

ADAPTIVE SHORTENING OF LONG FLEXORS IN PARALYTIC CLAW HANDS

BY

DR. G.A. ANDERSON

Between the years 1983 and 1991, 87 paralytic claw hands out of 252 displayed adaptive shortening of their extrinsic flexors. This was identified by assessing the adaptive shortening angle. Moderate and severe adaptive contracture was found in 86.4% of hand. Supervised physiotherapy preceded reconstructive surgery. Follow up assessment showed no adaptive shortening. This secondary problem in paralytic claw hands can be prevented if home self-care exercises are introduced early.

INTRODUCTION :

Partial paralysis of the ulnar nerve with or without an associated partial median neuropathy does not pose too great a problem for an individual to cope with the routine demands of daily living. But an established and completely paralysed nerve does incapacitate a person to a considerable degree. It is reported that the grip strength of the hand following distal ulnar and median nerve palsy can be decreased as much as 60% to 80% when compared to the normal side (Mannerfelt 1966, Brown 1970). It is easy to understand why, this is so. For, the weakness following nerve paralysis completely wastes away the intrinsic muscles. And we are aware that the strength of a muscle is related to its effective cross sectional area, whereas the excursion of a muscle is proportionate to the length of its fibres. Therefore a workman with intrinsic paralysis may be seriously handicapped.

The hand deprived of intrinsic muscle power is left solely under the control of the long flexors and extensors. This results in an unstable system (Landsmeer 1961), because the increased extending force moment at the metacarpophalangeal (MCP) joint will give rise to the characteristic claw deformity, namely : MCP joint hyperextension and proximal interphalangeal (PIP) joint flexion. The principal disability in this

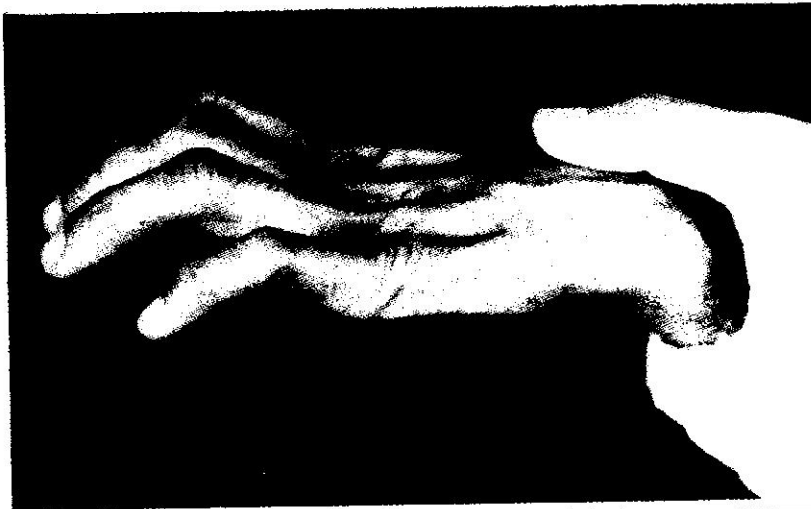
deformity is the lack of MCP joint and PIP joint independance. The PIP joint continues to adopt a state of flexion, whether the MCP joint is flexed or extended. The PIP joint never gets to fully extend. As a result the structures on the volar aspect of this joint remain lax and secondary changes of an adaptive nature develop in the skin, fascia, tendon or capsule. Further there is a selective worsening of the problem related to the superficialis muscletendon unit when an individual acquires the habit of flexing the wrist to obtain some opening of the fingers to grasp large objects. Here he makes use of the tenodesis effect of the extensors to open the fingers i.e., to extend the interphalangeal joint but, the long flexors mainly, the superficialis gets dysfunctioned to a variable degree. Myostatic contracture, which is the fibrotic change of the supporting connecting tissue of a muscle gradually develops.

In the past, treatment which was directed towards removal of joint contracture in claw hands diminished to some extent this secondary problem of adaptive shortening of long flexors. But, the isolated presence of adaptive shortening (contracture) of long flexors in claw hands had never been specifically looked into.

Material and Methods :

During a period of 9 years, from 1983 to 1991, there were 252 established paralytic claw hands

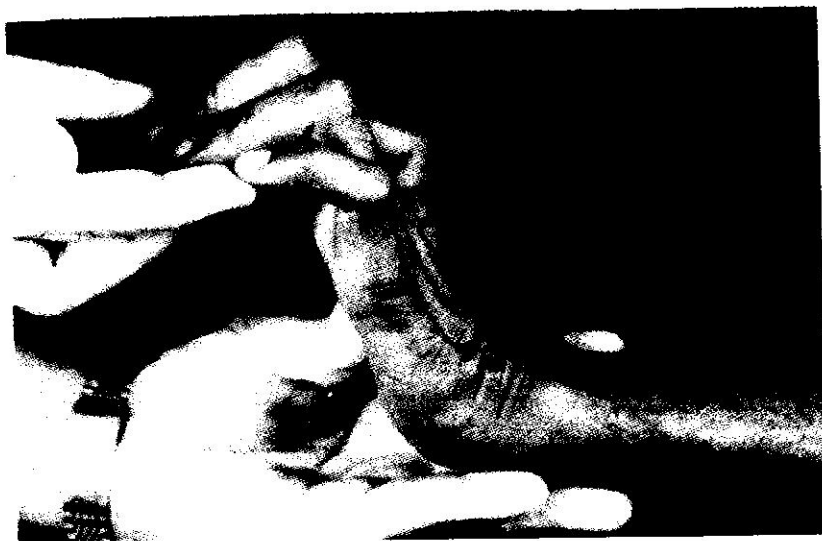
M.S. (Orth.), D. Orth., MNAMS (Orth.), M.Ch. Orth. (Liverpool), FAMS (Vienna).
Assoc. Professor of Orthopaedic Surgery, Head of the Department : Hand & Leprosy Reconstructive Surgery, Christian Medical College Hospital, VELLORE-632 004.



Paralytic Claw Hand showing MCP joint extension and interphalangeal joint flexion.



Paralytic Claw Hand stabilised at the MCP joint showing that the flexion of the interphalangeal joint can be passively corrected.



With the wrist joint dorsiflexed the PIP joint flexion deformity is revealed, characteristic of superficialis tendon adaptive contracture.

that had reconstructive surgery. Out of this number, 87 claw hands manifested long flexor contracture as a secondary problem, 74 had skin, capsular and long flexor contracture and the remaining 91 claw hands were either supple and mobile or hypermobile. The aetiology was Hansen's neuropathy in 223 cases and post traumatic nerve palsy in 29.

In C.M.C. Hospital, Vellore a new protocol for managing paralytic claw hands was introduced from 1982. The reconstructive surgical method chosen varied with the 'Hand Type'. The association of secondary problems in these hands besides age, occupation and duration of deformity were the important parameters for the physiotherapist and surgeon to select an appropriate insertion site and motor to correct the deformities.

Assessment :

In the 87 paralytic claw hands with long flexor contracture the adaptive shortening angle was measured.

The adaptive shortening angle is that angle measured at the PIP joint with the wrist kept in neutral position, in 30 degrees extension and 60 degrees dorsiflexion position. The presence of the long flexor contracture (principally the superficialis) was thus verified if the PIP joint kept extended passively began instead to flex as the wrist was extended beyond neutral (Fig. 1, 2 & 3).

The author's grading System was followed :

Mild Adaptive Contracture : PIP joint flexion deformity seen only when the wrist is held at 60° extension.

Moderate Adaptive Contracture : PIP joint

flexion deformity seen only when the wrist is held at 30° extension.

Severe Adaptive Contracture : PIP joint flexion deformity seen even when the wrist is held at or just above the neutral position.

According to the author's grading there was mild, moderate and severe superficialis tendon contracture in different percentage; moderate being the largest. (Table 1).

Physiotherapy :

Wax bath and oil massage preceeded gentle passive stretching exercises for all fingers. In addition to this, muscle strengthening exercises and isolation exercises were taught to the patient. Exercises are specially directed towards maintaining straight interphalangeal joints while gently extending the wrist. After a 20 minute period of exercises, a well padded volar POP slab is applied extending from 2" distal to the cubital crease upto the finger tips. Twice a week the angles are recorded on the angle measurement graph. Exercises and splinting are continued until no further improvement in the angles are seen for a whole week. This would show a plateau on the graph. Great care is taken to avoid forcing the pace of exercises so that joint swelling or palmar redness does not develop. Functional assessment at the occupation therapy unit, is done before commencing physiotherapy and thereafter on a weekly basis. At the point when grip strength shows any early signs of deterioration when compared to the first assessment, then physiotherapy measures are stopped. It is after this stage that the patient is admitted for reconstructive surgery.

TABLE-1

Pre-physiotherapy and Post-operative Adaptive Shortening Angle Grades.

*Grade	Pre-Physiotherapy Stage N : 87	Post-Operative Stage N : 87
Mild	12 (13.8%)	18 (20.7%)
Moderate	51 (58.6%)	64 (73.6%)
Severe	24 (27.8%)	3 (3.4%)

*Refer to Author's grading in the text.

Results :

Supervised hand physiotherapy done judiciously and with a specific objective for these hands showed a reduction in the angles of the severe adaptive contracture group by 24.4%, 21 hands shifted to a moderate grade. Six hand in the moderate group attained a mild grade. The total absence of adaptive contracture i.e., no PIP joint angle with the wrist above 60° dorsiflexion was never achieved in any hand (Table 1).

In the 64 claw hands showing only moderate adaptive contracture of the superficialis an Extended Pulley Insertion (modified Zoncolli Lasso) using either the F.D.S.R. or F.D.S.M. as the motor, was performed. The combined excellent and good results was a little over 90% as assessed by the method of percentage correction of pre-operative unassisted angles at the PIP joint, as proposed by Brandsma and Watson (1982). In the hands showing mild adaptive shortening, 11 had the Palmaris Longus Four Tail operation (PL4T). In the 3 hands with severe adaptive contracture the procedure done was intrinsic replacement using a single superficialis (modified Littler's modification of Stiles-Bunnell operation) and 7 underwent Brand's Extensor-Flexor Four Tail procedure (EF4T). The Extended Pulley insertion using a superficialis as motor (the subject of another communication) resulted in the MCP joint obtaining a position 10° short of neutral as is intended. This does not permit for any hyperextension. However no finger of any hand showed adaptive contracture of other superficialis at the minimum 2 year follow up period.

Discussion :

Any state of prolonged resistance to passive stretching in a muscle may be considered as a contracture. Physiological contracture of any muscle, results from mechanical or chemical causes acting directly on the contracted mechanism without involving an action potential. Myostatic contracture is a fibrotic condition of the supporting connective tissue of the muscle or joint, resulting from immobilization of the muscle in a short position while the innervation remains intact. Brand (1985) has described the tendon as acquiring Drag and resistance to movement if they remain in any degree of disuse. In paralytic claw

hands the extrinsic flexors mainly the superficialis, is at a disadvantage since they are not used to their full potential and they are not stretched to their total amplitude. When a range of motion is not used it will be gradually lost. Eventually para articular structural changes overshadow the primary deformity. Long duration of deformity in the hands of patients also having glove type of sensory deficit and who are not given the benefits of simple physiotherapeutic measures in time are likely to develop these problems (Anderson 1984). Patients with paralysis due to Hansen's neuropathy are more susceptible to these adverse changes than those with paralysis following nerve injuries. In this study the occupation of the patients were mostly as farmers or casual labourers. The insidious onset and progress of Hansen's neuropathy in these social groups are more likely to go unnoticed by the sufferers themselves. It is therefore necessary for centres carrying out Leprosy eradication programmes and rehabilitation projects to direct their efforts of deformity prevention to this vulnerable group as well.

Grading of adaptive shortening of long flexors are an essential step in assessment and record keeping. It enables the team to identify the patients hands which deserve special attention and perhaps prolonged physical therapy.

Simple physical therapy such as oil massage and passive stretching exercises of weak and deformed hands at the outset of treatment or when a patient develops intrinsic muscle weakness while under medical treatment, can be instituted and imparted to the patient themselves. They can perform these as home self-care exercises. This is a totally inexpensive proposition which is likely to be cost effective in the long run when surgical or vocational rehabilitation are carried out.

Physical therapy plays a vital role to reduce long flexor contracture so that optimal results are obtained from reconstructive surgery. The simplicity of physical measures in paralytic claw hands cannot be more simpler. It is actually a demand on the therapist's patience rather than his/her skill. Any signs of weakness in the grip strength during the course of pre-operative physiotherapy should warn the therapist and surgeon not to persist with physical measures. A

weak hand cannot be re- educated well in the post-operative period, stiffness will undoubtedly thwart the efforts of the surgeon and the patient will be the ultimate loser. It negates the very purpose of physiotherapy goals.

Prevention of long flexor contracture making

sure that hands are supple and mobile and in turn serviceable with minimal need for substitution patterns of hand function at home and at work would help the deformed NOT to become disabled.

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Captions for Figures 1, 2 and 3 (Photographs)

Figure—1 :

Paralytic Claw Hand showing MCP joint extension and interphalangeal joint flexion.

Figure—2 :

Paralytic Claw Hand stabilised at the MCP joint showing that the flexion of the interphalangeal joint can be passively corrected.

Figure—3 :

With the wrist joint dorsiflexed the PIP joint flexion deformity is revealed, characteristic of superficialis tendon adaptive contracture.