Technical aspects and outcome review of continent catheterizable channels in the adult neurourologic population

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Abstract

Multiple techniques for the creation of continent catheterizable channels have been reported. Several continence mechanisms have been used, including tunneled flap valves, nipple valves, and hydraulic valves. Moreover, several organs have been used, including the appendix, bowel, ureters, and bladders. In this review, we describe various techniques and their outcomes in the adult neuro-urological population. Compared to nipple valves, tunneled flap valves using the appendix and other organs are the most commonly performed procedures but have a higher number of reported complications when compared to nipple valves. Hydraulic valves have been largely abandoned due to disappointing long-term results.

Keywords: Clean intermittent catheterization, neuro-urology, urinary tract reconstruction

INTRODUCTION

Continent catheterizable channels provide alternative routes to access native or augmented bladders by clean intermittent catheterization. The major indications for this procedure are the inability to access the native urethra by catheterization either due to a diseased urethra or due to the patient’s physical disability to reach his native urethra because of obesity or spinal cord diseases.[1-5] Several techniques have been described in the literature by using different organs, including the bowel, urinary tract, skin, and genital tract.[6,7] Several continence mechanisms for these catheterizable channels have been used.[8,7] In this article, we will review the adult literature on continent catheterizable channels, their outcomes, and their long-term complications.

Appendicovesicostomy (Mitrofanoff procedure)

The use of the appendix as a continent catheterizable channel was first described by Mitrofanoff in 1980 for pediatric patients with neurogenic bladder.[8] Shortly, thereafter, this procedure became popular, and it has since been expanded to various indications and adult populations.[9] It is an attractive approach, as the appendix is a readily available tubular organ that can be used without significant sequelae affecting the gastrointestinal tract. The continence mechanism of this procedure is the tunneled flap valve.

The basic technique of this procedure is to isolate the appendix [Figure 1a]. If needed, a cecal cuff can be included...
with the appendix to gain extra length [Figure 1b].\textsuperscript{10} After mobilization of the appendix, the distal end is then transected, spatulated and implanted through a 2–4 cm submucosal tunnel into the native bladder in a fashion similar to ureteral reimplantation [Figure 1c]. The proximal end is then delivered to the skin in a straight line, usually to the umbilicus or to a location accessible to the patient. There should be no tension on the appendix. Then, the stoma is made in the U, V or VQZ flap of the skin using interrupted sutures.\textsuperscript{5,11} A size 14F catheter is usually used to stent the appendix.\textsuperscript{11,12}

Reconfigured ileal channel (Yang-Monti procedure) Yang\textsuperscript{13} and Monti et al.\textsuperscript{14} described this technique. Although it was first described in the pediatric urology literature, it has been reported to be used for adults when the appendix is stenotic, is absent due to a previous appendectomy, has been previously used for Malone antegrade continence enema, or is short.\textsuperscript{13} The basic principle of this procedure is to isolate a 2-cm ileal segment, detubularize it on its antimesenteric border, and then retubularize it in the transverse direction [Figure 2a-c], creating a longer but narrower segment that is then implanted in the bladder in a tunneled fashion and to the skin, similar to Mitrofanoff appendicovesicostomy. Single Monti usually results in a 6 cm channel.\textsuperscript{16} In the case of a short channel, the use of a second segment (double Monti) [Figure 3a] or spiral or Z-shaped reconfigured ileum (Casale procedure) has been described. The use of a 3.5 cm ileal segment and retubularization in a Z-shaped fashion will result in a channel length of 10–14 cm [Figure 3b].\textsuperscript{14} In addition, the use of a short appendix and anastomosis to reconfigure the ileum using combined Yang-Monti and Mitrofanoff techniques has been described in a case report.\textsuperscript{17}

The outcomes, complications, and long-term follow-up of the tunneled flap valve (Yang-Monti and Mitrofanoff) In contrast to the pediatric urology literature, the adult urology literature has limited case series with small patient numbers that report long-term outcomes of performing tunneled continent catheterizable channels, and most of these studies grouped the patients who underwent Mitrofanoff, Monti, double Monti, Casale and/or tapered ileum procedures into one category and reported the overall outcomes for all of them.\textsuperscript{1,18-23} The reported follow-up was up to 190 months. The reported stomal continence rate in adult series ranges between 100% and 66%, and the reported total continence rate is between 96% and 66%. The definition of incontinence was not clear in the studies; some studies reported only incontinence that needed intervention, while others reported all incontinence rates. The overall revision rate for complications varied from 20% to 67%. The risk of stenosis also varies between case series from 6.8% to 54%. The stenosis level was reported to be at the skin or more proximally at the fascia level or bladder level.

Comparisons among Mitrofanoff, Monti, Spiral Monti, and double Monti are limited in the adult literature. In the pediatric urology literature, the risk of complications is higher with the spiral, double Monti and single Monti
procedures than with the Mitrofanoff procedure.\[^5\]

The revision rate, when compared to the Mitrofanoff procedure, is two times higher for the Monti procedure and four times higher for the spiral Monti procedure.\[^24\]

Furthermore, the subfascial revision is higher with the use of spiral Monti with a stoma at the umbilicus level.\[^24,25\]

Double Monti has been associated with diverticular pouch formation, reported in a case series to have an incidence of up to 28%.\[^5,22\]

In a recent, large adult series (176 patients) with a median follow-up of 78.6 months, the reported overall continence rate at last follow-up was 90.2%, with a higher rate of continence in the appendicular channel than in the ileal channel (95.2% vs. 84.0%, \(P = 0.045\)). Furthermore, the researchers reported a 100% rate of continence in ureter channels and only a 12.5% continence rate in tapered ileum cases. Fifty-five percent of their patients reported difficult catheterization, which was higher in appendicular and reconfigured ileal groups (57.5% and 53.3%, respectively) and lower in tapered ileum and ureter channels (37.5% and 25%, respectively). Forty-one percent of patients required skin level revision, which was not different between the appendicular and ileal groups (43.7% vs. 37.3%, \(P = 0.41\)), but complete revision for either channel stenosis or incontinence was higher in the ileal group than in the appendicular group (overall revision 50.7% vs. 29.9%, \(P = 0.003\), channel stenosis 22.7% vs. 17.2%, \(P = 0.39\), and incontinence 36.0% vs. 19.5%, \(P = 0.03\)).\[^23\]

Other described procedures using a tunneled flap valve

Other segments have been used as continent catheterizable channels. These include the ureter, bladder, tapered ileum, stomach, fallopian tube, vas deferens, and skin. A tunneled flap valve was used as a continence mechanism for those procedures.

The use of the ureter has been described since Mitrofanoff’s first description of his procedure in 1980.\[^8\]

The ureter is preferred over the appendix when available (i.e., dilated ureter in a nonfunctioning kidney). The proximal ureter is anastomosed to the contralateral ureter by transureteroureterostomy, or ipsilateral nephrectomy is performed for nonfunctioning kidneys. Then, the distal segment will be reimplanted in a nonrefluxing fashion with careful dissection to preserve the blood supply, and the proximal segment will be implanted into the skin using the V flap or VZQ technique.\[^26\]

This procedure has been described mainly in the pediatric literature, with no reported case series for adults. The need for transureteroureterostomy and the fraught risk of incontinence and stenosis, which is slightly higher than that with the appendicular Mitrofanoff
channel, have made this procedure less appealing and seldom used.\[26-28\] In a further report by Woodhouse,\[29\] he stated that the use of a normal nondilated ureter with transureteroureterostomy has not stood the test of time, as the normal ureter has narrowed progressively, and the wall has thinned, leading to the need to form a new conduit in the majority of their patients with a normal caliber ureter, which was not the case in patients with dilated ureters.

The use of the bladder flap as a tunneled channel has been described by Rink et al.\[30\] in pediatric patients with good bladder capacity. A full-thickness bladder flap was isolated for the extravesical portion of the channel [Figure 4a and b]. Then, the incision was extended to the intravesical part through the mucosa only [Figure 4d]. Next, closure of the mucosa over a catheter [Figure 4d] followed by closure of the lateral mucosal flap was performed to create the continence mechanism [Figure 4e and f].\[30,31\] The reported complication was stenosis, which was reported by Rink et al.\[30\] to have an incidence of 45%. This incidence was higher in patients with neurogenic bladder (60%) and with umbilical sites (86% vs. 36% for lower abdominal sites).\[31\] This procedure has been performed on pediatric patients but has not been reported in adults. The major drawback of this approach is that the use of a bladder flap requires a large bladder capacity, which is not the case in the majority of patients needing this procedure.

Another reported approach is the use of the fallopian tube as a catheterizable channel. Although few cases have been reported among a few case series, the use of fallopian tubes has not been popular due to the risk to future fertility. Such use has only been reported in the pediatric literature. The fallopian tube blood supply passes through the ovarian artery, and the distal end is spatulated and attached to the skin, while the proximal end is tunneled into the bladder.\[9,31\]

Dykes et al.\[32\] reported, among their series of pediatric patients who underwent the Mitrofanoff procedure, one case where a preoperative cystogram showed vesical reflux and the vas was found severely dilated intraoperatively, along with a nonusable appendix. They reported the use of the vas deferens as the reimplantation of the proximal right vas into the bladder, and the distal vas was transected at the internal inguinal ring and attached to the abdominal wall skin as a stoma.\[32\]

The use of a tubularized stomach stoma has also been reported by Bihrl et al.\[33\] A 12–15 cm segment in the greater curvature is selected and grasped with Babcock clamps, and the distal end is maintained at least 3–4 cm proximal to the pylorus. Next, the short gastric vessels proximal to the segment are divided. The segment will be based on the right gastroepiploic vessels. The left gastroepiploic vessels are divided at the proximal end of the segment, followed by division of the omentum at the same level. Then, a small gastrotomy is made on both ends of the segment, a 12 F catheter is passed, and a bowel clamp is applied just superior to the catheter. Next, the segment is divided just beneath the clamp to isolate it from the stomach [Figure 5a]. Then, the stomach is closed with 3-0 silk sutures [Figure 5b] in 2 layers or divided by a GIA stapler [Figure 5c and d], and the stomach is closed with 3-0 silk sutures. The resulting gastric segment is retubularized over a 12 F catheter with 3-0 polygalactic sutures in two layers or 1 layer if a stapler...
is used. The distal end is implanted into the reservoir in a 4 cm submucosal tunnel. The proximal end is attached to the abdominal skin in any desired area, as the gastric tube and its vascular pedicle are highly mobile and can be attached to any area in the anterior abdominal wall. It can be done by simple attachment of the gastric mucosa into the skin in four quadrants\(^\text{[33]}\) or by using a V-Y shaped skin flap\(^\text{[34]}\) [Figure 6].\(^\text{[34]}\) Long-term follow-up (median 3.5 years) has been reported for a group of 10 adults and pediatric patients with a 30% risk of peristomal skin irritation and a 20% risk of exuberant growth of granulation tissue at the stoma requiring excision of the stoma at the skin level and reanastomosis to the skin. One patient in their series developed stomal protrusion and severe peristomal irritation with severe ulceration that led to erosion of skin vessels and significant hemorrhage, which was managed conservatively.\(^\text{[34]}\) These complications were attributed to gastric acid secretion. They also reported a 100% continence rate when using tunneled flaps using the Mitrofanoff principle.

The use of tapered ileum has also been described in the literature. The technique has also been used for both adults and pediatric patients. It involves isolation of 10–12 cm of the distal ileum, then tapering it over a 12 F catheter along its antimesenteric border using a GIA stapler device\(^\text{[35]}\) [Figure 7a]. The reservoir end is tapered and closed with absorbable sutures\(^\text{[35]}\) [Figure 7b] and then tunneled submucosally\(^\text{[35]}\) [Figure 7c] after careful dissection of the mesenteric fat at this end. Alternatively, the tapered ileum can be stapled to the bladder with a TA stapler using hydraulic pressure as a mechanism for continence\(^\text{[35]}\) [Figure 8]. Then, the stomal end is brought to the abdominal wall skin and anastomosed in a V-Y fashion.\(^\text{[35]}\) The short-term (mean 14.5 months) follow-up of this small series of 8 patients showed a 30% risk of catheterization difficulty, and one patient had stomal stenosis that needed reoperation. One patient had incontinence requiring reoperation.\(^\text{[35]}\) The adaptation of the tapered ileum has been limited due to the use of a long ileal segment that might accompany augmentation, which will cause more loss of the bowel segment, along with the introduction of the Yang-Monti procedure, which uses less ileal length.

The use of tubularized skin flaps has also been reported. The use of preputial skin has been reported in 3 cases by Krstić,\(^\text{[36]}\) with 7 months of follow-up without complications in pediatric patients. Perovic S reported the use of preputial and clitoral skin flaps that were used as catheterizable channels in 14 male patients and seven female patients (both children and adults) with a mean of 6 months of follow-up and minimal complications.\(^\text{[37]}\) One
patient had a kinked tube that was corrected endoscopically, and 1 had incontinence that was managed with collagen. This procedure has not been adopted widely, as it is technically demanding, and no reported long-term follow-up for this procedure has been reported.

Abdominal wall skin has also been used as a channel in adults and children.\(^{[38,39]}\) This has been reported in adults to have unacceptably high failure rates. The reported stenosis occurred in all patients within a mean time of 24 days.\(^{[39,40]}\)

Another reported organ used for the creation of a tunneled flap valve is Meckel’s diverticulum, which was reported in two case reports of pediatric patients: A child 6 years old and a teenaged girl.\(^{[41,42]}\) A follow-up of up to 14 months revealed no complications.\(^{[42]}\)

**Nipple valve continence mechanism**

This technique involves the use of intussusception of the ileum to create a nipple valve, similar to the ileocecal valve, to provide continence by circumferential coaptation. This was first described by Kock as an efferent limb in the Kock pouch.\(^{[43]}\) Later, it was modified to be used as an isolated outlet channel.\(^{[44]}\) The creation of an intussuscepted ileal nipple flap valve involves isolation of a 12–15 cm ileal segment 15 cm away from the ileocecal valve. Then, after the continuity of the bowel is restored, the mesentery is divided from the ileum over 5 cm in the middle of the resected segment at \(\approx 1\) cm from the ileum. The mucosa of the middle segment is grasped from the distal end, anastomosed to the bladder, and intussuscepted [Figure 9a]. Next, with the use of a TA stapler, the intussuscepted ileum is stapled at the antimesenteric side (6 o’clock) [Figure 9b], followed by the second line of stapling at 2 o’clock. An opening at the reservoir (bladder) is made [Figure 9c], followed by stapling the outer leaflet of the intussusception into the external bladder wall at the 10 o’clock position [Figure 9d]. Then, anastomosis of the intussuscepted segment into the reservoir with absorbable sutures is performed, followed by external fixation of the intussuscepted ileum to the reservoir wall with interrupted absorbable sutures. The stomal part is anastomosed to the umbilicus, with skin and ileal spatulation and 16 F and 10 F catheters for irrigation and drainage [Figure 9e]. The procedure is nicely illustrated by Thüroff et al.\(^{[44]}\) Deuker et al.\(^{[45]}\) reported the long-term follow-up of 47 pediatric and adolescents who underwent this procedure. The stenosis risk of this stoma was reported to be 20%, and 82% of the patients were continent over a median follow-up of 15.9 years. The rate of revision due to incontinence was 20%.\(^{[45]}\) When compared to the corresponding rates obtained with the submucosally embedded appendix in their series, the stenosis rate was 49%, and the incontinence rate was 1.8%.\(^{[44]}\) Skinner et al.\(^{[46]}\) reported their series of Kock pouches using ileal intussuscepted nipple valves for over 500 patients and found a continence rate of 86% and a stenosis rate of 2.6%.\(^{[46]}\) Wiesner et al.\(^{[47]}\) reported their large case series.
of over 200 adult patients who had ileal intussuscepted nipple valves. The rate of revision was 17%, and the risk of stenosis at 10 years was 18%. Thirty-four percent had stone formation that required endoscopic intervention. The stone-free rate at 10 years was 74.3%. Comparison with their patients receiving the submucosally embedded appendix revealed that the risk of stomal stenosis was higher with the appendix (32% compared to 18%), and the risk of stone formation was higher in the intussuscepted nipple valve than in the appendix (34% compared to 25%).

Application of the nipple valve is also employed in the use of the reinforced ileocecal valve. Kock initially described the use of ileocecal valves for continent cutaneous diversion in the ileocecal reservoir. Then, it was described as part of the Indiana pouch for the continent reservoir after cystectomy for bladder cancer. Later, it was described as part of bladder augmentation and called a hemi-Indiana pouch or continent catheterizable ileoceccystoplasty. The procedure is performed by harvesting 10 cm of the cecum and 10 cm of the terminal ileum. The detubularized cecum is then anastomosed to the bivalved bladder using absorbable sutures. The ileocecal valve is reinforced with interrupted imbricating slowly absorbable sutures or nonabsorbable sutures. The detubularized cecum is then anastomosed to the bivalved bladder using absorbable sutures. The stomal end is anastomosed to the skin in a similar fashion to a Mitrofanoff stoma. This procedure is reported to be performed along with an augmentation, not as an outlet procedure only. The continence rate with this procedure is reported in multiple case series in the range of 95%–
Hydraulic valve continence mechanism

Another continent mechanism that has been described in the literature is the hydraulic valve. Benchekroun reported the use of his technique to create hydraulic valves. A 14 cm ileum is first harvested with its intact mesentery. Then, it is folded inward on itself for the entire length. Next, it will be attached to the reservoir, leaving a distinct space between the inner and outer ileal walls that will be filled with urine and provide compression with filling. The initial follow-up showed a continence rate of 75% and a valve failure rate of 17.6% with a mean follow-up of 38 months. Sanda et al. conducted a 5-year follow-up of this procedure, which showed disappointing results, with 91% requiring revision. The rate of stomal stenosis was 73%, that of stone formation was 36%, and that of devagination was 36%. This procedure has been abandoned because it is surgically demanding with poor long-term results.

Comparison of outcomes between continent catheterizable channel techniques

When comparing tunneled channels to continent cutaneous cecocystoplasty with ileocecal valves, Redshaw et al. found a higher rate of secondary procedures with tunneled channels than with continent cutaneous cecocystoplasty (50% vs. 13%). Stomal leakage was similar between the two groups (29% for cecocystoplasty vs. 43% for tunneled channels, $P = 0.12$).

DISCUSSION

Which technique to use? It is clear that the best technique is the one that can be mastered while limiting the risks of reconstruction mistakes, preventing complications and facilitating their management when they occur. The choice of the best technique can also be dictated by published outcomes summarized in a systematic review of the use of continent catheterizable channels in adult neurourolological patients recently conducted by Phé et al. They found that the overall catheterization ability for all patients was above 84% in all types of stomas, with a continence rate of more than 75% and a follow-up range from 1.8 to 8.7 years (median follow-up 36 months). Channel stenosis ranged between 4% and 33%, and the overall rate was 15%. The lowest rate of stenosis was reported to occur with the Indiana pouch (reinforced ileocecal valve) and ranged between 4.2% and 11.8%. In addition, the researchers reported that the highest stenosis rate was found in the Mitrofanoff/Casale principle (tunneled valve), with a channel stenosis rate of 32.3%.

CONCLUSION

Various techniques have been described to create a continent catheterizable channel. Currently, the use of the appendix and other flap valve techniques are the most commonly performed procedures but have higher reported complications, such as stenosis and incontinence, than nipple valves. The surgeon should be familiar with these various techniques and their limitations. Future studies must focus on comparing different techniques in a multicenter prospective fashion, as most of the current literature is derived from small retrospective case series. In addition, we should modify the current techniques to lower the rate of complications and optimize outcomes.

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There are no conflicts of interest.

REFERENCES

1. Redshaw JD, Elliott SP, Rosenstein DI, Erickson BA, Presson AP, Conti SI, et al. Procedures needed to maintain functionality of adult continent catheterizable channels: A comparison of continent cutaneous ileal eecocystoplasty with tunneled catheterizable channels. J Urol 2014;192:821-6.

2. Lapides J, Diokno AC, Silber SM, Lowe BS. Clean, intermittent self-catheterization in the treatment of urinary tract disease. 1972. J Urol 2002;167:1584-6.

3. Bakke A, Ingens LM, Malt UF, Høisaeter PA. Clean intermittent catheterisation-performing abilities, aversive experiences and distress. Paraplegia. 1993 May;31(5):288-97.

4. Touma NJ, Honovitz D, Shetty A, Cauamartin Y, De Maria J, Luke PP. Outcomes and quality of life of adults undergoing continent catheterizable vesicostomy for neurogenic bladder. Urology 2007;70:454-8.

5. Levi ME, Elliott SP. Reconstructive techniques for creation of catheterizable channels: Tunneled and nipple valve channels. Trans Androl Urol 2016;6:136.

6. Macedo A Jr, Rondon A, Bancel H, Leslie B, Ortoni S, Liguori R, et al. An alternative channel for the Mitrofanoff principle based on transverse skin flaps: An extraperitoneal minimal invasive approach (the RPM technique). J Pediatr Urol 2012;8:437.

7. Aardelt PU, Woodhouse CR, Riedmiller H, Gerharz EW. The efferent segment in continent cutaneous urinary diversion: A comprehensive review of the literature. BJU Int 2011;109:288-97.

8. Mitrofanoff P. Cystostomie continent transappendiculaire dans le traitement des vessies neurologiques. Chir Pediatr 1980;21:297.

9. Woodhouse CR, Macenly AE. The Mitrofanoff principle: Expanding upon a versatile technique. Br J Urol 1994;74:447.

10. Cromie WJ, Barada JH, Weingarten JL. Cecal tubularization: Lengthening technique for creation of catheterizable conduit. Urology 1991;37:41.

11. Veeratterapillay R, Morton H, Thorpe AC, Hardin C. Reconstructing the lower urinary tract: The Mitrofanoff principle. Indian J Urol 2013;29:316-21.

12. Boilbot B, Corcos J, Mitrofanoff P. The trans-appendicual continous cystotomy technique (Mitrofanoff principle). In: Corcos J, Ginsberg DB, Karsenty G, editors. The Textbook of the Neurogenic Bladder. 3rd ed. Boca Raton, FL: CRC Press Taylor & Francis Group; 2015, p. 536.

13. Yang WH. Yang needle tunneling technique for the Mitrofanoff principle in achieving clean intermittent catheterisation and urinary continence in children. J Pediatr Surg 1991;26:535.

14. Monti PR, Lara RC, Dutra MA, de Carvalho JR. New techniques for construction of efferent conduits based on the Mitrofanoff principle. Urology 1997;49:112-5.

15. Wagner M, Bayne A, Daneshmand S. Application of the Yang-Monti channel in adult continent cutaneous urinary diversion. Urology 2008;72:828-31.

16. Gor RA, Elliott SP. Surgical management of neurogenic lower urinary tract dysfunction. Urol Clin North Am 2017;44:475-90.

17. Cassini ME, Rodrigues AA Jr, Tucci S Jr, Cologna AJ, Reis RB, Martins AC, et al. Using Mitrofanoff’s principle and Monti’s technique as a surgical option for bladder augmentation with a continent stoma: A case report. J Med Case Rep 2011;5:49.

18. Perrouin-Verbe MA, Chartier-Kastler E, Even A, Denys P, Rouprêt M, Phé V. Long-term complications of continent cutaneous urinary diversion in adult spinal cord injured patients. Neurourol Urodyn 2016;35:1046-50.

19. Van der Aa F, Joniau S, De Baets K, De Ridder D. Continent catheterizable vesicostomy in an adult population: Success at high costs. Neurourol Urodyn 2009;28:487-91.

20. Hadley D, Anderson K, Knopick CR, Shah K, Flynn BJ. Creation of a continent urinary channel in adults with neurogenic bladder: Long-term results with the Monti and Casale (Spiral Monti) procedures. Urology 2014;83:1176-80.

21. De Ganck J, Everaert K, Van Laecke E, Oosterlinck W, Hoebeke P. A high easy-to-treat complication rate is the price for a continent stoma. BJU Int 2002;90:240-3.

22. Sahadevan K, Pickard RS, Neal DE, Hasan TS. Is continent diversion using the Mitrofanoff principle a viable long-term option for adults requiring bladder replacement? BJU Int 2008;102:236-40.

23. O’Connor EM, Foley C, Taylor C, Malek S, Raja L, Wood DN, et al. Appendix ileum—which is the best material for mitrofanoff channel formation in adults? J Urol 2019;202:757-62.

24. Leslie JA, Cain MP, Kaefer M, Meldrum KK, Dussinger AM, Rink RC, et al. A comparison of the Monti and Casale (Spiral Monti) procedures. J Urol 2007;178:1623-7.

25. Whittam BM, Szymanski KM, Flack C, Misseri R, Kaefer M, Rink RC, et al. A comparison of the Monti and spiral Monti procedures: A long-term analysis. J Pediatr Urol 2015;11:6.e1-6.

26. Mor Y, Kahfahafzeh AM, German K, Mouriquand PD, Duffy PG, Ransley PG. The role of ureter in the creation of Mitrofanoff channels in children. J Urol 1997;157:635-7.

27. Van Savage JG, Khouy AE, McLeorie GA, Churchill BM. Outcome analysis of Mitrofanoff principle applications using appendix and ureter to umbilical and lower quadrant stomal sites. J Urol 1996;156:1794-7.

28. Farrugia MK, Malone PS. Educational article: The Mitrofanoff procedure. J Pediatr Urol 2010;6:330-7.

29. Woodhouse CR. The Mitrofanoff principle for continent urinary diversion. World J Urol 1996;14:199.

30. Cain MP, Rink RC, Yerkes EB, Kaefer M, Casale AJ. Long-term followup and outcome of continent catheterizable vesicostomy using the Rink modification. J Urol. 2002 Dec;168(6):2583-5.

31. Barroso U Jr, Duel B, Barthold JS, Gonzalez R. Orthotopic urethral substitution in female patients using the mitrofanoff principle. J Urol 1999;161:251-3.

32. Dykes EH, Duffy PG, Ransley PG. The use of the Mitrofanoff principle in achieving clean intermittent catheterisation and urinary continence in children. J Pediatr Surg 1991;26:535.

33. Bährle R, Klee LW, Adams MC, Steidle CP, Foster RS. Transverse colon-gastric tube composite reservoir. Urology 1991;37:36-40.

34. Close CE, Mitchell ME. Continent gastric tube: New techniques and long-term followup. J Urol 1997;157:51-5.

35. Figueroa TE, Sabogal L, Helal M, Lockhart JL. The tapered and reimplanted small bowel as a variation of the Mitrofanoff procedure: Preliminary results. J Urol 1994;152:73.

36. Krstić ZD. Preputial continent vesicostomy: Preliminary report of a new technique. J Urol 1995;154:1160-1.

37. Porovic S. Continent urinary diversion using preputial penile or clitoral skin flap. J Urol 1996;155:1402-6.

38. Macedo A Jr, Rosito T, Pires JA, Liguori R, Ortiz V. A new extra-abdominal channel alternative to the Mitrofanoff principle: Experimental and preliminary clinical experience. Int Braz J Urol 2009;35:205-15.

39. Eisenberg L, Johnson J, Santucci R. Pilot study of the vesicocutaneous continent catheterizable stoma (Mitrofanoff) in adults—High complication rates. Urology 2012;79:222.

40. Morey AF. Re: Pilot study of the vesicocutaneous continent catheterizable stoma (Mitrofanoff) in adults—High complication rates. J Urol 2012;188:179.

41. Boemers TM. Mitrofanoff procedure with Meckel's diverticulum. BJU Int 2001;88:799-800.

42. Prabhakaran K, Patankar JZ, Mali V. Meckel's diverticulum: An alternative conduit for the Mitrofanoff procedure. J Postgrad Med 2003;49:151-3.
43. Kock NG, Nilsson AE, Nilsson LO, Norlén LJ, Philipson BM. Urinary diversion via a continent ileal reservoir: Clinical results in 12 patients. J Urol 1982;128:469-75.

44. Thüroff JW, Gillitzer R, Franzaring I, Hampel C, Melchior S. Intussuscepted ileal flap valve for revisional surgery. BJU Int 2005;96:1425-37.

45. Deuker M, Roos FC, Großmann A, Faé P, Thüroff JW, Stein R. Long-term outcome after urinary diversion using the ileocecal segment in children and adolescents: Complications of the efferent segment. J Pediatr Urol 2016;12:7.e1-7.

46. Skinner DG, Lieskovsky G, Boyd S. Continent urinary diversion. J Urol 1989;141:1323-7.

47. Wiesner C, Stein R, Pahernik S, Hähn K, Melchior SW, Thüroff JW. Long-term followup of the intussuscepted ileal nipple and the in situ, submucosally embedded appendix as continence mechanisms of continent urinary diversion with the cutaneous ileocecal pouch (Mainz pouch I). J Urol 2006;176:155-9.

48. Rowland RG, Mitchell ME, Bihrle R, Kahnoski RJ, Piser JE. Indiana continent urinary reservoir. J Urol 1987;137:1136-9.

49. Sarosdy MF. Continent urinary diversion using cutaneous ileoceccystoplasty. Urology 1992;40:102-6.

50. Khavari R, Fletcher SG, Liu J, Boone TB. A modification to augmentation cystoplasty with catheterizable stoma for neurogenic patients: Technique and long-term results. Urology 2012;80:460-4.

51. Sutton MA, Hinson JL, Nickell KG, Boone TB. Continent ileocecal augmentation cystoplasty. Spinal Cord 1998;36:246-51.

52. King DH, Hlavinka TC, Sarosdy MF. Additional experience with continent urinary diversion using cutaneous ileoceccystoplasty. Urology 1996;47:471-5.

53. Husmann OA, Cain MP. Fecal and urinary continence after ileal cecal cystoplasty for the neurogenic bladder. J Urol 2001;165:922.

54. Bencheckroun A, Essakalli N, Faik M, Marzouk M, Hachimi M, Abakka T. Continent urostomy with hydraulic ileal valve in 136 patients: 13 years of experience. J Urol 1989;142:46-51.

55. Sanda MG, Jeffs RD, Gearhart JP. Evolution of outcomes with the ileal hydraulic valve continent diversion: Reevaluation of the Bencheckroun catheterizable stoma. World J Urol 1996;14:108-11.

56. Phé V, Boissier R, Blok BF, Del Popolo G, Musco S, Castro-Díaz D, et al. Continent catheterizable tubes/stomas in adult neuro-urological patients: A systematic review. Neurourol Urodyn 2017;36:1711-22.