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CHAPTER 4

Effect of vaginal delivery on long-term pouch function

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Abstract

Background
The optimal method of childbirth for women with a restorative proctocolectomy (RP) has yet to be determined. Little is known about long-term ileal pouch function after vaginal delivery, especially when childbirth occurred before RP. The aim of this study was to evaluate the effect of vaginal delivery before or after RP on long-term pouch function.

Methods
All 267 women who underwent RP between January 1985 and November 2004 were invited to participate. Functional outcome was assessed by colorectal functional outcome questionnaire, and patients were asked about their pregnancies and risk factors for obstetric injury. Linear regression analysis was performed to study potential risk factors for poor pouch function.

Results
The response rate was 82.6%. Median follow-up after pouch surgery was 7.2 (range 1.0–19.7) years. One hundred patients had at least one delivery. Fifty-two (60%) of the 86 patients who attempted a vaginal delivery had an increased risk of obstetric injury according to predefined risk factors. In these patients ageing and longer follow-up were significant risk factors for impaired incontinence.

Conclusion
Women who had RP and vaginal delivery with a high risk of obstetric injury had impaired continence with ageing and longer follow-up. Patients with RP should be informed about the considerable risk of vaginal delivery on long-term ileal pouch function.
Introduction

Restorative proctocolectomy (RP) is the preferred surgical procedure in patients with refractory ulcerative colitis or familial adenomatous polyposis (FAP). Most women are in their reproductive years at the time of operation. Although there is evidence that fertility in women decreases after surgery\(^1\), many become pregnant after the operation. In general, pregnancy and vaginal delivery are considered safe but some authors prefer a caesarean section because of the potential for damage to the ileal pouch, pelvic floor, anal sphincters or pudendal nerves.\(^3\) At present, however, there is no consensus about the optimal mode of delivery in these women.\(^4-6\)

In a meta-analysis of 717 women from the normal population, anal sphincter defects were demonstrated by ultrasonography in 26.9 per cent after a first delivery and in an additional 8.5 per cent after a second vaginal delivery. Only one-third of these women were symptomatic after delivery\(^7\), but the maximum follow-up in the included studies was only 6 months after childbirth. It is likely that more patients with the demonstrated anal sphincter defects would become symptomatic with increasing follow-up. As the incidence of occult obstetric injury in the general population is much higher than commonly estimated, such injuries can also be expected in a substantial proportion of women with ulcerative colitis or FAP who have undergone RP. It is likely that damage to the anal sphincter, pelvic floor or pudendal nerves in these patients has more clinical impact at an earlier age. This is because stools are generally looser after RP.

The few studies that have described the effect of childbirth in women with RP have focused on deliveries that occurred after the pouch procedure. Most did not discriminate between an uncomplicated vaginal delivery and a delivery with increased risk of obstetric injury. Moreover, postoperative follow-up was generally too short to draw valid conclusions on the long-term impact of vaginal delivery.\(^5,6,8-10\) Because obstetric injury before RP can have a negative impact in the period after pouch construction, vaginal deliveries before pouch surgery should also be taken into account when evaluating long-term pouch function.

The aim of this study was to evaluate the effect of vaginal delivery and its potential complications both before and after RP on function of the ileal pouch.
Patients and methods

All women who underwent RP between January 1985 and November 2004 were recruited retrospectively from three academic medical centres in the Netherlands (Amsterdam Medical Centre, Vrije Universiteit Medical Centre Amsterdam and Leiden University Medical Centre).

Women eligible for RP routinely underwent physical examination of the anal sphincters and an obstetric history was taken. Anorectal physiology was investigated if there was any doubt about sphincter dysfunction. Only patients with clinically adequate sphincters were counselled for pouch surgery. A double-stapled anastomosis was normally constructed, but mucosectomy with a handsewn anastomosis was performed in a few patients with FAP and polyps extending to the dentate line.

All patients were mailed two questionnaires and invited to participate in the study. They were followed until January 2005, which was defined as the end of the study period. The colorectal functional outcome (COREFO) questionnaire, described in detail by Bakx et al., was used to evaluate pouch function. This validated questionnaire contains 27 questions that assess functional outcome after colorectal surgery, including RP. The questionnaire related to events during the 2 weeks before it was completed. A pregnancy questionnaire was developed after consultation with the department of gynaecology. Patients were asked about their number of pregnancies, complications during pregnancy, number of deliveries, type of delivery (spontaneous vaginal, instrumental vaginal or caesarean section) and complications during delivery. Patients who did not respond within a month were sent a reminder.

From responses to the COREFO questionnaire, scores on a scale from 0 to 100 were calculated for incontinence, social impact, defaecation frequency, bowel motion-related aspects and medication. A total score was also calculated. Low scores corresponded to better outcome on all scales. Defaecation frequency was defined as the number of times a patient had to defaecate during the day or night. A score of less than 5.6 points on the incontinence scale was defined as perfect continence. This score was based on the mean incontinence score of a cohort of patients without complaints of incontinence.

Patients who responded and had a minimum follow-up of 1 year were divided into three groups. Group 1 included patients who never gave birth. Group 2 included patients who had one or more uncomplicated vaginal deliveries (before or after pouch surgery). Group 3 included patients who had one or more vaginal deliveries, at least one of which had an increased risk of obstetric injury or resulted in an emergency caesarean section (before or after pouch surgery). Vaginal delivery with high risk of obstetric injury included forceps or vacuum delivery, delivery with episiotomy, delivery with vaginal tears requiring perineoplasty, delivery of a baby weighing more than 4000 g, delivery that resulted in an emergency caesarean section or delivery with a prolonged second stage of labour (more than 2 h).

Predictors of pouch function, including ageing, length of postoperative follow-up, age at time of operation and vaginal deliveries (with increased risk of obstetric injury), were analysed. Functional outcome of patients with a follow-up of less than 1 year was analysed separately.
Statistical analysis
To test for any differences between groups, the Mann-Whitney U test or Kruskal-Wallis test was performed for quantitative variables and $\chi^2$ or Fisher’s exact test for categorical variables. Multiple linear regression analysis was performed to analyse the effect of risk factors on incontinence scores. $P < 0.050$ was considered statistically significant for all tests. Statistical analysis was performed using the SPSS version 12.0 statistical package (SPSS, Chicago, Illinois, USA).

Results
Between January 1985 and November 2004, 267 consecutive women underwent RP, of whom more than 95% had a double-stapled anastomosis. Questionnaires were sent to 253 patients; the remaining 14 had died. Two hundred and nine patients returned the questionnaires and 44 did not respond, giving a response rate of 82.6%. Of the 209 patients who responded, ten were excluded from the analysis of functional outcome because they refused to participate (n=8) or did not complete the questionnaires fully (n=2). Another 27 patients were not included in the analysis because the pouch was excised (n=13), they had a temporary stoma (n=3) or postoperative follow-up was less than 1 year (n=11) (Figure 1).

Figure 1 Study flow chart

267 patients
- Died 14
- Did not respond 44

209 patients responded
- Refused to participate 8
- Did not fully complete the questionnaires 2

199 patients
- Pouch excision 13
- Temporary stoma 3
- Follow-up < 1 year 11

172 patients
- No childbirth (group 1) 72
- Childbirth 100

199 patients
- Uncomplicated vaginal delivery (group 2) 34
- Vaginal delivery 83
- Emergency caesarean section 3
- Elective caesarean section 14

199 patients
- High risk of obstetric injury (group 3) 52
- Childbirth 100
- No childbirth (group 1) 72
The postoperative pathological diagnosis in the 267 patients was ulcerative colitis in 174 (65.2%), FAP or hereditary non-polyposis colorectal carcinoma in 43 (16.1%), Crohn’s disease in 14 (5.2%), indeterminate colitis in 12 (4.5%) and ‘other’ or unknown in 24 women (9.0%).

The 172 patients included in the analysis had a median age of 42.0 (mean 42.1, range 19.1–73.7) years at the time of completing the questionnaires. Median age at the time of RP was 34.7 (mean 34.4, range 9.5–66.0) years. The median interval between RP and completion of questionnaires was 7.2 (mean 7.7, range 1.0–19.7) years.

Of the 172 women, 72 never gave birth (group 1) and 100 delivered at least once. The mean number of deliveries for the parous women was 1.9. Of these, 83 delivered at least once vaginally and 14 patients by elective caesarean section only. Three patients had an emergency caesarean section. Of the 83 patients who delivered at least once vaginally, 78 had their first delivery before RP. In 34 (40%) of 86 women who attempted a vaginal delivery, deliveries were always uncomplicated (group 2) and in 52 (60%) at least one delivery was associated with an increased risk of obstetric injury according to the predefined risk factors (group 3). Patients in group 1 were significantly younger than patients in both other groups, both at the time of operation and at the time of assessment (P<0.001) (Table 1). The median time from delivery of the first child until the end of the study period was 18.0 (mean 19.6, range 0.1-39.5) years.

Of the 17 patients who delivered by caesarean section, four gave birth before and 13 after RP. Indications for caesarean section before RP were purely obstetric in three patients and a result of surgical advice in one patient. After RP the decision to perform a caesarean section was made on obstetric grounds in two patients, for surgical reasons in five patients, and as a result of mutual agreement between the patient, gynaecologist and surgeon in six. The indication for emergency caesarean section in three women was obstetric.

Thirteen (6.5%) of the 199 patients who fully completed the questionnaires underwent pouch excision. Three of these women previously had a vaginal delivery and all three had a delivery with increased risk of obstetric injury.

**Functional outcome**

Long-term functional outcome in the 172 patients was assessed using the COREFO questionnaire (Table 1). Most patients had a daily defaecation frequency of seven or less and a nightly defaecation frequency of two or less. Perfect continence was reported in 32.6% of the patients and this did not differ significantly between the three groups (P=0.164). Some 21.0% reported soiling during the day at least once a week. During the night, this was 27.3%. A total of 10.1% of the women reported no defaecation during the night.

There was no difference in mean scores on various scales from the COREFO questionnaire between the three groups (Table 1). However, when univariate linear regression analysis was performed to evaluate time effects, a significant increase in incontinence, social impact and total scores in group 3 was observed with increasing length of postoperative follow-up (R=0.402, P<0.001; R=0.084, P=0.037; and R=0.147, P=0.005, respectively) (Figure 2).
Scores for frequency, medication and bowel motion-related aspects did not correlate significantly with the duration of follow-up in group 3. In groups 1 and 2 there was no correlation between length of postoperative follow-up and subscale score or the total score for functional outcome.

<table>
<thead>
<tr>
<th>Table 1 Functional outcome of the three groups included in analysis</th>
<th>All patients (n = 172)</th>
<th>Group 1 (n = 72)</th>
<th>Group 2 (n = 34)</th>
<th>Group 3 (n = 52)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incontinence*</td>
<td>17.4 (13.9)</td>
<td>16.2</td>
<td>18.5</td>
<td>18.5</td>
<td>0.356†</td>
</tr>
<tr>
<td>Social impact*</td>
<td>21.8 (13.9)</td>
<td>24.1</td>
<td>22.8</td>
<td>19.5</td>
<td>0.460†</td>
</tr>
<tr>
<td>Frequency*</td>
<td>40.0 (37.5)</td>
<td>41.1</td>
<td>40.4</td>
<td>37.7</td>
<td>0.548†</td>
</tr>
<tr>
<td>Bowel motion aspects*</td>
<td>24.7 (25.0)</td>
<td>28.4</td>
<td>22.8</td>
<td>20.7</td>
<td>0.197†</td>
</tr>
<tr>
<td>Medication*</td>
<td>22.7 (16.7)</td>
<td>26.0</td>
<td>18.4</td>
<td>22.9</td>
<td>0.500†</td>
</tr>
<tr>
<td>Total score*</td>
<td>22.1 (19.2)</td>
<td>23.4</td>
<td>22.2</td>
<td>21.0</td>
<td>0.801†</td>
</tr>
<tr>
<td>Age at time of operation (years)*</td>
<td>33.4 (34.7)</td>
<td>31.5</td>
<td>40.3</td>
<td>35.8</td>
<td>&lt;0.001†</td>
</tr>
<tr>
<td>Age at time of assessment (years)*</td>
<td>42.1 (42.0)</td>
<td>38.6</td>
<td>48.7</td>
<td>43.4</td>
<td>&lt;0.001†</td>
</tr>
<tr>
<td>Postoperative follow-up (years)*</td>
<td>7.7 (7.2)</td>
<td>7.1</td>
<td>8.5</td>
<td>7.7</td>
<td>0.213†</td>
</tr>
<tr>
<td>Daily frequency (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.462‡</td>
</tr>
<tr>
<td>- 2-4 times</td>
<td>22.2</td>
<td>19</td>
<td>21</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>- 5-7 times</td>
<td>55.7</td>
<td>54</td>
<td>50</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>- &gt; 8 times</td>
<td>22.2</td>
<td>26</td>
<td>29</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Nightly frequency (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.934‡</td>
</tr>
<tr>
<td>- None</td>
<td>10.1</td>
<td>11</td>
<td>12</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>- 1-2 times</td>
<td>69.6</td>
<td>67</td>
<td>74</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>- &gt; 3 times</td>
<td>20.2</td>
<td>22</td>
<td>15</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Soiling at night (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.924‡</td>
</tr>
<tr>
<td>- None</td>
<td>56.1</td>
<td>60</td>
<td>59</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>- Less than once</td>
<td>16.6</td>
<td>14</td>
<td>15</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>- 1-2 times</td>
<td>14.6</td>
<td>15</td>
<td>15</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>- &gt; 3 times</td>
<td>12.7</td>
<td>11</td>
<td>12</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Soiling during day (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.877</td>
</tr>
<tr>
<td>- None</td>
<td>57.3</td>
<td>61</td>
<td>53</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>- Less than once</td>
<td>21.7</td>
<td>18</td>
<td>24</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>- 1-2 times</td>
<td>8.9</td>
<td>7</td>
<td>15</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>- &gt; 3 times</td>
<td>12.1</td>
<td>14</td>
<td>9</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

*Values are mean / values in parentheses are median / Group 1 = no childbirth / Group 2 = uncomplicated vaginal delivery / Group 3 = high risk of obstetric injury / †Kruskal-Wallis test / ‡χ²-test (group 1 versus group 2 versus group 3)
Ageing was found to correlate with higher incontinence scores in univariate linear regression analysis in group 3 (R=0.086, P=0.035) (Figure 3), but not with any of the other subscales or total score for functional outcome. In groups 1 and 2, there was no correlation between ageing and any of the subscales or the total score.

Multiple linear regression analysis was performed to determine whether the correlations in group 3 calculated by univariate linear regression, were significantly different from those in groups 1 and 2. The correlation between incontinence scores and duration of postoperative follow-up in group 3 was significantly different from that in both other groups (P=0.004). The correlation of incontinence scores with ageing in group 3 was different from that in group 2 (P=0.048) but not group 1. The correlations between social impact or total scores and length of postoperative follow-up in group 3 were not significantly different from those in both other groups (P=0.431 and P=0.265, respectively).

In an attempt to distinguish the effects of ageing and length of postoperative follow-up on continence, each of the three groups was divided into two subgroups with higher and lower than median age (34.7 years) at the time of operation. To test whether the correlation between

Figure 2  Multiple regression analysis: effect of follow-up on incontinence scores
duration of postoperative follow-up and incontinence scores varied between the age groups, the predictors were included in a multiple linear regression model. In none of the three groups was there a significant difference between the two age subgroups after adjustment for length of postoperative follow-up (P=0.687, P=0.640, and P=0.703 for groups 1, 2, and 3, respectively).

Considering only patients with a postoperative follow-up of more than 10 years, the 13 women with an uncomplicated delivery had significantly lower incontinence scores than the 17 who had a delivery with an increased risk of obstetric injury (P=0.012) (Figure 4). Incontinence scores were significantly worse in women with follow-up of less than 1 year after RP than in those with longer follow-up (P=0.001) (Figure 5).

**Discussion**
This study shows that vaginal delivery does not necessarily impair faecal continence in women who have undergone RP. However, patients who had a vaginal delivery with a high risk of ob-
**Figure 4** Incontinence scores in patients with an uncomplicated vaginal delivery or a high risk of obstetric injury who were followed up for more than 10 years

Kruskal Wallis test, $P = 0.012$

**Figure 5** Incontinence scores in relation to length of follow-up
Obstetric injury had significantly higher incontinence scores with ageing and increasing length of postoperative follow-up than those who had an uncomplicated vaginal delivery.

The present study is one of the largest to assess long-term pouch function specifically in women. Although a response bias cannot be excluded, this was unlikely because the major reason for a lack of response to the questionnaires was an incorrect address.

No discrimination between deliveries that occurred before or after RP was made, because it can be expected that obstetric injury (damage to the pudendal nerves, pelvic floor or anal sphincters) before RP can have a negative impact on function of a pouch constructed at a later date. This is in contrast to other studies that evaluated the effects of childbirth on pouch function.8,9

Patients in group 1 were significantly younger than those in the other groups. In the Netherlands, the mean age of a mother at the time of a first delivery is approximately 30 years.12 The median age of patients in group 1 was 38.6 years and it is likely that only a small proportion of these patients will have children in the future.

Overall functional outcome in terms of daily and nightly frequency were similar to published figures.13–15 The pouch was excised in 6.5% of the women, comparable with other large series with long-term follow-up.16,17 Although three of the 13 patients who had the pouch excised had a delivery with an increased risk of obstetric injury, it is not known whether obstetric injury was the cause of pouch excision.

No significant differences between the three groups were apparent when mean scores on the different subscales were compared using a non-parametric test. The fact that there were no differences in functional outcome scores is in accordance with the results of most other studies. Significant differences in incontinence scores were noted only between groups 2 and 3 in women with a minimum postoperative follow-up of 10 years. Linear regression analysis gave more insight into the time effects of ageing and duration of follow-up. Ageing and length of postoperative follow-up were significantly associated with higher incontinence scores in group 3 only, and both correlations in this group were significantly different from those in group 2. It is difficult to explain why there was no effect of ageing on incontinence scores in group 2. A few outliers with high incontinence scores among relatively young patients might partially explain the paradoxical effect of ageing in this group. Despite the correlation of both ageing and postoperative follow-up with social impact and total scores in group 3, these were not statistically different from correlations in group 1 and 2 in multiple linear regression.

Although it is difficult to discriminate between the effect of longer follow-up and ageing (patients become older with increasing follow-up), it seems that the effect of postoperative follow-up in group 3 was more strongly associated with higher incontinence scores than was ageing. Ramalingam et al.18 have already hypothesized that incontinence in middle age is probably the result of several ‘hits’, including ageing and obstetric injury. Anal sphincter defects might initially be masked by compensation of the puborectal muscle. However with ageing, especially after menopause, muscle strength is thought to decrease, eventually resulting in symptomatic incontinence.19 Faecal incontinence is estimated to occur in about 2% of
the adult general population and in about 7% of healthy independent adults over the age of 65 years.20–24 Patients in the present study were generally young (half were younger than 42.0 years). A considerable number of young patients had high incontinence scores. This might be related to the ileal pouch function itself and therefore be inevitable. However, most patients with higher incontinence scores had a delivery with an increased risk of obstetric injury. Although comparison with a control group of healthy women from the general population was not performed, it is conceivable that the present patients became less continent earlier in life. A recent study from the Cleveland Clinic, in which the effect of vaginal delivery on pouch function was assessed, concluded that vaginal delivery was associated with a higher incidence of anal sphincter injury than caesarean section.25 Although anal sphincter damage did not substantially influence pouch function in these patients on short-term follow-up, the authors concluded that long-term effects remain unknown.

In this study patients with a postoperative follow-up of less than 1 year after RP had higher incontinence scores than women with longer follow-up. This can be explained by the fact that it takes about 18 months for the pouch to reach its final volume, during which time function improves.

The defined risk factors for obstetric injury are well recognized.26 However, it can only be assumed that patients with a vaginal delivery in which one of these factors was present actually had an increased risk of obstetric injury. Objective measurements such as ultrasonography of the anal sphincter, anal manometry and assessment of pudendal nerve function were not performed to confirm the presence of such injury. The association between both ageing and length of postoperative follow-up with higher incontinence scores might be stronger if more objective measurements had been made to decrease the number of false positives (predefined risk factor for obstetric injury present without objective findings) and false negatives (absence of predefined risk factor for obstetric injury with positive objective findings). Therefore, the impact of obstetric injury as assessed in the present study might have been underestimated.

In this retrospective study, women who had a vaginal delivery with an increased risk of obstetric injury had significantly worse functional outcome in terms of continence in the long term. The most likely reason for this was occult sphincter or pelvic floor damage. Because incontinence and night-time stool frequency have been shown to be the most important determinants of quality of life after RP27, preservation of the anal sphincter as a key factor in continence is of great importance. Patients with ulcerative colitis or FAP should be informed about the considerable risk of vaginal delivery on long-term pouch function, which can be avoided by an elective caesarean section.

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