



## Original Research Article

## Outcome of active mobilization after tendon repair: A study in a tertiary care centre

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## ABSTRACT

**Introduction:** An injury to the hand will cause a massive deterioration of the regular function. The most affected areas are the fingers. Following the tendon repair, it is important to mobilize the hand at the earliest to stimulate the healing process as well as reduce adhesions.

**Materials and Methods:** The primary repair was done for the patients under general anesthesia with tourniquet control within 6-8 hours of the injury. After 24 hours of surgery, rehabilitation for the damaged fingers were done, which involved active mobilization of the fingers with active flexion initially and then further passive flexion, according to Kleinert's regimen.

**Results:** In the 30 patients in the study, 80% of them were males and 20% were females. The predominant active mobilization scores according to the Louisville scores was good in 62.3% of the cases, while it was excellent in 17.4% of the cases. 13% of the patients and 7.2% of the patients had fair and poor scores respectively

**Conclusion:** Early active mobilization with passive extension as per Kessler's technique is a very useful method for the recovery of the muscle strength and movement of the tendon after repair.

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## 1. Introduction

Hand is one of the most active part of our body and one of the most used part in our normal daily life. For the proper functioning of the hand, an integrity of the bones, tendons and neurovascular system is very essential. Due to its regular use, the hand is normally exposed to injuries.<sup>1</sup> In case of an injury to the hand, there will be a massive deterioration of the regular function.<sup>2</sup> Injuries to the hand are estimated to account for 1/5<sup>th</sup> of the patient population in the casualty, with 1-2% of them having tendon lacerations.<sup>3,4</sup> These lacerations normally occur closer to the skin and may be due to injuries due to glass cuts, knives, sharp objects injuries or crushing injuries. Most of the times, this occurs in the lower socioeconomic status. The most affected areas are the fingers. The patient experiences pain and is unable to bend fingers with a lot of swelling.<sup>5</sup>

Zone 2 of the hand is referred to as the 'no man's land' as this area is difficult to treat and restore normal function. Some of the major obstacles are scarring, formation of adhesion and stiffness.<sup>6-9</sup>

Following the tendon repair, it is important to mobilize the hand at the earliest to stimulate the healing process as well as reduce adhesions.<sup>10-13</sup> One of the methods of mobilizations was by extension – passive flexion mobilization, with the help of a dynamic traction splint.<sup>14</sup> However, a flexion contracture may develop which is usually caused due to poor differential gliding of the profundus tendons and the superficialis in the Zone 2, resulting in adhesion formation. This is supposed to be resolved using the active mobilization of the finger as it provides differential gliding between the two tendons in a normal manner.<sup>15</sup>

We had in this study, assessed the effectiveness of active mobilization after a tendon repair.

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## 2. Materials and Methods

This prospective study was performed by the Department of Orthopaedics in RVM institute of medical sciences and research center from Sep 2019 to April 2020, on 30 patients between the ages 10-75 years. The nature of the study was thoroughly explained to the patients and informed consent was taken from all of them. Those who were not willing to be included into the study were excluded. All the patients included had unilateral injuries to the flexor tendons of the hands in all the zones. Injuries needing finger replantations and extensor tendon injuries were excluded from the study. The primary repair was done for the patients under general anesthesia with tourniquet control within 6-8 hours of the injury as far as possible, where the wound was clean. In case where there was a possible infection or the patient had come to the hospital late, delayed primary repair was done. The delayed primary repair involved the debridement of the wound with antibiotics to prevent further infection before the surgery.

The wounds were opened to retrieve the retracted tendons. Zone 2 wounds were opened with a palmar zig-zag incision mostly or with the modified Brunner lateral incision. The pulleys were not excised after opening the flexor sheath to facilitate the repair. The damaged pulleys were repaired using polypropylene 6-0 suture.

In case of zone 3-5 repair, lazy S or L incisions were made to cut the tendons and end to end repairs were done of the cut ends with polypropylene 3-0 or 4-0 sutures. The cut nerves were repaired using 6-0 or 8-0 sutures as required under loupe magnification. There was no vascular repair done in any of the cases.

After 24 hours of surgery, rehabilitation for the damaged fingers were done, which involved active mobilization of the fingers with active flexion initially and then further passive flexion, according to Kleinert's regimen.<sup>14</sup> In the case of nerve repair, 5<sup>0</sup> palmar extension was done and in case of ulnar nerve damage, the metacarpopharyngeal joint was kept at 90<sup>0</sup> flexion.

The rehabilitation protocol that was used was Kleinert's regimen,<sup>14</sup> Elastic bands are applied to all the fingers of the injured hand and extended from the volar aspect to the nails. A dorsal splint is added on the wrist, with 0<sup>0</sup>-5<sup>0</sup> dorsoflexion and a 70<sup>0</sup> metacarpopharyngeal joint flexion and full IP extension. However as mentioned earlier, a different protocol was observed in case of ulnar nerve damage. The supination and pronation of the shoulder and elbow was also done along with the flexion and extension of the fingers. After the tension of the elastic bands were removed, active extension of all the fingers was done without much force. With the other hand, the fingers were flexed passively. This was done 10 times, 3 times in a day. After 4-8 weeks, the elastic bands were removed and the splint was removed during the exercised and scar mobilization was done. The exercises to the wrist, shoulder

and elbow were continued. As above, these exercises were done 3 times a day, 10 times each time.

For the rehabilitation protocol, the flexor digitorum profundus of all the fingers were blocked and isolated function of flexor digitorum superficialis was done. Similarly, the FDS of all the fingers was blocked and the isolated contraction of FDP was done. A fist was done with all the fingers and then extended to the full extent. In case of the PIP joint contracture, passive stretching was done at the volar splint with the help of cotton padding. To keep the hand supple, passive overflexion and extension of the digits was done.

After 8 m- 12 weeks, power grip was allowed and ball exercises were done using the ball 5 times in each session, 3 times a day. Light work such as holding items, food drink, buttons etc were resumed. The shoulder and elbow exercises were aggressive at this time. They patients were also asked to refrain from heavy work. After 12-14 weeks, the splints were completely removed and the patient resumed his daily work routine. The length and the duration of the hand exercises was further increased to 50 times per session.

The lag in flexion was measured as the pulp to palm distance and the extension lag as the amount of extension in comparison to the normal digits. The active and the mobilization extent was measured as the Total Active Motion (TAM) score and grading was done according to Luoisville system of Lister.<sup>14</sup>

## 3. Results

In the 30 patients in the study, 69 digits were affected. 24 (80%) of them were males and 6 (20%) were females (Figure 1).

17 (56.67%) of them had injuries in their left hand and 10 (33.33%) of them had in their right hand and 3 (10%) had in both (Figure 2).

Out of the 69 digits involved, 2 occurred in zone 1, 19 of them occurred in Zone 2, 12 in zone 3, 9 in zone 4 and 27 in zone 5 (Figure 3).

Among the digits that were involved, 3 of the injuries were in the thumb, 10 were the index fingers, 21 involved were the middle finger, 26 were the ring fingers and 9 were the little fingers (Figure 4).

Excellent results were observed in the ring and the middle fingers. The flexion lag in this case was about 1cm or less as seen in 14 out of 26 cases in the ring finger and 13 out of 21 cases in the middle finger affected patients. Lower results were observed in the thumb and little fingers, with the flexion lag of < 1cm seen in 2 and 4 patients respectively. >3cm flexion lag was seen in 2 patients in the ring finger and in 1 patient only on the middle finger affected persons (Figure 5).

Extension lag of less than 15 cm was seen in 17 patient who were treated for tendon repair in the middle finger, while it was 11 of the patients with middle finger affected

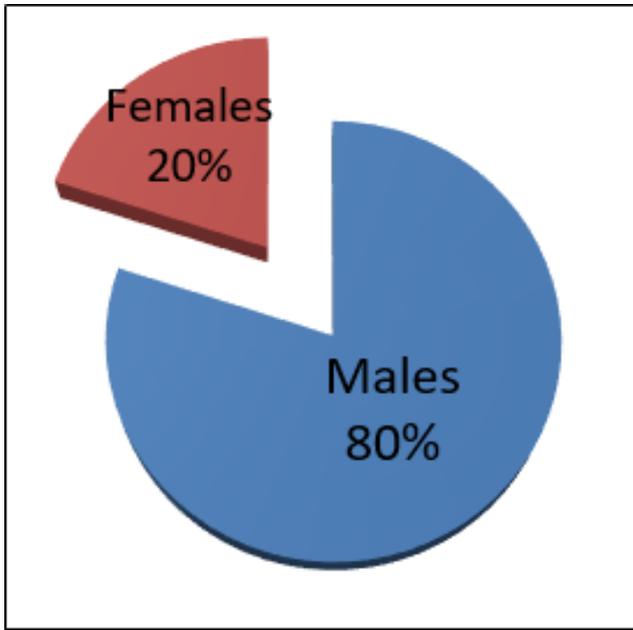


Fig. 1: Sex wise division of the patients

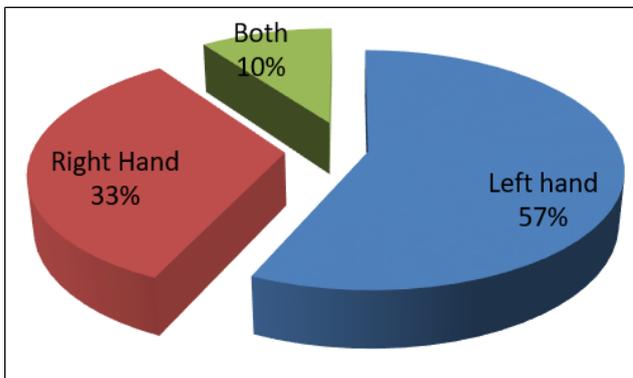


Fig. 2: Hand where injury occurred

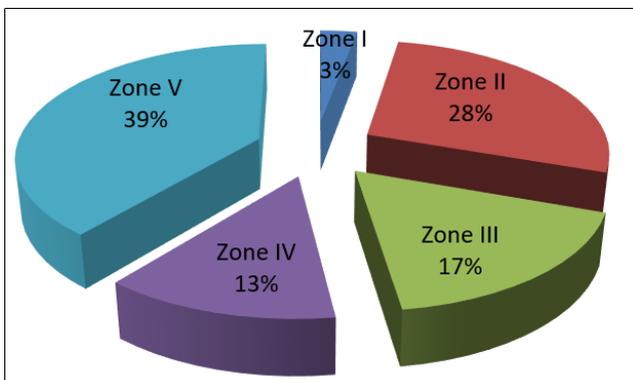


Fig. 3:

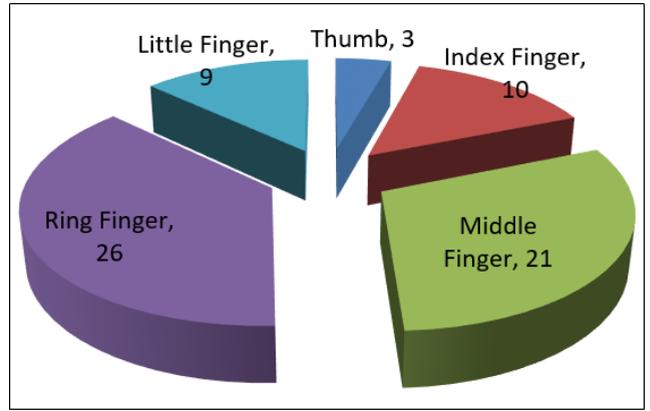


Fig. 4: No of injured digits

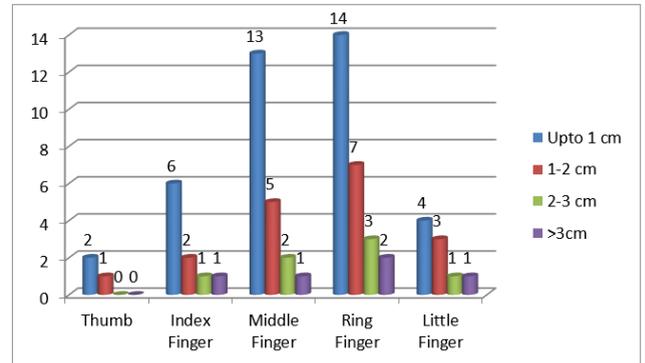


Fig. 5: Flexion lag of the digits

tendons. 5 each of the index and little finger affected patients and 2 with thumb affected patients showed an extension lag of <15cms. While, > 45cm lag was seen in 2 patients in the middle finger, 1 each in index, spring and little finger affected persons (Figure 6)

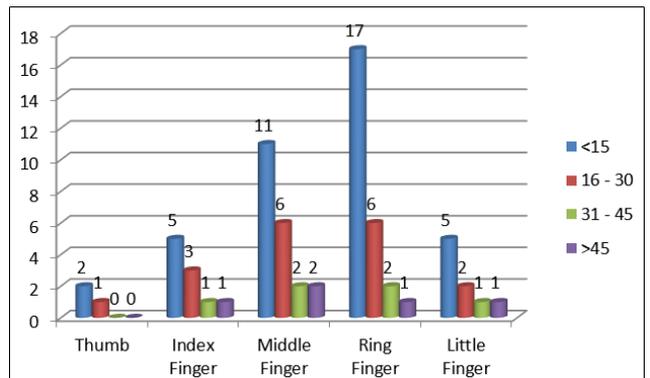


Fig. 6: Extension lag

The predominant active mobilization scores according to the Louisville scores was good in 43 (62.3%) of the cases, while it was excellent in 12 (17.4%) of the cases. 9 (13%)

of the patients and 5 (7.2%) of the patients had fair and poor scores respectively (Figure 7).

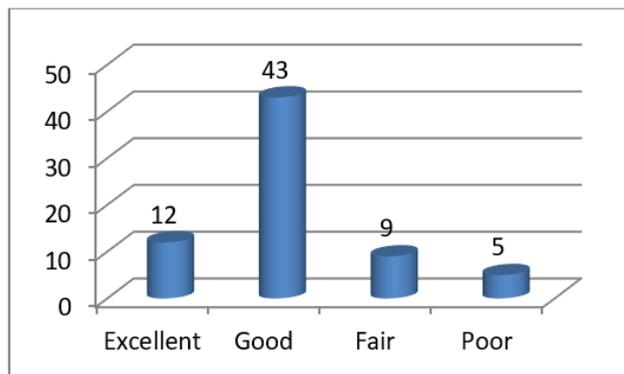


Fig. 7: Louisville scores

#### 4. Discussion

Most of the affected people in our study were males maybe most of the manual labour is also done by them only especially those which involves sharp instruments. Out of the 30 patients enrolled in our study 24 (80%) of them were males and most of them belonged to the working class. A study by Saini et al also observed a predominance of males in a similar study.<sup>16</sup>

Flexor tendon injuries are one of the most common injuries of the hand. This is very common among the younger male population as they are the ones with heavy manual labour using their hands.

The treatment for this is very frustrating to the treating surgeon as there are great chances of malformation and adhesions resulting in lower functional motion. This it is very important to start the mobilization exercises as early as possible. The most useful method of early mobilization is the Kleinert's type of traction with active extension and passive flexion mobilization. In the case of poor differential gliding, there may be formation of adhesions which may hinder the recovering process. Passive mobilization alone cannot overcome the lack of the differential gliding.<sup>15,17</sup> For the passive gliding of these flexor tendons, extension of the interphalangeal joints must be maximum. When properly performed, the results are bound to be good, with little complications.<sup>15,17–21</sup> This along with the active mobilization further helps in the gliding of the flexor tendons and improves the muscle strength and tone.

In our study too, 43 out of the 69 (62.3%) digits shows good results with active flexion and passive extension, with 12 (17.4%) results being excellent. A long term study by Riaz et al showed 70-80% of the patients to have excellent or good results. After 10 years, 94% of the patients had a good grip strength and moved from good to excellent results.<sup>22</sup> A study by Hung et al also demonstrated a good to excellent

strength recovery of the hand in 75% of the patients in their study.<sup>23</sup> The results also depend on the delay in the repair of the tendon. The delay time leads to better repair, shorter rehabilitation time, lesser adhesion formation and better healing rate.<sup>24</sup> A six month period is considered to be the minimum period before the consideration of tenolysis and complete motion. In a multicentral study by Chow et al, excellent results were observed for the zone 2 tendon injuries, with rubber band traction.<sup>25</sup>

In the first 4-8 weeks, the active movements of the tendons generate the muscle strength and this is chiefly attributed to the neural responses and their adaptations to the motor learning and improved coordination. The motor units which are recruited in this case are increased in number result in the increased rate of action and synchronized firing.<sup>26</sup> A reduction in the active mobilization would result in the loss of strength, atrophy and increased amount of connective tissue formation.<sup>27</sup>

In our study, there were no cases of tendon rupture as a complication of the healing process. In some of the studies, this is known to occur, due to unconscious strong gripping with the injured finger, either due to stupidity or during sleep. To overcome, this, during sleep, a resting splint platform is kept to dissuade the fingers to extend during sleep. This splint may be removed while the patient is awake to move the fingers.<sup>23</sup> The rupture rate was found to be around 4.5% in patients who underwent passive mobilization and 4.4% in the patients with active mobilization in a study by Trumble et al.<sup>28</sup> In another study by Abdel Sabour et al, 6.25% in active group and 10% in passive group showed rupture rate. This difference was not significant.<sup>29</sup>

#### 5. Source of Funding

None.

#### 6. Conflict of Interest

None.

#### 7. Conclusion

Early active mobilization with passive extension as per Kessler's technique is a very useful method for the recovery of the muscle strength and movement of the tendon after repair. This reduces the ruptures of the tendon as well as the formation of adhesions.

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