A New Method of Tendon and Ligament Repair using Mitek Mini Anchor System in the Hand

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Introduction

For fresh mallet finger with terminal tendon rupture and collateral ligament rupture of the phalanges, conservative treatment is the method chosen by many hand surgeons. But some cases of open rupture of tendon or ligament in the hand or chronic cases need sometimes operative treatment. In some cases of tendon or ligament injury in the hand, end-to-end anastomosis is impossible because of their anatomical characteristics, especially in the chronic cases, then tendon advancement or the placement of a pull out suture passing through the finger is a standard practice. But these fixation of tendon or ligament at their insertion is thought to be insufficient. A new method of tendon and ligament repair using Mitek Mini Anchor System (Mitek Surgical Products, Inc, 57 Providence Highway, Norwood, MA) is introduced in this article. This is a device that provides a rapid, safe and useful surgical method for various hand injury, such as mallet finger and collateral ligament tear.

Materials and methods

The body of Mitek Mini Anchor is composed of a titanium alloy with a hole for suture placement, whereas a highly elastic nickel titanium alloy is used for the two attached wire arcs that serve to lock the anchor into the cancellous bone (Figure 1. a). The technique using Mitek Mini Anchor System was used in 7 patients. The group consisted of 3 mallet fingers, 1 radial collateral ligament tear of thumb MP joint, 1 ulnar collateral ligament tear of thumb MP joint, 1 ulnar collateral ligament tear of little finger PIP joint, and 1 avulsed fracture of the volar base of middle phalanx and volar plate injury of ring finger PIP joint.

The surgical technique was as followed: an oblique hole was drilled away from the joint in the center of the base of the phalanx using a drill guide to avoid exiting through the opposite cortex. The Mitek Mini Anchor was placed with its arcs in the drilled hole using an inserter to push it directly in. The anchor remained in the bone for several seconds after which the security of the device was tested.
by exerting tension on the attached suture. Then, the suture with the needles were placed through the distal stump of the tendon or ligament (Figure 1. a, b).

**Case report**

**Case 1.**  
The patient was a 63 year old male who sustained open injury to the dorsum of DIP joint of his index finger. He was treated in another clinic at the first time, but he was seen in our hospital because of remaining extension deficit of DIP joint (Figure 2. a). Roentgenogram showed the avulsion fracture of the dorsum base of distal phalanx and hyperextension deformity of middle phalanx (Figure 2. b). A small avulsed fragment was removed and Mitek Mini Anchor was placed to the dorsal joint surface. Proximal edge of tored extensor terminal tendon was pulled to the bone by Mitek Mini Anchor (Figure 3.). Slight extension deficit was observed postoperatively.

**Case 2.**  
A 38 year old male, a taxi driver, sustained contused wound to his thumb and was treated with only skin suture. After the surgery, ulnar deviation deformity of the thumb remained. So, he came to our hospital complaining the MP joint instability of the thumb (Figure 4.). Operative finding showed
complete tear of radial collateral ligament of the thumb (Figure 5. a). The Mitek Mini Anchor was applied, and stability of it was gained after that (Figure 5. b).

**Case 3.**

The patient was a 19 year-old female who underwent tendon transfer few years ago for ulnar collateral ligament tear of MP joint of the thumb. She was seen in our hospital where examination
revealed slight swelling over the thumb MP joint and slight tenderness in the ulnar collateral ligament. Stability examination demonstrated significant instability to abduction stress at both 0 and 30 degrees of flexion indicative of complete re-rupture of transferred tendon (Figure 6.). She was brought to surgery for exploration and repair using Mitek Mini Anchor. A distally based strip of extensor pollicis brevis tendon was separated to the level of wrist joint where it was then passed through drilled hole of the metacarpal bone and reinserted to the ulnar base of the proximal phalanx to create a new ulnar collateral ligament. After the surgery, deformity was corrected and good pinch was gained.

**Case 4.**

The patient was a 17 year old male who sustained hyper extension injury to the middle phalanx of his ring finger. He was seen in our hospital where examination revealed impossible complete flexion of PIP joint of ring finger and significant pain on motion (Figure 7. a). Roentgenogram showed a small fragment at the PIP joint (Figure 7. b). Operative finding revealed volar plate injury associated with avulsion fracture of the volar base of the middle phalanx. The Mitek Mini Anchor was applied and volar plate was re-attached to the surface of the middle phalanx (Figure 7. c). An excellent flexion range was gained using modified Kleinert method.

**Postoperative evaluation**

In mallet finger cases, the results were evaluated according to Crawford's criteria:\(^{17}\): namely excellent: full extension, full flexion, no pain, good: 0-10 degrees extension loss, full flexion, no pain, fair: 10-25 degrees extension loss, any flexion loss, no pain, poor: over 25 degrees extension loss, any patient with persistent pain.
In ligament tear cases, all patients were graded according to their amount of postoperative pain and stability of suffered joint. An excellent result consisted of no postoperative pain and no instability without discomfort. A satisfactory result consisted of slight postoperative pain and no instability with some discomfort. A poor result consisted of significant pain and obvious instability with discomfort.

In the case of avulsion fracture of volar base of the middle phalange and volar plate injury, the result was evaluated according to Buck-Gramcko's method of flexor tendon injury.

Results

All of mallet finger patients had a good result as they had less than 10 degrees extension deficit. And all of other ligament tear patients had an excellent result.

The patient with avulsion fracture of the volar base of the middle phalanx and volar plate injury had also an excellent result.

Discussion

Many surgeons prefer nowadays conservative treatment than surgery for fresh mallet finger with terminal tendon rupture. In some cases of open injury or chronic flexion deformity of dorsum of DIP joint, surgical treatment may be required. But there are some technical difficulties of the surgery. The terminal extensor tendon is very thin, the surgical approach is difficult because of the nail root restricts the incision, and poor blood supply to the skin is another problem. Nakamura et al. showed that the average distance of the gap between the distal and proximal stumps of the terminal tendon was 4mm. So, end-to-end anastomosis is considerably difficult in such cases. Then tendon advancement or pull out wire methods are standard next choices.

Most of the procedures mentioned for chronic cases are aimed at stabilizing the DIP joint and improving extension range, but not at increasing the range of joint mobility. A new technique using Mitek Mini Anchor System is reasonable surgical option from an anatomical point of view. In this series, slight extension deficit still remains, however, there is no problem functionally. Nakamura et al. stated that the extension deficit increased temporarily until the eighth postoperative week after release of the DIP joint by removal of the Kirschner wire and gradual improvement was observed.

When a patient who has an acute injury to the radial or ulnar aspect of phalangeal joint is first seen, the surgeon must check whether the joint is stable or unstable. And when the instability is exist, the surgical repair is required to restore stability. Early surgical intervention has led to good results in the treatment of collateral ligament injury. However, the prognosis is far worse if surgical intervention is delayed. Mitek Mini Anchor System is also good application for such a chronic case. An excellent result is observed in all cases in this series, although follow-up time is short.

One of considered problems of this material is a possibility of implant migration. Retrival of an infected anchor could be extremely difficult, perhaps requiring overdrilling around the insertion hole. The fairly high expense of this material is another disadvantage when compared with conventional techniques for tendon or ligament reinsertion.

Conclusion

The Mitek Mini Anchor offers the following benefits for the repair of tendon and ligament, especially in the chronic cases. The anchor supplants the use of pull out wires which must be removed during the third or fourth postoperative weeks. The repair strength provided by this method often
allows early range of motion exercise and other rehabilitation.

References


手の外科領域における靱帯・腱損傷への
アンカーシステムの使用経験

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手における靱帯・腱損傷は症例によっては端々縫合が不可能なことがある。pull out wire法や腱のavancement法など要することが多い。しかし、これらは固定性が弱く、その他の合併症を生すこともある。我々はこれらの症例にマイテック・ミニ・アンカーよ用いた修復術を行い、良好な成績を得ているので報告する。

対象は陳旧性損傷3例、母指 MP関節橈側側副靭帯断裂1例、同尺側側副靭帯断裂1例、小指PIP関節尺側側副靭帯断裂1例、環指PIP関節掌側板損傷・中節骨基部剥離骨折1例の計7例である。

手術成績は陳旧性損傷の3例は10度以下のDIP関節の伸展不全を呈したため良であったが、他の症例は全て優であった。

今回使用したミニ・アンカーは強固な固定性が得られ、しかも解剖学的仮説で修復でき、二次的手術の必要性もなく、治療期間も短縮できる有用な方法であると思われた。