NOTE

Surgery

Application of buccal mucosal graft to establish a new urination passage in male cats with penile traumatic injury

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ABSTRACT. Two male cats were presented with penile part of urethra injury due to dog attacks to the perineum and genitalia area. Chronic wound around a remained penile part of urethra due to the dog bite and perineal area was evident due to urine irritation. The buccal mucosa was harvested and subsequently placed on the granulation tissue of the wound to reconstruct the urinary passage. The buccal mucosal graft completely attached to the skin and urethra without any complications. From the follow-up at 3 months, the cats were able to urinate normally and the skin irritation from urine was resolved. In summary, the buccal mucosa is a good graft source and is suitable for the reconstruction of the urinary passage in severe and complicated cases of penile part of urethra injury in male cats.

KEYWORDS: buccal mucosal graft, cat, urethral injury

Extravasation of urine from the distal urethra of cats is reported in the literature as being an uncommon but possible complication subsequent to urethral obstruction, iatrogenic perforation following urethral catheterization, perineal urethrostomy, and traumatic injury, including road traffic accidents, gunshot, bite wounds, and pelvic fracture [9, 11, 19, 22]. The clinical signs of penile part of urethra rupture are hemorrhage and urine leakage into the perineal tissue. The deleterious effects of urine on tissue are toxic to the subepithelial tissue, causing periurethral inflammation, fibrosis, and delayed healing [21]. Urethral rupture can be treated surgically or conservatively. The surgical criteria are generally based on the severity of the lesions, such as complete obstruction, large laceration, and rupture [9, 12]. For example, in minor urethral injuries, contusion and small laceration, the conservative treatment is commonly indicated by temporary urinary diversion through urethral catheterization or tube cystostomy. Currently, in cases of complete urethral rupture, anastomosis between the two ends of the urethra is required as a primary treatment [9, 10]. Nowadays, the effective procedure to treat postpelvic rupture (of the penile part of urethra) is perineal urethrostomy (PU) [1, 2]. Although PU is usually a successful procedure when performed correctly, this technique may lead to various side effects, such as hemorrhage from erectile tissue, wound dehiscence, subcutaneous infiltration with urine in the surgical area, induced dermatitis from chronic urine irritation, recurrent cystitis, ascending urinary tract infection, urethral stricture, urinary and fecal incontinence, perineal hernia, rectal prolapse, and rectourethral fistula [23]. Therefore, an alternative technique to establish a new urinary passage is required to prevent further urine irritation and to avoid post-operative complications from PU.

This study was performed in accordance with the Institutional Animal Care and Use Committee of Kasetsart University, Bangkok, Thailand and was approved for animal intervention with the approval number ACKU62-VET-028. Informed, written consent was obtained from both cat owners prior to involvement in the study.

Cat 1: A 3.1 kg, 11-month-old domestic short-haired male cat was referred to the Kasetsart University Veterinary Teaching Hospital Hua Hin, Thailand with penile part of urethra injury due to a dog attack to its perineum and genitalia. The pretreatment history indicated that the owner had tried to treat the wound at the local veterinary clinic for 3 weeks but without any improvement. Physical examination revealed the absence of a body of penis and scrotum. The tissue around the remained penile part of urethra and perineal area had chronic wounds caused by urine irritation (Fig. 1). There was no sign of urinary bladder distension from abdominal palpation and there was no difficulty or discomfort during urination. Initial hematological testing revealed leukocytosis (WBC 19,500 cells/µL [reference range, 5,500–19,000 cells/µL]). Blood urea nitrogen (BUN) and creatinine were 21.1 mg/dL (reference range, 15–34 mg/dL).
mg/dL) and 1.92 mg/dL (reference range, 1.0–2.2 mg/dL), respectively. Analysis of urine obtained by cystocentesis did not show any indication of infection, which was confirmed by bacterial culture. Surgical intervention was performed twice for management of the loss of the penile part of urethra and to repair the chronic wounds around the remaining urethra. The first surgery was to harvest a graft from the oral cavity and attach it to the granulation wound ventral to the urethra. The second surgery was to connect the graft with the urethra and the edge of the wound. Prior to both surgeries, morphine (0.2 mg/kg), alfaxalone (2 mg/kg), and cephalixin (22 mg/kg) were administered for pain management, anesthetic induction, and prophylaxis antibiotic, respectively. Anesthesia was maintained using isoflurane throughout the surgery. In the first surgery, the cat was positioned in ventral recumbency. The oral cavity was rinsed with 0.12% chlorhexidine solution. A 1 × 2.5 cm graft from the buccal area was harvested from the inside of the buccal mucosa near the upper molar teeth and parallel to the dental arch, using a scalpel and sharp scissors. During harvesting process, the parotid papilla and zygomatic papilla were identified to avoid injuring the orifice or the duct itself. The excised graft was gently trimmed with scissors to remove the fat and muscle under the mucosal layer. Then, the graft was soaked in 0.9% normal saline. The donor site, the buccal area, was not sutured but compressed with gauze for hemostasis. The buccal mucosal graft was placed on the granulation tissue of the wound on the ventral side of the urethral and sutured using 5–0 polydioxanone with a simple interrupt pattern (Fig. 2). Afterward an indwelling catheter 1.0 × 130 mm was inserted to avoid urinary irritation to the buccal mucosal graft. The urine collection bag was connected to the end of the catheter to monitor the urine output (UOP) of the cat every 4 hr in the Critical Control Unit of the hospital. The cat was kept in a cage with an absorbent pad; a litter box was avoided to limit graft irritation. The buccal graft was rinsed twice daily with 0.9% normal saline solution and kept dry. The cat was fitted with an Elizabethan collar to deter self-mutilation. Soft food was given for one week. Medications were oral amoxy-clavulanic acid (15 mg/kg) for two weeks and subcutaneous injection of morphine every 4–6 hr for three consecutive days, with the second surgery two weeks later. In the second surgery, the adhesion between the graft and its bed was grossly examined on the criterion of a solid union between graft and bed, including a pale pink color with an apparent vascularization on the graft. The graft appeared to have almost 100% survival (Fig. 2). Once the well-grown adhesion of the graft was confirmed, incisions and undermining around the graft edges were made using scissors with gentle care. Then, the border of the wound and the urethral were undermined and trimmed. The dorsal sides of the graft edges were sutured directly to the ventral mucosal urethral border and the other sides of the graft edges and the urethral were sutured to the border of the skin using 5–0 polydioxanone with a simple interrupt pattern to create the new supporting urine passage (Fig. 3). The wound around the anus was left to be healed by second intention. Again, post-operatively, an Elizabethan collar was used to...
can be easily attached to the urethral bed given the similarities of composition with buccal mucosa graft are that it is hairless, easily harvested, accustomed to a wet environment, and resistant to infection. Buccal mucosa has a thick epithelium and rich elastin that make them durable and easy to handle. Other positive aspects of the buccal mucosa graft include thin and highly vascularized lamina propria that facilitate imbibition, inosculation, and angiogenesis of the graft. Therefore, we modified these single procedure techniques to perform a complete penile urethral rupture. The buccal mucosal graft was chosen due to its excellent characteristics. Histological studies reported that buccal mucosa is composed of a thick epithelium, together with thin and highly vascularized lamina propria that facilitate imbibition, inosculation, and angiogenesis of the graft. In addition, the thick epithelium and rich elastin of buccal grafts make them durable and easy to handle. Other positive aspects of the buccal mucosa graft are that it is hairless, easily harvested, accustomed to a wet environment, and resistant to infection. Buccal mucosa can be easily attached to the urethral bed given the similarities of composition.

**Cat 2:** A 2.8 kg, 3-year-old domestic short-haired male cat was referred to the Kasetsart University Veterinary Teaching Hospital Hua Hin, Thailand with penile part of urethra injury due to a dog attack to the external genitalia. Before referring, the cat was treated with standard of care including wound suturing and management at hind limb and perineal area from referring veterinarian for two weeks. Physical examination revealed the absence of the body of penis and scrotum (similar to cat 1). A chronic wound was evident around the remained penile part of urethra continuous to the left hind limb on the inner side of the thigh area, which was induced by urinary irritation (Fig. 1). There was no sign of urinary bladder distension during abdominal palpation and there was no discomfort during urination. In the present treatment, a blood sample was collected to examine the complete blood count and leukocytosis was identified (WBC 20,080 cells/µL). BUN and creatinine were 51.1 mg/dL and 1.92 mg/dL, respectively. Analysis of urine obtained by cystocentesis showed no indication of infections and no growth from bacterial culture. Pre-operatively, morphine (0.2 mg/kg), alfaxalone (2 mg/kg), and cephalixin (22 mg/kg) were administered for pain management, anesthetic induction, and prophylaxis antibiotic, respectively. Anesthesia was maintained with isoflurane throughout the surgery. The cat was positioned in ventral recumbency. Previously applied stiches were removed from the wound. Dissected tissue around the urethra was obtained carefully using scissors to identify the urethra (Fig. 4) and the skin was trimmed along the margin of the wound. The oral cavity was rinsed with 0.12% chlorhexidine solution. Three pieces of size 1 × 2 cm of buccal mucosal were harvested from the inside of the upper buccal area and treated, as described above. The buccal mucosal grafts were placed on the granulation tissue of the wound around the urethral and secured using 5−0 polydioxanone with a simple interrupt pattern. Then, all graft edges were sutured to the urethral mucosa and the border around the wound using 5−0 polydioxanone with a simple interrupt pattern, except in the case of the wound on the inner side of the thigh area, which could not be sutured directly to the buccal mucosal graft; therefore, that wound was left open until second intention healing (Fig. 4). An indwelling catheter was inserted and left for two weeks. The catheter was connected to a urine collection bag to monitor UOP. Post-operatively, the cat recovered well and was healthy without wound dehiscence. The medication and post-operation care protocol were the same as for the first cat. At two weeks after surgery, the skin sutures were removed. The chronic wound area on the inner side of the thigh was reduced in size and the sutured buccal mucosa graft had attached well to the urethra and skin without any complications at the surgical site. The cat was able to urinate normally and there was no evidence of skin irritation caused by urine. The rechecked complete blood count, blood urea nitrogen, and creatinine were unremarkable. The cat was monitored for 3 months and was able to urinate without any complications (Fig. 4).

Several studies recommended buccal mucosa as an appropriate source of tissue replacement due to its good results, particularly in complicated cases of urethral construction. There have been several reports on using a buccal mucosa graft for substitution urethroplasty in the management of many urethral abnormalities, such as complete urethra rupture in cat using sublingual mucosa to establish a new urinary passage in male cats and to repair hypospadias, epispadias, ureter and urethral stricture in humans. Therefore, we modified these single procedure techniques to perform a complete penile urethral rupture. The buccal mucosal graft was chosen due to its excellent characteristics. Histological studies reported that buccal mucosa is composed of a thick epithelium, together with thin and highly vascularized lamina propria that facilitate imbibition, inosculation, and angiogenesis of the graft. In addition, the thick epithelium and rich elastin of buccal grafts make them durable and easy to handle. Other positive aspects of the buccal mucosa graft are that it is hairless, easily harvested, accustomed to a wet environment, and resistant to infection. Buccal mucosa can be easily attached to the urethral bed given the similarities of composition. Based on the buccal mucosa characteristics, the

**Fig. 3.** Suture buccal mucosal graft (asterisk) with edges of skin and the remained penile part of urethra (arrow) using a simple interrupt pattern (A). At follow-up 3 months after surgery (B). Follow-up 1 year after surgery (C).
The present study reported a new technique using buccal mucosa to provide male cats that had lost the penile part of urethra with a new supporting urine passage with satisfactory outcomes and few complications.

In the present cases, the greater part of the penile part of urethra had been lost to a dog bite, with the penile part of urethra shrunken inside the wound. Although both cats in the present study could urinate, urine-scald dermatitis can occur from urine splashing on the skin around the urethral stoma. The treatment options for the penile part of urethra rupture include conservative treatment by temporary urinary diversion through urethral catheterization to protect wound irritation from urine and waiting for the wound around the penile part of urethra to heal by secondary intention. However, the secondary intention wound healing could lead to stricture formation around the urethra causing obstruction, especially in cat 2 where the rupture area was too cranial. For the surgery treatment, performing a PU as the first-choice procedure could result in numerous complications as has been reported. In the case that PU failed or the rupture site was too cranial, transpelvic urethrostomy (TPU) would be the second procedure to perform. The complications of TPU are urinary staining of fur, stricture formation around the urethra, lower urinary tract infection, and pubic fracture [7, 8, 12]. Therefore, we decided to use buccal mucosal grafts to establish a new supporting urine passage around the urethra in the two male cats to protect against skin irritation from urine, prevent the constriction of the urethra from skin contraction, and to help with wound healing. Other advantages are its ease and simplicity compared to the PU and TPU techniques. Our use of buccal mucosal grafts did not cause urethral trauma or laceration, muscle dissection around the urethra for identification of the urethral mucosa was not necessary, there was less bleeding, less damage to tissue and vessels from excessive dorsal dissection to the pelvic plexus, and less damage to the pudendal nerve during the surgery. In addition, there were no surgical concerns regarding tension of the urethra from failure to mobilize the urethra that can consequently cause urethral stricture, which is a complication from PU [18].

Usually, a buccal mucosal graft is divided into two types: onlay free-graft urethroplasty or tube graft urethroplasty. Onlay grafts seem to have better outcomes compared to tubular grafts due to the former having a greater blood supply [15, 25]. Our presented case technique used onlay free-graft urethroplasty for both cats. A richer vascular bed from the granulation tissue provides a good blood supply for the graft, helping to ensure that the graft does not fail. For the graft replacement technique, the harvested buccal mucosal graft was difficult to place and suture on the bed because of its small size and its thin tissue. We recommend using a stay suture at both ends of the graft to help the graft stretch well and cover the complete bedding area. Then, an interrupt suture can be used at both ends of the graft to stabilize the graft on the bed before suturing the graft on the granulation tissue of the wound. In cat 1, the graft was laid on top of the recipient tissue surface and left to allow graft adhesion to occur on the recipient site without any sutures between the border of the wound and the graft. This was different from cat 2 because an extensive portion of the wound in cat 1 was too wide to suture at once.
Post-operative complications at the donor site reported in humans include post-operative pain and swelling in the harvested area, mouth tightness, oral numbness, oral discomfort, salivary changes, difficulty in opening the mouth, damage to the parotid duct with symptoms of salivary obstruction, and injury to the long buccal and mental nerves [16, 20, 24]. Nevertheless, the cats in our study did not show any signs of pain or discomfort and the cats were able to eat shortly after the operation. Each cat maintained a good appetite and stable bodyweight. At the buccal mucosal graft donor site, the wound healed within one week without any signs of infection or degenerative reaction.

In summary, buccal mucosa is a good graft source as it is usually incorporated into urethral defects with few complications. Additionally, this surgical procedure substantially improved the patients’ quality of life.

CONFLICT OF INTEREST. The authors declare no conflicts of interest related to this report.

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