Early active motion protocol following triple Kessler repair for flexor tendon injury

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ABSTRACT

Purpose. To evaluate outcome of 6-strand triple Kessler repair for flexor tendon injuries, followed by early active motion rehabilitation.

Methods. 25 men and one woman (36 fingers) underwent 6-strand triple Kessler repair for flexor tendon injuries in zones 2 to 5, followed by early active motion rehabilitation. Rehabilitation was started at days 3 to 5. Patients were instructed to passively flex all the fingers with the uninjured hand and to actively retain this position for 10 seconds. Active extension within the confines of the splint was allowed. At the end of week 8, strength training was commenced until a satisfactory range of motion was regained. Outcome measures included total active motion, grip strength, and the Disabilities of the Arm, Shoulder and Hand (DASH) score. Complications such as infection and wound dehiscence were recorded.

Results. The mean follow-up was 1.2 (range, 1–2) years. Outcome was excellent in 24 digits, good in 4, and poor in 8. The mean grip strength was 80% (range, 60–100%) of normal in dominant hands and 60% (range, 50–65%) of normal in non-dominant hands. The mean DASH score was 15 (range, 0–52). One patient had wound dehiscence and superficial infection.

Conclusion. Six-strand triple Kessler repair for flexor tendon injuries, followed by early active motion rehabilitation yields satisfactory results.

Key words: finger injuries; treatment outcome

INTRODUCTION

A gap-resistant suture technique and early active rehabilitation following flexor tendon repair promotes intrinsic healing and results in less adhesion and better excursion.1 Results of passive motion programmes are inconsistent.2 A controlled degree of immediate active motion is necessary for true proximal migration of the repair site, whereas passive motion may cause the tendon to buckle, roll, or fold up.3 Active motion protocols become the standard of care in flexor tendon rehabilitation.4
and active motion depends on strong repair with increased suture material. We report outcome of 26 patients who underwent 6-strand triple Kessler repair for flexor tendon injuries of the fingers, followed by early active motion rehabilitation.

MATERIALS AND METHODS

Between 2009 and 2011, 25 men and one woman (36 fingers) aged 22 to 56 (mean, 33) years underwent 6-strand triple Kessler repair for flexor tendon injuries in zones 2 to 5, followed by early active motion rehabilitation. Patients with associated fractures, critical ischaemia of the limb or digits, or extensor tendon injuries were excluded, as were those who underwent a separate procedure for skin cover or had lacerations of the flexor pollicis longus.

Patients were operated on under regional or general anaesthesia. The wound was thoroughly debrided. The incision was extended in a zig-zag fashion to identify the proximal and distal cut ends. In case of zone 2 injuries where the proximal end had migrated into the palm, a palmar incision was made, and the proximal tendon end was retrieved. The cut tendon was repaired with 3’0 Ethibond in a triple kessler (6 strands) configuration (Fig.). In zones 2 and 3, an epitendinous running locking stitch was made using 5’0 prolene. In zone 5, the same Ethibond suture was used for epiten dinous repair. The flexor digitorum profundus tendon was repaired in zone 2 injuries only. The A2 pulley was released partially when there was an impediment to tendon motion. After the repair, adequacy of excursion was checked by tugging on the tendon proximal to the repair site. Wounds were closed primarily. A dorsal padded plaster-of-Paris slab was applied, with the wrist in 30º extension, metacarpophalangeal joints in 60º flexion, and the interphalangeal joints left free. This slab was retained throughout the rehabilitation. The dressings were debulked on day 2 and rehabilitation started.

Rehabilitation was supervised by a hand therapist and started at days 3 to 5. Patients were instructed to passively flex all the fingers with the uninjured hand and to actively retain this position for 10 seconds. They were instructed to repeat this manoeuvre 10 times every hour. Active extension within the confines of the splint was allowed. Oedema control and scar massage were performed. To prevent proximal interphalangeal joint contracture, passive stretching was performed with the metacarpophalangeal joints in 90º flexion. At week 2, differential gliding exercises were started if both the flexor digitorum profundus and superficialis were repaired. At the end of week 4, active flexion was allowed. Patients were encouraged to extend their fingers actively outside the confines of the splint. By week 6, the splint was worn only

![Figure](a) Laceration of the middle and ring fingers with zone 2 flexor tendon injuries, (b) repair of the flexor digitorum profundus in the middle finger, (c) the cut flexor tendons of the ring finger, and (d) full extension and flexion of the fingers at the one-year follow-up.
between exercises, and all active movements were allowed during exercises. At the end of week 8, strength training was commenced until a satisfactory range of motion was regained.

Outcome measures included total active motion (measured by a goniometer and the American Society for Surgery of the Hand total active motion score), grip strength (measured by a Jamar dynamometer), and the Disabilities of the Arm, Shoulder and Hand (DASH) score (measured at months 6 and 12). Complications such as infection and wound dehiscence were recorded.

Results

The mean follow-up was 1.2 (range, 1–2) years. Outcome was excellent in 24 digits, good in 4, and poor in 8 (Table). The mean grip strength was 80% (range, 60–100%) of normal in dominant hands and 60% (range, 50–65%) of normal in non-dominant hands. The mean DASH score was 15 (range, 0–52). One patient had wound dehiscence and superficial infection.

Discussion

Early active motion after flexor tendon repair stimulates healing and decreases adhesion. A strong repair is a prerequisite to prevent re-rupture during early active motion rehabilitation. A 6-strand repair with a running epitendinous stitch configuration is stronger than the conventional 2-strand configuration, which results in higher re-rupture rates in active motion protocols. The triple Kessler repair is capable of resisting strong forces and can be done using widely available non-looped sutures.

78% of our patients achieved good-to-excellent results, which is comparable to a study reporting 71% in zone 2 injuries and 77% in other zones after a double-strand repair using a modified Kessler configuration and a running epitendinous stitch, followed by active motion rehabilitation. In our study, 2 digits with zone 2 injuries and 6 digits with zone 3 injuries achieved poor results. The reason for the failures could not be ascertained because these patients refused to undergo further treatment and investigations.

Early active motion rehabilitation had some benefits. In zone 2 and 3 repairs, the adequacy of tendon excursion was checked by tugging on the repaired tendon through a proximal wound. In cases where the tendon edges were found within the zone of injury, the adequacy of excursion was checked by using the tenodesis effect, while passively flexing and extending the wrist. This was possible only with a strong repair. In zone 5 injuries, the running epitendinous stitch was made using the same suture material in continuum with the core sutures. This could not be performed in other zones as it added to the bulk of the repair and prevented tendon excursion. We preferred to position the wrist in dorsiflexion postoperatively, as this aids finger flexion and prevents adaptive shortening that compromises extension. One plaster-of-Paris splint was used for the entire rehabilitation. It costs approximately 150 Indian rupees (US$3), whereas a thermoplastic custom-made splint costs approximately 1250 Indian rupees (US$25).

One limitation of this treatment protocol was that we could not repair both the flexor digitorum profundus and superficialis in zone 2, because the bulk of the flexor digitorum profundus repair precluded gliding of the tendon within the sheath. To enable smooth gliding of the flexor digitorum profundus tendon, the flexor digitorum superficialis slips had to be excised. This may result in decreased grip strength but good range of motion. Treatment outcome for zone 3 injuries was not favourable. Six digits had poor results: 2 had symptoms similar to rupture, one had a wound infection, and in the others the reason was unknown because the patients refused further surgical intervention. Nonetheless, the triple Kessler repair enabled early active mobilisation of the flexor tendons following repair.

Disclosure

No conflicts of interest were declared by the authors.
REFERENCES