ZANCOLLI LASSO TENDON TRANSFER FOR ULNAR CLAW HAND; A SHORT TERM OUTCOME ANALYSIS OF SIXTEEN CASES

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Abstract
Sixteen patients (28 fingers) with mobile claw hand deformity following low ulnar nerve palsy were reconstructed by Zancolli lasso procedure, using the flexor digitorum superficialis tendon transfer for the deformity correction. Postoperatively, after follow up averaged 6.5 months, the outcome was evaluated only by the assessment of the claw deformity correction, and good results were attained in 81% of the patients, fair in 13%, and poor in 6 %.

After this procedure at follow-up, swan neck deformity was developed in one case and insufficient finger flexion also in one, and none of them effect the cosmetic results.

This study supports that Zancolli lasso procedure is simple and safe to perform, it creates a functionally dynamic tenodesis, gives good cosmetic deformity correction with better patient satisfaction in selected cases with least possible complications.

Introduction
Clawing of the ring and small fingers is the most notable physical finding in low ulnar nerve palsy, created by the paralysis of ulnar innervated intrinsic muscles1-4, and the claw hand is defined as metacarpophalangeal joints (MPJ) hyperextension with interphalangeal joints (IPJ) flexion1,5-7, that’s result the inability to flex the IP joints sequentially, leading to impaired grip and grasp strength6,8,9.

In most patients when the intrinsic muscles power fails to recover after the neurorraphy, a compensatory operation is indicated, because of the fact that the paralyzed muscles rarely recover10.

Ulnar claw finger deformity can be corrected by static procedures and by dynamic tendon transfer or tenodesis6-8,11.

The Zancolli lasso procedure (ZLP) is a dynamic tenodesis technique, that maintains the MP joint in flexion passively2,12,13, commonly indicated in simple clawing with positive Bouvier’s maneuver1,2,8,9,12,14. Zancolli lasso isolates the flexor digitorum superficialis (FDS) tendon for transfer and to loop around the A1 pulley creating a dynamic flexion tether for the MP joint, 12 and it corrects the clawing simply by preventing the MP joints hyperextension and allows simultaneous flexion of the IP joints1,2,15.

The purpose of the current article is to evaluate the relative efficacy of Zancolli’s Lasso procedure in correcting simple claw hand deformity and improving the disability after low ulnar nerve palsy.

Patients and methods
This study included 16 patients with 28 claw (ring and little) fingers following low ulnar nerve palsy who underwent reconstructive surgery, using the Zancolli-lasso procedure for the correction of mobile claw deformities.

Thirteen (81%) of the patients were males, and 3 (19%) females. Average age was 25 years (range 14-34 years). Eleven (69%) ulnar nerve injuries were at wrist and distal forearm 3 (19%) in the mid forearm, 2 (12 %) in the palm, and the cause of ulnar nerve injury was sharp objects in 14 (88%) cases, and low velocity missiles in 2 (12%).

In 9 (56%) patients the surgery was done on the right hand, and in 7 (44%) on the
left, and the duration of paralyses ranged from 4 to 12 months (average 8.7). In twelve (75%) patients the little and ring fingers together operated on, in 3 (19%) the little finger alone, and in one (6%) the ring finger alone.

All the claw fingers on which ZLP were performed had MP joint hyperextension greater than 15 degrees with lacked of full proximal interphalangeal (PIP) joint extension (Figure 1), and the

Figure 1: Preoperative photographs of a mobile clawing of the ring and little fingers, with MPJ hyperextension and IPJ flexion.

preoperative requirements included; mobile PIP and MP joints in passive extension and flexion with positive Bouvier's maneuver Figure 2 i.e., the IP joints can be extended with the passive flexion of MP joints (simple claw hand ), also the reconstruction requires good voluntary contraction of the flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) muscles1,2,5,7,9,10,16, and patients with mild clawing, or fingers with PIPJ contractures, or with extensor expansion damage were excluded from the study.

Figure 2: Bouvier's maneuver, prevention of MP joints hyperextension allows the extension of the IP joints.

Surgical technique
All the hands were operated under general anaesthesia with tourniquet control, we use a volar oblique incision at each MP joint just distal to distal palmar crease of the little and ring fingers with subcutaneous dissection the FDS tendon, flexor A1pulley and the proximal part of A2 pulley were exposed, and the FDS tendon slips divided distal to the A1 pulley approximately 2 cm distal to its separation. After division, the proximal part of the 2 FDS slips passed anteriorly between the A1 and

A2 pulleys (Figure 3), then looped proximally anterior to the A1 pulley, and secured over the A1 pulley and sutured back to the FDS tendon itself proximal to A1 pulley by 3-0 nonabsorbable sutures Figure (IV), with the MPJ placed in about 20 to 30° of flexion during tightening (little finger tension was set tighter than the ring).

Only in 2 patients (claw little fingers) we looped the FDS tendon around the A2 pulley, similar to that described by Omer modified ZLP1,2,16.
Postoperatively, a short arm dorsal blocking cast was applied, extending to the PIP joint with the wrist neutral and the MP joint in 70° to 90° flexion, and active and passive flexion and extension of the fingers was allowed, the sutures were removed after 2 weeks (Figure 5) and the slab after 4 weeks, then a splint worn for additional 2 weeks to block hyperextension of the joints and to protect the reconstruction, and at 5 to 6 weeks postoperative the functional use was encouraged.

**Results**

Most of the patients postoperatively were followed at one month intervals, and the follow-up period ranged from 4 to 12 months (average 6.5 months), and being less than 6 months in 12 (75 %) patients. The evaluation of our results was only based on the efficacy of ZLP in correcting the claw hand deformity (appearance), without assessment the sequence of phalangeal flexion, and hand function or grip strength, that used in the previous published articles. By measuring the angles of hyperextension or flexion at the MP and PIP joints with fingers actively extended or open out fully, the deformity correction was categorized into good, fair and poor, according to the previous published criteria and the grading was as follows:

- **Good**: Ability to extend PIPJ to neutral or 20° extension lag with MPJ position between 10° hyperextension and 30° flexion.

- **Fair**: Ability to extend PIPJ to neutral or 20° extension lag with MPJ position between 30° hyperextension and 40° flexion.

- **Poor**: Ability to extend PIPJ to neutral or 20° extension lag with MPJ position between 40° hyperextension and 50° flexion.
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Fair: PIPJ extension lags of 21 to 30° with MPJ position between 20° hyperextension and 50° flexion.
Poor: PIP joint extension lag >30° in any position of MPJ.

With the respect to the mentioned grading criteria, we also consider the disability correction poor, when there is PIPJ extension lag >30° with weak MPJ flexion, or recurrence of the MPJ extension after surgery.

In this study, out of 16 patients following ZLP, 13 patients (23 fingers) had good claw hand correction (Figure 6 & 7), fair in two patients (3 fingers), and one patient (2 fingers) had poor correction.

Some authors suggested that the fair result is quite satisfactory for most activity, in which the IPJ flexion begins and continues along with MPJ flexion, in fact it is the mechanism used for grasping small objects\(^{5,19}\) so the overall cosmetic correction was considered satisfactory (combined good and fair) in 15 patients.

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**Figure 6:** Postoperative photographs, after 4 weeks showing clawing correction

**Figure 7:** Postoperative photographs at final follow up, complete finger extension after ZLP.

There were 3 postoperative complications following ZLP; Swan neck hyperextension deformity in one patient’s ring finger (Figure 8), insufficient phalangeal joint flexion in 1 (Figure 9), and one patient had mild skin contracture following infection at the base of little finger (Figure 10).

**Figure 8:** Swan neck deformity of the ring finger, but with full flexion of the finger.
Discussion

In low ulnar nerve palsy, the claw deformity preferentially affects the ring and small fingers, results from the loss of intrinsics function in the presence of functioning extrinsic finger flexors and extensors, which describes the inability to coordinate MPJ flexion with the IPJ flexion that affects the appearance of hand. Preventing the MP joint hyperextension will permit the IP joint to extend by the normal long extensors, that corrects the clawing and the patient’s ability to actively extend the IP joint should be assessed by the Bouvier’s maneuver, and with a positive Bouvier test the clawing is defined as simple. Correction of clawing requires the correction of MP joint hyperextension, the problem that initiates clawing, and the procedures can be categorized as static or dynamic.

A number of static procedures have been described, as static osseous blocks or static tissue tightening techniques, but these procedures do not improve the synchrony of finger flexion or the grip strength, and the potential to lose correction as they stretch over time allowing the recurrence of deformities, and rarely use as an isolated procedure for low ulnar nerve palsy.

In general practice, most authors prefer the dynamic tendon transfers, they provide a flexion moment across the MP joint rather than preventing hyperextension, and may be divided into those that provide only MP joint flexion and those that provide both MP joint flexion and IP joint extension, and the surgeon can determine the type of transfer preoperatively, if with the MP joints flexed, the extrinsic extensor tendons can produce full extension at the IP joints the transfer may only need to produce strong MP joint flexion.

Multiple dynamic procedures have been described, to correct clawing and improve the pattern of digital flexion, as Fowler, Brand and the Riordan tendon transfers prolonged with a free tendon graft, or can be done by the Zancolli lasso procedure and Modified Stiles-Bunnell transfer. The Zancolli lasso and the modified Stiles-Bunnell tendon transfers are most commonly used both are volar FDS transfers and do not require tendon grafting, and the FDS tendon transfer is available in low ulnar nerve palsy, that provides an independent motor to do the work of a very small muscles (the lumbricals).

The ZLP creates a dynamic MP joints flexion and allows the flexion of IP joints,
by passive tenodesis for cases in which
finger extension is present \(^1,2,15,20\), but
without change in the grip strength \(^1,16,21\).
The procedure requires only one incision
on each finger, and provides a straight
course for the transferred FDS tendon to
loop over the A1 pulley by the shortest
route \(^7,8,17\).

Omer modified the ZLP to loop the FDS
tendon around the A2 pulley and attached
directly to it that will also serve as an MP
joint flexor \(^1,2,16,18\).

In the present study, I prefer the oblique
incision for ZLP, due to its wide exposure
with proper isolation of the flexor tendons
and the A1 and A2 pulleys, in addition it
can be extended on need although most
surgeons usually use the transverse
incisions \(^1,12,13,15\), and in 88% of the
patients we looped the transferred FDS
tendon around the A1 pulley, while in 12
% it was looped around the A2 pulley
because of thin A1 pulley in longstanding
nerve palsy (Omer modified ZLP) \(^1,2,16\).

The ulnar nerve is portrayed as the least
favourable nerve in the upper limb in
terms of recovery especially its most distal
motor component, 6 we performed ZLP in
a minimum of 4 months duration of ulnar
nerve palsy with established clawing,
when recovery was no longer expected.

Timing of tendon transfers for ulnar nerve
palsy primarily dependent on the
probability of motor function recovery
after nerve repair \(^4,23\), and also because of
the fact that the paralyzed intrinsic
muscles rarely recover, some authors
recommended early tendon transfer at the
time or shortly after ulnar nerve repair, to
prevent MP joints hyperextension and
deviation \(^6,10,13,23\).

Our outcome measurement, based only on
the assessment of claw hand correction,
and after relatively short follow up
averaged 6.5 months the disability
correction being good in 81% of the
patients (82% of the fingers), fair in 13%,
and in 6% of the patients was poor in
whom the MP joints hyperextension
recurred. In the Hastings et al study, 1 the
clawing was corrected in 83% of the
fingers after FDS lasso procedure, but at
an average of 5 years after surgery, in
addition some authors \(^5,19\) have suggested
the fair result is also quite satisfactory,
therefore 94% of our patients could said to
have satisfactory disability improvement.

The recurrence of the MP joints
hyperextension may attributed to faulty
operative technique, as low tension being
placed on the FDS slips, or the transferred
slips probably slackened due to
inadequate postoperative hand
protection \(^1,19,24\), so proper tensioning of
the tendon slips with adequate hand
protection are critical for a better
outcome \(^1,21\).

The drawbacks of ZLP; in general,
releasing the FDS tendon from its
insertion can lead to a swan-neck
deformity or weakness in flexion, due to
the removal of the prime PIPJ flexor, and
unopposed pull of the extrinsic
extensors \(^1,2,13,19,22\). And other reported
complications after ZLP includes
insufficient finger flexion, adhesions, and
flexion contractures \(^2,19,21,22\).

Postoperative complications in the current
study nevertheless occurred in 10 % of the
operated fingers (3/28), swan-neck
deformity developed in one finger,
insufficient flexion in 1 and in one a mild
skin contracture following infection at
distally extended wound, and none of
them compromise the final surgical
deformity correction.

Some authors suggested, minimizing the
development of swan neck deformity,
require retaining enough distal FDS
stump, to scar down to the sheath and
create a tether to minimise PIPJ
hyperextension \(^1,2\) or the FDS distal stump
can be tenodesed to the proximal phalanx
or sutured to the sheath \(^2,12,20\).

The main limitations of this study were,
the number of patients was relatively
small, with interrupted and short follow
up period, and the outcomes were
measured only by the evaluation of claw
hand improvement after ZLP, without
assessment of the sequence of finger flexion and hand function, so there was no basis for wide comparison, and a considerable follow-up period will be needed for additional information about the effects of this procedure. Finally, Zancolli lasso procedure is a simple dynamic transfer technique performed in the same surgical field, preferred for the correction of simple claw hand deformity allows passive MPJ flexion and IPJ extension, with least possible morbidities, and the only essential requirements includes functioning FDS along with the FDP muscles.

References