

Long-Term Follow-Up of Gracilis Muscle Transposition in Children

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Sixteen children of uncontrollable fecal incontinence have been treated with Pickrell's gracilis muscle transposition since 1983: 12 had an imperforate anuses with multiple corrective operative procedures and 4 had traumatic destructions of anal sphincters. We report a series of 11 cases whom we followed-up over a period of 0.8 to 10.5 years (mean; 5.6 years). Seven patients were evaluated by anorectal manometry. All patients except one who had left hemipelvectomy and permanent colostomy showed nearly normal continence during the follow-up period. There was no evidence of fibrosis in the transposed muscles and the tensions of the transposed muscles were well maintained. The voluntary contractions of the transposed muscles were well maintained and efficient in all cases. The general manometric parameters did not correlate well with the functional results; however, there was a strong correlation in the S/R ratio (maximum squeeze pressure/resting pressure) with the functional results. We believe that the good functional outcome of this procedure need not only the meticulous surgical technique but also the personal motivation and the compliance with physiotherapy. In conclusion, although the gracilis muscle transposition never results in normal continence, acceptable continence can be achieved in the selected patients.

Key Words: Fecal incontinence, gracilis muscle transposition, anorectal manometry

Children with fecal incontinence or smearing are always handicapped in their personality development and social adaptation. Despite recent improvement in the management of an imperforate anus, a few of the children remain incontinent with repeated operations and conservative managements. Severe traumatic perineal injury with sphincter muscle destruction occasionally results in fecal incontinence.

Since the original description of the gracilis muscle transposition (Pickrell *et al.* 1952), this procedure has become the last resort for the treatment of fecal incontinence (Raffensper-

ger, 1979; Leguit *et al.* 1985; Sonnino *et al.* 1991).

We report a long-term follow-up study of 11 children who underwent the gracilis muscle transposition for total fecal incontinence. The subjective functional results are compared with the objective manometric parameters.

MATERIALS AND METHODS

Sixteen children underwent gracilis muscle transposition for fecal incontinence from 1983 to 1994. Eleven patients were able to be followed-up on by Templeton's questionnaires for fecal continence (Templeton and Dietesheim, 1985). The follow-up period ranged from 0.8 years to 10.5 years (mean; 5.6 years). The clinical history and functional results of eleven patients are summarized in Table 1. The postoperative manometric studies were per-

Received July 25, 1995

Accepted September 5, 1995

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formed on seven patients. The functional results were compared with manometric parameters.

CASE REPORTS

Case 1. A 2-year-old boy had suffered from severe pelvic trauma with avulsion injury of left lower extremity. On rectal examination, the entire sphincter apparatus had been destroyed by a large perineal defect. He had undergone the left hemipelvectomy and protective colostomy. The infected perineal wound healed up but the anus was patulous with severe perianal fibrosis. After wound healing, there was no contraction of the anal sphincter but the rectal sensation was intact. At five years of age, he underwent the gracilis muscle transposition.

Case 2. A 15-year-old boy remained totally incontinent despite numerous surgical procedures for a high imperforate anus. On rectal examination, his anus was widely patent with minimal sphincter contraction. An electromyographic study on the external anal sphincter showed reduced motor unit recruitment patterns in all direction of the anal sphincter.

Case 3. A 19-year-old girl had a protective colostomy performed in another hospital for major perineal injury. She was referred to our hospital because of the absence of anal sphincter tone. On rectal examination, her anus was patulous with no appreciable sphincter contraction but rectal sensation was well preserved. The electromyographic study revealed complete denervation of the anal sphincter muscle.

Case 4. A 9-year-old boy had suffered from socially embarrassing incontinence, after a pull-through operation for an imperforate anus which had been performed at 12 months of age in another hospital. On rectal examination, only weak and ineffective contractions of the anal sphincter could be felt. The pelvic computerized tomography showed normal position of the rectum in the external sphincteric apparatus.

Case 5. A 3-year-old girl underwent a

sacroabdominoperineal pull-through operation for an imperforate anus. At 7 years of age, she was totally incontinent in spite of conservative managements. On rectal examination, her anus had minimal sphincter contractions. An electromyographic study showed reduced recruitment patterns of motor unit potential in the left anal sphincter.

Case 6. A male infant underwent repair of a high imperforate anus. At 1.7 years of age, he underwent a V-Y advancement anoplasty for an anal stenosis. At 6 years of age, he suffered from total incontinence in spite of conservative management. On rectal examination, only weak and ineffective contractions of the external sphincter could be felt. Computerized tomography showed severe atrophy of the puborectalis muscle. Electromyographic study revealed reduced recruitment patterns of the anal sphincter.

Case 7. A 1-year-old girl underwent posterior sagittal anorectoplasty for an imperforate anus at another hospital. At 5 years of age, she was referred to our hospital due to total incontinence under conservative management. On rectal examination, her anus had minimal sphincter contraction. An electromyographic study showed reduced recruitment patterns of motor unit of the anal sphincter muscle.

Case 8. A 11-year-old boy had been totally incontinent after an abdominosacroperineal pull-through operation for a high imperforate anus at 14 months of age. He had a congenital sacral anomaly as well. Right gracilis muscle transposition was performed at six years of age. Despite this procedure and biofeedback training of transposed muscle, he remained unacceptably incontinent. On rectal examination, the previous transposed muscle felt loose. The contralateral gracilis muscle transposition was performed.

Case 9. A 4-year-old girl had suffered from severe pelvic trauma with a large perineal defect. On rectal examination, the anal sphincter apparatus had been destroyed by trauma. She had undergone diverting colostomy. The infected perineal wound had healed up but the anus was patulous. There was no contraction of the anal sphincter but the rectal sensation was preserved. The gracilis muscle transposi-

tion was performed at 6 years of age.

Case 10. A 8-year-old boy has suffered from fecal incontinence after several unsuccessful attempts to repair the imperforate anus at another hospital. The right gracilis muscle transposition was performed at 6 years of age. The transposed gracilis muscle was lost due to a postoperative wound sepsis. Two years after the first transposition, he underwent the contralateral gracilis muscle transposition.

Case 11. A 6-year-old boy referred to our hospital from another hospital where he had undergone diverting colostomy two years ago because of severe perineal injury. On rectal examination, the anal sphincter apparatus had been destroyed by trauma. The anus was patent and there was no contraction of the anal sphincter. The rectal sensation was intact. The electromyographic study showed decreased motor unit potential of external sphincter.

OPERATIVE PROCEDURES

Before operation, the patients were instructed by a physiotherapist on the exercise of the gracilis muscle by EMG based biofeedback therapy for one week. Mechanical bowel cleansing was achieved by a warm saline enema and preoperative antibiotic prophylaxis was given for 3 days.

The operation was performed essentially the same way as described by Pickrell (Pickrell *et al.* 1952). One long incision was made in the medial aspect of the thigh and another short oblique incision was made over the medial condyle of the tibia where the tendon of the gracilis muscle enters as the pes anserinus. After mobilization of the muscle and careful dissection of the neurovascular bundle, the muscle was drawn clockwise or counterclockwise around the anal canal through two or four perianal incisions. These incisions were chosen to preserve the anterior and posterior raphe under where the muscle and its tendon was positioned. Finally, before the tendon was sutured to the opposite ischial tuberosity with non-absorbable sutures, the thigh was ad-

ducted to its normal position to ensure tight closure of the anal canal in this position. After the operation, the patients were placed on liquid diets and loperamides for 5 days, and were confined to their beds with both legs adducted for 10 days. The gracilis muscle exercise was started on the 14th day after the operation and continued for several months after discharge.

MANOMETRIC STUDY

The flexible multichannel catheter was perfused with normal saline (0.6 mL/min) by a lower-compliance pneumohydraulic capillary infusion pump (Arndorf Medical Specialists, USA). The infusion system was linked to a personal computer software (Polygram, Lower GI edition, Version 5.06C4, Gastrosoft Inc). The patient was placed on a left lateral position and the anus was calibrated at zero. No enema was given. We measured rectal sensation using a balloon distention test. The collapsed balloon which connected to the catheter was inserted into the rectum and then it was inflated with progressive volumes of air by a hand-held syringe. The volume of the first defecation sensation was recorded as a sensory threshold. The maximum tolerated volume was the inflated volume when the patient could not tolerate. The mean resting pressure of the anal sphincter and the length of the anal canal length were recorded by a station-pull through technique. The maximum squeeze pressure was recorded when the patient voluntarily contracted the sphincter muscles. The rectoanal inhibitory reflex was checked.

RESULTS

All patients except case 1 had acceptable continence after gracilis muscle transposition; scored as fair or good by Templeton's score (Table 1). There were 3 failures out of thirteen gracilis muscle transpositions. The first

Table 1. Summary of clinical history and follow-up results

No.	Sex	Age*(yrs)	Etiology	Follow-up(yrs)	Functional results**
1.	M	5	Trauma	6	Poor
2.	M	15	Imperforate anus	0.8	Good
3.	F	19	Tranuma	6	Good
4.	M	9	Imperforate anus	10.5	Fair
5.	F	7	Imperforate anus	6	Fair
6.	M	6	Imperforate anus	5	Fair
7.	F	5	Imperforate anus	4	Fair
8.	M	11	Imperforate anus	3	Good***
9.	F	6	Trauma	5	Fair
10.	M	8	Imperforate anus	8	Good****
11.	M	6	Trauma	8	Good

*Age at operation

**Functional results interpreted according to Templeton JM⁶

***Functional results of second gracilis muscle transposition after previous failure

Table 2. Long-term postoperative manometric evaluation

No.	Resting pressure (mm Hg)	Squeeze pressure (mm Hg)	Anal canal length(cm)	Sensory threshold(mL)	Rectal capacity(mL)	RAIR
1.	42	100	3	20	30	+
2.	19	98	2	5	30	-
3.	45	93	4.5	50	130	+
4.	51	158	3	?	?	-
5.	12	40	3	?	?	+
6.	18	86	2	70	110	+
7.	14	60	2.5	60	130	-

RAIR: Rectoanal inhibitory reflex

? The values of rectal sensation could not be obtained due to poor cooperation of children.

(case 1), was the patient with the permanent colostomy because of the severe perianal scar contracture despite the function of the neosphincter. The second (case 8) failed from the looseness of the transposed muscle. The third (case 10) was the result of a severe wound infection which ended in the loss of the transposed muscle. Two patients (case 8, 10) underwent reoperation with contralateral gracilis muscle transposition and they controlled their feces and flatus after the second operation.

The postoperative manometric parameters do not correlate well with the clinical results

(Table 2). We used the S/R ratio (maximum squeeze pressure/resting pressure) for evaluation of the results because there was no age-matched normal values of manometric parameters in children. In a normal individual, the S/R ratio would range from 2 to 3 because intra-anal pressures usually reach two or three times their baseline resting value during a maximum squeeze effort (Jorge and Wexner, 1993). Figure 1 demonstrates the relationship between the S/R ratio and the functional results.

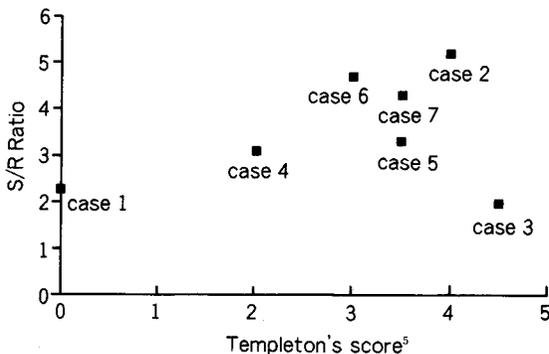


Fig. 1. The S/R ratio shows good correlation with the Templeton's score. The case 1 had permanent colostomy due to severe perianal scar contracture, but the S/R ratio of this patient reveals good voluntary contraction of transposed muscle.

DISCUSSION

Results of gracilis muscle transposition for anal incontinence have been conflicting after Pickrell's original description. Previous reports revealed the favorable results in young patients with congenital anal incontinence (Corman, 1980; Schärli, 1987; Sonnino *et al.* 1991) and irreparable traumatic damage (McGregor, 1965; Nieves *et al.* 1975). But Yoshioka reported extremely poor results in a series of six children (Yoshioka and Keighley, 1988). Five of their six patients suffered severe postoperative sepsis.

We also experienced surgical failure of severe local sepsis in one case. It seems that the meticulous surgical technique with careful dissection and preservation of the vascular supply in the transposed muscle obviates ischemic necrosis and infection. We also experienced another failure because of a loosening of the transposed muscle. Another important technical detail seems to be the adduction of the legs before suturing the gracilis tendon to the ischial tuberosity for prevention of a loosening of the transposed gracilis muscle (Leguit *et al.* 1985). Despite the failure of the first op-

eration, contralateral transposition eventually gave nearly complete continence to two patients.

Evaluation of anal incontinence and its surgical result is difficult both subjectively and objectively. Many systems of scoring have been suggested but they are largely based on historic data such as the number of inadvertent stools passed, frequency of soiling, etc (Templeton and Dietesheim, 1985; Kelly, 1969; Cywes *et al.* 1971). Anal manometry has proved to be a valuable objective indicator of the degree of incontinence. However, the manometric examination may be too coarse to measure finer differences in the sphincter's function. Read found that there was a high degree of overlap in the results of an anal manometry between normal and incontinent subjects (Read *et al.* 1979). This suggested that some causes of incontinence were not reflected by reduced anal sphincter pressure as reported. A major problem in studying young children is that such subjects may be unable or unwilling to cooperate while maximum squeeze pressure is measuring. Furthermore, even if some cooperation is obtained, the observer cannot be sure that the maximum pressure has been produced. Shandling recommended the anal sphincter force as another objective measurement of strength in the anal sphincter of children, which is the force necessary to withdraw the Foley ballooning from the anal sphincter (Shandling and Gilmour, 1987). However, this force does not give an exact reflection of the maximum squeeze pressure when the patient does not cooperate.

We used the S/R ratio to evaluate the manometric result in children. The S/R ratio showed a strong correlation with the functional result except in case 1 who had permanent colostomy because of severe perianal scar contracture. The S/R ratio seemed to be useful to evaluate the continence in children.

The training of the transposed gracilis muscle under professional surveillance is important and should be continued for several months after operation; in some patients the maximum effect is only obtained after several months of exercise.

Gracilis transposition will not result in

absolute normal control of defecation since a striated muscle is unable to maintain contraction for a prolonged period of time. This problem may be overcome by the implantation of a neuromuscular stimulator, as recently described in a series of reports (Baeten *et al.* 1988; Baeten *et al.* 1991; Konsten *et al.* 1993; William *et al.* 1991; George *et al.* 1993).

In conclusion, based on our long-term follow-up, the gracilis muscle transposition is a good alternative for the treatment of total fecal incontinence in children despite the some problems. The S/R ratio is useful to evaluate the function of a transposed muscle in children.

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