



Original Article

Pelvic reconstruction improves pelvic floor strength in pelvic organ prolapse patients

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ABSTRACT

Objective: To evaluate pelvic floor muscle strength after the modified pelvic reconstruction procedure for pelvic organ prolapse (POP).

Materials and methods: Patients were assigned to two groups consisting of 37 patients diagnosed with POP and undergoing modified pelvic reconstruction (reconstruction group), and 30 patients admitted to our hospital during the same period for other surgical indications (control group). Vaginal palpation of pelvic floor muscle strength was performed according to the modified Oxford grading system before operating on the two groups and again in the 3rd month following surgery for the reconstruction group. A comparative study was performed to evaluate the differences between the two groups and the improvement of pelvic floor muscle strength in the reconstruction group.

Results: The pelvic floor muscle strength was significantly improved postoperatively when compared with preoperative results in the reconstruction group ($t = -17.478$, $p < 0.001$). However, pre- and postoperative muscle strength in the reconstruction group was significantly lower relative to the control group, respectively ($\chi^2 = 63.293$, $p < 0.001$; $\chi^2 = 31.550$, $p < 0.001$).

Conclusion: The modified pelvic reconstruction procedure could improve pelvic floor muscle strength in POP patients, which remains lower when compared with the normal population. Pelvic floor muscle strength should be included in the assessment of surgical outcomes in POP.

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Introduction

The pelvic reconstruction procedure is widely used for pelvic organ prolapse (POP) globally [1]. Recent studies evaluated the pelvic reconstruction procedure in terms of clinical outcomes and improved quality of life [1–7], however, none have assessed its impact on pelvic floor muscle strength in POP patients. Therefore, it is yet to be determined whether surgical intervention involving pelvic reconstruction is capable of altering pelvic floor muscle strength. Considering that pelvic floor muscle strength could play a role in POP pathogenesis and its recurrence after surgical management, complete assessment of the pelvic reconstruction procedure should include pre- and postoperative muscle strength in addition to clinical outcomes and quality of life.

As a representative surgical system, the “Prolift” procedure is widely used for anterior wall prolapse worldwide [1]. However, it was withdrawn from the medical market globally because of complications due to the mesh material. Recently, a modified uterus-conserving pelvic floor slingplasty was reported [8] based on Ulmsten's theory, the efficacy and safety of which was confirmed in our previous study [9].

In this study, muscle strength in POP patients was measured before and after the modified pelvic reconstruction procedure in order to investigate the impact of pelvic surgery on the recovery of pelvic muscle strength.

Materials and methods

Patient selection

For the reconstruction group, the inclusion criteria were women with Stage III and Stage IV symptomatic vaginal wall prolapse assigned to receive the modified pelvic reconstruction procedure

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Table 1

Preoperative Oxford grading of pelvic floor muscle strength: reconstruction group vs. control group.

Group	N	0	1	2	3	4	5	χ^2	p
Control group	30	0	0	0	0	11	19	63.293	<0.001
Reconstruction group (preoperative)	37	0	15	16	5	1	0		

Table 2

Oxford grading of pelvic floor muscle strength: preoperative group vs. postoperative group.

Reconstruction group	N	0	1	2	3	4	5	t	p
Preoperative	37	0	15	16	5	1	0	-17.478	<0.001
Postoperative	37	0	0	1	8	27	1		

and willing to participate in the study. For the control group, the inclusion criteria were women with a clear indication for oophorectomy due to benign disease and willing to participate in the study. Excluded from both groups were those with a clear indication to hysterectomy, history of hysterectomy, or pelvic surgeries, urinary incontinence, neurological diseases, mental disorder, pregnancy, or lactation.

All patients gave written consent to participate and the local ethical committee approved the study. Pelvic floor exercise was not recommended to the patients in both groups pre- or postoperatively during the follow-up period.

The palpation test of pelvic floor muscle strength

Pelvic floor muscle strength was tested within one week prior to the operation in both the reconstruction and control groups and again at the 3rd month after surgery in the reconstruction group.

An experienced physical therapist conducted the tests. In order to reduce subjective bias, the therapist was not informed of the grouping of the patients. The palpation test was performed in random order when the patients were not in the period of menstruation. After thorough instruction on how to correctly contract the pelvic muscle, patients were told to relax in a resting room for 30 minutes before testing.

During testing, the patients were in the supine position after emptying their bladder. The position of the levator ani muscle was identified by putting the forefinger and middle finger into the vagina and advising the patient to contract correctly. The two fingers in the vagina were separated and positioned on two sides of the levator ani muscle. The patient was told to contract the anus with maximum strength. Meanwhile, another hand was placed on the abdomen to determine whether the abdominal muscle was relaxed. The contraction was graded according to the modified Oxford grading system [10]. After a 5-minute rest, the physical therapist repeated the procedure.

Surgical procedure

Patients enrolled into the reconstruction group underwent pelvic reconstructive procedure as previously described by Fatton et al [1]. In the reconstruction group, 20 patients underwent total pelvic floor reconstruction, 10 patients underwent anterior wall

reconstruction, and 7 patients underwent posterior wall reconstruction. All procedures were performed by two experienced surgeons.

Statistical analysis

The values and variables were indicated as mean \pm standard deviation. Student *t* test was performed for comparison of variables in the Gaussian distribution and the Chi-square test was used to evaluate differences in the distribution of pelvic floor muscle strength pre- and postoperatively between the study and control groups. Paired Student *t* test was used to evaluate the improvement of pelvic floor muscle strength in the reconstruction group. The differences and correlations were considered as statistically significant at *p* < 0.05. All statistical analyses were carried out using SPSS version 13.0 (SPSS Inc., Chicago, IL, USA).

Results

In this study, 37 POP patients receiving the modified pelvic reconstruction procedure were included as a study group and 30 women admitted with other surgical indications were included as a control group from 2008 to 2010. A comparative study was performed to evaluate improvement of pelvic floor muscle strength in the reconstruction group. Furthermore, the pre- and postoperative muscle strengths in the reconstruction group were compared with the control group, respectively.

There were no significant differences in demographic parameters between the reconstruction and control groups, including age, body mass index, vaginal deliveries, menopause status, and hormone therapy (all *p* > 0.05).

Preoperative Oxford grading of pelvic floor muscle strength was significantly lower for the reconstruction group when compared with the control group (Table 1). Postoperative pelvic floor muscle strength was significantly improved relative to pre-operative results in the reconstruction group (Table 2), however, postoperative pelvic floor muscle strength in the reconstruction group was significantly lower relative to the control group (Table 3).

Discussion

The main finding of this study was that the pelvic floor muscle strength was significantly improved in women who underwent the modified pelvic reconstruction procedure, but remained lower than the normal population.

The relationship between the POP and pelvic floor muscle strength has been well established in previous studies. The levator ani muscle is a major component of the pelvic floor muscle and plays an important role in supporting the pelvic organs. The elevated intra-abdominal pressure caused by some factors, such as

Table 3

Postoperative Oxford grading of pelvic floor muscle strength: reconstruction group vs. control group.

Group	N	0	1	2	3	4	5	χ^2	p
Control group	30	0	0	0	0	11	19	31.550	<0.001
Reconstruction group (postoperative)	37	0	0	1	8	27	1		

pregnancy and chronic cough, enhances contraction of the levator ani muscle, which can lead to long-term muscle overload [11,12]. If the contraction force exceeds 30% of maximal voluntary contraction, local blood vessels could be oppressed, leading to muscle ischemia, degeneration, atrophy, and pelvic floor muscle weakness, thus giving rise to pelvic floor disorders. Furthermore, previous studies indicated significant pathological changes in the levator ani muscle from biopsy specimens of POP patients [13–16], including decreased muscle fiber density, island-shaped distribution, increased fibrous tissue, inflammatory cell infiltration, and reduced numbers of nerve fibers. These changes may provide possible pathological bases for POP occurrence and development.

As a widely used total pelvic reconstructive surgery, the aim of the modified pelvic reconstruction procedure is to restore the anatomical structure of the prolapsed pelvic floor. If the expected surgical efficacy is achieved, the overloaded burden of pelvic muscles is alleviated by anatomical reduction of the pelvic organs, resulting in improved blood circulation and local nutrition, which could promote regeneration of impaired pelvic muscle fibers, recovery of neurological function, prevention of muscle atrophy, and improvement in muscle strength and motor function. Additionally, anatomical reduction may improve the coordination of pelvic floor muscle contraction, consequently generating larger torque with smaller contractile strength at the right angle. Finally, it could ameliorate muscle hyperextension and avoid muscle fatigue. Based on these findings, pelvic floor muscle strength can be improved by surgical intervention due to anatomical reduction, which was confirmed in this study. Therefore, we argue that pelvic floor muscle strength should be an important parameter in the assessment of surgical outcomes in POP and be included in both clinical evaluations and well-designed studies.

In the present study, the pre- and postoperative pelvic floor muscle strength was significantly lower than the normal population, indicating that pelvic floor muscle strength was poor in POP patients and could be associated with POP pathogenesis. The relatively low level of pelvic floor muscle strength in postoperative POP patients could contribute to POP recurrence. However, this interpretation should be carefully adapted, given its basis on the results of pelvic floor muscle strength at the 3rd month following surgery in the reconstruction group. These results merit further investigation into whether muscle strength restoration might be observed in a longer follow-up study.

Current research into pelvic floor muscle strength mainly focuses on the levator ani muscle [13,14,17,18]. Several methods are available for measuring levator ani muscle strength, including vaginal palpation, needle electrode for electromyography, surface electrode for electromyography, and vaginal pressure measurements. Among vaginal pressure measurements, vaginal palpation is more simple and feasible, whereas other methods have major drawbacks due to the complex apparatus required and instability based on various factors, such as body mass index, vaginal length, and location of the vaginal probe [19].

The major limitation of vaginal palpation is measurement bias, due to its reliance on subjective assessment. In the present study, an experienced physical therapist conducted the tests without being informed of the grouping of the patients, which partially eliminated subjective bias. However, it was impossible to avoid subjective bias completely, because measurements were subjective, indicating defects in the Oxford grading system, which need to be improved upon.

In conclusion, we present our results of evaluating the surgical efficacy of pelvic surgery for POP by measuring pre- and postoperative pelvic floor muscle strength. Our results indicate that current available methods for measuring muscle strength need to

be improved upon in order to reflect the exact conditions of pelvic floor muscle strength. Therefore, it is imperative that simpler, more feasible and reliable methods for detecting pelvic floor muscle strength be determined for clinical research.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

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References

- [1] Fattouh B, Amblard J, Debodinance P, Cosson M, Jacquelin B. Transvaginal repair of genital prolapse: preliminary results of a new tension-free vaginal mesh (Prolift technique)—a case series multicentric study. *Int Urogynecol J Pelvic Floor Dysfunct* 2007;18:743–52.
- [2] Vaiyapuri GR, Han HC, Lee LC, Tseng LA, Wong HF. Use of the Gynecare Prolift system in surgery for pelvic organ prolapse: 1-year outcome. *Int Urogynecol J* 2011;22:869–77.
- [3] Huang WC, Lin TY, Lau HH, Chen SS, Hsieh CH, Su TH. Outcome of transvaginal pelvic reconstructive surgery with Prolift after a median of 2 years' follow-up. *Int Urogynecol J* 2011;22:197–203.
- [4] Benbouzid S, Cornu JN, Benchikh A, Chanu T, Haab F, Delmas V. Pelvic organ prolapse transvaginal repair by the Prolift system: evaluation of efficacy and complications after a 4.5 years follow up. *Int J Uro* 2012;11:1010–6.
- [5] Gad N, Duvvuru A, Burchgart B. Outcome of Prolift mesh repair in treatment of pelvic organ prolapse and its effect on lower urinary tract symptoms: 5-year retrospective case study. *J Obstet Gynaecol Res* 2012;39:243–9.
- [6] de Landsheere L, Ismail S, Lucot JP, Deken V, Foidart JM, Cosson M. Surgical intervention after transvaginal Prolift mesh repair: retrospective single-center study including 524 patients with 3 years' median follow-up. *Am J Obstet Gynecol* 2012;206:e1–7.
- [7] Cho MK, Kim CH, Kang WD, Kim JW, Kim SM, Kim YH. Anatomic and functional outcomes with the prolift procedure in elderly women with advanced pelvic organ prolapse who desire uterine preservation. *J Minim Invasive Gynecol* 2012;19:307–12.
- [8] Zhu L, Lang J, Sun Z, Ren C, Liu X, Li B. Pelvic reconstruction with mesh for advanced pelvic organ prolapse: a new economic surgical method. *Meno-pause* 2011;18:328–32.
- [9] Yang X, Li H. A modified anterior compartment reconstruction and Prolift-a for the treatment of anterior pelvic organ prolapse: a non-inferiority study. *Arch Gynecol Obstet* 2012;285:1593–7.
- [10] Laycock J. Incontinence. Pelvic floor re-education. *Nursing (Lond)* 1991;4:15–7.
- [11] Thompson JA, O'Sullivan PB, Briffa NK, Neumann P. Altered muscle activation patterns in symptomatic women during pelvic floor muscle contraction and Valsalva manoeuvre. *Neurourol Urodyn* 2006;25:268–76.
- [12] Thompson JA, O'Sullivan PB, Briffa NK, Neumann P. Differences in muscle activation patterns during pelvic floor muscle contraction and Valsalva maneuver. *Neurourol Urodyn* 2006;25:148–55.
- [13] Zhu L, Lang JH, Chen J. Morphologic study on levator ani muscle in patients with pelvic organ prolapse and stress urinary incontinence. *Int Urogynecol J Pelvic Floor Dysfunct* 2005;16:401–4.
- [14] Pierce LM, Baumann S, Rankin MR, Wasserman RM, Biaggi A, Kuehl TJ, et al. Levator ani muscle and connective tissue changes associated with pelvic organ prolapse, parity, and aging in the squirrel monkey: a histologic study. *Am J Obstet Gynecol* 2007;197:e61–9.
- [15] Badiou W, Granier G, Bousquet PJ, Monrozier X, Mares P, de Tayrac R. Comparative histological analysis of anterior vaginal wall in women with pelvic organ prolapse or control subjects. A pilot study. *Int Urogynecol J Pelvic Floor Dysfunct* 2009;20:461–74.
- [16] Kerkhof MH, Hendriks L, Brolmann HA. Changes in connective tissue in patients with pelvic organ prolapse—a review of the current literature. *Int Urogynecol J Pelvic Floor Dysfunct* 2009;20:461–74.
- [17] Chen J, Lang JH, Zhu L, Liu ZF, Sun DW, Leng JH, et al. Study of morphological changes in levator ani muscle of patients with stress urinary incontinence or pelvic organ prolapse. *Zhonghua Fu Chan Ke Za Zhi* 2004;39:519–21.
- [18] Chen J, Lang JH, Zhu L, Ren HT, Zhao YH, Guan HZ. Study of morphological changes in levator ani muscle of patients with stress urinary incontinence. *Zhonghua Fu Chan Ke Za Zhi* 2003;38:733–6.
- [19] Sanches PR, Silva Jr DP, Muller AF, Schmidt AP, Ramos JG, Nohama P. Vaginal probe transducer: characterization and measurement of pelvic-floor strength. *J Biomech* 2009;42:2466–71.