Buccal Mucosa Graft for Ureteral Stricture Substitution: Initial Experience

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OBJECTIVES To evaluate the use of buccal mucosa tubal graft for reconstruction of extensive ureteral stricture.

MATERIALS AND METHODS Between April 2006 and July 2008, 5 patients (mean age, 51.2 years) underwent reconstructive ureteral surgery for ureteral obstruction using buccal mucosa graft. The indication of surgery was extensive ureteral stricture of a 4.4-cm average length (range, 3.5-5.0). The site of stricture was in the proximal and the middle ureter in 3 and 2 patients, respectively. The causes of stricture were postinflammatory (3 cases) and iatrogenic after ureteroscopic procedures for impacted stones (2 cases).

RESULTS All 5 patients underwent successful ureteral defect replacement using buccal mucosal tube. The intraoperative course was uneventful without any major complications. Mean operative time was 106 minutes (range, 85-130). With a mean follow-up of 24 months (range, 14-39), the operated kidneys showed no obstruction.

CONCLUSIONS Oral buccal mucosal tubal graft for reconstruction of extensive ureteral stricture is a good available option. Although the results of this initial experience are encouraging, a bigger series and longer follow-up is recommended to evaluate our procedure. UROLOGY 76: 971–976, 2010. © 2010 Published by Elsevier Inc.

Correction of long ureteral defects, which result from many benign and malignant conditions, represents a challenge for most urologists. Many techniques were suggested to overcome this problem of which ileal loop replacement forms the most common option with its known procedure complexity and high morbidity. We present our initial experience with tabularized buccal mucosa graft for reconstruction of extensive ureteral stricture. The technique was described and the results were evaluated for its feasibility for long ureteral defects.

PATIENTS AND METHODS

Between April 2006 and July 2008, 5 patients (4 male, 1 female) with a mean age of 51.2 years (range, 34-67) underwent reconstructive ureteral surgery for ureteral obstruction using buccal mucosa graft. The indication of surgery was extensive ureteral stricture of a 4.4-cm average length (range, 3.5-5.0). Three strictures were on right side and two were on the left side. The site of stricture was in the proximal and the middle ureter in 3 and 2 patients, respectively. We defined the proximal ureter as extending from the renal pelvis to the cephalad end of the sacroiliac (S-Z) junction, and the middle ureter as extending from there to the pelvic prim. The causes of stricture were postinflammatory (2 cases) and iatrogenic after ureteroscopic procedures for impacted stones (3 cases) (Table 1).

All patients had normal serum creatinine. Diagnosis of stricture was based on intravenous urography, where there was a various degree of ipsilateral hydronephrosis, stoppage, and/or passage of thin trace of the contrast through the stricture (Fig. 1A). Retrograde pyelography was done at the time of surgery to define the lower limit of the stricture.

For all cases, there were previous failed trials of minimally invasive management using endoscopic cutting incision (3 cases) or laser incision (2 cases).

All procedures were done with patient consent and full ethics committee support.

Surgical Technique

Under general anesthesia with nasal intubation, the patient was placed in the lateral lumbar position. Two team approaches operated synchronously at the oral and urological sites.

Extraperitoneal incision was used to expose and dissect the concerned ureter. The diseased ureteral segment was longitudinally incised and was meticulously excised, leaving behind the vascularized ureteral adventitia to support the tabularized buccal graft. A 7-Fr. double-J-ureteral stent was then inserted through both ureteral ends (Fig. 2A).

After placing a self-retaining retractor in the oral cavity, the appropriate-sized graft was marked on the mucosa of the cheek. The buccal mucosa graft was harvested from the inner cheek with care taken to avoid Stensen's duct. The quality of the graft needed was determined either by preoperative radiological findings or by measuring the ureteral defect intraoperatively. To minimize bleeding and to facilitate graft dissection, diluted epinephrine (1:200 000 in 0.5% lidocaine) was injected sub-

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Table 1. Patient demographic data, causes of ureteral stricture, operative and postoperative data

Patient No.	Patient Age (years)	Sex (M/F)	Stricture Length (cm)	Etiology	Stricture Location/Laterality	Operative Time (min)	Hospital Stay (days)	Complications	Follow-up (month)
1	53	M	5	Iatrogenic	Proximal/R	115	6	Fever (39 °C)	26
2	47	M	4.5	Postinflammatory	Middle/R	85	9	—	21
3	67	F	4	Iatrogenic	Proximal/L	130	11	Ileus for 2 days	18
4	34	M	5	Postinflammatory	Proximal/R	95	6	—	16
5	55	M	3.5	Postinflammatory	Middle/L	105	7	—	14

M = male; F = female; R = right side; L = left side.

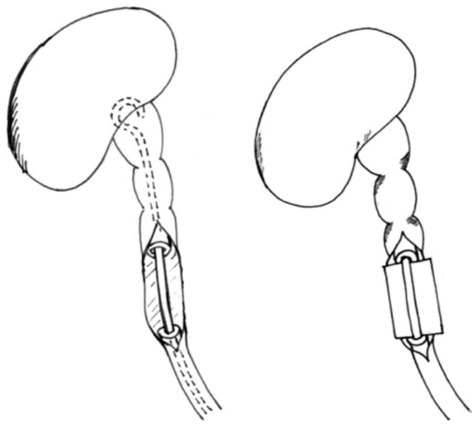
A B

Figure 1. (A) preoperative intravenous urography of patient 4 shows right upper long ureteral stricture with ipsilateral hydronephrosis with passage of thin trace of the contrast through the stricture. **(B)** Postoperative intravenous urography of the same patient shows the unobstructed state of the operated ureter (normal width and free passage of the contrast through the reconstructed segment).

mucosally. The harvested graft was then cautiously prepared by removing any attached muscle or adipose tissue remnants from the underside of the graft. The graft was stored in saline solution until it was used for reconstruction.

The graft was laid down and fixed in the ureteral adventitial bed by submucosal stitches (Fig. 2B). The graft was then tabularized over the double-J stent with running sutures. The buccal mucosal tube was then anastomosed to both ureteral ends using interrupted sutures (Fig. 3A,B). Five-to-zero polyglactin was the suture material used for the previous operative steps. The ureteral sheath was then carefully approximated with no tightness over the graft (Fig. 3C) and wrapped with a tongue of omentum using 4-0 polyglactin sutures. The wound was drained with a 20-Fr. latex tube. Finally, a Foley catheter was inserted into the urinary bladder. The double-J stent was removed if there was to be no extravasation with intravenous urography done 6 weeks later.

Intravenous cefotaxime was given for all patients for 3 days started 1 hour preoperatively. Then, they received an oral course of 500 mg ciprofloxacin for 5 days. Chlorhexidine oral wash was also prescribed postoperatively to limit bacterial colonization.



A B

Figure 2. (A) The diseased ureteral segment was longitudinally incised and meticulously excised, leaving behind the vascularized ureteral adventitia and a double-J-ureteral stent inserted through both ureteral ends. **(B)** The graft was laid down and fixed in the ureteral adventitial bed by submucosal stitches.

RESULTS

A total of 5 buccal mucosal tube ureteral stricture substitutions were performed successfully in 5 patients. The intraoperative course was uneventful without any major complications. Mean operative time was 106 minutes (range, 85-130). Early postoperatively one patient complained of fever (39 °C) for 24 hours and responded well to paternal antibiotics and antipyretics. Another patient had ileus for 2 days and was managed conservatively. The urethral Foley catheter and tubal drain were removed on the third and fifth postoperative day, respectively. Hospital stay ranged from 6 to 11 days (mean, 7.6). Patients were followed for 14 to 39 months (mean, 24) (Table 1). Urinanalysis and culture were done 2 weeks postoperatively and every month thereafter where no urinary tract infection was detected. Abdominal ultrasound was done every month and intravenous urography was performed at 3, 9, and 12 months after double-J stent removal. Radiologic findings showed reasonable improvement. In all patients, intravenous urography showed the unobstructed state of the operated ureter (normal width and free passage of the contrast through the reconstructed segment) (Fig. 1B). Pelvicalyceal dilatation improved in 4 cases. Residual dilatation of the pelvicalyceal system remained

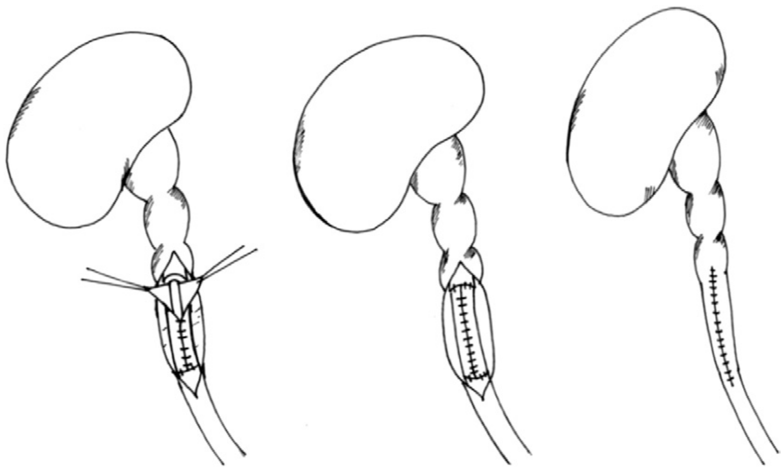


Figure 3. (A, B) The graft was tabularized over the double-J stent with running sutures, and the buccal mucosal tube was anastomosed to both ureteral ends using interrupted sutures. **(C)** The ureteral sheath was then carefully approximated with no tightness over the graft.

markedly in one case (patient 3), with no obstruction as confirmed with renal isotope scan done at the fourth postoperative month.

COMMENT

Ureteral defects may result from chronic inflammatory conditions such as tuberculosis or bilharziasis, traumatic damage to the ureter, and extensive retroperitoneal fibrosis, and from the conservative excision of a primary low-grade ureteral tumor.[1]

Different techniques were suggested to overcome this problem, including combining a Boari flap and psoas bladder hitch, downward mobilization of the involved kidney, complete or partial ileal replacement of the ureter, renal autotransplantation, urinary diversion by cutaneous or intubated techniques, and even nephrectomy.[2]

Although end-to-end anastomosis is always a feasible solution for short ureteral strictures of the upper and middle ureter, tissue replacement is often necessary for longer segments. Urologists have been challenged by the optimal tissues needed for the management of long ureteral strictures. Ileal replacement of the ureter is the most common treatment option applied clinically to bridge these defects.[2] Nevertheless, this option rather than its complexity as a procedure is not free of complications, and long-term evaluation revealed an unfavorable outcome with high morbidity rates.[3,4]

Different nondegradable synthetic grafts (Vitallium, tantalum silicone, and expanded polytetrafluroethylene).[5-8] Nevertheless, all of these substances ended in failure because of bio-incompatibility, a lack of peristaltic activity, and salt deposition in the replaced ureter.[1]

Biodegradable collagen sponge tube was also tried experimentally to bridge the ureteral defect, but failed.[9] Small intestine submucosa (SIS)[10-13] and acellular matrix (AMX)[1,12,14] were also tried for the management of ureteral defects. However, the results were not encouraging and did not support the use of AMX for clinical ureteral replacement because it was concluded that the replacement of a long segment of ureter with a biodegradable tube results in fibrosis unless a part of the circumference of the healthy intact wall is left behind, which is rarely observed in clinical practice.

Human dura mater and amniotic membrane allografts were also used by some authors for ureteral substitutions,[15,16] with good results. They used the allografts as patches to cover the ureteral wall defect without ureteral transection. Unfortunately, the dura mater allografts carry the threat of prion-related disease transmission. Moreover, the amniotic membrane allografts are fragile and easily damaged and have to be carefully treated during the procedure.

Buccal mucosa graft has been used for clinical urethral surgery with good results. Although Humby reported the first use of oral mucosa for urethroplastic repair,[17] it was not until a report by Burger et al,[18] closely followed by a report from Dessanti et al,[19] that use of the oral mucosa in reconstructive urology came into widespread use. It has been widely suggested that oral mucosa is now the preeminent donor for the reconstruction of urethral defects.[20] Its versatility is confirmed by the vast use of the tissue for the reconstruction of a variety of urethral defects such as hypospadias,[21] epispadias,[22] and stricture,[23] among others.

Buccal mucosa graft has gained popularity for its unique histologic features,[24] particularly its thick nonkeratinized epithelial layer and thin, highly vascularized lamina propria, which facilitates graft imbibition, inosculation, and angiogenesis. Furthermore, histologic and immunohistochemical studies have shown pronounced similarities between normal urethral and oral mucosa with regard to comparative cytokeratin expression and immunoglobulin concentration.[25] Moreover, buccal mucosa is rich with elastin, which explains its relative stiffness and easy harvesting and suturing.[26] Finally, although it hosts a number of micro-organisms, inflammatory infiltrate is rarely detected under histologic examination in healthy individuals.[27]

However, there is a paucity of published research work about ureteral stricture reconstruction using oral mucosa grafts, where only two clinical papers were found in the literature.[28,29] In both papers, the authors used buccal mucosa as a patch graft to cover the ureteral wall defect without ureteral transaction. The graft take was good in all patients and the results were good.[28,29] The use of tabularized buccal mucosa graft to interpose massive ureteral segment defects was first reported experimentally by Somerville et al in 1984 and the results showed a maintained perfect viability of the graft, and there was no evidence of graft shrinkage or loss of patency in all cases.[30] Tabularized buccal mucosa graft was only applied for one human case to replace 4-cm-segment ureteric loss by Naude et al in 1999, with good results.[28]

Herein, we present our initial experience with tabularized buccal mucosa graft for reconstruction of extensive ureteral stricture. Our initial results are encouraging, with complete replacement after total excision of the strictured part. Besides providing a long replacement segment (range 3.5-5.0 cm in our study), it can theoretically be used in patients with renal impairment without increasing morbidity and without the metabolic problems encountered with ileal loop replacement.

Two team approaches were used synchronously at the oral and urologic sites to diminish the general anesthesia time. This combined approach also reduces the time of the lumber position, which in turn reduces its complications (neuropraxia, compartment syndrome, etc). Moreover the team approach decreases the urologic surgeons' fatigue and allows them to concentrate on ureteral reconstruction.

Although we present a small sample series, the results are encouraging, with 24 months mean follow-up, where operated kidneys showed no obstruction. However, a bigger series and longer follow-up is recommended to evaluate our procedure.

References

1. Osman Y, Gabr M, El-Tabey N, Mohsen T, El-Baz M. Canine ureteral replacement with Long acellular matrix tube: is it clinically applicable? *J Urol.* 2004;172:1151-1154.
2. Schoeneich G, Winter P, Albers P, Frohlich G, Muller S. Management of complete ureteral replacement. Experiences and review of the literature. *Scand J Urol Nephrol.* 1997;31(4):383-388.
3. Bazeed MA, El-Rakhawy M, Ashamallah A, El-Kappany H, El-Hammady S. Ileal replacement of the bilharzial ureter: is it worthwhile? *J Urol.* 1983;130(2):245-248.
4. Chung BI, Hamawy KJ, Zinman LN, Libertino JA. The use of bowel for ureteral replacement for complex ureteral reconstruction: long-term results. *J Urol.* 2006;175(1):179-183.
5. Baltaci S, Ozer G, Ozer E, Soygur T, Besalti O, Anafarta K. Failure of ureteral replacement with gore-Tex tube grafts. *Urology.* 1998; 51(3):400-403.
6. Lord JW Jr., Eckel JH. The use of Vitallium tubes in the urinary tract of the dog. *J Urol.* 1942;48:412.
7. Lubash S. Experiences with tantalum tubes in the reimplantation of the ureters into the sigmoid in dogs and humans. *J Urol.* 1974;57: 1010.
8. Homann W, Schreiber B, Mlynek ML, Kropfl D, Fenkl HF. Long-term results of prosthetic ureteral replacement in minipigs. *Urol Int.* 1984;39(2):95-99.
9. Tachibana M, Nagamatsu GR, Addonizio JC. Ureteral replacement using collagen sponge tube grafts. *J Urol.* 1985;133(5):866-869.
10. Smith TG 3rd, Gettman M, Lindberg G, Napper C, Pearle M, Cadeddu JA. Ureteral replacement using porcine small intestine submucosa in a porcine model. *Urology.* 2002;60(5):931-934.
11. Liatsikos EN, Dinlenc CZ, Kapoor R, Bernardo NO, Pikhasov D, Anderson A, et al. Ureteral reconstruction: small intestine submucosa for the management of strictures and defects of the upper third of the ureter. *J Urol.* 2001;165(5):1719-1723.
12. Shalhav AL, Elbahnasy AM, Bercowsky E, Kovacs G, Brewer A, Maxwell KL, et al. Laparoscopic replacement of urinary tract segments using biodegradable materials in a large-animal model. *J Endourol.* 1999;13(4):241-244.
13. Sofer M, Rowe E, Forder DM, Denstedt JD. Ureteral segmental replacement using multiplayer porcine small intestinal submucosa. *J Endourol.* 2002;16(1):27-31.
14. Dahms SE, Piechota HJ, Nunes L, Dahiya R, Lue TF, Tanagho EA. Free ureteral replacement in rats: regeneration of ureteral wall components in the acellular matrix graft. *Urology.* 1997;50(5):818-825.
15. Koziak A, Kania P, Marcheluk A, Dmowski T, Szcześniewski R, Dorobek A. Reconstructive surgery of the extensive ureter strictures using human dura mater allografts. *Ann Transplant.* 2004;9(4): 12-16.
16. Koziak A, Salagiersk M, Marcheluk A, Szczesniewski R, Sosnowski M. Early experience in reconstruction of long ureteral strictures with allogenic amniotic membrane. *Int J Urol.* 2007;14:607-610.
17. Humby G. A one-stage operation for hypospadias. *Br J Surg.* 1941; 29:84-92.
18. Bürger RA, Müller SC, El-Damanhoury H, Tschakaloff A, Riedmiller H, Hohenfellner R. The buccal mucosal graft for uretheral reconstruction: a preliminary report. *J Urol.* 1992;147(3):662-664.
19. Dessanti A, Rigamonti W, Merulla V, Falchetti D, Caccia G. Autologous buccal mucosa graft for hypospadias repair: an initial report. *J Urol.* 1992;147(4):1081-1083. [Discussion:1083-1084].
20. Bhargava S, Chapple CR. Buccal mucosal urethroplasty: is it the new gold standard? *BJU Int.* 2004;93(9):1191-1193.
21. Fichtner J, Filipas D, Fisch M, Hohenfellner R, Thüroff JW. Long-term followup of buccal mucosa onlay graft for hypospadis repair: analysis of complications. *J Urol.* 2004;172(5 Pt. 1):1970-1972. [Discussion:1972].
22. Dessanti A, Iannuccelli M, Ginesu G, Feo C. Reconstruction of hypospadias and epispadias with buccal mucosa free graft as primary surgery: more than 10 years of experience. *J Urol.* 2003;170(4 Pt. 2):1600-1602.
23. Kellner DS, Fracchia JA, Armenakas NA. Ventral onlay buccal mucosal grafts for anterior urtheral strictures: long-term followup. *J Urol.* 2004;171(2 Pt. 1):726-729.
24. El-Sherbiny MT, Abol-Enein H, Dawaba MS, Ghoneim MA. Treatment of urethral defects: skin, buccal or bladder mucosa, tube or patch? An experimental study in dogs. *J Urol.* 2002;167(5):2225-2228.
25. Filipas D, Fisch M, Fichtner J, Fitzpatrick J, Berg K, Störkel S, et al. The histology and immunohistochemistry of free buccal mucosa

and full-skin grafts after exposure to urine. *BJU Int.* 1999;84 (1):108-111.
26. Ahmed S, Gough DC. Buccal mucosal graft for secondary hypospadias repair and urethral replacement. *Br J Urol.* 1997;80(2):328-330.
27. Rudney JD, Chen R. The vital status of human buccal epithelial cells and the bacteria associated with them. *Arch Oral Biol.* 2006; 51(4):291-298.
28. Naude JH. Buccal mucosal grafts in the treatment of ureteric lesion. *BJU Int.* 1999;83:751-754.
29. Kroepfl D, Loewen H, Klevecka V, Musch M. Treatment of long ureteric strictures with buccal mucosal grafts. *BJU Int.* 2009. [Epub ahead of print].
30. Somerville JJ, Naude JH. Segmental ureteric replacement: an animal study using a free non-pedicled graft. *Urol Res.* 1984;12(2):115-119.

EDITORIAL COMMENT

Patients with complex ureteral strictures and a salvageable renal unit present the urologist with a challenging problem. When stricture length and location prohibit direct ureteroneocystostomy (with or without bladder mobilization or flap creation) or ureteroureterostomy, another layer of complexity is added to this already difficult issue. The traditional options left for reconstruction, namely bowel interposition, transureteroureterostomy, and autotransplantation, come with their own set of immediate technical complexities and intermediate and long-term complications that leave the surgeon wanting for a more straightforward approach.

In this small case series, the authors present an intriguing set of patients with long, proximal ureteral strictures treated by excision of the diseased segment and subsequent interposition of a tubularized buccal mucosal graft. Although buccal mucosa is currently the most commonly used graft source for urethroplasty[1] when one is needed, there is a paucity of literature on its use in ureteral reconstruction. In keeping with the basic tenets of ureteral surgery, in this series the adventitia of the diseased ureteral segment was preserved with the hope of maintaining a suitable blood supply to promote inosculation and imbibition, the two processes responsible for successful graft take. Although this step theoretically aids in graft take and decreases the likelihood of graft failure (ie, stricture formation), one wonders how much vascularity is actually left. In addition, urologists performing urethral reconstruction are quite familiar with the higher rate of stricture formation with tubed grafts than with onlay grafts or flaps, mainly attributed to the fact that tubed grafts are generally not surrounded circumferentially with vascularized tissue.[2,3] Given this observation, the authors' technique of preserving the ureteral adventitia seems prudent, but again, it leaves one wondering whether this graft bed is sufficient enough to allow the graft to thrive.

Also left unanswered is how to follow these specific patients post reconstruction. Although the authors did not report the preoperative function for each involved renal unit, it was presumably enough to warrant reconstruction, and postreconstructive surveillance is critical to ensure improvement in or preservation of renal function in that kidney. It would be a shame to ultimately lose the kidney after such a laudable effort. Are serial serum creatinine levels sufficient to ensure preservation of unilateral renal function? Where do excretory urography and renal scintigraphy fit in, if at all? We cannot infer from this small series the optimal surveillance schedule either, because there are no data on the natural history of these tubularized grafts. As with any pioneering therapy, however, the expectation is that these questions will ultimately be answered with time.

Although this approach to ureteral reconstruction is not entirely unique (references 28-30 in the article), the authors are to be commended for their management of a complex problem in a difficult subset of patients. We look forward to further reports on their continued experience and long-term durability with this approach. Our guess is that if the results continue to be as robust in the long run, this technique may become another reliable treatment option for this complex problem.

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References

1. Dubey D, Kumar A, Mandhani A, et al. Buccal mucosal urethroplasty: a versatile technique for all urethral segments. *BJU Int.* 2005;95:625-629.
2. El-Sherbiny MT, Abol-Enein H, Dawaba MS, et al. Treatment of urethral defects: skin, buccal or bladder mucosa, tube or patch? An experimental study in dogs. *J Urol.* 2002;167:2225-2228.
3. Pansadroro V, Emiliozzi P. Which urethroplasty for which results? *Curr Opin Urol.* 2002;12:223-227.

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REPLY

It is not expected in all cases that the ureteral adventitia still contains much vascularity. We were fortunate to find a supple adventitia in some but not all cases. We have cases not included in this study (done after submitting this work) in which the adventitia was totally fibrosed and tough. In these cases, we excised the whole ureteral segment, including the adventitia, and we wrapped the buccal mucosa tube with a pedicled piece of omentum hoping that it would maintain a suitable blood supply to promote inosculation and imbibition. The results of these cases are promising and the work is now prepared for publication.

We agree that it is critical to evaluate the renal unit under reconstruction pre- and post surgical intervention to ensure improvement in or preservation of renal function in that kidney. We agree also that serial serum creatinine levels are not sufficient to ensure preservation of unilateral renal function. It is a good question: "Where do excretory urography and renal scintigraphy fit in—if at all?" In our study we did preoperative intravenous urography where all obstructed renal units included in this series were excreting. This means that these kidneys were functioning and had a reasonable renal function. Postoperatively, intravenous urography was performed at 3, 9, and 12 months after double-J stent removal. Intravenous urography showed reasonable improvement in renal function in the form of normal width and free passage of the contrast through the reconstructed segment and improvement in the dilatation of the pelvicalyceal system. About renal scintigraphy, of course it gives accurate estimation of renal function, but unfortunately is not used as a routine investigation in our locality because of its unavailability and its relative expensive cost.

Our technique was not our invention but it was preceded with experimental[1] and clinical observations.[2,3] We expect that buccal mucosa would be a good option for massive ureteral