Optimal Design for Ileal-Pouch Anal Anastomosis

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Introduction

Since its description in 1978 [1], the ileal-pouch anal anastomosis (IPAA) has become the most commonly performed procedure for patients with ulcerative colitis requiring surgery. In their initial description of the IPAA, Parks and Nichols constructed a three-limb "S" pouch with a hand-sewn pouch-anal anastomosis. Several years later, Utsunomiya [2] et al. reported on a two-limb "J" pouch; with the advent of the surgical stapler, this generally became the procedure of choice due to its ease of construction. As practice patterns have changed over time, the optimal pouch configuration has been debated in the literature. Both the S-pouch and J-pouch configurations have well described functional and complication profiles. In this chapter, the literature comparing the complication rates and functional results of these pouches is reviewed and followed by our recommendation on the optimal design for IPAA (Table 34.1).

Table 34.1 PICO Table

(P) Patients	(I) Intervention	(C) Comparator	(O) Outcome
Ulcerative colitis patients undergoing ileal pouch-anal anastomosis	J-pouch	S-pouch	Complication rates, functional results

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Search Strategy

A comprehensive literature search of Cochrane Database of Collected Research, EMBASE, MEDLINE, and PubMed was performed to identify all of the English-language publications related to ulcerative colitis and ileal pouch-anal anastomosis complication rates and functional results from 1985 to 2018. Key search terms included the following: "ileal pouch-anal anastomosis," "inflammatory bowel disease," "proctocolectomy," and "ulcerative colitis," "J-pouch," "S-pouch." Studies were excluded if they did not directly compare J-pouch and S-pouch configurations or if they failed to measure any post-operative complications or functional outcomes of interest. Several studies included comparisons of J-pouches and S-pouches, in addition to comparisons to other pouch designs (K-pouch, W-pouch). Only the most recent study was included if similar studies from the same institution were encountered. References of the included studies were reviewed to identify additional studies that were incorporated as appropriate.

Results

After the description of the J-pouch and the development of the end-to-end surgical stapler, many surgeons began to favor J-pouch creation for patients with ulcerative colitis due to ease of construction. Subsequently, a number of studies have compared both post-operative complications and functional outcomes between the J-pouch and the previously described S-pouch. The majority of these studies are limited to retrospective, single-center series of patients undergoing IPAA for either ulcerative colitis or familial adenomatous polyposis. No randomized controlled trials exist and few studies focus solely on patients with UC.

Complications

Pouch Failure

Anastomotic leak and pelvic sepsis have been shown to be important risk factors for pouch failure, defined as the need for permanent ileostomy or pouch excision [3]. A prospective, non-randomized analysis of 23 J-pouches and 15 S-pouches evaluated at 6 months after surgery by DeSilva [4] showed no difference in surgical complications before or after diverting ileostomy closure, including pelvic sepsis, wound infection, anastomotic dehiscence, stricture, and hemorrhage. Macrae [5] and Tulchinksy [6] similarly showed no difference in pouch failure in retrospective single-center studies.

A meta-analysis performed in 2007 of 23 studies found no difference in rates of anastomotic leak, pelvic sepsis or pouch failure [7]. One study by Mukewar [8] focusing on long-term complications evaluated 215 J-pouches at a median of 15 years after pouch creation and 45 S-pouches at a median of 9 years after surgery. Pouch failure was similar between groups at 6.7% and 7.9% respectively. The most

recent large retrospective single-center study of 4525 patients (4098 J and 427 S pouches) in 2017 again found no difference in pouch failure [9]. Interestingly, one study [10] of 502 handsewn IPAAs at a single tertiary care center (68.7% with UC) including 333 J pouches and 169 S-pouches, found a statistically higher rate of complications in J-pouches. Specifically, pelvic sepsis (13.8% vs. 7.7%), pouch fistula (15.8% vs. 9.5%), and pouch-related complications (33.0% vs. 23.1%) were higher in patients with J-pouches. However, anastomotic leak, separation, and pouch failure rates were similar between groups. The authors of that study hypothesized that the S-pouch had more favorable anatomy for a hand-sewn anastomosis due to its extra 1–2 cm of length.

Pouchitis

Pouchitis is the most common long-term complication for patients with IPAA. Several studies have looked at the incidence of pouchitis by pouch design with mixed results. At least six retrospective studies [4, 10–14] and two meta-analyses [7, 15] have found no differences in pouchitis rates between configurations. These studies have a fair amount of heterogeneity in the reported incidences of pouchitis (10–39%), likely due to variable follow up rates and definitions of pouchitis (some studies used clinical diagnosis while others relied on endoscopic evidence). In contrast, at least three studies have found a higher rate of pouchitis in patients with J-pouches. McMullen [16] retrospectively compared 38 J-pouches and 35 S-pouches and found pouchitis rates of 23.7% and 5.7% respectively, and Durno [17] reported pouchitis in 12 out of 41 J-pouches and none of 13 S-pouches. The highest quality data demonstrating an increased risk of pouchitis in J-pouches comes from Mukewar [8], who identified rates of acute pouchitis in 36% of J-pouches and 15.6% in S-pouches. Furthermore, this study reported that chronic antibiotic-resistant pouchitis occurred in 13% of J-pouches and none of the S-pouches (S-pouch vs. J-pouch OR 0.07; 0.001–0.54, $p = 0.001$). The etiology for the potential increased rates of pouchitis in J-pouches is unclear; however, some authors have hypothesized that there is likely a mechanical etiology, such as stretch on the mesenteric vasculature during pouch creation.

Mechanical Complications

Mechanical obstruction in patients with IPAA can present in the form of adhesive small bowel obstruction, pouch-anal anastomotic stricture, or efferent limb syndrome. Two large meta-analyses [7, 15] showed no differences in adhesive small bowel obstruction when the data were viewed in aggregate. A retrospective study [12] of pediatric patients with ulcerative colitis also demonstrated no differences in small bowel obstruction between J-pouches and S-pouches. Wu's comparison of handsewn J-pouch and S-pouch [10] highlighted a higher rate of partial SBO in J-pouches (35% vs. 22%, $p = 0.003$).

Obstruction at the pouch-anal anastomosis itself has been widely studied, as S-pouches appear to be uniquely susceptible to "efferent limb syndrome" in which the segment of ileum that exits the pouch and is anastomosed to the anus prevents spontaneous evacuation. In one of the earliest comparisons between the two designs,

Schoetz [11] reported that two of 20 S-pouches required pouch intubation compared to none of the J-pouches. DeSilva's [4] prospective study of 23 J-pouches and 15 S-pouches at 6 months post-operatively reported the ability to evacuate in all J pouches and only 7 of the 15 S-pouches. Pescatori [14] reported that a small number of S-pouches (4 of 59) required intubation, however none of the 131 J-pouches had difficulty evacuating.

Furthermore, three retrospective single-center studies [17–19] cite spontaneous evacuation rates of 46–75% in S-pouches compared to 88–98% in J-pouches; Lovegrove's [7] meta-analysis calculated a cumulative odds ratio of 6.2 in the need for pouch intubation when comparing S-pouches to J-pouches. Mukewar's study on long term outcomes of pouches reported that S-pouches were more likely to have pouch-related complications than J pouches (44% vs. 9%), with the majority of complications in S-pouch being related to obstruction due to a long distal limb or anastomotic stricture [8].

In contrast, a number of studies comparing J-pouches and S-pouches have demonstrated no difference in pouch intubation or spontaneous evacuation; however, these are often small retrospective studies with lower quality data [20, 21]. Stricture at the pouch-anal anastomosis has been reported in a small number of studies. A retrospective single-center study [12] of pediatric patients with UC reported an incidence of 2.0% in J-pouches compared to 21% in S-pouches. Wu's analysis of hand-sewn anastomosis did not favor S-pouches or J-pouches in regard to anastomotic stricture (21% vs. 26%).

Functional Outcomes

Many studies have examined functional outcomes in J-pouches compared to S-pouches and the two pouch designs therefore have very well described profiles. Several of these studies have focused on pouch anatomy and physiology, attempting to characterize differences in pouch function that may be attributed to the extra volume associated with the third limb of the S-pouch. The earliest review of pouch physiology was conducted by Nasmyth [22] in 1987 and examined 10 J-pouches and 7 S-pouches. The average maximum volume and compliance of S-pouches was 440 mL and 13.3 mL/mmHg respectively, which was higher than the average measurements in the J-pouches (340 mL and 8.8 mL/mmHg). However, this study was possibly confounded by differences in the times from surgery, as S-pouches were measured at a mean of 23 months from time of creation while J-pouches were measured at an average time of 5 months from creation. One other study by Hallgren [23] concluded that S-pouches have greater maximum pouch volume at 1 year compared to S-pouches (420 mL vs. 305 mL). Two other prospective studies [4, 21] and one retrospective study [24] found no difference in maximum pouch volume, but reported greater compliance in

S-pouches (14 mL/mmHg vs. 7–8 mL/mmHg). Interestingly, there was also no difference in resting anal canal pressure between groups. The clinical significance of these parameters is unclear.

Frequency of defecation, urgency, and fecal incontinence have a tremendous impact on patient quality of life. In some of the earliest retrospective analyses in the late 1980s [22, 25, 26], J-pouches were associated with an increase in stool frequency by about one bowel movement over 24 h (5–6 vs. 4–5). One of these studies [25] interestingly found that urgency was increased in J-pouches in the short term, but that this disappeared at 8 months. Schoetz [11] reported an incontinence rate of 10.6% in J-pouches vs. 5% in S-pouches, but no differences in urgency, frequency, or need for absorptive pads. Cohen's retrospective study [20] of 70 J-pouches and 80 S-pouches initially found worse urgency, frequency, and nocturnal awakening with J-pouches, but again these differences disappeared at 8 months.

As technical proficiency in J-pouch creation increased, several studies [4, 14, 23, 24, 27, 28] reported no statistically significant difference in 24-h stool frequency. Of these studies, one [24] demonstrated a significantly higher prevalence of nocturnal bowel movements in J-pouches compared to S-pouches (70% vs. 50%). DeSilva [4], Romanos [18], and Sarigol [12] all reported no differences in overall, daytime or nocturnal incontinence, and Tekkis [27] showed no difference in urgency. In a small prospective single center study of 17 J-pouches and 18 S-pouches, Tuckson [21] reported an increase in median stool frequency over 24 h in J-pouches (6 vs. 5, $p < 0.05$), as well as a higher rate of nocturnal incontinence (53% vs. 28%), nocturnal bowel movements (75% vs. 40%), and lower proportion of patients that were able to defer defecation for greater than 1 h (35% vs. 50%). The groups in this study had no difference in daytime incontinence rates and had similar average duration of deferred defecation.

In Wu's analysis of handsewn pouch-anal anastomoses, J pouches had significantly more bowel movements over 24 h (7 vs. 6, $p < 0.001$), higher prevalence of use of absorptive pads (46% vs. 29%, $p < 0.001$), and higher fecal incontinence severity index scores (26.8 vs. 21.4, $p = 0.02$). Both of the large meta-analyses [7, 15] comparing pouch designs concluded that J-pouches were subject to increased stool frequency with an average of one more bowel movement over 24 h. All other functional outcomes however were equivalent between pouch designs.

The creation of an IPAA inherently results in an increase in diarrhea due to the lack of colonic absorptive capacity. Consequently, many patients require anti-diarrheal agents for symptom management. Studies evaluating necessity for anti-diarrheal agents have shown a clear advantage for the S-pouch design. In Schoetz's earliest analysis in 1986, 51% of J pouches required anti-diarrheal agents compared to 30% of S-pouches [11]. Similarly, three other retrospective studies [4, 18, 21] found a significantly increased need for anti-diarrheal agents and a meta-analysis [7] calculated an aggregate odds ratio of 0.36 for S-pouch compared to J-pouch ($p = 0.01$).

Alternative Pouch Designs

In addition to J and S pouches, several other IPAA designs have been described, in particular the four-loop W-pouch, the H-reservoir, and the ileoanal Kock pouch. While detailed analysis of these designs is outside the scope of this chapter, it should be noted that some groups have reported improved outcomes over the more commonly performed J-pouch. A meta-analysis [15] of studies comparing pouch configurations found that the W-pouch had a lower rate of pouch failure when compared to the J-pouch (OR 2.8, $p < 0.01$) and S-pouch (OR 4.9, $p < 0.01$). Furthermore, the W-pouch had a weighted mean difference of 0.6 bowel movements per 24 h less than the J-pouch ($p < 0.01$) and a lower rate of need for anti-diarrheal medications (J vs. W, OR 2.7, $p < 0.01$), but similar rates of seepage, pad usage, urgency, incontinence, and ability to evacuate spontaneously. This meta-analysis did include three randomized control trials; however close to 50% of W-pouches were created by a single high-volume center and therefore these favorable outcomes may not be generalizable.

Recommendations Based on Data

Surgeons performing restorative IPAA after proctocolectomy for ulcerative colitis should favor creation of a J-pouch configuration over an S-pouch configuration, although both designs have generally good outcomes when performed by experienced surgeons. Although the quality of evidence in the literature is low, a distinct advantage for the J pouch over the S pouch exists when considering the ability to spontaneously evacuate without pouch intubation, as this has been a reported complication of S-pouch creation.

Because the J pouch configuration is associated with slightly increased stool frequency (one BM/day) and higher rates of pouchitis, one can make the case for the S-pouch configuration. However, the difference in stool frequency is small and may decrease with time as the pouch matures. Furthermore, the pouchitis data are heterogenous with a number of studies (including 2 meta-analyses) showing no difference in pouchitis rates and only one retrospective study showing increased pouchitis rates in J-pouches in the long-term. S-pouches may have improved functional outcomes for handsewn pouch-anal anastomosis, however prospective randomized controlled trials are needed to support this practice. (*Evidence quality: low; strength of recommendation: moderate*).

Personal View of Data

Taken together, we continue to favor the J-pouch design over the S-pouch because of relative ease of creation and comparable functional outcomes in terms of stool frequency, continence, etc. There may be slightly less pouchitis with the S-pouch, but we suspect the incidence is probably similar if one were to perform a careful study that included histologic as well as clinical criteria. The main problem with the S-pouch is the association with poor evacuation and need for intubation, difficulties that are virtually absent in the J-pouch patients. However, in patients where extra length is required to reach the anal canal, the S-pouch is a reasonable alternative (Table 34.2).

Table 34.2 Selected studies comparing pouch configurations

Study (year)	Study design	Patients, n J-pouch vs. S-pouch	Outcomes measured	Finding	Quality of evidence
Remzi (2017) [9]	Retrospective, 4525 IPAAs at single institution (66.8% with UC)	4098 vs. 426	Pouch failure	No difference – OR 0.66 (0.37–1.18) for S vs. J pouch	Very low
Wu (2015) [10]	Retrospective, 502 handsewn IPAA from 1983–2012 at single tertiary care center (68.7% with UC)	333 vs. 169 *S-pouch patients tended to be younger (35.5 ± 12 vs. 3.8.9 ± 12), higher BMI (26 vs. 24), fewer extra-intestinal manifestations	*Complications* Ileus Anastomotic leak Wound infection Anastomotic separation Anastomotic stricture Pouch fistula Partial SBO Pelvic sepsis Pouchitis Dehydration Pouch-related hospitalizations Pouch failure *Function* Bowel movements/24 h Use of pads (daytime/nighttime) Fecal incontinence severity index	No difference (13.5% vs. 12.4%, p = 0.73) No difference (1.5% vs. 3.0%, p = 0.32) No difference (6.9% vs. 10.7% p = 0.15) No difference (90.0% vs. 8.3%, p = 0.79) No difference (20.7% vs. 26.0%, p = 0.18) 15.9% vs. 9.5% (p = 0.047) 35.4% vs. 22.5% (p = 0.003) 13.8% vs. 7.7% (p = 0.044) No difference (39.3% vs. 37.9%, p = 0.75) No difference (16.2% vs. 13.0%, p = 0.15) 33.0% vs. 23.1% (p = 0.021) No difference (13.5% vs. 10.1%, p = 0.23) 7.0 vs. 6.0, p < 0.001 45.8% vs. 28.9% (p = 0.001)/55.2% vs. 41.3% (p = 0.001) 26.8 ± 15.5 vs. 21.4 ± 14.8 (p = 0.02)	Moderate

(continued)

Table 34.2 (continued)

Study (year)	Study design	Patients, n J-pouch vs. S-pouch	Outcomes measured	Finding	Quality of evidence
Mukewar (2014) [8]	Retrospective, all patients with UC	215 vs. 45 (36 with continent ileostomies) *J pouches more likely to be male (56% vs. 35%)	Acute pouchitis Chronic-antibiotic resistant pouchitis Pouch related complication Pouch failure	36.3% vs. 15.6%, p = 0.002 13% vs. 0%, S vs. J - OR 0.07 (0.001–0.54); p = 0.001 9.3% vs. 44.4%, S vs. J – OR 8.0 (3.7–17.5), p < 0.001 No difference (6.7 vs. 7.9%)	Moderate
Ozdemir (2014) [13]	Retrospective, tertiary care center. 433 pediatric IPAA patients (78.3% with UC)	371 vs. 62	Pouchitis	No difference (31.8% vs. 32.3%, p = 0.094)	Low
Tekkis (2010) [27]	Retrospective, multi-center study; 2491 patients, (79.9% with UC)	1464 vs. 110 (612 W pouches, 305 unspecified)	Urgency Frequency	No difference No difference	Low
Lovegrove (2007) [7]	Meta-analysis of 23 studies; 1519 IPAA patients	689 vs. 524 (306 W pouches)	Anastomotic leak Anastomotic stricture Wound infection Pelvic sepsis SBO Pouchitis Pouch failure Stool frequency/24 h Seepage Day/night pad usage Urgency Incontinence Anti-diarrheal medications Pouch intubation	No difference No difference No difference No difference No difference No difference No difference S vs. J – Coefficient − 1.48 (−2.10 to −0.85); p < 0.001 No difference No difference No difference No difference S vs. J – OR 0.36 (0.16–0.81); p = 0.01 S vs. J – OR 6.19 (1.12–34.07); p = 0.04	High

Table 34.2 (continued)

Study (year)	Study design	Patients, n J-pouch vs. S-pouch	Outcomes measured	Finding	Quality of evidence
Tulchinksy (2003) [6]	Retrospective, single center (96.5% with UC)	202 vs. 46 (296 W pouches, 90 Kock pouches)	Pouch failure	No difference (15% vs. 22%)** compared to 5% in W pouch, p = 0.001)	Very low
Romanos (1997) [18]	Retrospective, single center (87.5% with UC)	130 vs. 41	Incontinence Urgency Spontaneous evacuation Antidiarrheals	No difference (17.6% vs. 14.6%, p = 0.649) 13.8% vs. 2.4%, p = 0.427 97.7% vs. 46.3%, p < 0.001 36.9% vs. 7.3%, P < 0.001	Low
Macrae (1997) [5]	Retrospective, single center	321 vs. 228	Pouch failure	No difference	Very low
Sarigol (1996) [12]	Retrospective, single center pediatric patients (all with UC)	51 vs. 38	Anastomotic stricture Perineal infection Small bowel obstruction Pouchitis Daytime incontinence Nocturnal incontinence	2.0% vs. 21.1%, P = 0.004 No difference No difference No difference No difference No difference	Very low
Gemlo (1995) [28]	Retrospective, single center, 297 IPAAs 9 months post-op (282 with UC)	68 vs. 229 (50 vs. 30 within non-mucosectomy group)	Frequency/24 h Functional index Night-time pad use	No difference 95.5 vs. 91.8, p = 0.009 Higher in S pouch, p = 0.031	Low

(continued)

Table 34.2 (continued)

Study (year)	Study design	Patients, n J-pouch vs. S-pouch	Outcomes measured	Finding	Quality of evidence
DeSilva (1991) [4]	Prospective, functional pouches 6 months	23 vs. 15 (23 W pouches)	Reoperation and complications Evacuation Pouchitis Frequency Incontinence Anti-diarrheals Pouch capacity	No difference 8 S-pouches could not evacuate ($P < 0.001$) No difference No difference (5 vs. 4) No difference (5 vs. 4) 12 vs. 1 ($P < 0.05$) No difference	Moderate
Tuckson and Fazio (1991) [21]	Prospective, single center (31/35 with UC)	17 vs. 18 (</>6 months)	Anal canal pressure Pouch capacity Compliance Daytime incontinence Night time incontinence Median frequency Nocturnal bowel movement Time to defer defecation % deferring defecation >1 hr. Spontaneous evacuation Anti-diarrheals	No difference No difference (250 vs. 254/275) 7.6 mL/mmHg vs. 14.1/15.4 mL/mmHg No difference (29% vs. 22%) 53% vs. 28%, $p < 0.05$ 6 vs. 5/4 (>6 months $p < 0.05$) 75% vs. 40% No difference (1.7 h) 35% vs. 50%/70% (>6 months $P < 0.05$) No difference 71% vs. 44%/29% (>6 months $p < 0.05$)	Moderate

Table 34.2 (continued)

Study (year)	Study design	Patients, n J-pouch vs. S-pouch	Outcomes measured	Finding	Quality of evidence
Tuckson, McNamara et al. (1991) [24]	Retrospective, single center	69 vs. 47	Frequency Nocturnal bowel movement Pouch volume Compliance	No difference 70% vs. 50% No difference (228 vs. 276) 8.4 vs. 14.4 mL/mmHg ($P < 0.005$)	Low
Pescatori (1990) [14]	Retrospective, 207 IPAAs multiple centers (141 with UC)	131 vs. 59 (13 W and 4 L pouches)	Pouchitis Bowel frequency Evacuation	No difference (13% vs. 11%) No difference (4.4 ± 1.9 vs. 3.9 ± 2.1) 4 S-pouches required intubation, 0 J-pouches	Very low
Hallgren (1989) [23]	Retrospective	11 vs. 11	Pouch volume Frequency	J-pouch significantly less at 1 year (305 vs. 420; $p < 0.05$) No difference	Low
McHugh (1987) [25]	Retrospective, single center 74 patients (2 surveys, 8 months apart)	20 vs. 19	Urgency Frequency Nightime soiling	J > S ($p = 0.0015$) on first survey; no difference on 2nd 6.6 vs. 5.5/6.8 vs. 5.9 No difference	Low
Schoetz (1986) [11]	Retrospective, single center, 91 patients	66 vs. 20	Required intubation Pouchitis Incontinence Urgency Wearing pad Antidiarrheals Frequency	0 vs. 2 (NS) No difference 10.6% vs. 5% No difference No difference 51.5% vs. 30% No difference	Low

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