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# Effectiveness of Using Venous Graft as a Tendon Sheath Substitute in Repair of Flexor Tendon Injuries of the Hand

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***Abstract***
***Background: The main goal of flexor tendon surgery is to restore digital motion by providing tendon healing and preserving tendon gliding. The formation of peritendinous adhesions around the repair site is one of several adverse events that may prevent achievement of this goal Flexor tendon injuries occur frequently, adhesions between the tendon and its sheath are the most common complication after tendon repair. The using of venous graft as a tendon sheath substitute following tendon repair is a new technique for managing tendon injury that may improve the result of existing method [1, 2].***
***Methods: In this study twelve patients were seen within 6 months in Plastic Surgery Unit, Surgery Department, Zagazig University Hospital, and El-Ahrar Teaching Hospital in Zagazig. However, no patient escaped or was excluded from the study. Those 12 patients were selected among the cases of hand trauma coming to the hospital with Pure Flexor tendon injuries to assess our study without affecting other injures ( orthopedic, vascular and nerve injures).***
***Results: All patients were assessed using the total active motion (TAM) scoring Final assessment after a follow-up period of 6 months revealed excellent range of movement in two cases, good range of movement in 10 cases and good result in 2 cases.***
***Conclusion: the use of autologous vein graft as a replacement of tendon sheath has many advantages like; it is not expensive, being autologous so not carrying the risk of infection, also it will not affect the tendon healing like other materials. It also improves tendon nourishment.***
***Keywords: Flexor Tendon Injuries, Venous Graft, LAD, Tendon Sheath Substitute.***

## Introduction

Hands are frequently exposed to injuries during daily working hours which might affect its function **[3].**

On average, hand injuries count for 14% to 30% of all treated patients in emergency care.

Tendon lesions are in 2nd position (29%), whereas fractures are 1st (42%) and skin lesions 3rd of all patients treated for hand injuries **[4].**

Over 30 million musculoskeletal injuries occur annually worldwide and nearly half of them involve tendon and ligament injuries. With the increase in life expectancy, it is predicted that tendon injuries will continue to rise, placing an enormous financial strain on healthcare systems **[4].**

Acute flexor tendon injuries represent a substantial burden to both the individual and society, because flexor tendon injuries commonly occur in young, working people. The costs associated with the treatment of flexor tendon injuries include the direct costs associated with surgery and postoperative therapy, as well as the indirect cost of lost productivity **[5].**

The main goal of surgery is to restore function, and avoid the occurrence of postoperative adhesions. The restoration of an injured digital flexor tendon to a functional state after its repair within the digital sheath remains a major problem **[6].**

While mobilization is the key to preventing adhesions and achieving maximum ROM (Range Of Movement), it is at the risk of rupture. In vivo and in vitro studies confirm that mobilization with cyclic tension delivers nutrients more efficiently and promotes better and faster healing **[7].**

Adhesion of the tendon is one of the major challenges for the hand surgeon during tendon repair. In the present day, there is no ideal method to prevent adhesion. The using of venous graft as a tendon sheath substitute following tendon repair is a new technique for managing tendon injury that may improve the result of existing method **[2].**

**Aim of work**

The aim of this study is to evaluate the effectiveness of Using Venous Graft as a Tendon Sheath Substitute in Repair of Flexor Tendon Injuries of the Hand.

**Patients and Methods**

This Intervention Study was carried out on 12 patients with Acute Pure Flexor Tendon Injuries who were presented to the casualty departments in both Zagazig University Hospitals (Z.U.H.) and El-Ahrar Teaching Hospital (E.T.H.). Both hospitals were chosen as they represent the main two referal "Tertiary" hospitals in Sharkia Governorate for hand injuries. This study was done within six
(6) months.

**Inclusion criteria:**

- Injury: Flexor tendon injury in the hand.
- Sex: Both male and female.
- Age: at any age.

**Exclusion criteria:**

- Concomitant fractures, nerve injury, vascular injury, injured extensor mechanism, heavy skin laceration, and skin loss.

- Previously injured hands or deformed hands.
- Highly contaminated injuries.

**Patients Pre-operative Assessment**

All patients were first seen in the casualty E.R. Patients were first evaluted as a polytrauma patients and dealt with according to the Stabilization of the general condition of the patient takes the first priority.

All patients were prepared for operative intervention. In addition to plain x-rays and other routine radiological investigations for poly traumatized patients, Laboratory investigations were ordered for all patients.

* In children & young adults: Complete Blood Count & Coagulation profile were done.

**Operation steps**

The surgical treatment is done in the operating room under general anesthesia. All areas are available for operative treatment, including the legs, if harvesting of the Great Saphenous Vein is required should be prepped and draped. Pneumatic tourniquet (The tourniquet is inflated up to 50 – 100 mm of mercury above the systolic pressure. The surgical exposure is either a midlateral or zigzag incision where possible incorporating the original laceration.

Regardless of which incision is used to expose the flexor mechanism, the skin and subcutaneous fat should be dissected carefully to preserve the vascular supply. Once the fibrous flexor sheath is exposed, the laceration of the sheath can be more readily seen. Its location is critical in determining how the sheath should be best further opened, with two competing interests in mind:

1. More extensive exposure yields the best chance of a technically good tendon repair.

2. Increasing the exposure also results in greater flexor sheath disruption, impairing synovial nutrition that is important in the healing process, and harming the flexor sheath system’s ability to provide maximal mechanical advantage in composite flexion.

An appropriate balance must be decided upon. The A2 and A4 pulleys have been described as "inviolable", and most authors advocate preservation wherever possible. Partial incisions of the A2 and A4 pulleys are also described. Other pulleys can be vented without major functional loss, but should be preserved or repaired if possible.

Laceration of the sheath is identified and a limited debridement of the hemorrhagic ends of the sheath is performed. The distal and proximal tendon stumps are searched. The distal stump can often be found by passive flexion of the DIP and PIP joints. The proximal tendon stumps may be visible within the fibro-osseous sheath, depending on the zone of injury and the position of the hand and fingers during the injury. If the tendon stumps are not visible, the tendons may be detected by milking the wound using a proximal-to-distal massage of the digit. If the stumps are still not visible, the incision should be extended**.**

Once visible the stump may be brought through the sheath carefully using fine-toothed forceps (avoid passing instruments blindly down the tendon sheath as it increase the risk of intrasynovial damage and secondary adhesions) and should be held in the right position without tension. The two ends of the tendon should be explored the proximal and the distal ends. All repairs will be done by the modified Kessler technique will be done by a 2-strand core suture with Proline 4/0 on a rounded needle. This will be combined with a peripheral epitenon suture (Proline 6/0 rounded) to provide smooth outer gliding surface.

Before reaching the step of tendon repair the assistant will harvest part of the vein. The vein graft is dilated using saline injection and putting it into saline. Then we insert small straight mosquito into the venous graft from one end passing to the other end and holding one end of the injured tendon by this mosquito then the vein graft will be threaded over the proximal or distal part of the tendon, and then the vein graft will be threaded over the sutured part after tendon repair.

We used two methods to apply vein graft:

1-If the diameter of the vein is larger than the injured tendon we will pass either proximal or distal end of the tendon through the segment of the vein prior to the repair and then sliding the venous segment over the repair site.

2-If the diameter of the vein is less than the injured tendon the vein graft will be preserved in an isotonic saline till the repair will be performed then vein graft will be incised longitudinally and used as a patch around the repaired site then sutured to itself behind the repaired site converting it into tunnel.

Closure of the wound without closing so many layers over the repair to minimize adhesions formation. Immediate post-operative splint while the patient is still under anesthesia.

**Statistical analysis**

Data was analyzed statistically after 6 months of follow up with Statistical Package for Social Sciences (SPSS).

Statistical Analysis: Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) (Statistical Package for the Social Sciences) software for analysis.

**Administrative design:**

Written informed consent have been obtained from the cases participating in this study after informing them about the steps of the study and possible complication. The approval have been obtained from Zagazig University Institution Review Board (IRB).

**Results**

Twelve patients with flexor tendons injury in the hand were included in the study, and they completed the final follow up period of 6 months. However, no patient escaped or was excluded from the study. The ages were ranged from 26 to 43 years with a mean age of 33.58 years and a Median age of 34.5. They were 12 (100 %) males and zero (0 %) females.

The injured fingers distributed as 5 (41.67%) patients in zone II and 7 (58.33%) patients in zone III. There were isolated FDS lesions in 2 (16.67%) patients, and isolated FDP lesions in 2 (16.67%) patients and combined FDP with FDS in 8 (66.67%) patients.

The causative agent was a glass in 5 (41.67%) patients, knife in 3 (25%) patients, and other agents in 4 (33.33%) patients. (Table 1).

Final assessment after a follow-up period of 6 months revealed excellent range of movement in 10 (83.33%) cases and good range of movement in 2 (16.67%) cases.

The result according to zone of injury:

In Zone II revealed excellent range of movement in 3 (25%) cases and good range of movement

in 2 (16.67%) cases.

In Zone III revealed excellent range of movement in 7 (58.33%) cases. (Table 2).

The result according to Tendons involved: With isolated FDS injury revealed excellent range of movement in 2 (16.67%) cases. With isolated FDP injury revealed good range of movement in 2 (16.67%).With both FDS and FDP injury revealed excellent range of movement in 8 (66.67%) cases. (Table 3).

The final results showed that 83.33 % of cases showed excellent results, 16.67% showed good results. (Table 4).

**Table 1: Patients who completed follow-up.**

| | Age | Gender | Zone of Injury | Mode of Injury | Tendon Injured |
|---|---|---|---|---|---|
| Case 1 | 31 | Male | Zone II | Knife | FDS & FDP |
| Case 2 | 35 | Male | Zone II | Other agent | FDS & FDP Case |
| 3 | 43 | Male | Zone III | Glass | FDS |
| Case 4 | 26 | Male | ZoneII | Knife | FDP |
| Case 5 | 37 | Male | Zone III | Other agent | FDS & FDP |
| Case 6 | 41 | Male | Zone III | Glass | FDS & FDP |
| Case 7 | 29 | Male | Zone III | Other agent | FDS & FDP |
| Case 8 | 38 | Male | Zone II | Knife | FDP |
| Case 9 | 34 | Male | Zone III | Glass | FDS Case |
| 10 | 36 | Male | Zone III | Other agent | FDS & FDP |
| Case 11 | 30 | Male | Zone III | Glass | FDS & FDP |
| Case 12 | 33 | Male | Zone II | Glass | FDS & FDP |

**Table 2: The result according to zone of injury.**

| Zone of Injury | Final result | Number of Cases | % |
|---|---|---|---|
| Zone II | Excellent | 3 | 25% |
| | Good | 2 | 16.67% |
| Zone III | Excellent | 7 | 58.33% |

**Table 3: The result according to tendons involved.**

| Involved tendon | Final result | Number of Cases | % |
|---|---|---|---|
| **Isolated FDS** | **Excellent** | **2** | **16.67%** |
| **Isolated FDP** | **Good** | **2** | **16.67%** |
| **Both** | **Excellent** | **8** | **66.67%** |

**Table (4): The absolute result of the series.**

| Final result | Number of Cases | % |
|---|---|---|
| Excellent | 10 | 83.33% |
| Good | 2 | 16.67% |
| Fair | 0 | 0% |
| Poor | 0 | 0% |

## Discussion

Menderes, et al studied in 30 rabbits Seprafilm which was used for the prevention of peritendinous adhesions following flexor tendon repair. Seprafilm Bioresorbable Membrane (Genzyme Corporation, Cambridge, MA) contains sodium hyaluronate and carboxymethyl cellulose. They concluded that in rabbit the peri-tendinous adhesions following flexor tendon repairs could be lowered with Seprafilm and hyaluronic acid. Small et al., showed the benefit of early mobilization following flexor tendon repair in zone II [8].

Moran et al., studied the effect of a single intra operative application of 5-FU at concentrations of 25mg/mL appears to be an effective mechanism for reducing postoperative flexor tendon adhesions **[9].**

In our study, the average age was 34.5 years ranged from 26-43 years, almost the same as

other studies, because it is the average age of workers all over the world.

Our use of modified Kessler technique also can forms with the choice of the majority of authors. The advantage of this technique is its simplicity to apply and the relative minimal suture material within the repair site **[10].**

Using venous graft made us making another wound that made the female patients refused doing this technique, so all the cases in our study are males. Although, in the other studies that used venous graft as a tendon sheath substitute and caused another wound, there were female patients. It may be because of their sufficient awareness that restoration of hand function is more important than aesthetic appearance, or maybe because of the high financial level that makes them able to use aesthetic techniques to remove scars later.

This study is significantly different from previous studies on the same subject in that it takes only acute tendon injury without concomitant fractures, neurovascular, extensor injuries, or skin loss. This gives the study much specificity of the effect of tendon sheath substitution by venous graft.

Sakr et al., Final assessment in their study revealed excellent range of movement in two (28.57%) cases, good range of movement in 3 (42.86%) cases and fair result in 2 (28.57%) cases. The results of this study are different from the results of our study, despite the use of the same technique and about the same average age, but this difference may be because of, in their studies four of the patients presented with failed primary repair of their flexor tendon injury. Also they repaired both FDS and FDP in zone II that could not give good results **[11].**

Other comparative studies compared between repairing flexor tendon injures using and without using venous graft as a tendon sheath substitute, their results about using venous graft as a tendon sheath substitute are nearly the same to our results:

Moosavi et al., in their study a prospective randomized clinical trial, 210 patients were divided into two groups of test and control. In the test group (105 patients), were operated using venous graft as a tendon sheath substitute following tendon repair, the results of this group revealed excellent range of movement in 86% of cases, good range of movement in 11% of cases and fair range of movement in 3% of cases, while the results without using venous graft as a tendon sheath substitute following tendon repair revealed excellent range of movement in 0% of cases, good range of movement in 12% of cases, fair range of movement in 38% of cases and poor range of movement in 50% of cases **[12].**

So the use of autologous vein graft as a replacement of tendon sheath has many advantages like; it is not expensive, being autologous so not carrying the risk of infection, also it will not affect the tendon healing like other materials. It is not only used to treat post-operative tendon adhesions but also can be used as prophylactic procedure in cases of lost tendon sheath in fresh cases

## Conclusion

Results of this study appeared encouraging when compared with the outcomes achieved by the conventional tendon repair technique. As this technique reduces the adhesion formation, improves tendon nourishment and decreases the need of intensive physiotherapy,

it may substitute the conventional one and become a standard technique in the future. Also it can be cheaper and easier technique in preventing post-operative peri-tendinous adhesions if compared with other conventional methods. So the combination of this new technique with the early mobilization after tendon repair will add to minimizing adhesions and improving the results of tendon repair.

Some normal autologous substances like amniotic membrane or fascia should be compared with vein graft on wider scale with studies on a larger number of patients

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