Repair of Urethral Defects Using Fascia Lata Autografts in Dogs

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Objective—To evaluate the feasibility of urethraloplasty using a free fascia lata (FL) graft in the dog.
Study Design—in vivo experimental study.
Animals—Mixed-breed dogs (n = 14).
Methods—Half of the circumference of the urethra, ~1.5 cm long, was excised in 14 male dogs to induce a urethral defect. FL (~2 cm × 2 cm) harvested from the lateral thigh was sutured to the urethra using a 3-0 polyglactin 910 continuous pattern. Dogs were monitored daily for bladder distention and had urethral catheters until normal voiding was observed. On day 60, each dog had a positive contrast urethrogram, and then 8 dogs were euthanatized for gross and histologic examination. Six dogs were monitored for urologic problems for 6 months, and a positive contrast urethrogram was repeated.
Results—All dogs recovered successfully; 4 dogs had difficulty voiding for 2–3 days and urine was aspirated from these dogs every 3 hours until signs of painful urination disappeared. On positive contrast urethromgrams, urethral anatomy was considered normal except in 4 dogs that had an irregular contour. Gross urethral examination confirmed an absence of ulceration, stricture, diverticula, or fistula formation, and the FL-lined graft survived in all dogs. No degenerative and reparative responses were observed. On histologic examination of the penile urethra, the lumen was intact, covered with transitional epithelium, and surrounded by corpus spongiosum with cavernous spaces and blood-filled vessels.
Conclusions—Free FL grafts are incorporated satisfactorily and would appear to be useful for repairing urethral defects.
Clinical Relevance—FL grafts should be considered for repair of urethral defects in dogs.
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INTRODUCTION

URETHRAL STRICTURE occurring after improper closure of a urethrotomy needs to be reconstructed.1,2 Inflammatory and post-traumatic strictures, congenital defects, and tissue loss caused by malignancy may require extensive urethral reconstruction.1,2 One objective of tissue engineering for urethral reconstruction is to perform tubularized urethral replacement that demonstrates functional compatibility with the native urethra.4,5 Many methods for restoring urethral continuity and establishing a normal urethral lumen have been developed. Genital and extra genital skin grafts have frequently been used to achieve this but substantial complications with fistula, hair growth, stone formation, and graft contraction have been reported.6,7 Buccal mucosa was widely used as a source of tissue replacement, especially when urethral reconstruction is complex, and satisfactory short- and long-term results have been reported.8,9 However, in other studies, anastomotic strictures and fistulas were the most common complications.5,10,11 Oral par-
aestheasias and pain have also been associated with use of buccal mucosa grafts.\(^ {12,13} \) Bladder mucosa grafts have been associated with glandular protrusion of bladder epithelium causing secondary meatal stenosis and urinary obstruction.\(^ {14-16} \) The need for more satisfactory alternative tissues for use as urethral substitutes has led others to study the use of intestinal submucosa,\(^ {17} \) vascularized tunic vaginaflis flaps,\(^ {18} \) and free colonic mucosa\(^ {19} \) in experimental models.

Use of fascia lata (FL) within the urinary tract has been reported in rabbits.\(^ {20} \) Thus, we were interested in determining whether FL autograft could be used for repairing urethral defect in dogs. To test this, we repaired a longitudinal hemicircumferential urethral defect in dogs with autogenous FL and evaluated outcome using clinical observation, positive contrast urethrogram (2 and 6 months), and gross and histologic evaluation (2 months).

**MATERIALS AND METHODS**

**Animals**

Fourteen mixed-breed dogs (weight: 11–30 kg; age: 1–7 years) were studied. Clinical and physical examinations were used to determine health status and rule out any congenital and metabolic disorders.

**Anesthesia**

Food was withheld for 12 hours before surgery. Dogs were sedated with xylazine (2 mg/kg, intravenously [IV]), and were anesthetized by administration of a combination of ketamine (10 mg/kg, IV) and propofol (4 mg/kg, IV) after 10 minutes. Anesthesia was maintained by intermittent half doses of ketamine as required. Fluids were administered intraoperatively (10 mL/kg/min, IV). Intramuscular gentamicin (20 mg/kg) was administered before surgery.

**Surgical Procedures**

FL. Dogs were positioned in left lateral recumbency. After aseptic preparation, an \(~ 7–10\) cm skin incision was made over the lateral aspect of the thigh to harvest a FL autograft. Subcutaneous tissue was dissected to expose the FL. A suitable shape of graft tissue (\(~ 2\) cm \times 2\) cm) was bluntly separated and harvested using surgical scissors. The graft was protected in sterile gauze impregnated with 0.9\% NaCl solution until transplantation. The remaining FL was sutured to the facial edge of the biceps femoris muscle using 2-0 polyglaclin suture.

Creation of Urethral Defect and Transplantation of FL Autograft. Dogs were positioned in dorsal recumbency for creation of the urethral defect and grafting. The area between the scrotum and middle of the prepuce was prepared and draped for surgery. A 14-16 Fr urethral catheter was passed into the urethra to facilitate dissection of penile tissue. An \(~ 3\) cm long incision was made through the middle of the prepuce, and then subcutaneous tissue was dissected to the level of the retractor penis muscle. The corpus spongiosum and corpora cavernosa were identified carefully, and the retractor penis muscle retracted laterally. The caudal end of the penis was compressed by sterile gauze to minimize hemorrhage. A longitudinal incision (\(~ 3\) cm) was made into the corpus spongiosum urethra. A hemicircumferential section \(~ 1.5\) cm long of urethral tissue was resected, exposing the urethral catheter. Then, FL graft was shaped to, and placed over the urethral defect, and sutured in position using 3-0 polyglactin 910 in a continuous pattern. Corpus spongiosum penis and skin incision were closed separately by simple interrupted sutures of 3-0 polyglactin 910.

**Postoperative Care**

The urethral catheter was secured to the tip of prepuce with a non-absorbable suture for 1 week to ensure urethral patency and urine drainage. Dogs were monitored daily for bladder distention. A cervical collar was used to prevent the dog from removing the urethral catheter. The urethral catheter was irrigated twice daily with povidone-iodide solution, and then removed at 7 days provided the dog was voiding without difficulty. Butorphanol (0.1 mg/kg, IV) administered at the start of general anesthesia was continued postoperatively every 5 hours for the first day for analgesia. IV lactated Ringer's solution (10 mL/min) administration was continued for 2–3 hours postoperatively, and then 1 L/day for 3 days. Meticulous postoperative care was carried out. Antibiotic prophylaxis was continued for 5 days. Dogs were observed daily for any evidence of voiding difficulty.

**Positive Contrast Urethrogramy**

On day 60, dogs were sedated and positive contrast urethrogramy performed using radiocontrast (20 mL sodium meglumine iothalamate; Telebrix 35; Guerbet, Cedex, France). At 6 months, positive contrast urethrogramy was repeated on 6 dogs.

**Necropsy Examination**

The genitourinary system was inspected grossly for fistula formation and inflammatory reaction, and the urethra was catheterized by the same size catheter used during surgery to detect signs of stricture. The penile urethra was opened longitudinally for macroscopic examination including the status and surface contour, any inflammatory reaction, stricture formation, and adaptability of graft material with urethral tissue. Urethral tissue including the junction between FL and urethra were removed and fixed in buffered formalin. Fixed specimens were cut longitudinally and transversally, embedded in paraffin, and stained with hematoxylin and eosin. Tissue sections were assessed by light microscopy (\(~ 5, ~10, ~40\)).
RESULTS

Four dogs had difficulty voiding and painful urination for 2 (3 dogs) to 3 days (1 dog) postoperatively despite a urethral catheter. Urine was aspirated from these dogs through the catheter every 3 hours until voiding difficulty and painful urination were no longer noted. All dogs voided without difficulty or signs of discomfort after catheter removal. Each dog had a patent and functional urethral lumen, and signs of caudal abdominal distention were not observed. Urination was considered within normal limits with a mean of 6.2 attempts (range, 3-9) within 10 minutes. Surgical wounds area at the graft donor site and penis healed within 10 days without signs of infection.

Positive contrast urethrogramms indicated normal urethral anatomy, although a slightly irregular contour was observed in 4 dogs. The urethral lumen was intact with no sign of stricture or fistula formation. Distinction between the native and grafted area was difficult to detect, and dogs had a normal contrast agent silhouette in the urethral lumen (Fig 1).

Macroscopic examination of the urethra confirmed the absence of ulceration, stricture, diverticula, or fistula formation (Fig 2). Grafts survived with good adherence in all dogs and no degenerative responses were observed. The junction between graft and normal urethra was barely discernable except for 2 dogs where residual suture material was noted.

On histologic examination of the penile urethra, the lumen was intact, covered with transitional epithelium, and surrounded by corpus spongiosum with cavernous spaces and blood-filled vessels (Fig 3). In the dermal layer, fragments of polyglycacin filaments that had separated from the sutures were surrounded by a few fibro-
Contrast urethograms at 6 months revealed that the urethral lumen was intact, with no sign of stricture or fistula formation. A normal silhouette of contrast agent within the urethral lumen was observed in all dogs.

**DISCUSSION**

Clinical, radiologic, and histopathologic examinations indicated that an FL graft could repair a urethra with minimal postoperative complication. Good graft survival and incorporation was observed in all dogs.

Defects in the male urethra caused by congenital malformation or traumatic injuries often require tissue that can serve as adequate urethral substitutes. In dogs with a damaged urethra, an end-to-end anastomosis using 4-0 absorbable suture in a simple interrupted pattern has been recommended, but tension at the anastomotic site occurred. Urethral stricture can be either excised and repaired by anastomosis, or managed by scrotal or perineal urethrostomy or pubic urethrostomy, which permit urine diversion during voiding.

In humans, the challenges of hypospadias surgery and the treatment of urethral stenosis resulting from traumatic injury have prompted development of various surgical procedures including genital and extra genital skin flaps, bladder, and buccal mucosa, tunica vaginalis, and intestinal free flap. Initial results with these methods yielded a reasonable success rate. However, over time, complications such as stricture, fistula formation, hair growth, stone formation, and graft contracture were reported. None of these complications were observed in our dogs. Indeed, we did not observe degenerative changes, stricture, or fistula formation in 8 dogs by 2 months or in 6 dogs by 6 months after grafting. All dogs had non-obstructive urine outflow with a normal frequency of urination. Further, the new urethral tissue was histologically and functionally similar to the native urethra, a finding also reported in rabbits.

Four dogs had voiding difficulty and painful urination for 2–3 days postoperatively despite a urethral catheter. Observed signs of discomfort were standing up on the toes of the rear limbs and slight squatting. Treatment was directed toward keeping the bladder empty by catheter aspiration every 3 hours until signs of voiding difficulty or painful urination were no longer observed. Urination returned to within normal limits with a mean of 6.2 attempts within 10 minutes, which was similar to a study in normal dogs, where the mean number of attempts was nearly 7.

Our study demonstrated that urethral reconstruction of a 50% circumferential urethral defect could be carried out successfully using an FL autograft. However, it is also known that urethral defects can re-epithelialize if stented with a urinary catheter for 1–4 weeks. Where-

as we consider that it may be difficult to re-epithelialize a 50% circumferential urethral defect stented with a urinary catheter, this remains to be determined. Our intent was to evaluate the feasibility of urethroplasty using FL autograft.

The distal aspect of the urethra and prepuce has a normal bacterial flora, which includes organisms commonly responsible for infection. We secured a urethral catheter to the tip of prepuce for 1 week postoperatively to ensure patency and urinary drainage. To minimize the likelihood of infection, urethral catheters were flushed twice daily using a povidine–iodide solution. A closed collection system used in recumbent or paraplegic patients was considered impractical for our dogs because of their activity level.

FL is firm, elastic, and tensile in nature and covers the lateral aspect of thigh. It has been used to repair various tissue injuries like defects in the abdominal wall, joint surface, diaphragm, and oral cavity mucosa. FL graft was easily harvested, non-hair bearing, and in abundant supply. That no degenerative reactions such as ulcer formation and necrosis occurred in grafted areas of any dog may reflect good vascular supply in the urethra. Donor site morbidity has occurred after harvesting of grafts such as skin and free flaps; however, we did not encounter donor site morbidity for FL grafts in these dogs. Donor sites healed by primary intention without sign of infection or degenerative reaction.

Summarily, FL was a good source of graft material, and FL grafts were readily incorporated into urethral defects without morbidity and should be considered for clinical use in dogs with urethral large circumferential urethral defects.

**REFERENCES**


