

## Prepuccial urethrostomy performed using the coating technique

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**Abstract:** Penile urethral obstruction in cats is a commonly seen clinical case in veterinary medicine practice. In cases where there is no response to catheterisation or medical intervention, surgery is needed to enable urination and correct uraemia and hyperkalaemia. Several surgical techniques of urethrostomy have been described for this aim.

In performing standard prepuccial urethrostomy great care must be taken to minimise leakage in the anastomosis site and promote healing when performing the pelvic urethra and prepuccial mucosa anastomosis. To achieve this, the line of anastomosis has been reinforced by covering the anastomosis with the bilateral bulbourethral tissue, m. ischiourethralis and m. ischiocavernosus using simple mattress sutures. This modification, which varies from the technique performed by Yeh and Şaroğlu, has been termed the coating technique. Advantages of this new technique over standard perineal urethrostomy are discussed.

This technique was used in the treatment of 55 cats with penile urethra obstruction presented to our clinic. Among them 52 cats showed uncomplicated recovery. Following anastomosis, a male dog urethral catheter with an outer diameter of 2.6 mm was placed in each patient. In order to avoid infection, the catheter was removed after 2 days. Stenosis developed after 1 month in 3 cases in which normal urination was resumed by performing the standard perineal urethrostomy. All cats returned to good health.

**Key words:** Cat, urethrostomy, penile urethral obstruction, coating

### Mantolama tekniği kullanılarak yapılan prepusyal uretrotomi

**Özet:** Veteriner hekimlik pratiğinde, kedilerde gelişen penil üretral tıkanmaya sık rastlanır. Kateterizasyon ve ilaç sağaltımına yanıt alınamayan olgularda, idrar akışını sağlamak ve gelişen üremi, hiperkalemi tablosunu düzeltmek için operasyon yapılmalıdır. Bu amaçla pek çok şirurjikal teknik geliştirilmiştir.

Pelvik üretranın prepusyal mukozaya anastomozu tekniğinde, anastomoz alanından idrar kaçığı gelişimini önlemek ve iyileşmeyi sağlamak için çok dikkatli olunmalıdır. Bu çalışmada idrar kaçığının engellenebilmesi için, anastomoz alanı bilateral bulboüretal doku, m. ischiourethralis ve m. ischiocavernosus kullanılarak desteklendi. Daha önce Yeh ve Şaroğlu'nun uygulayıp yayınladığı tekniğin bir modifikasyonu olan bu uygulama, mantolama tekniği olarak adlandırıldı. Bu yeni modifiye tekniğin avantajları standart perineal üretrotomi ile karşılaştırıldı.

Bu teknik, penil üretra obstrüksiyonu bulunan 55 kedinin sağaltımında uygulandı. Elliiki kedi komplikasyon görülmesiz iyileşti. Üç hastada üretral kateter uzaklaştırıldıktan 1 ay sonra stenoz geliştiği gözlemlendi ve bu kedilere standart perineal üretrotomi tekniği uygulandı. Anastomozun ardından her bir hastaya dış çapı 2,6 mm olan erkek köpek idrar sondası uygulandı. Enfeksiyondan sakınmak için operasyondan 2 gün sonra sondalar uzaklaştırıldı. Obstrüksiyonlu tüm kedilerin sağlık durumu iyiydi.

**Anahtar sözcükler:** Kedi, üretrotomi, penil üretral obstrüksiyon, mantolama

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## Introduction

Obstruction of the penile urethra, in particular, is a serious problem commonly seen in male cats. The most important causes of urethral blockage and obstruction of urine flow are struvite crystals, calcium oxalate crystals cell accumulation related to urinary tract infections and hardening of these structures. It has been reported that feeding low-quality cat food containing excessive amounts of magnesium and phosphate plays an important role in the development of this condition. It has also been expressed that in male cats urethral atrophy may develop following early castration and this may form a risk for penile urethra obstruction (1-3).

Anatomically, the urethra of male cats is divided into 5 sections: preprostatic urethra, prostatic urethra, postprostatic urethra, pelvic urethra, and penile urethra. The diameter of the urethra in the abdominal and pelvic region is 3-5 mm, whereas within the penis the diameter of the penile urethra begins to constrict like a cone and drops to 1-1.5 mm. The penile urethra is the most common site for obstruction by the accumulation of crystal plaques and cells (1-4).

In the case of penile urethra obstruction there is no outflow of urine, therefore uraemia and hyperkalaemia develop. Hyperkalaemia may cause disruption of cell membrane potential and leads to ventricular fibrillation. All these negative events carry life-threatening risks for the patients (5).

The first actions to take in urine flow obstruction are catheterisation of the urethra, massaging the pelvic urethra via rectal touché and performing cystocentesis to drain the urinary bladder (1,6). As well as these steps, medical treatment may be effective in some patients. As long as urine can be drained, prescription pet foods selected depending on laboratory test results may prevent further crystal formation (7,8). However, relapse may occur and surgery may be required in cases where these interventions are ineffective (1-4,6-19).

Many surgical methods and their modifications have been described for the treatment of penile urethra obstruction in cats. Antepubic urethrostomy (McCully 1955), urethrocolostomy-ureterocolostomy (Beamer 1959, Whittick and Bonar 1961), penile

urethrostomy (Meier 1960, Christensen 1964)(12) and perineal urethrostomy (Carbone 1963) (11) are techniques having been used since the 1950s. Among them the perineal urethrostomy technique, published by Wilson and Harrison in 1971 (20), was used extensively and in later years, and other researchers (Johnston 1974) developed modifications of this technique.

In Turkey, the first perineal urethrostomy in cats was reported by Arıkan and Acar (2) in 17 male cats with urethral obstruction. Of these, 1 cat died during surgery and 1 developed stenosis 3 months after the operation.

Common complications related to penile urethra obstruction operations are death due to anaesthesia, postoperative haemorrhage, subcutaneous urine pooling, irritation dermatitis, perineal hernia, stricture, urinary incontinence, urethrorectal fistula and urinary system infection (1,4,8,14,15,21-24).

In a study published in 2000, Yeh and Chin (25) described a modified perineal urethrostomy technique performed using the prepuccial mucosa. They reported complete and uncomplicated recovery in 14 cats with either partial or total urethral obstruction, when they carried out this technique. This new technique had several advantages such as rapid return to urination, better urination potential compared to normal cats, more aesthetic appearance of the operation site (same as castrated cats), and no development of irritation dermatitis in the area, as well as no stricture of the urethral opening due to growing hair in the area after the operation (6).

In a study carried out by Saroglu et al. (26), concerning the anastomosis technique of the prepuccial mucosa to the urethra, leakage through the line of anastomosis and subsequent stenosis developed in 3 of 20 cases. In this report, this technique was modified in order to prevent anastomosis leakage and provide short-term recovery of the anastomosis site before stenosis could develop. In the modification, a coating technique was developed by covering the bilaterally positioned bulbourethral gland, m. ischiourethralis and m. ischiocavernosus over the anastomosis site using simple mattress sutures (Figure 1A-J).

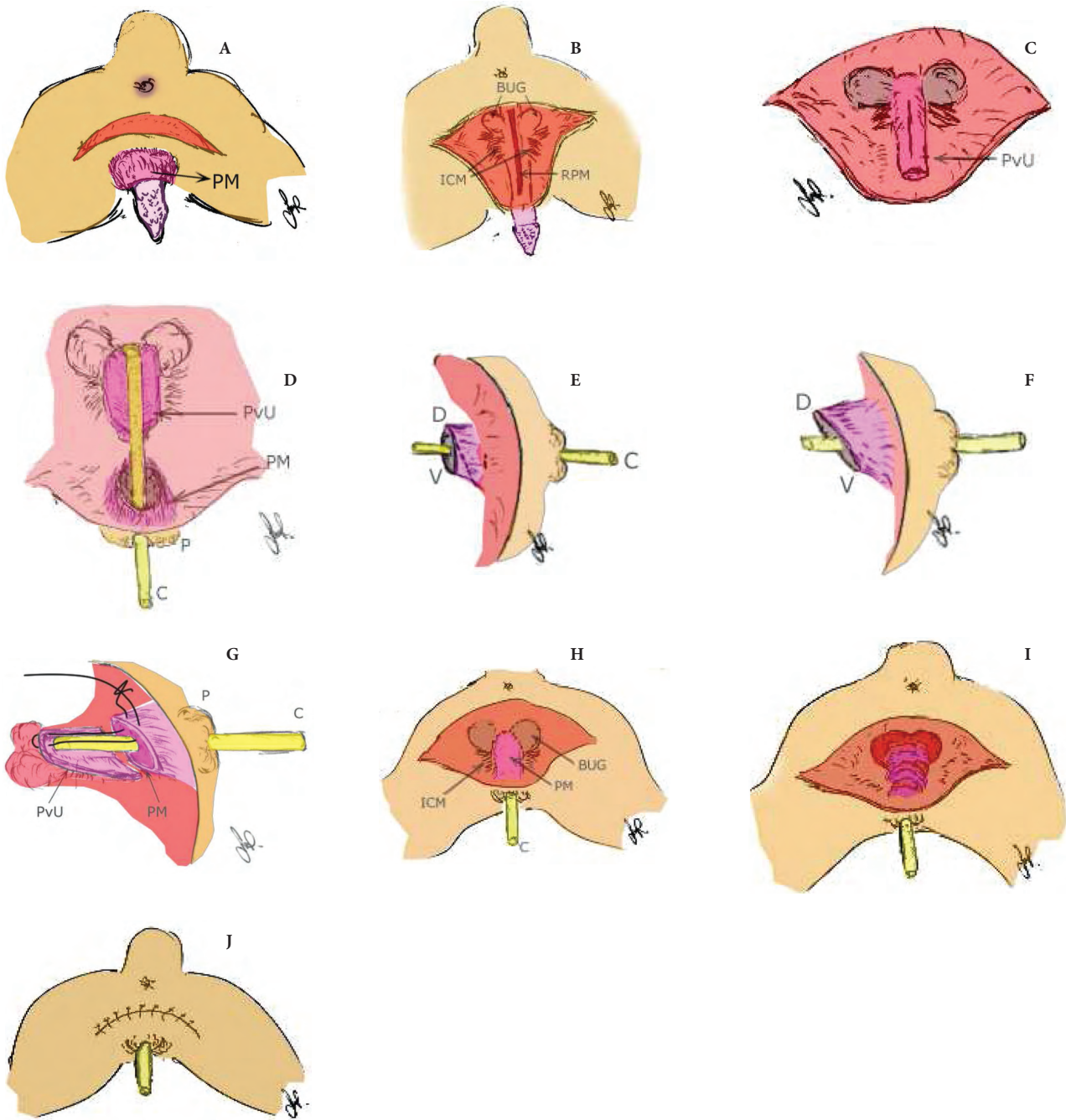


Figure 1. A-J. Schematic views of the operation time. S = Scrotum, P = Prepuce, BUG = Bulbourethral Gland, IUM = Ischiourethralis Muscle, ICM = Ischiocavernosus Muscle, RPM = Retractor Muscle of Penis, PeU = Penile Urethra, PM = Prepuce Mucosa, C = Catheter, D = Dorsal, V = Ventral, I = Incision line, PN = Penis, PvU = Pelvic Urethra.

### Materials and method

The material of the study comprised a total of 55 male cats between the ages of 1 and 13 years, with urethral obstruction in which urination could not be

achieved via catheterisation or rectal touché and those which relapsed a few weeks after the obstruction had been cleared. Twenty-four of these patients had previously been castrated, whereas 31 were intact.

History taken from patient owners revealed that the cats had been fed pet food containing high levels of magnesium and phosphorus.

Preoperative blood serum tests were carried out and biochemical values were assessed. Those with high levels of blood urea nitrogen (BUN) and Creatine (Crea.) were given treatment to lower these levels. In urolithiasis cases, diazepam (Diazem<sup>®</sup>, Deva, İstanbul, Turkey) was administered at a dose of 0.5 mg/kg iv and attempts were made to clear the obstructed pelvic and penile urethra via rectal touché. Urine was removed by cystocentesis in the cases that could not be cleared so as not to damage the urethral mucosa by the urinary catheter. The collected urine was analysed.

Afterwards, urethrostomy was performed. Intravenous saline solution was administered to support general body condition. Although BUN and Crea. levels were higher than normal and despite a life-threatening risk, the operation was nevertheless performed in the cases where partial obstruction remained.

Each case was premedicated with atropine (0.02 mg/kg SC) (Atropin<sup>®</sup>, Vetaş, İstanbul, Turkey) and diazepam 0.5 mg/kg iv (Diazem<sup>®</sup>, Deva, İstanbul, Turkey), followed by short-term general anaesthesia with iv administration of ketamine hydrochloride (2.2-4.4 mg/kg iv) (Ketalar<sup>®</sup>, Pfizer, İstanbul, Turkey). The animals were intubated and connected to a closed circuit anaesthesia machine and anaesthesia was maintained with isoflurane (Forane<sup>®</sup>, Abbott, İstanbul, Turkey).

The patients were put into the Trienburg position on the operating table (where the sternal recumbency with the tail folded cranially over the back of the patient on an operating table sloping 15-20° forward with the perineal region at the higher end (Figure 2). The operation site was prepared for surgery and an inverted crescent-shaped incision was made, with the 2 arms of the incision facing downwards, immediately above the scrotum encompassing the perineal region (Figure 1A and 3). Intact male cats were castrated through this incision. An elliptical excision was used to discard the excess skin of the scrotum following castration. The penis was dissected until it was fully separated from connecting tissue. The ventral ligament of the penis and the bilateral



Figure 2. Appearance of castrated male cat ready for surgery S (Scrotum).



Figure 3. Shape of the skin incision.

ischiocavernosum muscles were severed. Penis dissection was continued in a ventral and lateral direction and all connections with the pelvis were cut, freeing the penis in the apertura caudalis region (Figure 1B).

M. retractor penis positioned dorsally to the penis was severed and removed. The bulbourethral glands (BUG) on the left and right of the urethra and m. ischiocavernosum (ICM) were then excised to either side and mini retractors were used to reach the pelvic urethra (PvU) (Figure 1C, D). A male cat catheter of 1.3 mm outer diameter was placed into the urethral canal. Under the guidance of this catheter a small incision was made on the dorsal side of the pelvic urethra. Starting from the incision line, iris scissors

were used to make a 1 cm incision in the urethral canal. The pelvic urethra mucosa was pulled to either side (Figure 1 C, D). Any blockages in the region were cleared via lavage. Using 4/0 polyglactine 910 (Vicryl<sup>®</sup>, Ethicon, Edinburgh, UK), a ligature was placed approximately 1 cm distal to the incision in the penile urethra and the distal portion of the penis was amputated (Figure 1B and C).

The small diameter feline catheter was removed and replaced with a male dog urethral catheter (Buster Sterile, Denmark) with an outer diameter of 2.6 mm, placed into the pelvic urethra in the direction of the urinary bladder (Figure 1D-I).

A circular incision was made along the connection of the penis with the prepuce mucosa using a fine 15 size scalpel (Figure 4). This line of incision was then carefully dissected using sharp-tipped scissors and the prepuce connection with the penis was totally severed (Figure 5). The prepuce mucosa was then incised in a cranio-dorsal direction, as if intersecting the hypotenuse of a right-angled triangle, starting 2-3 mm behind the ventral end of the prepuce mucosa. A triangular piece of tissue was removed and the prepuce mucosa was prepared for anastomosis to the pelvic urethra (Figure 1E, F) (the lateral view of the region) (Figure 6).

Polyglactine 910, 4/0 was also used for anastomosis. The most dorsal part of the prepuce mucosa prepared for anastomosis, and the top end of

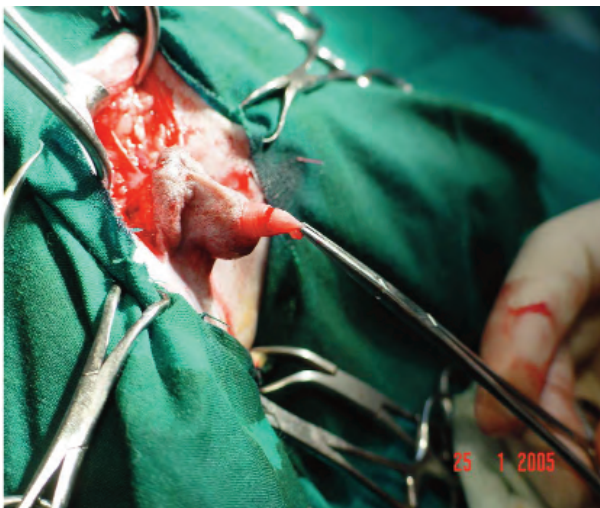


Figure 4. Incision to sever the prepuce mucosa freed from the penis.

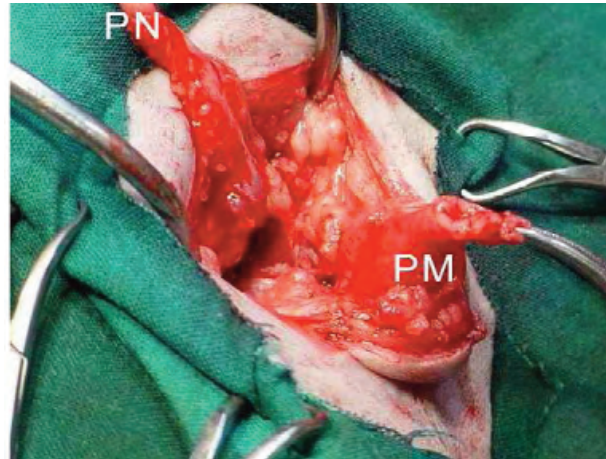


Figure 5. Appearance of prepuce mucosa freed from the penis PN (Penis), PM (Prepuce Mucosa).

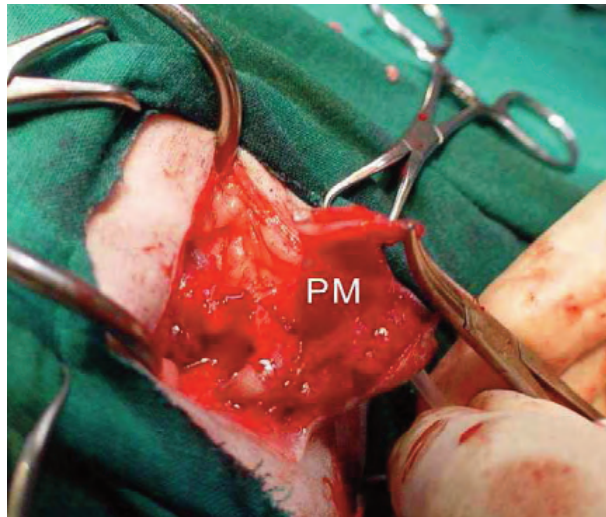


Figure 6. Appearance of prepared prepuce mucosa prior to anastomosis.

the incision in the pelvic urethra was fixed with a mattress suture. The ends of the suture material were left long. Anastomosis of the caudo-ventral end of the prepuce mucosa to the caudal end of the pelvic urethra was achieved using 2 separate mattress sutures and the ends of the suture material were left long. Using the long sutures left at the cranio-dorsal and caudo-ventral ends, full-thickness anastomosis was performed using simple continuous sutures on both sides (Figures 1G, H and 7). To prevent urine leakage from the dorsal and ventral and the lateral surfaces of the anastomosis, the bilateral bulbourethral glands, the ischiourethral muscles (IUM), and

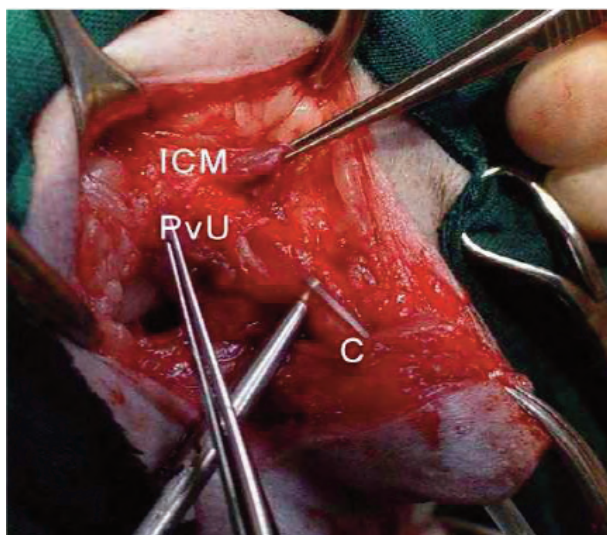


Figure 7. Appearance of pelvic urethra anastomosis.



Figure 9. Performing the coating technique.

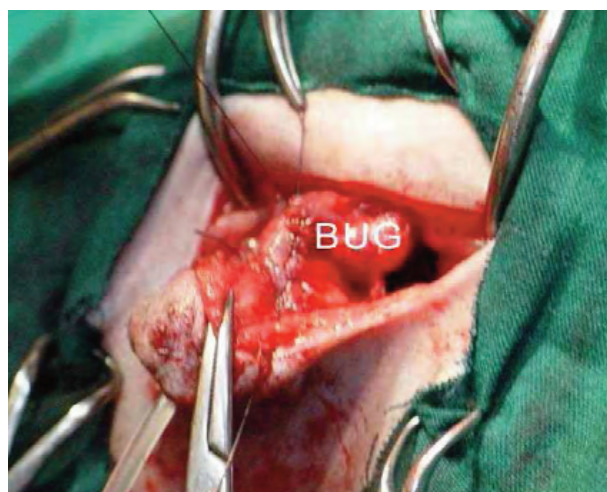


Figure 8. Appearance of completed anastomosis.



Figure 10. Appearance of the operation site following skin closure and urethral catheter.

ischio-cavernosum muscles (ICM) were sutured using simple mattress sutures. This covering procedure is referred to as the coating technique (Figures 1H, I, 8, and 9). Surrounding soft tissues and subcutaneous connective tissue were closed using 4/0 polyglactin 910 and the skin was closed with 3/0 silk suture material (Figure 1J and 10).

The male dog urethra catheters were cut down to the size of a standard male cat catheter and fixed to the prepuce skin using 2/0 silk suture material (Figure 10). To prevent infection, the catheter was removed at the end of day 2. During this time the urethra was

flushed with 0.5% Metronidazole iv solution (Nidazol, I. E. Ulugay, İstanbul, Turkey). The patients were fitted with Elizabethan collars for the duration of the catheterisation, thus protecting the operation site and the catheter. All the patients were given wide spectrum antibiotics (Cefatin, Roche, İstanbul, Turkey) for 7 days after the surgery. Skin sutures were removed in 10 days.

In 46 of the cats (93% of our study population) repeated catheterisation of patients caused damage to

the penile and pelvic urethra loss of its normal structure, and subsequent scar formation. Post-operatively male dog catheters were left in situ for 2 days (in all 46 cats). Fibrous tissue was encouraged to develop in the anastomosis site. In the meantime, urine was allowed to flow continuously through the catheter.

Complete urine analysis of all cats was performed before and after the surgery. Post-operative urine analysis revealed normal levels of leucocytes and the presence of crystals. In all cases a bacteriological examination was therefore not requested.

The cats were kept under observation for 10 days following the surgery. It was advised that the patients be fed with prescription food depending on the properties of the crystals present. Late period check-ups of 36 cats were done by the authors. Information on the other 19 cats was obtained by telephone.

## Results

The operation wound healed primarily in all cases and an overall success rate of 94.5% was observed in 55 cases with the coating technique. In 3 cases (5.5%), the owners reported that the cats were frequently taking an unproductive urination position 1 month after the catheter removal. In the examination of these cases using male cat catheters, the catheter was introduced into the prepuce with difficulty and only advanced for 1 cm. Male dog catheters could not be introduced at all. This examination revealed the development of the stenosis; therefore radiographic imaging was not required. In these cases, the standard urethrostomy technique, open perineal urethrostomy, was performed and the patients were restored to good health. The 6 month and 1 year follow ups of the other cases showed no complications such as urinary incontinence or any kind of lower urinary tract infection and all other cases with the coating technique (94.5%) urinated comfortably and led a normal life.

In the case of the intact males, if the scrotum was left remaining after castration performed during urethrostomy, the scrotum became necrotic and this tissue was seen to prevent primary healing of the operation site. In this study, necrosis was observed after castration in only the first 3 of 31 intact males. In

them, the empty scrotum was left after the operation, which gradually filled with serous fluid. In the perineal region of these patients post-operative oedema was seen to develop, followed by necrosis. This situation delayed the healing time for the operation wound. Therefore, in the other 28 intact males, an elliptical piece of skin was removed from the scrotum, preventing the formation of a pouch and complications that could influence healing time were eliminated.

In the coating technique, there was no leakage in the line of anastomosis in any of the cases and the operation wound healed within the expected time. The potential for urine outflow was seen to be higher than that of a healthy intact male cat.

## Discussion

In penile urethra obstruction, frequently seen to occur in male cats, as well as emergency treatment methods, more permanent and aesthetic urethrostomy operations are used extensively. Researchers using different urethrostomy techniques have stressed the importance of the complications developed immediately after the operation and in the long term. Complications, in particular the stenosis due to scar formation, usually developed from 1 to 3 months after the operation, depending on the method of urethrostomy performed (1,3,12,13).

The fact that stenosis developed after 3-4 weeks in 3 of the 50 cases included in this study is consistent with reports of other researchers (1,21-23). However, there are some interesting points in the anastomosis technique carried out in this study. In the authors' opinion, one of the major reasons for stenosis developing in the anastomosis site 1 month after removal of the catheter is the severe damage in the urethra mucosa. This damage is caused by repeated catheterisation of the urethra with urolithiasis and this can be observed macroscopically during urethrostomy. Repeated attempts to unblock the obstruction in the penile and pelvic urethra cause more damage than dwelling the catheter within the urethral canal for long periods. This leads to the loss of normal urethral mucosal structures. The scar tissue formed by the healing process of the damage to the urethral mucosa makes it difficult to perform

anastomosis. Great care must be taken in the anastomosis of severely damaged pelvic and penile urethra. In the authors' opinion, the catheter should remain in situ for more than 3 days later to encourage fibrous tissue formation around the catheter.

Urethral obstruction in male cats can usually be cleared without surgery, by exerting pressure on the pelvic urethra via rectal touché. Even in temporary unblocking via catheterisation, cystosentesis, or cystotomy methods, it must be kept in mind that obstruction may recur. Obstruction of the urethra prior to surgery would cause irritation in the bladder. Therefore, continuous urine flow would prevent accumulation and resolve any cases of cystitis, and authors (1,7,9,12,14-17) agree with the idea that one of the urethrostomy techniques with less risk of recurring obstruction must be employed as soon as possible. If there is no damage in penile urethra and pelvic urethra, the technique of prepuccial urethrostomy has to be preferred according to the experiences of the doctor. It would be difficult if there were much damage in the pelvic urethra. Therefore, the perineal urethrostomy technique should be preferred. If any stenoses occur after the prepuccial urethrostomy, the perineal urethrostomy technique should definitely be preferred.

It has been reported that castration in male cats may cause urethral atrophy and related penile urethra obstruction (2). However, the fact that only 24 of the 55 cats in this study had been previously castrated showed that urethral obstruction is not necessarily a risk factor in castrated cats. The authors agree with the notion that this condition can also be observed in intact male cats and among the main reasons is feeding the animals food high in magnesium and phosphorus. (3)

In the standard urethrostomy technique, it has been reported that swelling and bruising may occur post-operatively. The cause of this is the destruction of blood vessel connections in the area and urine leakage from the urethra into the operation site (1). In addition, the most frequent complication encountered in later periods is narrowing of the external urethral opening, development of stenosis and stricture, partly contributed to by the newly growing perineal hairs (1,4,10,11,20).

The fact that none of the above-mentioned complications reported in the post-operative or later periods with the anastomosis technique of the prepuccial mucosa to the pelvic urethra confirms the opinion of Yeh and Chin (25) and supports the superiority of the modified coating technique developed by the authors.

In the standard urethrostomy technique, urine is in contact with the skin while it is voided and frequently causes irritation dermatitis in the perineal region (4,22,25). Moreover, bacterial urinary system diseases occur due to continuous exposure of the urethra. In our modified technique based on the technique developed by Yeh and Chin (25), due to direct outflow of urine from the original prepuccial opening there was no irritation dermatitis and therefore no bacterial urinary system disease. In addition, there is no urinary incontinence, because there is no nerve in the operation region regarding the urinary mechanism, and the appearance of the area was similar to that of a castrated male cat. The findings of our study also indicated that the potential for urine outflow was higher than that in healthy intact male cats.

Yeh and Chin (25) reported that in all the patients that underwent prepuccial urethrostomy the urination potential was at a high level compared to that in healthy cats. In the study carried out by Saroglu et al. (26), with the exception of 3 cases in which urine leakage was recorded and 1 case where oedema developed in the perineal region, all cases recovered without complication. In the authors' opinion, leaving the male dog catheter in situ for 2 days and using the modified technique are beneficial in the healing of the anastomosis wound without any leakage of urine and the potential for urination is higher than that of healthy male cats.

In intact males, when the scrotum is left in situ after castration during urethrostomy, scrotal necrosis may develop and later the necrotised tissue may obstruct the primary healing of the operation site. In the authors' opinion, the blood vessels distributed in the scrotum were weakened after castration and freeing of the penis, which in turn caused necrosis. Necrosis was encountered in only 3 of the 31 cases of intact males. During the successive urethrostomy operation of intact males (n = 28), an elliptical piece



of scrotal skin corresponding to the dorsal wound edge of the incision was removed to prevent the formation of a pouch, which encouraged primary healing of the wound.

When performing the anastomosis technique, a right-angled triangular piece of tissue should be removed from the prepuccial mucosa. If the length of the hypotenuse of this right-angled triangle is short, narrowing will occur in the inner diameter of the urethra in the line of anastomosis. The authors point out that this should be considered in the preparation stage for anastomosis of the prepuccial mucosa (Figure 1E, F).

In the authors' opinion, urine leakage in the line of anastomosis as well as the secondary stenosis is due to lack of experience with the operation technique, especially the anastomosis phase. Post-operatively male dog catheters were left in situ for 2 days (in all 46 cats) to ease the anastomosis procedure and prevent urine leakage from the stitches. Furthermore, based on the principle that the organism forms fibrous tissue around an aseptic object, fibrous tissue was encouraged to develop in the anastomosis site.

Yeh and Chin (25) applied this technique to cases with no damage in the urethra, whereas Şaroğlu et al. (26) encountered complications due to overlooking urethral damage and not performing catheterisation following anastomosis. In the light of these

assessments, the anastomosis technique performed by Yeh and Chin (25) as well as the modified technique is superior to the standard perineal urethrostomy technique due to the absence of irritation dermatitis, bacterial urinary system disease or urinary incontinence, the fact that the region has the appearance of a castrated male cat, and that the potential for urination is higher than that of a healthy intact male cat. Moreover, in the event of stenosis developing in the prepuccial urethrostomy technique, alternative urethrostomy techniques can be employed as salvage.

When anastomosis of the prepuccial mucosa is with urethritis and ruptured urethral mucosa due to forceful catheterisation, excessive scar tissue formation in the anastomosis site must be anticipated. The authors recommend, in such cases, the catheterised coating technique can be reliably performed following anastomosis, in order to minimise leakage in the line of anastomosis, based on the principle that the anastomosis site was covered with fibrous tissue and healed. In cases with little damage to the urethral mucosa, the coating technique may be still used in addition to the technique of Yeh et al. (6), to prevent urine leakage in the line of anastomosis and encourage healing.

## References

1. Akın, F., Samsar, E.: Özel Cerrahi. Medipres Yayıncılık. Ankara. 2006: 295-314.
2. Arıkan N., Acar S.A.: Erkek kedilerde üretra tıkanması ve üretrostomi. İstanbul Üniv. Vet. Fak. Derg., 1993; 19: 39-47.
3. Blake, J.A.: Perineal urethrostomy in cats. J. Am. Vet. Med. Assoc., 1968; 152: 1499-1506.
4. Carbone, M.G.: Perineal urethrostomy to relieve urethral obstruction in the male cat. J. Am. Vet. Med. Assoc., 1963; 143: 34-39.
5. Christensen, N.R.: Preputial urethrostomy in the male cat. J. Am. Vet. Med. Assoc., 1964; 145: 903-908.
6. Drobotz, K.J., Hughes, D.: Concentration of ionized calcium in plasma from cats with urethral obstruction. J. Am. Vet. Med. Assoc., 1997; 211: 1392-1395.
7. Folger, W.R.: Calcium oxalate urolithiasis in a cat. Feline Pract., 1999; 27: 17-20.
8. Gregory, C.R., Vasseur, P.B.: Long-term examination of cats with perineal urethrostomy. Vet. Surg. 1983; 12: 210-212.
9. Gregory, C.R., Vasseur, P.B.: Electromyographic and urethral pressure profilometry: long-term assessment of urethral function after perineal urethrostomy in cats. Am. J. Vet. Res., 1984; 45: 1318-1321.
10. Gregory, C.R., Holliday, T.A., Vasseur, P.B., Bruhl-Day, R.A.G.A., Parker, H.R., McNeal, D.: Electromyographic and urethral pressure profilometry: assessment of urethral function before and after perineal urethrostomy in cats. Am. J. Vet. Res., 1984; 45: 2062- 2065.

11. Griffin, D.W., Gregory, C.R.: Prevalence of bacterial urinary tract infection after perineal urethrostomy in cats. *J. Am. Vet. Med. Assoc.*, 1992; 200: 681-684.
12. Johnston, D.E.: Feline urethrostomy - a critique and new method. *J. Small Anim. Pract.*, 1974; 15: 421-435.
13. Kyles A.E., Stone E.A.: Urethra. In: *Current Techniques in Small Animal Surgery*. Ed. Bojrap M. J. Ed., Williams & Wilkins. Baltimore 4<sup>th</sup> Edn. 1998; 461- 477.
14. Long, R.D.: A technique for perineal urethrostomy in the cat. *J. Small Animal Pract.*, 1977; 18: 407-413.
15. McLoughlin, M.A.: Surgical emergencies of the urinary tract. *Vet. Clin. North Am. Small Anim. Pract.*, 2000; 30: 581-601.
16. Mendham, J.H.: A description and evaluation of antepubic urethrostomy in the male cat. *J. Small Anim. Pract.*, 1970; 11: 709-721.
17. Osborne, C.A., Caywood, D.D., Johnston, G.R., Polzin, D.J., Lulich, J.P., Kruger, J.M.: Perineal urethrostomy versus dietary management in prevention of recurrent lower urinary tract disease. *J. Small Anim. Pract.*, 1991; 32: 296-305.
18. Osborne, C.A., Kruger, J.M., Lulich, J.P., Bartges, J.W., Polzin, D.J.: Medical management of feline urethral obstruction. *Vet. Clin. North Am. Small Anim. Pract.*, 1996; 26: 483-498.
19. Osborne, C.A., Caywood, D.D., Johnston, G.R., Polzin, D.J., Lulich, J.P., Kruger, J.M., Ulrich, L.K.: Feline perineal urethrostomy: a potential cause of feline lower urinary tract disease. *Vet. Clin. North Am. Small Anim. Pract.*, 1996; 26: 535-549.
20. Wilson, G.P., Harrison, J.W.: Perineal urethrostomy in cats. *J. Am. Vet. Med. Assoc.*, 1971; 159: 1789-1793.
21. Sevestre J.: *Elements de Chirurgie Animale. Chirurgie Abdominale*. Tome. 2. Les editions du point veterinaire. Paris. P. 1979 ; 149-157.
22. Slatter, D.: *Textbook of Small Animal Surgery*. 2<sup>nd</sup> edn., 1983; 1465-1468.
23. Smith, C.W.: Effects of indwelling catheters in male cats. *J. Am. Anim. Hosp. Assoc.*, 1981; 17: 427.
24. White, R.N., Tick, N.T., White, H.L.: Naturally occurring xanthine urolithiasis in a domestic shorthair cat. *J. Small Anim. Pract.*, 1997; 38: 299-301.
25. Yeh, L.S., Chin, S.C.: Modified perineal urethrostomy using preputial mucosa in cats. *J. Am. Vet. Med. Assoc.*, 2000; 216: 1092-1095.
26. Saroglu, M., Acar, S.E., Duzgun, O.: Urethrostomy done using the anastomosis technique of the prepuce mucosa to the pelvic urethra in cats with penile urethral obstruction. *Vet. Med.-Czech.*, 2003; 48: 229-234.