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# 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)

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**Purpose:** We analyzed stoma related complications and continence rates in patients who underwent continent urinary diversion with the cutaneous ileocecal pouch (Mainz pouch I). We compared the intussuscepted ileal nipple and in situ, submucosally embedded appendix as continence mechanisms.

**Materials and Methods:** A total of 401 patients were included in a retrospective followup study. Continence mechanisms were the intussuscepted ileal nipple in 205 patients and the in situ, submucosally embedded appendix in 196.

**Results:** A total of 144 patients (36%) required intervention for a stomal complication. Of patients who received an intussuscepted ileal nipple 34 (17%) had stomal stenosis at a mean time to first stenosis of 43.8 months, 41 (20%) had stones at a mean interval to the first stone of 62.8 months, 12 underwent reoperation for stomal incontinence, including 1 because of nipple necrosis, and 82% were completely continent. Of patients who received an in situ, submucosally embedded appendix 63 (32%) had stomal stenosis at a mean time to first stenosis of 31.4 months, 20 (10%) had stones at a mean interval to the first stone of 47.5 months, 3 underwent reoperation for stomal incontinence, 4 had appendiceal necrosis and 92% were completely continent.

**Conclusions:** Of stomal complications 63% were treated endoscopically. The higher rate of stomal stenosis with the appendiceal stoma is most likely due to the smaller diameter of the appendix. The higher rate of stone formation in patients with the intussuscepted ileal nipple is related to metal staples. Continence rates of the 2 outlets are good with somewhat larger amounts of mucous secretion from the larger stoma of the intussuscepted ileal nipple.

*Key Words:* urinary diversion, complications, appendix, ileum

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Urinary diversion by the continent cutaneous ileocecal pouch (Mainz pouch I) was established in 1983 using 10 to 15 cm of cecum and ascending colon, and 2 terminal ileal segments of equal length.<sup>1</sup> Currently the first choice of continent urinary diversion in patients is an orthotopic pouch. However, continent cutaneous diversion is still a valid option when an orthotopic pouch is not indicated because of oncological reasons (eg tumor in the urethra), anatomical reasons (eg bladder extrophy) or functional reasons (eg neurogenic sphincteric incontinence). Continent cutaneous urinary diversion with an umbilical stoma offers continence and an unchanged body image.<sup>2</sup> The variety of surgical techniques used to create a continent cutaneous outlet and the number of surgical modifications illustrate that 1 solution does not exist for all cases.<sup>3-8</sup> Stoma related problems are the most prevalent complications of continent cutaneous urinary diversion and do mostly require surgical reintervention.<sup>9-11</sup> We studied stoma related complications

of the intussuscepted ileal nipple and the in situ, submucosally embedded appendix as continence mechanisms of continent cutaneous Mainz pouch urinary diversion.

## MATERIALS AND METHODS

Stoma related complications and continence rates were evaluated in 401 patients, including 250 males and 151 females with a mean age of 45.6 years (range 2.5 to 79.4), of a total of 566 who underwent continent cutaneous ileocecal pouch urinary diversion between 1985 and 2002 at our institution. Of the patients 165 were excluded from analysis, 70 underwent continent cutaneous ileocecal pouch urinary diversion using another type of outlet than the intussuscepted ileal nipple or in situ, submucosally embedded appendix, 82 had a followup of less than 12 months and 13 had undergone conversion from incontinent conduit diversion to continent cutaneous diversion. The continent cutaneous outlet was established with an intussuscepted ileal nipple in 205 patients and with an in situ, submucosally embedded appendix in 196 who were included in the analysis. Table 1 lists patient characteristics. Mean followup was 95.0 months (median 95.8, range 12.8 to 206.3). Indications for urinary diversion were radical surgery for malignant diseases in 253 patients (63%), functional or morphological bladder and/or

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TABLE 1. Demographics in patients with continent cutaneous Mainz pouch urinary diversion

	Ileal Nipple	Appendiceal Stoma
No. pts (%)	205 (51.1)	196 (48.9)
Median age (range)	51.8 (2.5–75.0)	54.2 (2.5–79.4)
No. sex (%):		
M	120 (59)	130 (66)
F	85 (41)	66 (34)
Median yrs followup (range)	9.8 (1.1–17.2)	6.2 (1.1–14.7)
No. disease (%):		
Benign	73 (36)	75 (38)
Malignant	132 (64)	121 (62)

sphincter problems in 78 (19%) and neurogenic bladder in 70 (18%).

### Surgical Techniques

The ileal nipple is created by a 12 to 15 cm segment of ileum, which is intussuscepted isoperistaltically over a length of about 5.5 cm through the ileocecal valve (fig. 1).<sup>12</sup> It is stapled to the ileocecal valve with 2 applications of 4.8 mm metal staples from TA 55 magazines and to the inferior wall of the cecum with 1 application of 4.8 mm metal staples from TA 55 magazines. For surgical revision of a previously failed continence mechanism construction of an ileal intussusception flap valve is the method of choice. Distal ileum (12 to 15 cm) must be resected from the bowel continuity. The mesentery is excluded in the middle of the resected ileum for a distance of 5 cm. Intussusception is accomplished by inserting 2 Allis clamps from the aboral end and grasping the ileal wall in the middle of the segment from inside. Stabilization of the ileal intussusception is performed by 2 rows of titanium staples, including 1 antimesenterically at the 6 o'clock position and the other at the 2 o'clock position of the nipple. Anastomosis of the intussusception with the reservoir is performed by inserting the nipple through a corresponding opening into the reservoir. The ileal intussusception is fixed to the reservoir by stapling the outer wall of the nipple to the anterior wall of the reservoir at the 10 o'clock position of the nipple, so that a flap valve configuration results. Circumferential anastomosis of the basis of the ileal nipple and closure of the reservoir are accomplished with several 4-zero absorbable monofilament running sutures. The serosa lined slit between the inner and outer walls of the ileal intussusception is closed by a row of nonabsorbable 3-zero monofilament sutures. Finally, the nipple is anastomosed to the umbilicus.

The in situ, submucosally embedded appendix is a modification of the Mitrofanoff principle<sup>13</sup> and it has been used since 1990 (fig. 2).<sup>3</sup> The appendix is calibrated to 16Fr to 18Fr after its tip is excised. A silicone catheter is inserted through the appendix into the cecum. The mesentery of the appendix is fenestrated between the vascular arcades. Anatomical variations of the appendicular artery must be respected to avoid vascular damage. Excessive fatty tissue must be removed from the mesentery to ensure easy closure of the tunnel. The submucosal tunnel is created by incising the seromuscularis of the taenia libera of the cecum for a distance of about 5 cm, starting from the insertion of the appendix and down to the mucosa with some mobilization of the lateral margins of the seromuscularis. The appendix is bent over and placed onto the mucosa. The margins of the incised seromuscularis of the cecum are closed over it with

4-zero polyglyconate sutures through the windows of the mesentery of the appendix to secure the blood supply of the appendix from its arcades.

Patients were stratified according to outlet type. Complications, recurrent complications and continence rates in 188 patients were evaluated retrospectively. Continence was defined as no stomal protection or band aids only used to cover the stoma. Complication-free and stenosis-free intervals were estimated using Kaplan-Meier analysis. Cox regression analysis was used to assess differences in outcome between the 2 types of continent outlets. Differences in continence rates were calculated by Fisher's exact test with statistical significance considered at  $p < 0.05$ . All statistical analyses were performed using the SPSS® statistical package.

### RESULTS

Of the 401 patients 144 (36%) had a total of 178 complications requiring 285 interventions, including endoscopic and open revision in 63% and 37%, respectively. Of 205 patients with an ileal nipple 34 (17%) underwent a total of 56 interventions and 63 of 196 (32%) with an appendiceal stoma underwent a total of 107 interventions for stomal stenosis ( $p < 0.001$ ). Of these interventions 42 of 56 (75%) in ileal

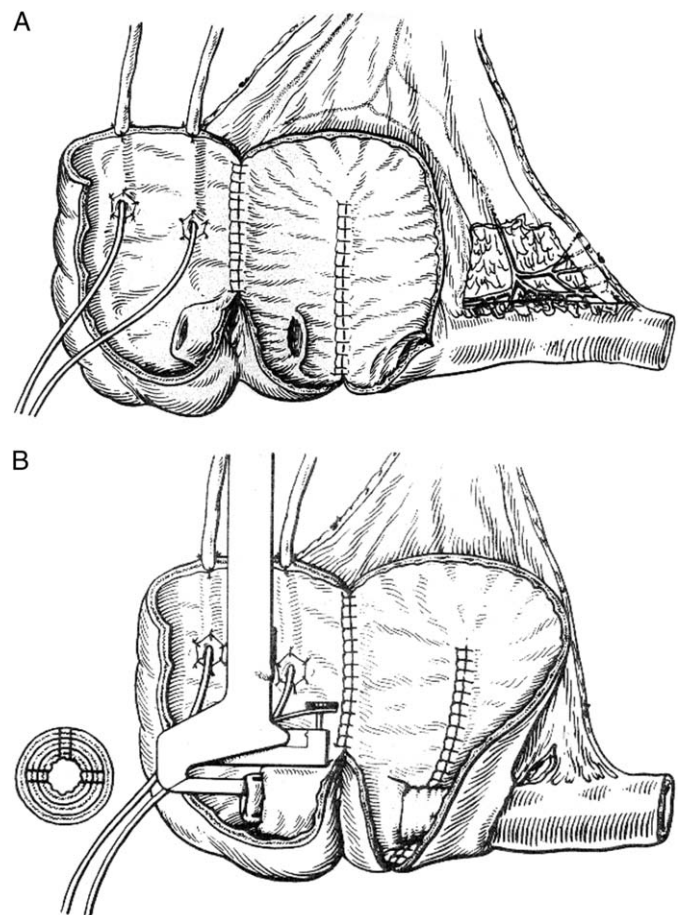


FIG. 1. Ileum (12 to 15 cm) is used to construct intussuscepted ileal nipple. Serosa and fatty tissue are removed from mesentery (A). Intussusception through ileocecal valve is performed by 2 Allis clamps. Intussusception is fixed by 3 rows of metal staples, of which 2 secure nipple in ileocecal valve and 1 secures it to reservoir wall (B).

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