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Update on Ileal Pouch-anal Anastomosis

Eduardo F. Moreno,* José M. Domínguez,* Peter M. Sagar,*
John H. Pemberton*

** Division of Colon & Rectal Surgery, Mayo Clinic, 200 First Street SW, Rochester, MN 55905, USA.*
Correspondence to: John H. Pemberton, M.D., Mayo Clinic, 200 First Street SW, Rochester, MN 55905, USA.
Phone: (507) 284-2359, fax: (507) 284-1794.

Background *The surgical management of chronic ulcerative colitis and familial adenomatous polyposis was revolutionized in 1978 by the introduction of the ileal pouch-anal anastomosis, following proctolectomy and avoiding the necessity of a permanent stoma.* ***Aims:*** *To analyze the current status of ileal pouch-anal anastomosis.* ***Method:*** *Factors such as age, concurrent medical conditions, and most importantly anal sphincter function are to be considered. Many technical aspects are reviewed such pouch design, mucosectomy, alternatives to perform the anastomosis, the use of diverting ileostomy, reservoir function and morbidity.* ***Results:*** *Patient selection is of paramount importance to achieve good results. Many modifications to pouch design have been made in an attempt to improve functional results. Shorter mucosectomy is performed with hand-sutured anastomosis and double stapled anastomosis are the surgical alternatives to restore intestinal continuity. The use of diverting ileostomy is recommended in most patients to prevent pelvic sepsis. Mortality following ileal pouch-anal anastomosis is extremely unusual, however, morbidity is moderate. Small bowel obstruction, pelvic sepsis, fistula formation and pouchitis are the most common complications. Sexual dysfunction represents a major concern for younger patients in need of this kind of surgical treatment. However, its occurrence is rare.* ***Conclusions:*** *The ileal anal-pouch anastomosis has become the surgical treatment of choice for patients suffering from chronic ulcerative colitis and familial adenomatous polyposis. Primary advantages offered by this technique are that the disease is removed completely and adequate reservoir is restored and transanal defecation and fecal continence are reestablished, avoiding the necessity of a permanent stoma.*

Key words: Ileal pouch-anal anastomosis.

Antecedentes *Hasta antes de 1978 el tratamiento de algunos tipos de alteración benigna del colon que eran resueltos con proctolectomía, dejaban una ileostomía permanente con los problemas y complicaciones propios de ella. A partir de esa fecha el panorama se modificó radicalmente al efectuarse la anastomosis ileoanal con reservorio, ya que eliminaba el estoma permanente.* ***Aim:*** *Revisar los conceptos actuales sobre la anastomosis ileoanal con reservorio, sus indicaciones, la selección de pacientes y sus resultados.* ***Método:*** *Se señala quiénes son los candidatos para este tipo de procedimiento, se describen los diferentes aspectos técnicos de la operación que incluyen la posición del paciente, los diversos tipos de reservorios, la mucosectomía, las técnicas para la anastomosis, el uso de la ileostomía temporal, la función de reservorio y las complicaciones.* ***Resultados:*** *En la selección de pacientes es importante tomar en cuenta la edad, la presencia de otros padecimientos y sobre todo las condiciones funcionales del esfínter. No existe el reservorio ideal y pocas diferencias se han observado entre los llamados en J, H, S y W. La mucosectomía y el manguito muscular han disminuido en longitud. Se tienen los mismos resultados realizando la anastomosis manual o con engrapadoras, la morbilidad es moderada y la mortalidad es ocasional.* ***Conclusiones:*** *Este tipo de abordaje quirúrgico es el ideal para pacientes con poliposis múltiple familiar y colitis ulcerosa crónica. Las mayores ventajas de esta técnica son que se elimina todo el colon enfermo, la defecación se realiza por la vía natural y en muchos pacientes la continencia es prácticamente normal.*

Palabras clave: Anastomosis ileoanal.

INTRODUCTION

The surgical management of chronic ulcerative colitis (CUC) and Familial adenomatous polyposis (FAP) was revolutionized in 1978 by the introduction of the ileal pouch-anal anastomosis (IPAA) following proctocolectomy by Parks and Nicholls.[1] IPAA has become the procedure of choice in most cases of CUC and FAP. Since the first description, IPAA has undergone many modifications to improve the functional results. Technical factors such as design of the ileal pouch and type of anastomosis remain controversial. Refinement of technique and greater experience have led to decreased morbidity.

The purpose of this review is to analyze the current status of IPAA. The operative technique will be reviewed as well as other important issues. Long term results and quality of life after the IPAA are emphasized.

TECHNIQUE

As with most surgical procedures, results are highly dependent on patient selection. IPAA is indicated for selected patients with CUC and FAP. Important factors to be considered include age, medical condition, body habitus and strength of the anal sphincter. Cooperation between the gastroenterologist and colon and rectal surgeon is extremely important.

Preoperative radiographs, endoscopy and pathology must be reviewed carefully. Patients with Crohn's disease are not candidates for IPAA.

OPERATION

The patient is positioned in the synchronous (combined) position to give access to the abdomen and perineum. The abdomen is opened and explored through a lower midline incision. Crohn's disease is excluded. The cecum and colon are mobilized. The ileocolic artery is initially preserved, but may be later sacrificed to improve length of the pouch's reach. The terminal ileum is divided close to the cecum with a stapler. The colon is removed by conservative mesenteric dissection. lf the diagnosis is in question, the distal sigmoid colon is transacted allowing frozen section examination to confirm the diagnosis. The rectum is then mobilized to the level of levator ani muscle. Care is taken to preserve the hypogastric nerves. The dissection should be close to the bowel wall to minimize the chance of bladder and sexual dysfunction. The colon and the rectum can then be removed. Frozen section examination is carried out to exclude Crohn's disease.

The small bowel must be fully mobilized to the level of the duodenum. Assuming adequate length, the ileal pouch is then constructed. Various pouch designs are available.[2] To obtain a tension free anastomosis, the distal end of the pouch should reach 5 cm below the pubis. The anastomosis may be hand-sewn following a transanal mucosectomy or a double stapled anastomosis can be fashioned between the pouch and the anal stump. A diverting loop ileostomy is brought trhough a previously marked stoma site. Further technical details of this procedure have been reported previously.[3,4] A second operation to close the loop ileostomy is required to restore intestinal continuity. This is performed 8-12 weeks later.

ILEAL POUCH DESIGN

Although the neorectum may be created with a straight ileal-anal anastomosis, the functional results are significantly better if it is constructed from two, three or four limbs of distal ileum anastomosed in a side to side fashion.[2] There is no perfect pouch because there is little difference in functional results in the available pouch design.

Two Limbed Pouches

J-Pouch: The J-Pouch was initially described by Utsunomiya.[4] It is the most popular pouch used today and the pouch design of choice at the Mayo Clinic. It is constructed from a long side-to-side anastomosis along the antimesenteric border of the terminal ileum. The length of the two limbs is variable and is related primarily to the distribution of the ileal arcades. No functional differences are found between J-pouches constructed from 10 cm limbs or 20 cm limbs.[5] The popularity of the J-pouch is in part due to the ease of construction and good functional results.

H-Pouch: The H-pouch was initially described by Funkalsrud.[6] It is constructed with two limbs of ileum anastomosed in side-to-side, iso-iso peristaltic fashion. A short 5-7 cm spout exits from the lower end and is anastomosed to the anal sphincter. The suggested advantage of this pouch is efficiency of evacuation. Unfortunately, the efferent spout is associated with poor pouch emptying.[6] Reduction in the length of the efferent spout to 2 cm has led to improved evacuation

and functional results.[7] Poorly functioning straight ileoanal anastomosis can be converted to H-pouch with a 50 per cent reduction in stool frequency.[8]

The Three Limbed Pouch

S-Pouch: The S-pouch was the initial reservoir described by Parks and Nicholls.[1] This pouch is a modification of the Kock continent ileostomy.[9] Unlike the Kock pouch, the S-pouch has no nipple valve. A long efferent limb (4-6 cm) was initially used, but this led to outlet obstruction due to angulation.[10] Self catheterization was frequently required to empty the S-pouch with outlet obstruction. This problem was overcome by eliminating the efferent spout entirely. The S-pouch is particularly useful in cases when the J-pouch does not reach. The S-pouch can reach 2-3 cm farther than most J-pouches. The S-pouch is fashioned from three limbs of ileum each 15 cm in length. Obstructed S-pouches previously constructed with outlet obstruction from a long efferent spout can be revised by shortening the spout or conversion to a J-pouch. [11,12] Revisional surgery should not be undertaken lightly; only 50 per cent of patients eventually have good functional outcomes.[11]

Four Limbed Pouches

W-Pouch: The W-pouch was introduced in an attempt to improve evacuation of the S-pouch and achieves the same functional results of the J-pouch.[13,14] Four 12 cm lengths of ileum are sutured in a W arrangement to construct this pouch.[15] The anastomosis is side-to-end between the most dependent portion of the pouch and the anal canal.

Factors which favor the W-pouch include the spheroidal design which allows the greatest volume for a given length of the ileum and a horizontal diameter similar to the rectal ampulla.[16,17] Construction of this pouch is time-consuming and the pouch may not fit in a narrow pelvis. Comparative studies have suggested that W-pouches have some benefits over other pouch designs with respect to capacity, compliance and emptying.[15,16] However, prospective randomized studies have not shown a significant benefit in functional outcomes.[19]

ANASTOMOTIC TECHNIQUES

The technique of connecting the ileal pouch to the anal canal remains controversial. The two options include 1) a transanal mucosectomy with hand-sutured anastomosis between the ileal pouch and the dentate line or 2) a double-stapled technique with anastomosis at a slightly higher level and preservation of the anal transition zone (ATZ).

Mucosectomy: Proponents of a mucosectomy prior to anastomosis propose the following advantages: 1) all diseased mucosa is eliminated, 2) symptoms from residual diseased mucosa are abolished, and 3) risk of developing cancer in the residual persistent rectal mucosa is eliminated. It is for these reasons that this is the most common anastomotic technique employed at Mayo Clinic. Mucosectomy is strongly recommended in patients with FAP to eliminate the risk of developing polyps and cancer; this recommendation is accepted by most surgeons.

The original mucosectomy technique created a long muscular cuff up to 10- 12 cm in length starting at the dentate line. This was extremely difficult and time consuming. A combined abdominal and transanal approach was frequently required. This led to long periods of anal dilatation which was associated with functional impairment of the anal sphincter.[20] There was also a high rate of pelvic sepsis and cuff abscesses.[21] The realization that a long rectal stump was unnecessary led to a marked reduction in the length of mucosectomy. Transanal mucosectomy is now carried out for 2-3 cm and requires minimal time and anal retraction.

Double-stapled Anastomosis: Advocates of the double-stapled technique suggest that the technical aspects are simpler and the functional outcome is better. The latter point is debatable; most reports comparing the two techniques have not been randomized and include historical controls which often were taken from the "learning curve" phase of the surgeons' experience. To date, a randomized, as well as a case-controlled study have shown no differences between functional outcomes comparing mucosectomy with hand sewn versus double-stapled technique.[22,23]

The technique involves stapling across the distal rectum approximately 2 cm above the dentate line, thus preserving the ATZ. The circular stapling device is inserted transanally with creation of the ileal pouch-anal anastomosis. Minimal manipulation of the sphincter mechanism is required. The ATZ is highly innervated and seems to be important in discrimination between flatus and stool.[24,25] Preservation of the ATZ improves anal sensation and recovery of motor function of the anal sphincter following IPAA.[26,27,28] There is no

question that preservation of the ATZ is associated with a *potential* for proctitis, dysplasia and cancer to develop. The ATZ is irregular with tongues of rectal mucosa possible down to the dentate line. Histologic CUC is present in the ATZ of conventional proctectomies in 90% of cases.[29] The incidence of dysplasia in mucosectomy specimens is reported in 2.5% to 3.1%. Repeated biopsies have shown resolution of dysplasia in a few cases and ileal pouch advancement procedures have been employed in others.[31] Although the incidence of dysplasia in the ATZ is low, it is recommended that mucosectomy is performed in patients with a preoperative diagnosis of dysplasia or carcinoma.

THE USE OF DIVERTING ILEOSTOMY

The cause of pelvic sepsis is usually leakage from the IIPAA or the pouch itself. It is this fear of pelvic sepsis which has led to the routine use of diverting ileostomy in most centers. This allows diversion of the stool while the pouch and anastomosis heal. Unfortunately, the temporary ileostomy is itself a potential source of morbidity.[32] There is a significant risk of peristomal dermatitis, retraction, stenosis and prolapse. Since the stoma site is more proximal than standard ileostomies, dehydration can be a problem.

There are multiple reports of IPAA without temporary stoma (one-stage IPAA) which suggest that it can be performed safely.[13,16] The risk of small bowel obstruction may be decreased in one-stage IPAA compared with standard two-stage IPAA. Patient selection is critical in choosing appropriate cases for one-stage IPAA. Patients who are acutely ill, on high doses of steroids or malnourished should not be considered candidates for the procedure. If a one-stage IPAA is performed, the threshold to reoperate should be lower if pelvic sepsis is suspected. There is currently no large randomized prospective trial which compares one-stage and two-stage IPAA.

ILEAL POUCH FUNCTION

Patients with an ileal pouch pass about 600-700 ml of semiformed stool daily. This is approximately four times the volume a person passes with an intact colon, rectum and anus. Frequency of bowel movements is generally four to six stools daily with one night time bowel movement. Loperamide reduces intestinal motility and improves absorption which reduces stool frequency and volume. The use of stool-bulking agents can frequently help to control frequency and consistency of the stool.

The frequency of bowel movements inversely correlates with the ileal reservoir capacity.[13,37] The best results should be obtained with the larger reservoirs. However, huge reservoirs are associated with impaired contractility and poor evacuation. In non randomized studies, frequency of bowel movements was significantly less in patients with three limbed pouches compared with two limbed pouches[14,38,39] and in four limbed pouches compared with two and three limbed pouches.[13] The only prospective randomized trial comparing functional results failed to show a difference in stool frequency between two and four limbed pouches.[19]

COMPLICATIONS

With increased long term experience with IPAA morbidity rates have decreased but still range between 13% to 54%.[3] Mortality following IPAA is extremely rare. In the Mayo series of 1700 IPAA, there have been 2 death and an overall mortality rate of 0.1%. Patient selection, perioperative care and meticulous technique are important to minimize complications. The surgeon's experience in performing IPAA is the single most important factor in operative results. The most common complications encountered are discussed below.

Small Bowel Obstruction: The most common complication following IPAA is small bowel obstruction (SBO), which occurs in between 13% and 40% of cases depending on the report.[3,40] Resolution with conservative treatment such as bowel rest, nasogastric decompression and rehydration is common. About 50% of patients require laparotomy and enterolysis. If the SBO occurs prior to closure of ileostomy, consideration may be given to closure of the ileostomy at the time of enterolysis.[40] The patient should undergo a water soluble contrast pouchogram prior to closure of the stoma.

Pelvic Sepsis: Patients with pelvic sepsis present with fever, abdominal pain, diarrhea and localized or generalized peritonitis. Pelvic abscess may develop from an infected hematoma or leak from the pouch suture line or anastomosis. The rate of pelvic sepsis varies from 6% to 24% in the literature.[3,41,42] Pelvic sepsis is rare in FAP patients undergoing IPAA. The Mayo series showed an incidence of pelvic sepsis in 0% in FAP patients and 6% in CUC patients.[43] This is

likely to be due to the fact that patients with CUC may be on steroids, and are anemic and malnourished.

Treatment requires broad spectrum antibiotics and either operative drainage or CT guided drainage of any abscess collection. Approximately 50% of patients will come to operative exploration and drainage with creation of a second ileostomy. Early treatment is essential in order to save the ileal pouch. Pelvic sepsis may lead to extensive scaring and a "frozen pelvis" with a noncompliant ileal pouch and poor function. Among patients with pelvic sepsis, 40% of ileal pouches will eventually require excision.[41] Patients whose septic process can be controlled by CT guided drainage are more likely to have acceptable functional results.

Measures reported to decrease the chance of pelvic sepsis include mechanical bowel preparation, prophylactic antibiotics, rectal irrigation with povidone-iodine solution, meticulous hemostasis and irrigation of the distal ileum prior to ileal pouch construction.[41] The rate of pelvic sepsis in IPAA declines with operative experience.[11]

Fistula Formation: Multiple types of fistula may develop following IPAA. The most common include pouch-cutaneous and pouch-vaginal fistulas. Pouch-cutaneous fistula may develop from a pouch or anastomotic leak or following ileostomy closure with a suture line disruption. Pouch-vaginal fistulas may develop following pelvic sepsis or resulting from a technical error with injury to the posterior vaginal wall. Fistulas which occur in the early postoperative period are more likely related to a technical error or a postoperative complication such as pelvic sepsis.

The possibility of Crohn's disease must be addressed in patients who develop fistulas months to years after operation and in patients whose fistulas are not contiguous with the pouch. In these cases, the initial pathology specimen should be reevaluated to confirm the diagnosis. Evaluation including endoscopy, exam-under anesthesia and small bowel radiographs may be required to rule out Crohn's disease.

The treatment of ileal pouch related fistulas is difficult. Control of any septic focus is the first step. Diversion of the fecal stream if not already present may allow the fistula to heal. Local procedures such as advancement flaps and fistulotomies may be used if healing does not occur with diversion. Laparotomy with ileal pouch repair or revision may be required in complicated cases. Failure of all treatments may lead to ileal pouch excision and creation of a Brooke ileostomy.[11]

Anastomotic Stricture: Clinically significant stricturing occurs at the anastomosis in 8% to 38% of cases.[45,46] Predisposing factors include sepsis, tension and ischemia present with impaired evacuation and frequent watery stools. These strictures generally respond to anal dilatation. Self-dilatation may be useful in selected cases. The eventual pouch function if the stricture is successfully treated is no different to that of other patients with IPAA.[11]

Pouchitis: The development of pouchitis is characterized by increased stool frequency, bloody stools, cramps, abdominal pain and fever. The etiology is unknown. The incidence varies from 7% to 50% according to the definition of pouchitis used and the duration of follow-up.[47] Some have used the high incidence of pouchitis to argue against IPAA, but this seems unreasonable since the majority of cases have only one episode which responds well to oral metronidazole. It is rare for pouchitis to lead to the exclusion of ileal pouch.

Sexual Dysfunction: The development of sexual dysfunction after IPAA is uncommon. In contrast to pelvic dissection for rectal carcinomas, it is common practice to stay close to the rectal wall which decreases the chance of injury to the presacral sympathetic nerves. The incidence of impotence and retrograde ejaculation varies from 1% to 4% and may improve with time.[48]

SUMMARY

IPAA is the actual treatment of choice for CUC and FAP. The J-pouch is the most popular reservoir used today due to good functional results and relative ease of construction. There are two types of anastomosis of the reservoir to the anal canal: a) transanal mucosectomy with a hand-sewn anastomosis to the dentate line and b) double-stapled technique with anastomosis at a higher level with preservation of the anal transition zone (ATZ). To date there are no randomized or case-controlled studies showing differences in functional outcomes between these two techniques. In patients with CUC, fear of abdominal sepsis has led to the routine use of diverting loop ileostomy; nevertheless, there are several reports of double stapled IPAA without protecting ileostomy. Small bowel obstruction is the most common complication after IPAA; fifty percent of these patients require laparotomy and enterolysis. The most feared complication remains pelvic sepsis and it is more common in patients with CUC and is rare

in patients with FAP. Eventually up to 40% of patients will have their pouch removed secondary to pelvic sepsis. Other complications are fistula formation, anastomotic stricture, pouchitis and sexual dysfunction. Nevertheless, about 94% of patients do well after IPAA; their disease is cured and fecal continence is preserved.

REFERENCES

1. Parks AG, Nicholls RJ. Proctocolectomy without ileostomy for ulcerative colitis. *Br Med J* 1978;2:85-88.
2. Sagar PM, Taylor BA. Pelvic ileal reservoirs: The options. *Br J Surg* 1994;8:325-332.
3. Kelly KA, Wolff BG, Pemberton JH, Dozois RR. Ileal pouch-anal anastomosis. *Curr Surg Prob* 1992;29:59-132.
4. Utsunumiya J, Iwama T, Imajo M, *et al.* Total colectomy, mucosal proctectomy and ileo-anal anastomosis. *Dis Colon Rectum* 1980;23:459-466.
5. Williamson MER, Lewis W, Sagar PM, *et al.* Prospective randomized trial of pouch design in restorative proctocolectomy: Early results of J vs. W: Big vs little. *Dis Colon Rectum* 1993;36:38.
6. Stone MM, Lewin K, Funkalsrud EW. Late obstruction of the lateral ileal reservoir after colectomy and endorectal ileal pull-through procedures. *Surg Gynecol Obstet* 1986;162:411-417.
7. Funkalsrud EW. Update on clinical experience with different surgical techniques of the endorectal pull-through operation for colitis and polyposis. *Surg Gynecol Obstet* 1987;165:309-316.
8. Funkalsrud EW, Stelzner M, McDonald N. Construction of an ileal reservoir in patients with a straight endorectal ileal pull-through. *Ann Surg* 1988;208:50-55.
9. Kock NG. Intra-abdominal "reservoir" in patients with permanent ileostomy. Preliminary observations on a procedure resulting in fecal "continence" in five ileostomy patients. *Arch Surg* 1969;99:223-230.
10. Pescotori M, Manhire A, Bartram CI. Evacuation pouchography in the evaluation of ileoanal reservoir function. *Dis Colon Rectum* 1983;26:365-368.
11. Galandiuk S, Scott NA, Dozois RR, *et al.* Ileal pouch-anal anastomosis: Reoperation for pouch related complications. *Ann Surg* 1990;212:446-454.
12. Nicholls RJ, Gilbert JM. Surgical correction of the efferent ileal limb for disordered defaecation following restorative proctocolectomy with the S ileal reservoir. *Br J Surg* 1990;77:152-154.
13. Nicholls RJ, Lubowski DZ. Restorative proctocolectomy: the four loop (W) reservoir. *Br J Surg* 1987;74:564-566.
14. Harms BA, Pellet JR, Starling JR. Modified quadruple-loop (W) ileal reservoir for restorative proctocolectomy. *Surgery* 1987;101:234-237.
15. Nicholls RJ, Pezim ME. Restorative proctocolectomy with ileal reservoir for ulcerative colitis and familial adenomatous polyposis: A comparison of three reservoir designs. *Br J Surg* 1985;72:470-474.
16. Thompson AW, Simpson AHRW, Wheeler JL. Mathematical prediction of ileal pouch capacity. *Br J Surg* 1987;74:567-568.
17. Hatakeyama K, Yamai K, Muto T. Evaluation of ileal W pouch-anal anastomosis for restorative proctocolectomy. *Int J Colorectal Disease* 1989;4:150-155.
18. Sagar PM, Holdsworth PJ, Godwin PGR, *et al.* Comparison of triplicate (S) and quadruplicate (W) pelvic ileal reservoir. *Gastroenterology* 1992;102:520-528.
19. Keighley MRB, Yoshioka K, Kmiot W. A prospective randomized trial to compare the stapled double lumen pouch and the sutured quadruple pouch for restorative proctocolectomy. *Br J Surg* 1988;75:1008-1012.
20. Johnston D, Holdsworth PJ, Nasmyth DG, *et al.* Preservation of the entire anal canal in conservative proctocolectomy for ulcerative colitis: A pilot study comparing end-to-end ileoanal anastomosis without mucosal resection with mucosal proctectomy and endo-anal anastomosis. *Br J Surg* 1987;74:940-944.
21. Liljequist L, Lidquist K, Ljungdahl I. Alterations in ileoanal pouch technique 1980-1987: Complications and functional outcome. *Dis Colon Rectum* 1988;31:929-938.
22. Seow-Choen A, Tsunoda A, Nicholls RJ. Prospective randomized trial comparing anal function after handsewn anastomosis with mucosectomy versus stapled ileoanal anastomosis without mucosectomy in restorative proctocolectomy. *Br J Surg* 1991;78:430-434.
23. McIntyre PB, Pemberton JH, Beart RW, *et al.* Double-stapled vs handsewn ileal pouch-anal anastomosis in patients with chronic ulcerative colitis. *Dis Colon Rectum* 1994;37:430-433.
24. Duthie IHL, Gaims FW. Sensory nerve-endings and sensation in the anal region of man. *Br J Surg* 1960;47:585-595.
25. Duthie BL, Bennet RC. The relation of sensation in the anal canal to the functional anal sphincter: A possible factor in anal continence. *Gut* 1963;4:179-182.
26. Holdsworth PJ, Johnston D. Anal sensation after restorative proctocolectomy for ulcerative colitis. *Br J Surg* 1988;75:993-996.
27. Sagar PM, Holdsworth D, Johnston D. Correlation between laboratory findings and clinical outcome after restorative proctocolectomy: Serial studies in 20 patients after end-to-end pouch-anal anastomosis. *Br J Surg* 1991;78:67-70.
28. Tuckson W, Lavery IC, Fazio VW, *et al.* Manometric and functional comparison of ileal pouch-anal anastomosis with and without anal manipulation. *Am J Surg* 1991;161:90-96.
29. Ambroze WL, Pemberton JH, Dozois RR, *et al.* The histologic pattern and pathologic involvement of the anal transition zone in patients with ulcerative colitis. *Gastroenterology* 1993;104:514-518.
30. Tsunoda A, Talbot IC, Nicholls RJ. Incidence of dysplasia in the anorectal mucosa in patients having restorative proctocolectomy. *Br J Surg* 1990;77:506-508.
31. Ziv Y, Fazio VW, Sirimarco MT, *et al.* Incidence, risk factors and treatment of dysplasia in the anal transitional zone after ileal pouch-anal anastomosis. *Dis Colon Rectum* 1994;37:1281-1285.
32. Feimberg SM, Mc Loed RS, Cohen Z. Complications of loop ileostomy. *Am J Surg* 1987;153:102-107.
33. Sagar PM, Lewis WG, Holdsworth PJ, Johnston D. One stage restorative proctocolectomy without temporary defunctioning ileostomy. *Dis Colon Rectum* 1992;35:582-588.
34. Everett WA, Pollard SG. Restorative proctocolectomy without temporary ileostomy. *Br J Surg* 1990;77:621-622.

35. Metcalf AM, Dozois RR, Kelly KA, Wolff BG. Ileal pouch-anal anastomosis without diverting ileostomy. *Dis Colon Rectum* 1986;29:33-35.
36. Galandiuk S, Wolff BG, Dozois RR, Beart RW. Ileal pouch-anal anastomosis without ileostomy. *Dis Colon Rectum* 1991;34:870-873.
37. O'Connell PR, Pemberton JH, Brown ML, Kelly KA. Determinants of stool frequency after ileal pouch-anal anastomosis. *Am J Surg* 1987;153:157-163.
38. Mc Hugh SM, Diament NE, McLoed RS, Cohen Z. S pouches vs J pouches: a comparison of functional outcomes. *Dis Colon Rectum* 1987;30:671-677.
39. Nasmyth DG, Williams NS, Johnston D. Comparison of function of triplicated and duplicated pelvic ileal reservoirs after mucosal proctectomy and ileoanal anastomosis for ulcerative colitis and adenomatous polyposis. *Br J Surg* 1986;73:361-366.
40. Francois Y, Dozois RR, Kelly KA, *et al.* Small intestinal obstruction complicating ileal pouch-anal anastomosis. *Ann Surg* 1989;209:46-50.
41. Scott NA, Dozois RR, Beart RW Jr. Postoperative intraabdominal and pelvic sepsis complicating ileal pouch anal-anastomosis. *Int J Colorectal Dis* 1988;3:149-152.
42. Nicholls RJ, Pescatori M, Motson RW, *et al.* Restorative proctocolectomy with a three-loop ileal reservoir for ulcerative colitis and familial adenomatous polyposis: Clinical results in 66 patients followed for up to 6 years. *Ann Surg* 1993:383-388.
43. Dozois RR, Kelly KA, Welling DR, *et al.* Ileal pouch-anal anastomosis: comparison of results in familial adenomatous polyposis and chronic ulcerative colitis. *Ann Surg* 1989;210: 268-273.
44. Wexner SD, Rothemberger DA, Jensen L, *et al.* Ileal pouch vaginal fistulas: Incidence, etiology and management. *Dis Colon Rectum* 1989;32:460-465.
45. Schoetz DJ Jr., Coller JA, Veidenheimer MC. Can the pouch be saved? *Dis Colon Rectum* 1988;31:671-675.
46. Lewis WG, Kuzu A, Sagar PM, *et al.* Stricture at the pouch-anal anastomosis after restorative proctocolectomy. *Dis Colon Rectum* 1994;37:120-125.
47. Sandbom WJ. Pouchitis following ileal pouch-anal anastomosis: definition, pathogenesis and treatment. *Gastroenterology* 1994;107:1856-1860.
48. Pemberton JH, Kelly KA, Beart RW, *et al.* Ileal pouch-anal anastomosis for chronic ulcerative colitis. *Ann Surg* 1987;206:504-511.