



## Hunter's technique without Hunter's rod

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Silicon rods initially advocated by Hunter have been widely used in two-stage flexor tendon reconstruction. Two-stage tendoplasty is an expensive procedure ; with the addition of the high cost of rods, it is still more expensive. An experimental study investigated cheaper alternatives to silicon rods, but no clinical studies seem to have been reported so far. This study involved 17 patients undergoing two stage flexor tendon grafting. In all fingers, silicon urinary catheters were used as tendon prosthesis. The Wehbe *et al* modification of the Boyes and Stark classification was used for preoperative classification and Strickland formulation and Buck-Gramcko criteria for postoperative analysis. This clinical study showed that comparable clinical results and proper pseudo-sheaths for tendon grafting with similar histological and physical features can be obtained using a silicon urinary catheter which is fifty times less costly than Hunter's rod.

**Keywords :** silicon urinary catheter ; flexor tendon ; staged reconstruction.

### INTRODUCTION

Treatment of hand injuries is a challenging problem for plastic and hand surgeons due to their complex anatomical structures and functional importance. The first treatment option of tendon injuries is primary repair. Nevertheless, it is some-

times not possible because of crush injuries with loss of soft tissue or bone fractures and badly damaged pulley systems. In such cases, the standard technique is two-staged tendon reconstruction, as described by Hunter and Salisbury in 1971 and Hunter in 1983 (4). The other indications for this procedure are postoperatively badly scarred or infected fingers and neglected tendon injuries.

This staged operation with its subsequent physical therapy is a costly procedure. With the addition of the cost of a Hunter prosthesis, the cost is further increased. For this reason, we used silicon urinary

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*Each subject gave informed written consent and hospital-based Ethics Committees approved this study.*



**Fig. 1.** — Reconstruction of second finger FDP with a SUC

catheters (SUC) which are fifty times cheaper than silicon rods and are easily obtainable.

The purpose of this study was to evaluate and report the results of two-stage tendon reconstruction using silicon urinary catheters instead of Hunter's silicon rods.

### MATERIALS AND METHODS

We performed two-stage tendoplasty between 2009 and 2011 using a silicon urinary catheter (Fig. 1). Seventeen patients, ten male and seven female, with a mean age of 21 years (range : 8-37) were treated. The operation was on the flexor pollicis longus in six of them, and on a flexor digitorum profundus tendon in the others. For preoperative classification and evaluation of previous status of fingers, Wehbe *et al.*'s modification of the Boyes and Stark classification system (9) was used (Table I). According to this system, the distribution was as follows : Grade I, 2 ; Grade II, 12 ; Grade III, 2 ; and Grade IV, 1. The first stage of reconstruction was performed at a mean of 10.05 months (range : 2-36 months) after the injury, and the mean duration between two stages was 11.8 weeks (range : 10-16 weeks). The mean follow-up period was 11 months (range : 3-24 months). Written informed consent was obtained from each patient, and hospital-based Ethics Committees approved this study.

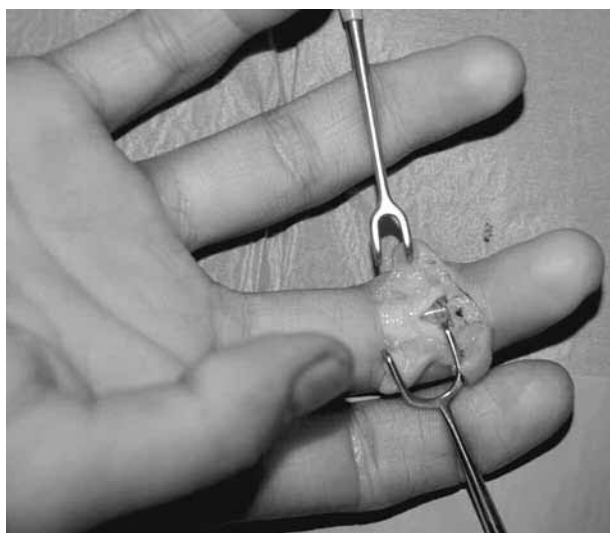
**Table I.** — Wehbe *et al.* modification of Boyes and Stark classification

Grade 1	Tendon injury only, good soft tissues, supple joints and no significant scarring
Grade 2	Injury to tendon and soft tissue, deep cicatrix from injury or previous surgery
Grade 3	Injury to tendon and contracture of more than 10° at any joint
Grade 4	Injury to tendon and one or both neurovascular bundles
Grade 5	More than one of the aforementioned injuries and in addition involvement of the palm or more than one finger injured

### Surgical Technique

Before any operation, the maximum possible passive range of motion was achieved by physical therapy and splinting. Stage one was then performed according to the technique of Hunter and Salisbury (4). After Brunner type zigzag skin incisions, all of the scarred tendons (with attempted preservation of at least 1 cm of their distal end), any scar tissue and scarred lumbrical muscles were removed. Care was taken to preserve annular pulleys and if not possible, a pulley system was reconstructed with the excised tendon. Persistent joint contractures were mobilized with volar plate or collateral ligament release and reconstruction of damaged nerves – if any – was carried out. A silicone urinary catheter (SUC) size F 14-18 was then inserted through the pulley system and was first sutured to the distal stump of the flexor tendon. If the distal stump was not adequate, the SUC was fixed using the 'button on the nail' technique. After the silicon length was determined, the proximal end of the injured tendon was sutured to the prosthesis. During suturing, we tried to push the tendon ends into the catheter as much as possible, and the skin incisions were then closed. Three to five days after the surgery, passive exercises were started at the metacarpophalangeal and interphalangeal joints. The exercises were continued until maximum passive range of motion was achieved and a pseudo sheath was formed.

In stage 2, small incisions were made only over the distal and proximal end of the prosthesis (Fig. 2). A tendon graft (Palmaris longus, Plantaris, etc) was harvested ; it was sutured to the distal end of the flexor tendon and was introduced into the new sheath. After determining the proper length of the tendon graft, the latter was sutured to the proximal end of the flexor tendon.



**Fig. 2.** — Incision of pseudosheath to reach the distal end of the SUC.

Postoperatively, the hand was immobilized for one week, and physical therapy was then started (Fig. 3).

## RESULTS

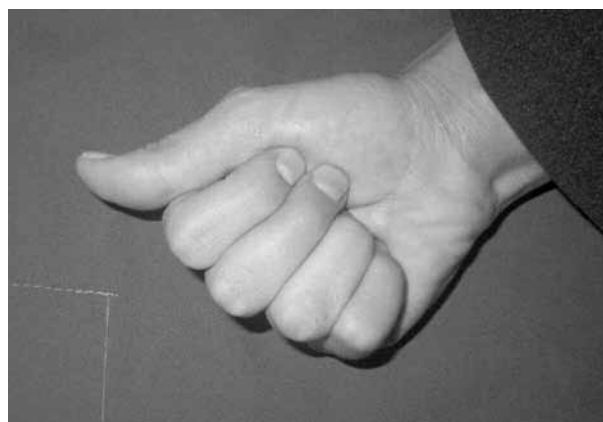
Results of the flexor digitorum profundus reconstruction (11 patients) were analyzed according to Strickland formula (Table II) (7).

Total Active Movement / Total Passive Movement  $\times 100$

Total Active Movement : (PIP+DIP) – limitation of extension

Total Passive Movement : (PIP+DIP) – limitation of extension

Results were excellent in four fingers, good in three fingers, moderate in two fingers and poor in two fingers.



**Fig. 3.** — Late outcome of same patient

Staged reconstructions of the flexor pollicis longus were evaluated (Table III and IV) using Buck-Gramcko criteria II (2). Total range of movement of one of the thumbs was excellent, two were good, two fair and one was poor according to these criteria.

Two patients developed infection after the first stage and the catheters were removed. We waited for regression of infection with antibiotherapy and performed the first stage again. Four patients had to undergo reoperation after the second stage because of complications ; tenolysis was performed in three cases for tendon graft adhesions and in one case, re-suturing was performed for suture dehiscence.

## DISCUSSION

Foley's urinary catheters have been used in plastic surgery in many anatomical areas besides the urinary tract, such as for bleeding control, reposition of facial fractures, eye socket reconstruction,

Table II. — Strickland formulation in flexor tendon repair and results

Range of Results (%)	Functional Healing	Our Results
75-100	Excellent	4
50-74	Good	3
25-49	Moderate	2
0-24	Poor	2

Table III. — Buck-Gramcko II Criteria

Buck-Gramcko II criteria	Degrees	Points
Flexion of interphalangeal	50-90	6
Joints	30-49	4
	10-29	2
	< 10	0
Extension Deficit	0-10	3
	11-20	2
	21-30	1
	> 30	0
Total Active Movement	> 40	6
	30-39	4
	20-29	2
	< 20	0

scrotal reconstruction, intraoperative tissue expansion, alar stabilization, as a nostril retainer, and for short-term drainage in frontal sinus surgery (6).

In 1998, Kuran *et al* reported an experimental study on the use of a silicon urinary catheter in staged tendon reconstruction. They inserted a Hunter prosthesis, a silicon urinary catheter (SUC), a rubber urinary catheter, and an angiocatheter into subcutaneous pockets in rats and evaluated the results two months later. According to their results, pseudosheaths induced by silicon rod and SUC were almost similar. Under  $\times 40$  magnification, microscopic features and average wall thickness were similar, and there was no significant difference in polymorphonuclear and lymphocyte cell infiltration. They also evaluated elemental analysis, microphotographs, and tensile strength, and the results showed similar features (5). When a SUC was used as a tendon prosthesis, they showed that the diameter of a silicon urinary catheter did not change during their experiment, and that the surface of a silicon urinary catheter prevents surface microorganism colonization. In tendon reconstruction, the duration between the first and second stage is almost 3 months and the prosthesis has to stay in its pocket at the same diameter and without any microbiologic reaction during this time (5).

Considering these experimental results we used a silicone urinary catheter, which is fifty times cheaper than a Hunter rod. Two-staged tendon reconstructions are expensive procedures. The long pre- and post-operative physiotherapy is a deter-

Table IV. — Buck-Gramcko II classification and results of reconstructions of flexor pollicis longus

Classification	Points	Our Results
Excellent	14-15	1
Good	11-13	2
Fair	7-10	2
Poor	0-6	1

mining factor of the outcome. The addition of the cost of a Hunter prosthesis makes these operations even more costly.

Besides its lower cost, the silicone urinary catheter also showed to be effective. Results of our study were comparable to the results obtained with Hunter's rod. Our outcomes on FPL and FDP reconstruction were respectively 50% and 64% excellent or good (Fig. 3).

In the study by Frakking *et al* using Hunter rods, the results of two-staged FPL reconstructions were very disappointing based on Buck-Gramcko classification. They could not achieve excellent results : only four were good, two were satisfactory, and four poor. However, their results of FDP tendon were much better, and they obtained excellent to good results in 70% of the patients (3). In another study on FPL reconstruction, the outcomes were 44% excellent to good (8).

The functional outcomes of the study by Aydın *et al* were also similar to Frakking's results. Their study concerned two-staged tendoplasty with Hunter's rod in 37 hands of 31 patients. They used the Strickland classification to evaluate the results and found that 70% were excellent and good (1).

In conclusion, the reason for using Hunter's rod is to obtain a suitable pseudo-sheath allowing for flexor tendon grafting. The results of this clinical study showed that a pseudo-sheath with similar histological and physical features can be obtained using a silicon urinary catheter which is fifty times less costly than a Hunter rod.

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