LIPODERMECTOMY AND FLEXOR PULLEY ADVANCEMENT:
A NEW SURGICAL ALTERNATIVE TO CLAW HAND CORRECTION

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SUMMARY

Tenodesis, arthroisis and arthrodesis procedures for paralytic claw hand have become obsolete, because of their static principles. Zancolli's metacarpophalangeal capsulorrhaphy stretches out with time, though the initial results are satisfactory (Zancolli, 1957). Tendon transfers by and large still remain the mainstay of treatment, much monopolised by the experienced surgeons and requires pains taking physiotherapy (Pandey, 1975). Lipodermectomy with flexor pulley advancement is suggested as a new alternative to surgical correction of claw hand, as a simple, safe, quick out-patient procedure requiring least surgical or physiotherapeutic expertise. The preliminary results are encouraging.

Materials and Methods

We operated upon thirty hands (106 fingers) at the Postgraduate Department of Plastic Surgery, King George's Medical College, Lucknow and Rehabilitation and Artificial Limb Centre, Lucknow between the year 1984-85.

Pre-operatively, after appropriate case selection the deformities were measured by a goniometer. Grip strength was measured by ability of the hand to elevate the mercury column of a sphygmomanometer, its cuff inflated to 20 mm Hg. The fixed deformities of IP joints were recorded. Two separate problems of claw hand were therefore objectively recognised. Goniometry evaluated the deformity while grip strength evaluated the functional disability.

Patient Selection

All cases presenting with ulnar or combined ulnar and median claw hand were selected. It was made sure that patients could flex their fingers. Patients with restricted extension at interphalyngeal joints were not excluded. Cases of Hansen's with bacillary index less than 2 were included. (In cases with higher bacillary index the probability of post surgical stiffness due to excessive cellular response was higher.) Any ulceration in the vicinity was obvious contra-indication. Most of the cases of Hansen's had already received dapsone-therapy for at least six months.

Pathodynamics of Paralytic Claw Hand

The intrinsic muscles i.e. interossie and lumbricals in general flex the MP joints and assist in extending the IP joints. The intrinsics provide the necessary fixation of MP joints to prevent the long extensors from hyperextending the MP joint. Intrinsic paralysis results in hyperextension of MP joint which prevents the long extensors from extending the IP joints which are instead flexed by the "tenodesing effect of long flexors"
Operative Principles

The limb was kept on a standard arm rest and the surgery was performed in axillary block after limb exsanguination with an Eschmarch’s bandage and maintenance of a tourniquette using a sphygmomanometer cuff. Transverse incision across the palmar crease was given at the level of MP joints, usually corresponding to the distal palmar crease till it reached well dorsal to the joint axis on the radial and ulnar borders of the hand. The distal skin flap was undermined and another convex incision was given connecting the limits of the first incision so as to map out an elliptical island of skin and fat distally (Fig. 1). This island was excised to expose the tendons and the intervening neurovascular bundle (Fig. 2). In each ray, the flexor pulley of the tendons adherent to the Antenor side of the flexor tendons was slit longitudinally in midline proximally upto the IP joint line leaving distal 1/3 of its length intact (Fig. 3).

This pulley advancement (Boyes, 1964) increased the mechanical advantage of the flexor at the MP joint and when the tendons were pulled they were confirmed to initiate flexion at MP joints. The skin edges were approximated with running monofilament nylon sutures which brought the fingers in flexion at MP joint at an angle of approximately 45° (Fig. 4). Dorso-volar
below elbow plaster cast immobilisation upto the IP joints was given after vaseline gauze dressing thus keeping the hand in the intrinsic plus position.

**Post-operative Care**

The majority of the patients were not hospitalised. After 10 days the volar cast was discarded. The dorsal cast was strapped with adhesive tape and more vigorous finger movements were encouraged. All support was discarded after 3 weeks when stitches were removed. Hot saline fomentation with grip strengthening exercises by asking the patient to squeeze a rubber ball in cast and during fomentation, was started as a home care programme along with frictional massage over the incision line. The sizes of rubber balls were decreased as the grip and mobility improved. Meanwhile full functions were allowed. There was usually no need for Physiotherapy after 4-6 weeks.

**Observations and Results**

Lipodermectomy corrected the deformity while flexor pulley advancement corrected the functional disability. Fifteen hands of right side and 15 of left side were separately evaluated. In 19 hands the underlying cause for clawing was Hansen's disease proved by positive bacterial smear, skin lesion and nerve thickening. In 8 of these the disease was lepromatous (all bilateral), in 7 it was tuberculoid, in 4 it was dimorphous. The classification was based on the Madrid classification. None of the cases had received dapsone-therapy for less than 6 months. For all except two hands pre-operative rifamycin 1350 mg. was given. In two hands the pathology was chronic Volkmann's ischaemia with mild radial nerve affection. In the remaining 6 hands, neurotmesis was the cause, proved by electromyography and demonstration of Erb's complete reaction of degeneration. In 2 hands, the case was entrapment neuropathy following rheumatoid disease, in one hand the cause was motor neuron disease of juvenile type. The patients were assessed periodically by four evaluation criteria and interpreted after a mean interval, of 6 months. The criteria were based on the parameters used by Brand (Brand, 1958).

**Open Hand Analysis :**
1. Excellent—Ability to completely open the hand without hyperextension at MP joints.
2. Good—Ability to open the hand to appear normal at rest i.e. unassisted angle of 30° or less.
3. Fair—Ability to open the hand to 30°—60° flexion.
4. Poor—less than fair.

**Closed Hand Analysis :**
1. Excellent—Ability to tightly close the first to touch the tips of digits fully at the base of each finger.
2. Good—same as excellent but not tightly.
3. Fair—Visible gap between the tip of the finger and the palmar surface of the hand.
4. Poor—Finger tips do not meet the palm.

**Grasp Analysis :**
1. Excellent—more than 50% increment in pre-operative finding.
2. Good—30—50% increment.
3. Fair—20—30% increment.
4. Poor—less than fair.
IV. Subjective Evaluation by Patient:
1. Excellent—Normal looking hand with restoration of full function of grasp.
2. Good—Normal looking hand with ability for independent self care.
3. Fair—less than normal look with partial dependence in self care.
4. Poor—less than fair.

Results
After an average of 6 months of follow up following is the evaluation of results:

I. Open Hand Analysis:
Out of the 106 fingers subjected to this procedure, 58 (54.7%) had excellent result, 34 (32.1%) had good, 7 (6.6%) each had fair and poor results respectively. The findings clearly affirm Frutschie observation that palmar skin has a great capacity to stretch. It is imperative that for lasting effect, the excision of palmar skin should be wide in order to give the flexor tendons a greater chance to establish their mobility. On analysis of the 7 fingers with poor results, all these fingers were found to be fixed between 30°-50°. These fingers were either index or little because of the presence of additional long extensors in them. The powerful long extensors are the main dynamic factor in stretching out the shortended palmar skin. Moreover, the elliptically excised skin limits the width of the skin in the regions of these digits. Unlike capsulodesis, this procedure has no chance of allowing the flexor tendons adhere to the incision site.

II. Closed Hand Analysis:
Excellent results were seen in 51 fingers (48.1%), good in 7 fingers (6.6%). Poor results were seen in cases with high paralysis where FDP was not strong and hence pulley advancement did not significantly improve its mechanical advantage. Best results were seen in all cases with low type nerve injury and wherever patients were motivated to mobilise the fingers early after surgery. We feel therefore that the procedure is ideal for cases with recent low-type non-inflammatory paralysis with supple distal joints.

III. Grasp Analysis:
Grasp improved by at least twice the pre-operative values. Poor improvement was seen in cases with poor closed hand analysis. In cases where both the hands were operated, the grasp strength reached to comparable values on both the sides.

Subjective Evaluation:
There was only one case with poor results in which no plaster support was given after surgery. This had stretched out the palmar suture line much before stabilisation of muscle dynamics. As in all other procedures described for the correction of claw hand, immobilisation in optimum position is necessary for optimum results. Subjective evaluation has been much influenced by variables, like occupation of patient, side of involvement, dominant hand, pre-operative status, associated paralysis, pinch strength, thumb functions and the underlying pathology.

Conclusion
The preliminary result of this procedure are encouraging. All the previously described procedures for correction of paralytic claw hand aim at fixing the MP joints in a desired flexed position to enable the long extensors to extend the MP joints. It is realised that any procedure requiring
prolonged immobilisation of hand is likely to produce suboptimal results because of consequent stiffness. Any soft tissue extension block surgery is likely to stretch out in due course due to the tractional pull of the powerful long extensors unless the procedure is combined with something more to counteract the extensor pull. Tendon transfers aim at restoring the intrinsic mechanism which stabilises the actions of long flexors and extensors. This new surgical alternative has several advantages over the conventional methods of treatment.

It is a much simpler procedure not involving the intricacies of subtle tendon tension balancing. It is least traumatic and makes the procedure a relatively quicker one. It can be performed by any general surgeon not necessarily trained in hand surgery. It can be performed under local anaesthesia as an outdoor procedure. It requires no special set of instruments. It does not jeopardise the functions of other structures of the hand. The procedure can be repeated conveniently if necessary without any difficulty. It does not prevent the surgeon to perform any other procedure if it fails, or if any other combination is desired. It does not require elaborate dynamic splintage or prolonged protection. Readucative exercises are not needed at all because no new motor unit is substituted for intrinsic functions. The scar being in the palm does not "show". It results in a much more normal looking hand (Fig. 5–8) especially in the open

Fig. 5. Pre-operative open hand.

Fig. 6. Pre-operative closed hand.

Fig. 7. Post-operative open hand.

Fig. 8. Post-operative closed hand.
hand position. Cost wise the procedure is most economic from the point of view of the patient and the hospital.

REFERENCES


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