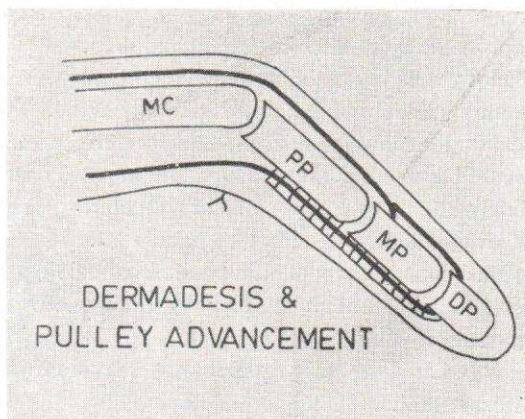


Fig. 2. Dermadesis and flexor pulley advancement.

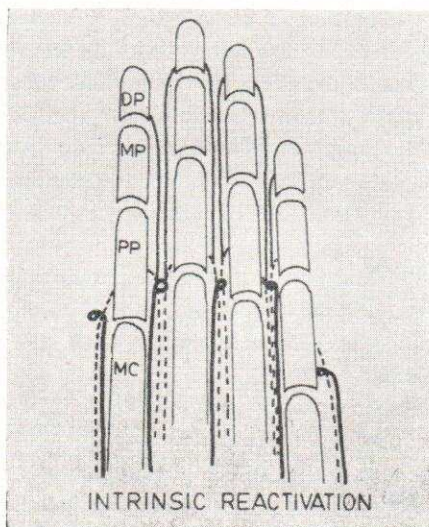


Fig. 3. Intrinsic reactivation procedure.

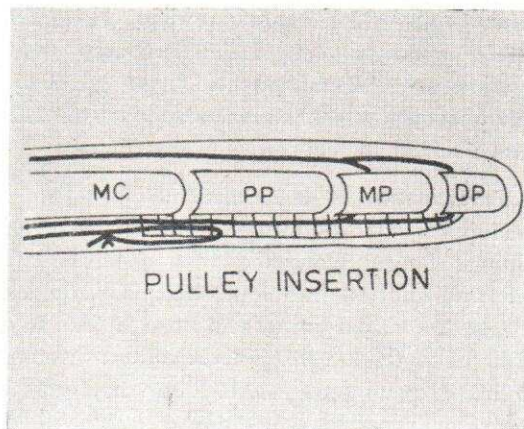


Fig. 4. Pulley insertion procedure.

extrinsic long flexor muscles. This principle has been successfully utilised in this procedure where an elliptical piece of skin overlying MCP joint is excised from distal palm. The subcutaneous tissue is left in situ and skin edges are sutured to produce a skin contracture to keep MCP Joint in 30° flexion. The wound stretches during post-operative mobilisation to give 10-15° flexion only. Before suturing the skin, flexor

forces are optimised by excising A₁ and part of A₂ pulleys of the long flexors so that the angle of approach of long flexors on MCP Joint increases. This in turn increases the leverage and enhances the flexor forces acting over proximal phalanx. The two procedures are complementary to each other (Fig. 2).

Independent control of fingers is not possible and the residual deformity (of MCP Joint

flexion) is not acceptable to many patients who keep on straightening their finger joints.

However, the procedure is technically simple and improves pinch and grip strengths. No re-education is required. The procedure can be repeated if needed. It is also useful in cases with extensive paralysis where suitable motors are not available for intrinsic replacement.

The contracture produced in skin can over stretch in some cases leading to recurrence of deformities. The procedure fails to work in hands with long fingers because leverage is not adequate.

Muscle substitution procedures

Here new muscle tendon unit is transferred to replace the paralysed muscle. Since additional forces are generated, grip and pinch strengths improve considerably and sequence of closure of finger is restored to normal. However, muscle re-education is required. Since these transfers are volarly placed, these can loose their tension if wrist flexing habit persists. This in turn results in recurrence of clawing.

(a) *Intrinsic reactivation procedure*⁷

Here an extrinsic muscle wrist dorsiflexor or palmaris longus elongated with a fascia lata graft and splitted into four slips, is tunnelled through the carpal tunnel and brought into mid palm. Each tendon slip is then routed through lumbrical canal and inserted into first dorsal interosseus; palmar and dorsal interossei in each inter digital space and hypothenar muscles close to the proximal phalanx (Fig. 3).

The operation is technically demanding but restores distal transverse metacarpal arch. Deformity correction is good and functional restoration is satisfactory. Over correction can occur in some cases (8%) specially with long hypermobile fingers, but is relatively uncommon.

(b) *Pulley insertion procedure*⁸

Here the motor tendon-wrist dorsiflexor or palmaris longus elongated with fascia lata graft

or flexor digitorum superficialis is divided into 4 slips in mid palm. The flexor sheath of all the fingers are exposed in distal palm through transverse incision to identify A₁-A₂ pulleys. The four slips, one for each finger, are tunnelled separately along the inter metacarpal space to be brought near flexor sheath. The slips are then routed through the flexor sheath to be brought out through middle of A₂ pulley and tied to itself after flexing the MCP joint 80-85° with wrist in neutral position (Fig. 4).

The tone of transferred muscle keeps MCP Joint in 5 to 10 flexion—a position of mechanical advantage for flexors.

The operation gives good anatomical and functional results. In few cases, arch reversal also gets corrected. It is specially suitable in cases with hypermobile finger joints where over correction is usually a problem. Insertion into A₁-A₂ pulley through the flexor sheath gives better leverage and avoids suturing into the sheath. Bony insertion as advocated by Burkhalter⁹ is not desirable because bones are osteoporotic.

Individual control of fingers is not possible but sequence of closure is restored to normal. Intrinsic plus deformity is not seen after this operation.

The merits and demerits of these procedures are summarised in table 1. The over all good results from these above procedures vary between 75-85% in the reported series. As discussed, the limitations and advantages of these procedures are different.

Though, none of the procedures are complete in themselves the aim should be to achieve best possible in a given set of circumstances. The selection of procedures should be need based and individualised. Even the active cases can be operated, if required. Use of so called 'Standard operations' should not be a regular practice. As far as possible surgery should be done before a patient is debilitated.

Table I. Comparison of Different Procedures

	Extensor Diversion	Dermadesis and Pulley Advancement	Intrinsic Reactivation Procedure	Pulley Insertion Procedure
Operative Technique	Simple	Simple	Demanding	Relatively Demanding
Successful Results	75%	80-85%	85%	90%
Grip Strength	Same	± Increased	Increased	Increased
Pinch Strength	Same	± Increased	Increased	Increased
Re-education Required	Nil	Nil	Yes	Yes
Arch Reversal	can get exaggregated	± exaggregated	Corrected	can get corrected
Lumbrical Position	deformity recurs	can form	can form	can form
Individual Finger Control	Present	±	Nil	Nil
Revision	can be done	can be done	difficult	difficult
Sequence of Closure	Not Normal	± Normal	Normal	Normal
Can be used in				
a. active cases	Yes	± Yes	No	No
b. extensive paralysis	Yes	Yes	No	No
c. hypermobile fingers	±	can fail	± Yes	Yes
Acts by	Redistribution of forces	Redistribution of forces	Generating new forces	Generating new forces

REFERENCES

1. **Bourrel, P.** : Palliative operations for correction of claw fingers. *Ann. Chir. Main* 5: 230, 1986 (In French).
2. **Brand, P. W.**, Paralytic claw hand. *J. Bone Jt. Surg.*, 40-B: 618, 1958.
3. **Riordan, D. C.**, Tendon transfers for median, ulnar or radial palsy. *The Hand*, 1: 42, 1969.
4. **Antia, N. H.**, The palmaris longus motor for lumbrical replacement. *The Hand*, 1: 139, 1969.
5. **Srinivasan, H.**, Extensor Diversion—A new approach in correction of intrinsic minus fingers. *J. Bone Jt. Surg.*, 55-B, 58, 1973.
6. **Srinivasan, H.**, Dermadesis and flexor pulley advancement—First report on a simple operation for correction of paralytic claw fingers in patients with leprosy. *J. Hand. Surg.*, 10: 979, 1985.
7. **Palande, D. D.**, Correction of intrinsic minus hand with reversal of transverse metacarpal arch. *J. Bone Jt. Surg.*, 65-A, 514, 1983.
8. **Malaviya, G. N., Husain, S. and Shantagunam, P.**, Correction of hypermobile claw fingers in leprosy by pulley insertion procedure. *Euro. J. Plas. Surg.*, 10: 148, 1987.
9. **Burkhalter, W. E. and Strait, J. L.**, Metacarpophalangeal flexor replacement for intrinsic muscle paralysis. *J. Bone Jt. Surg.*, 55-A: 1967, 1973.