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Comparison between four- and six-arm pelvic organ polypropylene mesh implantation for the treatment of pelvic organ prolapse

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Summary

Purpose: The incidence of pelvic organ prolapse (POP) increases with age, and the frequency of POP surgery has increased with time. The purposes of POP treatment are to restore pelvic anatomy and function, to ameliorate patient symptoms, and to improve quality of life. The present study aimed to compare the anatomic and functional outcomes between four- and six-arm polypropylene mesh implantations. *Materials and Methods:* The authors retrospectively evaluated patients who underwent surgical mesh implantation between January 2011 and July 2014. Group A was composed of patients who underwent four-arm mesh implantation (n=29), and group B consisted of patients who underwent six-arm mesh implantation (n=26). The authors compared operation durations and complications between the two groups. They also evaluated the patients using the Urogenital Distress Inventory (UDI-6) assessment form. *Results:* The average ages of groups A and B were 48.2 ± 8.3 and 39.3 ± 5.6 years, respectively. There were no significant differences in BMI, incontinence duration, operation duration, or post-operative UDI 1-2, 3-4, and 5-6 scores between the two groups. However, the post-operative UDI-6 scores of both groups were significantly lower than their pre-operative scores. *Conclusions:* The authors conclude that four- and six-arm mesh implantations facilitated comparably and significantly anatomic and functional recovery.

Key words: Surgical mesh; Pelvic organ prolapse; Urinary incontinence; Dyspareunia.

Introduction

Pelvic organ prolapse (POP) develops as a result of the loss of muscle and connective tissue supporting the pelvic muscles. POP can occur at any age and is characterized by the downward displacement of the reproductive organs during the Valsalva maneuver [1-4]. POP is frequently asymptomatic, but occasionally causes symptoms such as vaginal bleeding, pelvic pain, posterior or lower abdominal pain, constipation, genitourinary disturbances, urination difficulty, urinary retention, dyspareunia, and sexual dysfunction due to vaginal erosion [5]. Both POP and urinary incontinence (UI) are common complaints and frequently coexist in a patient. The most frequent type of UI is stress urinary incontinence (SUI), which occurs during activities that increase intra-abdominal pressure, such as exertion, coughing or sneezing. The International Continence Society (ICS) defines UI as incontinence that manifests when intra-vesicular pressure exceeds urethral pressure in the absence of increased detrusor muscle activity [6]. Sixty-three percent of women with SUI also have descensus, and 62% of women with descensus have comorbidity SUI [7]. In addition to traditional pelvic reconstruction methods, new surgical techniques for treating POP, including vaginal mesh implantation, have been defined by researchers [8]. Vaginal mesh implantation was first described by Julian *et al.* in 1996. These authors reported that this method significantly reduced recurrence and complication rates [9]. Subsequent studies have since established the high value and importance of meshes in POP surgery [10, 11]. In the present study, the authors aimed to compare treatment outcomes between four- and six-arm mesh implantation as a new treatment for patients with POP and SUI.

Materials and Methods

The authors retrospectively analyzed data pertaining to 55 patients who underwent vaginal mesh implantation between January 2011 and July 2014 in the present clinic. These patients were divided into the following two groups according to treatment modality: the patients who underwent four-arm anterior mesh implantation (n=29) were enrolled in group A, and the patients who underwent six-arm sacrospinous fixation with mesh implantation (n=26) were enrolled in group B. All patients were assessed according to their treatment history as well as the results of physical examinations, urine cultures, and office cystometry. The patients were also evaluated using the Urogenital Distress Inventory (UDI-6) quality of life questionnaire; the Turkish version of the UDI-6 was validated by Cam *et al.* [12]. The UDI-6 form is a self-report questionnaire consisting of six questions assessing the ex-

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istence and severity of urinary symptom-related complaints. The study involved patients with various severities of anterior and posterior POP, as well as patients with clinically and systematically demonstrable SUI accompanied by POP. SUI was diagnosed clinically in affected patients via cystometry, and POP severity determined clinically in accordance with the POP-Q classification. Patients who had undergone previous pelvic surgery, who had recurrent infection or lesions in urinary system or genital organs, or who had cancer and/or radiation exposure in the pelvic area were excluded from the study.

Anterior four-arm mesh implantation: A linear incision was made along the anterior vaginal mucosa, approximately 2.5 cm below the external urethral meatus, and the space was dissected until the base of the bladder was reached. Then, the vesico-vaginal ligaments were retracted, and the proximal portion of the four-arm mesh was passed over the arcus tendineus fasciae pelvis (ATFP) using an obturator fossa guide. The posterior portion of the four-arm mesh was subsequently passed through the obturator foramen, and the anterior arms were used to construct a mid-urethral sling, as in the intra-vaginal slingplasty (IVS) procedure, to support the midurethra and the bladder. The posterior fringes of the mesh were fixed to the sacrouterine and cardinal ligaments, and the posterior arms of the mesh were fixed at the level of the skin by performing traction; however, the anterior portion was not fixed at the level of the midurethra or skin. Instead, tension-free placement was performed. Finally, the vaginal mucosa was sutured in a continuous locking fashion using no. 1 Vicryl suture material.

Anterior six-arm mesh implantation: The proximal and distal portions of the six-arm mesh were implanted in a manner similar to that described for the four-arm mesh. The posterior fringes of the mesh were fixed to both the cardinal and sacrouterine ligaments, as well as the most distal 2-cm portion of the bilateral sacrospinous ligament, using a suture-capturing device. During the procedure, rectovaginal fascia dissection was performed beginning at the posterior vagina. Grade IV posterior prolapse was dissected broadly up to the apical region of the vagina. The tissue extending from the vaginal mucosa to the bladder floor was sutured in a continuous locking fashion using no. 2/0 Vicryl suture material, after which a purche suture was placed. Posterior repair was then performed by excising the prolapsed tissue in the shape of a wide lambda. Horizontal dissection of the perineum was performed next. The levator ani muscle was fixed to the pararectal region bilaterally, and perineoplasty was performed to enhance fixation to the medial portion of the puborectal (levator ani) muscle. Cleaning was performed, hemostasis was confirmed, and the operation was concluded by placing two tampons in the vagina.

Statistical analyses were conducted using SPSS version 21.0 software. Student's *t*-test was used for parametric variables, and the Mann-Whitney U test was used for nonparametric variables. A $p < 0.05$ was considered statistically significant.

Results

A total of 55 patients with POP with SUI were recruited for the study. Fifteen patients (65.2%) were found to have stage 3 anterior prolapse according to the POP-Q classification. The mean ages of groups A and B were 48.2±8.3 and 39.3±5.6 years, respectively; this difference was statistically significant. However, no other statistically significant differences in BMI, incontinence duration, operation duration, or post-operative UDI 1-2, 3-4, and 5-6 scores were noted between the two groups. All of these results are presented in Table 1. The patients in groups A and B experienced a significant decreases in their pre- and post-operative UDI 1-2, 3-4, and 5-6 scores ($p < 0.05$) (Tables 2 and 3). However, when the post-operative UDI 1-2, 3-4, and 5-6 scores were compared between the two groups, the two methods were found to have yielded similar results ($p > 0.05$) (Table 1). None of the patients experienced operative failure, which was defined as prolapse recurrence during the early post-operative period. None of the patients developed permanent urinary retention, although seven patients in group A and three patients in group B developed de novo urgency, which was treated successfully using short-term anticholinergic medication. Additionally, nine patients in group A and six patients in group B developed de novo dysuria, although no infections were detected via urine cultures. This symptom resolved within a short period. Nine patients in group A and six patients in group B experienced temporary urinary retention and were therefore catheterized for intervals ranging from three to five until recovery was observed. One patient in group B suffered an intraoperative urethral injury, which was repaired during the procedure by urologists. During the post-operative period, 26 patients in group A and 23 patients in group B developed pelvic pain, which was managed with physical exercise. One patient in group B experienced mesh erosion. The eroded area was subsequently dissected and treated with both local and systemic antibiotic therapy. One patient from each group experienced mesh exposure, for which partial excision was performed under local anesthesia. Eleven patients in group A and 13 patients in group B developed dyspareunia. These patients were encouraged to use local vaginal lubricants before intercourse (see Table 4).

Discussion

The incidence of POP increases with age, and the frequency of POP surgery has increased with time [8]. The purposes of POP treatment are to restore pelvic anatomy and function, to ameliorate patient symptoms, and to improve quality of life [2]. POP can be treated either surgically or conservatively. The best method for treating POP surgically remains a matter of debate, as the condition can treated with open, laparoscopic or robotic abdominal sacrocolpopexy or anterior or posterior colporrhaphy, with or without vaginal hysterectomy. The vaginally approach can be performed with or without mesh implantation, but mesh implantation has become more common because it facilitates anatomic and functional improvements in appropriately selected patients [8]. Meshes are categorized as biological or synthetic. Biological meshes are further classified as autologous grafts, allografts, and xenografts, whereas synthetic meshes are further classified as absorbable and non-absorbable meshes [13]. The present authors used four- and six-arm non-absorbable, monofilament macropore polypropylene synthetic meshes in the present

Table 1. — *Comparisons of the demographic characteristics and UDI-6 scores between the two groups.*

Groups	A (n=29)	B (n=26)	*p* value
Age (years) (mean+std)	48.2±8.3	39.3±5.6	0.000*
BMI (kg/m^2) (mean+std)	29.2±4.7	27.6±4.5	0.231
Incontinence duration (years) (mean+std)	4.4±4.8	3.8±3.8	0.596
Operation duration (ms) (mean+std)	32.7±3.9	33.4±4.6	0.545
Post-op UDI-6 1-2 (mean+std)	0.8±1	1.1±0.9	0.272
Post-op UDI-6 3-4 (mean+std)	0.2±0.4	0.4±0.5	0.113
Post-op UDI-6 5-6 (mean+std)	0.3±0.9	0.4±0.7	0.847

$p < 0.05$ was statistically significant.

Table 2. — *Comparisons between pre- and post-operative UDI-6 scores among the patients in group A.*

Group A (n: 29)	Pre-op UDI	Post-op UDI	*p* value
1-2	4.5±1.1	0.8±1	0.00*
3-4	4.03±1.1	0.2±0.4	0.00*
5-6	2.3±1.7	0.3±0.9	0.00*

$p < 0.05$ was statistically significant.

Table 3. — *Comparisons between the pre- and post-operative UDI-6 scores among the patients in group B.*

Group B (n:26)	Pre-op UDI-6	Post-op UDI-6	*p* value
1-2	3.1±1.1	1.1±0.8	0.00*
3-4	3.2±0.7	0.4±0.5	0.00*
5-6	1.9±1.4	0.4±0.7	0.00*

$p < 0.05$ was statistically significant.

Table 4. — *Pre-operative complications caused by mesh implantation and their associated rates.*

	Group A (n=29)	Group B (n=26)
Permanent urinary retention	None	None
Temporary urinary retention	9 (31%)	6 (23%)
De novo urgency	7 (2.03%)	3 (11.5%)
De novo dysuria	9 (31%)	6 (23%)
Bladder and urethral injury	None	1 (3.84%)
Pelvic pain	26 (89.6%)	23 (88.4%)
Mesh erosion	None	1 (3.84%)
Mesh exposure	1(3.4%)	1 (3.84%)
Major neurovascular injury	None	None
Dyspareunia	11 (37.9%)	13 (50%)

study. Some authors have reported that this approach is reliable and easily applicable, and can be performed with low failure and morbidity rates in patients treated with transvaginal anterior colporrhaphy, especially patients with recurrent cystocele and severe cystocele [14]. Farzaneh *et al.* followed patients who underwent four-arm polypropylene mesh repair within a two-year period and observed anatomic and subjective success rates of 87.5% and 92.1%, respectively. Based on their data, they reported that their method was effective and was associated with a low complication rate [15]. Chen *et al.* followed patients who underwent two-arm fringe mesh implantation for transvaginal cystocele repair and observed a 96% success rate. These authors concluded that the method was easily applied, economical, and safe; however, they also emphasized that its clinical utility should be confirmed in studies including larger numbers of patients [16]. The present comparison of patients who underwent four- and six-arm mesh implantation demonstrated that only one patient experienced mesh exposure and that 96.5% of patients in the four-arm group experienced anatomic recovery. One of the patients in the present study who underwent six-arm mesh implantation experienced mesh erosion, and one patient experienced mesh exposure; 92.3% of patients in this group experienced anatomical recovery, consistent with the literature.

SUI, which may coexist with POP in some patients, has been observed at unignorable frequencies and may cause profound social problems that decrease quality of life. Rozenweig *et al.* observed that 60% of women who had severe POP but did not have prominent symptoms of urinary incontinence, exhibited latent urinary incontinence on a urodynamic examination [17].

Similarly, Grady *et al.* reported that 30% of women with cystoceles exhibited bladder instability on urodynamic examination. These authors also reported that SUI resolved in 51 of 54 women after surgical repair, indicating that SUI is closely related to POP and that these conditions should be evaluated together [18]. Dong *et al.* divided their patients who underwent transvaginal mesh implantation into three groups according to age and assessed them with the UDI-6 scoring system. They observed significant differences in pre-operative UDI-6 scores between groups but noted that the post-operative UDI-6 scores were similar between groups. Thus, they reported that transvaginal mesh surgery was an effective and reliable method for treating POP [19]. The authors of another study reported that patients with POP who underwent single-incision vaginal mesh surgery and completed UDI-6 forms, and other quality of life questionnaires, exhibited significant improvements in their post-operative UDI-6 scores compared with their pre-operative UDI-6 scores. The authors also reported that vaginal mesh implantation facilitated anatomic recovery and improved quality of life [20]. The present authors evaluated the patients enrolled in the present study based on their UDI-6 scores and determined that the four- and six-arm vaginal mesh implantation groups exhibited similar anatomic and functional improvement; however, the post-operative results were significantly improved compared with the pre-operative results within each. Based on these results, both meshes were similarly highly effective in preventing in-

continence and facilitating anatomic recovery. Complications such as vaginal mesh exposure, de novo SUI, de novo overactive bladder, urinary tract infection, pelvic pain, bladder or urethral injury, chronic urinary retention, bleeding, temporary urinary retention, constipation, and de novo dyspareunia may develop following POP surgery [21]. In particular, dyspareunia may occur as a result of mesh exposure or mesh shrinkage after POP surgery. Dyspareunia develops in 14.5% to 36.1% of patients after traditional POP surgery [22]. A retrospective study reported that dyspareunia developed in 16.7% of patients following mesh surgery and Milani *et al.* reported that de novo dyspareunia developed in 2% of 61 sexually active patients who underwent absorbable mesh implantation. The latter authors therefore concluded that absorbable mesh implantation facilitated sufficient vaginal distention and less fibrotic reaction and that partially absorbable mesh implantation led to less dyspareunia [22, 23]. However, some studies have reported low dyspareunia rates when using polypropylene meshes. For example, one of these studies reported that de novo dyspareunia developed in two of 105 patients, and another study reported that dyspareunia developed in only two of 71 patients [15, 24]. The present authors used polypropylene meshes for the patients enrolled in this study and observed that dyspareunia developed in 37.9% and 50% of patients who underwent four- and six-arm polypropylene mesh implantation, respectively. The prevalence of dyspareunia noted in this study was higher than that observed in the literature, and this difference might be due to the short, three-month follow-up period used in this study.

Several studies have reported polypropylene mesh exposure-related complication rates ranging from 0% to 33%. The primary symptom of mesh exposure is vaginal discharge, which is treated with estrogen cream, vaginal metronidazole suppository, and mesh removal [25]. Mesh exposure was observed in 3.63% of patients in the present study, affecting one patient in each group. Although age is a risk factor for mesh exposure, the available information regarding this subject is contradictory. For example, Deffieux *et al.* [26] reported that increasing age increases the risk of mesh exposure, whereas Jacquetin *et al.* [27] reported that younger age increases the risk of mesh exposure. On the other hand, another study noted that the risk of mesh exposure is low among elderly women and that postoperative sexual activity is associated with a high risk of mesh exposure [28]. Moreover, the risk of mesh exposure is reportedly affected by the duration of the operation, the simultaneous performance of additional procedures, and the experience of the surgeon [25]. Although the patients in the present study were not very old and were sexually active, their exhibited a low rate of mesh exposure. The risk of mesh exposure is considered to be decreased by short operation durations using either type of mesh material, increased surgeon, and appropriate patient selection.

Urethral injury occurred in one patient who underwent six-arm polypropylene mesh surgery. This injury was repaired intraoperatively by urologists. Temporary urinary retention, de novo dysuria, de novo urgency, and pelvic pain were treated with short-term medical therapy and lifestyle changes. The limitations of the present study were as follows: the study included a limited number of patients, was retrospective in nature, and featured a short follow-up duration.

In conclusion, four- and six-arm mesh implantation facilitated anatomic and functional recovery, as well as improvement in quality of life. Additionally, there were no differences in operation duration or in the incidence of complications between the two procedure groups; thus, it can be concluded that these two surgical methods are comparable for treating POP. However, additional prospective studies involving more patients are needed to confirm the present findings.

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