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# Use of a fibrovascular tube in creation of neo-urethra during penile reconstruction

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## Summary

### Introduction
There are several techniques employed in the surgical treatment of total or partial penile reconstruction, hypospadias surgery, and urethral stricture. Urethral reconstruction is performed in different ways applying these techniques.

### Objective
We evaluated use of a fibrovascular sheath to create a neo-urethra formed around a silicon tube.

### Material and methods
We used nine male New Zealand rabbits for this study. In the first step, we placed a silicone tube under the skin in the lower abdomen of the rabbits and waited for the formation of a fibrovascular sheath to totally surround the tube. In the second step, the silicone tube was removed and the formed fibrovascular sheath was anastomosed with penile urethra over a silicone 8F Foley catheter. Ten days after the second step, the silicone Foley catheter was removed. Twenty days after the second step, we evaluated the newly created neo-urethra with a retrograde urethrogram. Thirty days after the second step, the rabbits were sacrificed and the bladder, urethra, and neo-urethra were removed for histopathological examination.

### Results
Six of the rabbits completed the study. After the first operation, in the third month, formation of the fibrovascular sheath was observed around the silicon tube. After anastomosis and removal of the silicon Foley catheter, urine was seen to pass through the neo-urethral meatus. Urethrocystography showed that the neo-urethra and penile urethra were aligned and urine flow was regular. Histopathological evaluation showed that the structural integrity of the newly formed urethra was comparable with the structure of the regular urethra (Table) and the calibration did not change over time, although the newly formed urethra was not covered with uroepithelium.

### Conclusions
In this study, we achieved promising results with use of a newly formed fibrovascular sheath as a neo-urethra.

**Summary Table** Evaluation methods of created neo-urethra and findings.

| Evaluation method | Findings |
|---|---|
| Macroscopic | Neo-urethra is patent |
| Radiologic | Neo-urethra has same alignment with the penile urethra |
| Histologic | - Neo-urethra has comparable structure with the natural one<br>- Mean cross-sectional after sacrifice is 2.664 $mm^2$ (which was 2.808 $mm^2$ before)<br>- Urethral epithelium did not advance towards the neo-urethra |

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## Introduction

There are several situations that require creation of a neo-urethra with or without penile reconstruction. In hypospadias surgery and urethral stricture repair, buccal mucosa, saphenous vein, bladder mucosa, synthetic materials, and *in vitro* tissue culture techniques can be used to produce a neo-urethra and these materials can be applied as a patch and/or tube graft [1,2]. However, in the case of urethral reconstruction with penile reconstruction, larger and longer urethral segments must be created.

Every surgical technique used in preparation of a neo-urethra has its own advantages and disadvantages [3—5]. In penile reconstruction, neo-urethra is generally created by full-thickness skin graft (FTSG) or from flap tissue. Neo-urethra created from FTSG has disadvantages of contracture and stricture. When created from flap tissue, flap dimensions are significantly increased (almost 30% bigger flap). Because of these disadvantages, there is a need for a better technique in terms of ease of preparation, preservation of healthy tissue, and fewer short- or long-term complications.

Foreign bodies cause a nonspecific immune inflammatory response that results in formation of a fibrovascular sheath, as seen after implantation of breast prosthesis and tissue expanders [6]. Studies have shown that the inner surface of the fibrovascular sheath formed around a silicone implant has a synovium-and endothelium-like [6,7] structure, and such sheaths become thicker over time up to 2.5 months, with no further changes noted after 2.5 months if the sheaths stay in contact with the prosthesis [8]. For almost 40 years fibrovascular sheaths created around silicone tubes have been used in clinical practice in the two-stage tendon repair procedure to provide a synovial sheath to tendon [9,10].

Therefore, we hypothesized that a fibrovascular sheath created around a silicone catheter could be used as neo-urethra in reconstruction of the penis, and designed the presented experimental study.

## Materials and methods

Following local ethical committee approval (Ethic No: 2014-3/14-142), nine male New Zealand rabbits (4000—4500 g) were used in this study. The study was conducted according to Guide for the Care and Use of Laboratory Animals, published by the National Institutes of Health. The rabbits were kept in separate cages during the experimental protocol and fed with standard laboratory chow and water *ad libitum*. A two-stage operation was performed on all animals and all surgeries were performed under general anesthesia with 35 mg/kg ketamine (Ketalar, Eczacibasi, Istanbul, Turkey) and 5 mg/kg $\alpha$-xylazine (Alfazyne, Veterinary Aegean, Istanbul, Turkey).

### Surgical technique

First operation: In the first operation, bilateral orchiectomy procedure was performed to prevent erection of the penis and wound dehiscence when urethral reconstruction was performed in the second stage. A 3 cm 8F silicon tube was placed in the subcutaneous area 3 cm cranially to the penile radix. To immobilize the silicon tube, both the cranial and caudal ends of the tube were fixed to abdominal skin (Fig. 1A—1D).

Second operation: The second operation was performed 3 months after the first operation. Under general anesthesia, the cranial and caudal ends of the silicone tube were found and the tube was removed, leaving a fibrovascular sheath around it (Fig. 2A—2B). This fibrovascular sheath was used as a neo-urethra. First, the penile skin was de-gloved over the penile shaft and the glans penis of the animal was excised to provide standardization and ease of anastomosis between the fibrovascular sheath and native urethra. The penile shaft was turned dorsally to the abdominal wall. The distal end of the native urethra was then anastomosed to the caudal end of the fibrovascular sheath in an oblique fashion. The proximal end of the sheath was anastomosed to the skin to create a neo-urethro-cutaneostomy. An 8F silicon catheter was inserted from the cranial end of the fibrovascular sheath through the whole length of the sheath and the native urethra to the bladder neck both to secure the urethral anastomosis during the healing process and to drain urine from the bladder (Fig. 2C—2D). Anastomosis site was wrapped by fat tissue and sutured in the midline using a 5/0 polyglecaprone suture material (Monocryl, Ethicon GmbH, Norderstedt, Germany). After excision of the excess penile skin, the skin was closed with 5/0 polypropylene (Propilen, Dogsan, Trabzon, Turkey).

A collar was placed on the rabbits to restrict free neck movements to prevent the animals from licking the suture lines or removing the catheter. Until the end of 10th day postoperatively, fibrovascular sheath and native urethra were checked for adequate urine drainage and stenosis of the external orifice of the neo-urethra. The collar and the catheter were removed on the 11th day postoperatively. To evaluate the newly formed urethra, a retrograde urethrogram and voiding cystourethrography were performed on the 20th day (Fig. 3). Rabbits were sacrificed at the 30th day. Their bladders, urethras, and neo-urethras were excised and fixed in formaldehyde solution (Fig. 4).

Evaluation: Clinical, radiological, and histological evaluation was performed.

1. Clinically, separate from checks on the general health of the animal, the external meatal orifice of the neo-urethra was evaluated in terms of stricture.
2. Radiologic evaluation was performed 20 days after the second operation. To evaluate the newly formed urethra, a retrograde urethrogram and voiding cystourethrography were performed (Fig. 3). Briefly, under general anesthesia, 20 mL of contrast medium (Iomeron 300 solusyon, Gurel Ilac, Istanbul, Turkey) was injected slowly and directly into the external urethral orifice by the same experimenter, with X-ray direction used to visualize the configuration of the lumen.
3. For histologic evaluation, following formalin fixing and paraffin embedding, we took transverse sections from the native distal penile urethra and the middle of the neo-urethra and longitudinal sections from the