

Characteristics of pantaloon inguinal hernia and evaluation of added laparoscopic iliopubic tract repair to transabdominal preperitoneal hernioplasty: a retrospective observational study

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Purpose: Pantaloon hernia (PH), defined as concurrent ipsilateral direct and indirect inguinal hernias, is known for its high postoperative recurrence rate. This study retrospectively investigated the characteristics of PHs and evaluated the safety and efficacy of incorporating laparoscopic iliopubic tract repair (IPTR) into transabdominal preperitoneal (TAPP) hernioplasty.

Methods: A total of 3,355 patients who underwent TAPP hernioplasty for groin hernias between October 2014 and December 2021 were analyzed. These patients were divided into 2 groups: PH (97 patients) and non-PH (3,258 patients). The PH group was further subdivided based on the surgical technique used: TAPP hernioplasty without IPTR (TAPP group, 39 patients) and TAPP hernioplasty with IPTR for defect closure (TAPP + IPTR group, 58 patients).

Results: The study included 93 male and 4 female patients with PH. Patients with PH were generally older and predominantly male compared to the non-PH group. The recurrence rate in the PH group was notably higher than in the non-PH group [2.1% [2 of 97] vs. 0.2% [6 of 3,258], respectively; $P = 0.007$]. Among the PH group, reoperations were more frequent in the TAPP group compared to the TAPP + IPTR group [10.3% [4 of 39] vs. 0% [0 of 58], respectively; $P = 0.048$]. The reasons for reoperation in the PH group included recurrences (2 patients), mesh bulge (1 patient), and chronic seroma (1 patient).

Conclusion: TAPP + IPTR hernioplasty is an acceptable approach in PH treatment, reducing reoperation. [Ann Surg Treat Res 2024;106(6):361-368]

Key Words: Iliopubic tract repair, Inguinal hernia, Pantaloon hernia, Transabdominal preperitoneal hernioplasty

INTRODUCTION

A pantaloon hernia (PH) is an infrequent type of hernia characterized by simultaneous, ipsilateral direct and indirect hernias, which are separated by the epigastric vessels [1]. This condition was first described in 1917 by Erdman [2], who referred to it as a "saddlebag" hernia. Although there are limited case reports in the literature [3,4], PH is an acknowledged

entity in the groin hernia classification system proposed by Nyhus [5] and is identified as Nyhus type 3B. One study reported that PHs are present in 6.2% of primary hernias and 13.4% of recurrent hernias [6]. Nyhus recommended the use of iliopubic tract repair (IPTR) with mesh implantation to treat PHs [5]. The iliopubic tract, initially described by Thomson [7], is a thickened portion of the transversalis fascia located beneath and parallel to the inguinal ligament [7,8]. Positioned

Received January 8, 2024, Revised February 18, 2024,
Accepted March 11, 2024

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posteriorly in the inguinal region, the iliopubic tract is crucial in hernia repair procedures [9]. IPTR is predominantly utilized in open preperitoneal hernioplasty, and while its application in laparoscopic hernioplasty can be challenging due to the complexities of intracorporeal suturing, it is presumed to be effective for complicated hernias such as PHs.

The recurrence rate following laparoscopic transabdominal preperitoneal (TAPP) hernioplasty for PH cases remains unclear, with reported rates varying between 0% and 4.7% for direct or indirect inguinal hernia repairs [10]. One study highlighted that a PH significantly increases the likelihood of recurrence compared with non-PHs [11]. The author believes that if the hernial defect is blocked, this reduces the possibility of the mesh migrating into the hernial defect. This led to the hypothesis that incorporating laparoscopic IPTR with TAPP hernioplasty could enhance the treatment efficacy for PHs. The author's approach critically examined the distinctions between laparoscopic and open hernia repairs. It is imperative for surgeons to preserve the advantageous elements of old procedures while adapting to new techniques. The use of large meshes necessitates the availability of various mesh sizes and extensive preperitoneal dissection. Therefore, following Nyhus' recommendations (open approach IPTR + mesh implantation for type 3b PH), the author added laparoscopic IPTR to TAPP hernioplasty [5].

The standard TAPP hernioplasty technique involves solely the placement of a mesh. In contrast, the combined approach of TAPP hernioplasty with IPTR (TAPP + IPTR) entails the closure of both direct and indirect hernia defects prior to mesh implantation. To the best of the author's knowledge, no published comparative study specifically investigates the surgical outcomes of TAPP vs. TAPP + IPTR in treating PHs. This study focused on examining the characteristics of PHs

and assessing the safety and efficacy of augmenting TAPP hernioplasty with IPTR for PH treatment.

METHODS

Between October 2014 and December 2021, 3,355 patients with inguinal hernias underwent TAPP hernioplasty at Damsoyu Hospital in Seoul, Korea (Fig. 1). Patients with femoral hernias were excluded from this study. Confirmation of each patient's PH was achieved intraoperatively. Throughout the study period, there were no changes in the surgical staff or facilities.

The author's analysis focused on the medical records of 97 patients with a PH, which was defined as the presence of concurrent ipsilateral direct and indirect hernias on either side of the epigastric vessels (Fig. 2). The author divided these PH patients into 2 subgroups based on the surgical approach used: TAPP and TAPP + IPTR. The TAPP procedure involved mesh implantation only, whereas TAPP + IPTR included an additional step involving the closure of both direct and indirect hernia defects using IPTR prior to mesh implantation (Fig. 2). From October 2014 to December 2016, 39 PH patients underwent TAPP hernioplasty. Starting in January 2017, the surgical approach was modified to include IPTR (Fig. 3A). Consequently, from January 2017 to December 2021, 58 PH patients received TAPP + IPTR (Fig. 3B). The IPTR technique utilized was based on methodologies detailed in previous publications [12-15].

The study was approved by the Institutional Review Board of Damsoyu Hospital (DSY-2018-005). All procedures were performed in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Written informed consent was

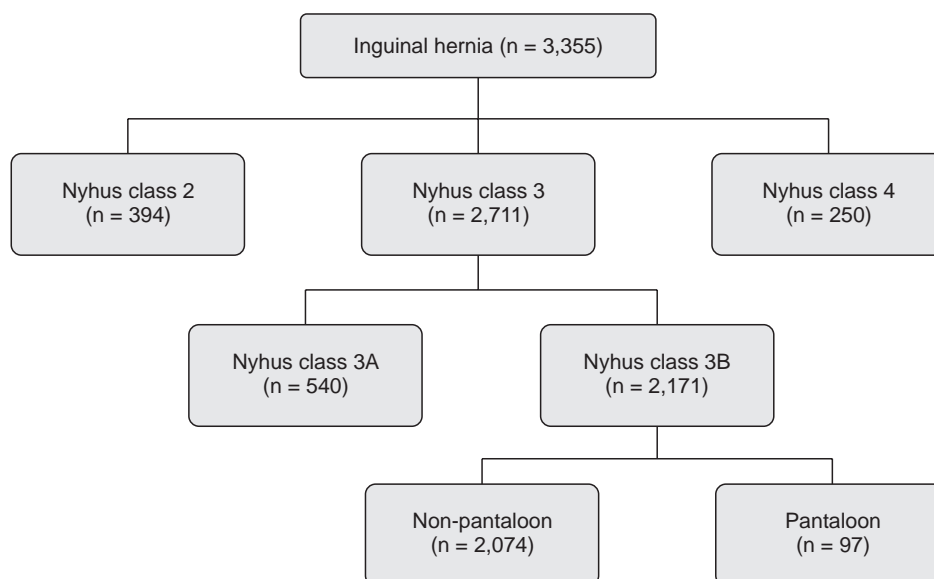


Fig. 1. Flowchart of patient enrollment. Nyhus class 2: indirect inguinal hernia with the internal ring dilated but the posterior inguinal wall intact, and the inferior epigastric vessels not displaced. Nyhus class 3A: direct inguinal hernia. Nyhus class 3B: indirect inguinal hernia with the internal inguinal ring dilated, medially encroaching on or destroying the transversalis fascia of Hesselbach's triangle (massive scrotal, sliding, or pantaloon hernias). Nyhus class 4: recurrent hernia.

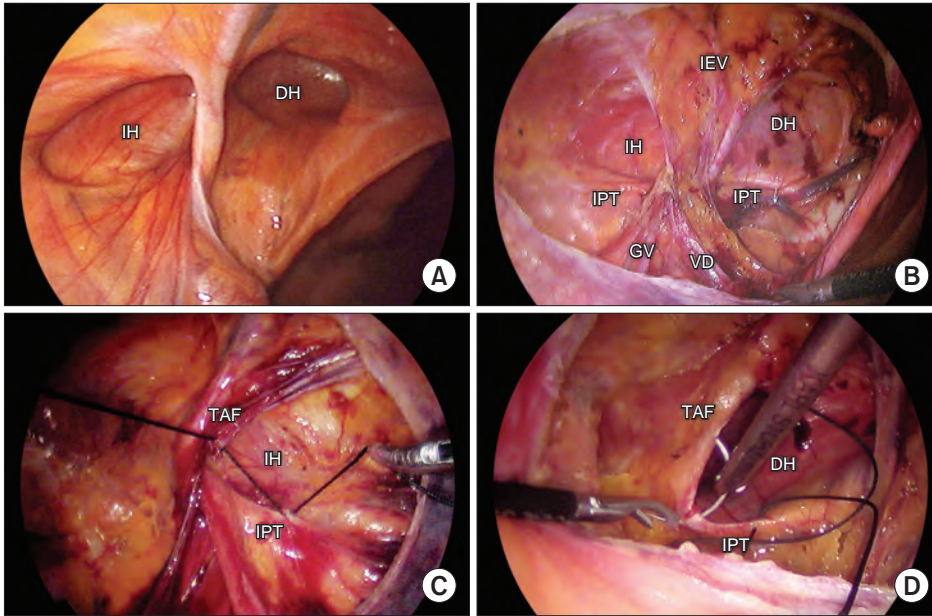


Fig. 2. Anatomy of a pantaloon inguinal hernia. (A) Laparoscopic view. (B) Preperitoneal dissection. (C) Iliopubic tract repair (IPTR) of indirect defect. (D) IPTR of direct defect. IH, indirect hernia; DH, direct hernia; IEV, inferior epigastric vessel; IPT, iliopubic tract; GV, gonadal vessel; VD, vas deferens; TAF, transversus abdominis fascia.

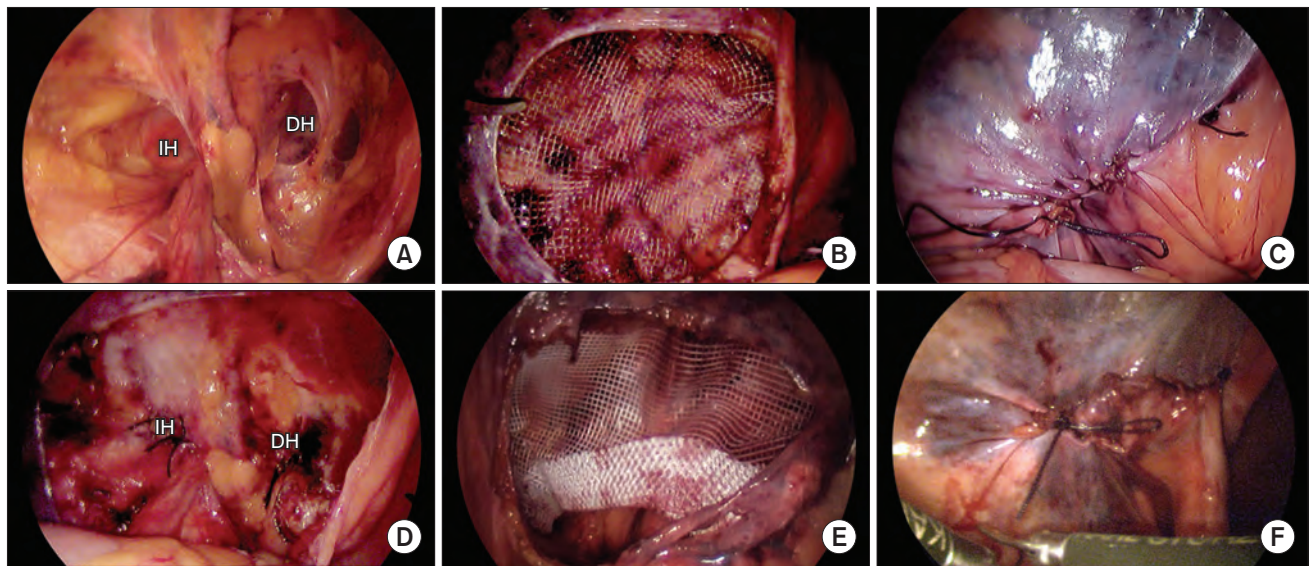


Fig. 3. Transabdominal preperitoneal (TAPP) hernioplasty vs. TAPP + iliopubic tract repair (IPTR). (A) TAPP hernioplasty. (B) Mesh implantation without defect closure. (C) Peritoneal closure. (D) TAPP + IPTR hernioplasty. (E) Mesh implantation with defect closure by IPTR. (F) Peritoneal closure. IH, indirect hernia; DH, direct hernia.

obtained from the patients for publication of this study and any accompanying images.

Laparoscopic iliopubic tract repair procedure

TAPP hernioplasty was performed using 3 ports, with a 5.0-mm camera and instruments of the same size. The procedures were performed with patient under general anesthesia in a supine position. The peritoneum was dissected to expose the underlying hernia anatomy. For hernial defects in female patients (Fig. 4A), a continuous running suture technique was employed to join the iliopubic tract and transversus abdominis

fascia. The first suture placement ensured adequate clearance for the round ligament, preventing any compression. In male patients (Fig. 4B), the first suture was strategically positioned to provide ample space for the vas deferens and gonadal vessels, also avoiding compression. For direct hernial defects, the author reinforced the lax transversalis fascia during the repair process, which served to mitigate the risk of seroma formation. After closing the hernia defect, a synthetic mesh implantation was performed. Specifically, the TAPP group received a 15 × 12-cm mesh implant, while the TAPP + IPTR group was treated with a slightly smaller 13 × 10-cm mesh, identical to that used in non-

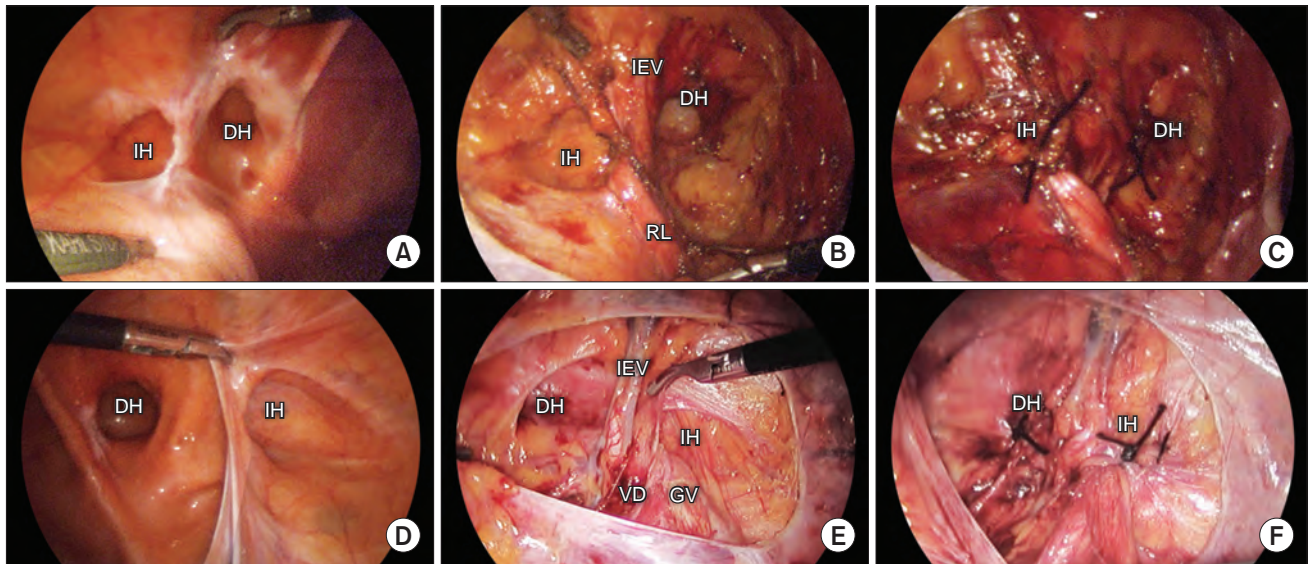


Fig. 4. Transabdominal preperitoneal (TAPP) + iliopubic tract repair (IPTR) hernioplasty of male and female patients. (A) Pantaloons hernia (PH) in a female patient. (B) Anatomy after preperitoneal dissection. (C) IPTR of both hernia defects. (D) PH in a male patient. (E) Peritoneal closure. (F) Anatomy after preperitoneal dissection. IPTR of both hernia defects. IH, indirect hernia; DH, direct hernia; IEV, inferior epigastric vessel; RL, round ligament; VD, vas deferens; GV, gonadal vessel.

Table 1. Patient characteristics

Characteristic	Pantaloons hernia group	Non-pantaloons hernia group	P-value ^{a)}
No. of patients	97	3,258	
Age (yr)	59.1 ± 12.1 (28–80)	44.1 ± 14.7 (17–83)	<0.001
Sex			0.005
Male	93 (95.9)	2,777 (85.2)	
Female	4 (4.1)	481 (14.8)	
Location of symptomatic hernia			0.426
Right	53 (54.6)	1,805 (55.4)	
Left	34 (35.1)	1,227 (37.7)	
Bilateral	10 (10.3)	226 (6.9)	
Location of pantaloons hernia			NA
Right	56 (57.7)		
Left	40 (41.3)		
Bilateral	1 (1.0)		
Incarceration	1 (1.0)	140 (4.3)	0.185
Organ resection	0 (0)	26 (0.8)	0.767
Reoperation	4 (4.1)	14 (0.4)	<0.001
Recurrence	2 (2.1)	6 (0.2)	0.007
Pseudorecurrence	2 (2.1)	8 (0.2)	0.022
Metachronous contralateral hernia	1 (1.0)	22 (0.7)	>0.999
Follow-up (mo)	72.1 ± 23.6 (24–110)	75.3 ± 25.0 (24–110)	0.181

Values are presented as number only, mean ± standard deviation (range), or number (%).

NA, not applicable.

^{a)}Most P-values represent comparisons of categorical variables, tested using the chi-square test; continuous variables were tested using the Wilcoxon rank-sum test and the t-test.

PH treatment. Finally, the peritoneum repair was accomplished using an absorbable multifilament suture (2-0 Vicryl, Ethicon Inc.).

Follow-up protocol

In the author's center, which specializes in day surgery, the author adhere to a standardized protocol for all patients

undergoing inguinal hernia surgery. This protocol allows patients to consume liquids 2 hours following the procedure. Criteria for discharge include stable condition and the ability to perform daily activities, such as walking, eating, and voiding. Posthernioplasty pain was evaluated using a visual analog scale (VAS) ranging from 0 to 10. Routine outpatient follow-up involved a physical examination at 1 week and 1 year postoperatively, followed by an annual telephone follow-up interview.

Statistical methods

All statistical analyses were performed using R software ver. 3.6.1 (The R Foundation; <https://www.R-project.org>). For data following a normal distribution, continuous variables are presented as mean \pm standard deviation, while for non-normal data, they were presented as median and interquartile range. The Wilcoxon rank-sum test was used to test the normality

of continuous variables. Categorical variables are presented as frequency and percentage. A P-value threshold of 0.05 was set, with any univariate P-value of ≤ 0.05 considered statistically significant.

RESULTS

The incidence of PH among all patients with inguinal hernias was 2.9% (97 of 3,355) (Fig. 1), and their characteristics are detailed in Table 1. Patients with a PH were generally older and predominantly male. The recurrence rate was also higher in the PH group (2.1% [2 of 97] vs. 0.2% [6 of 3,258], $P = 0.007$). Moreover, the incidence of pseudorecurrences (chronic seroma and mesh bulge), was greater in the PH cohort (2.1% [2 of 97] vs. 0.2% [8 of 3,258], $P = 0.022$).

Surgical outcomes for patients with PH are summarized in Table 2. No cases required conversion to open surgery. The

Table 2. Comparison of conventional and combined treatment groups in patients with pantaloon hernia

Characteristic	TAPP group	TAPP + IPTR group	P-value
No. of patients	39	58	
Age (yr)	57.4 \pm 11.8 (34–78)	60.1 \pm 12.3 (28–80)	0.278
Sex			0.910
Male	38 (97.4)	55 (94.8)	
Female	1 (2.6)	3 (5.2)	
Location of the pantaloon hernia			0.708
Right	23 (59.0)	33 (56.9)	
Left	16 (41.0)	24 (41.4)	
Bilateral	0 (0)	1 (1.7)	
Contralateral concurrent symptomatic hernia			0.449
Direct	4 (10.3)	5 (8.6)	
Indirect	1 (2.6)	0 (0)	
Operation time (min)	35.1 \pm 8.8 (30–60)	36.8 \pm 8.9 (30–60)	0.359
Hospital stay (day)	1.3 \pm 0.6 (0–2)	1.3 \pm 0.5 (0–2)	0.847
Complications			
Early	3 (7.7)	1 (1.7)	0.156
Hematoma	1	0	
Seroma	2	0	
Urinary retention	0	1	
Wound infection	0	0	
Late	0 (0)	0 (0)	NA
Testicular problem	0	0	
Chronic inguinodynia	0	0	
Pain score postoperative 1 wk ^{a)}	2.7 \pm 1.2 (1–5)	2.4 \pm 1.2 (1–5)	0.240
Time to return to daily life (day)	7.8 \pm 1.5 (6–11)	7.9 \pm 2.3 (5–12)	0.834
Reoperation	4 (10.3)	0 (0)	0.048
Recurrence	2	0	0.310
Pseudorecurrence			0.310
Mesh bulge	1	0	
Chronic seroma	1	0	
Follow-up (mo)	95.5 \pm 7.7 (84–110)	56.3 \pm 16.4 (24–83)	<0.001

Values are presented as number only, mean \pm standard deviation (range), or number (%).

NA, not applicable.

^{a)}Visual analog scale (5-point Likert scale).

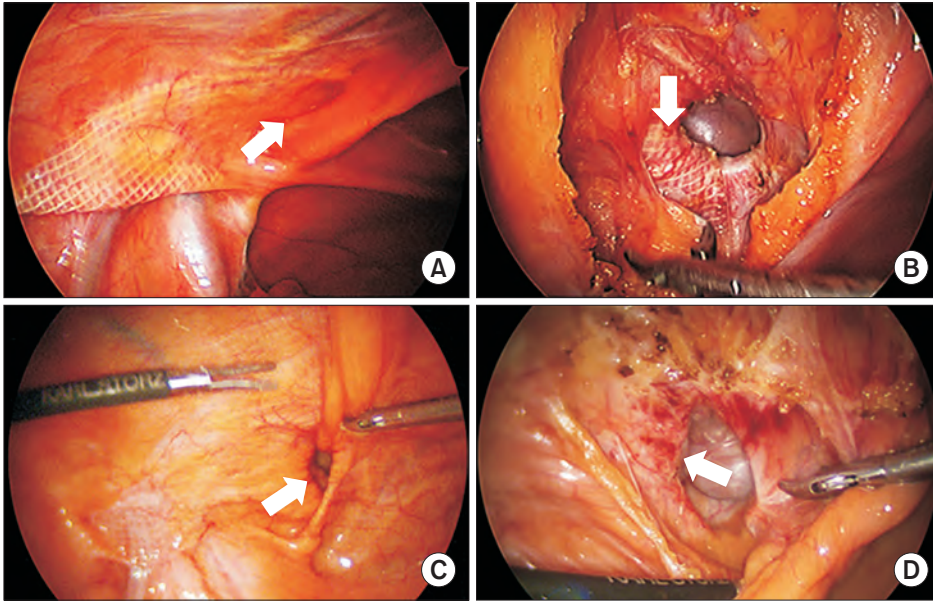


Fig. 5. Recurrence after transabdominal preperitoneal (TAPP) on pantaloon hernia. (A) Direct hernia following TAPP. The indirect area was well covered with mesh, but a direct hernia (arrow) occurred 1 year after surgery. (B) The previously used mesh (arrow) has migrated to the direct defect. (C) Direct hernia following TAPP. The indirect area was well covered with mesh, but a direct hernia (arrow) occurred 6 months after surgery. (D) The previously used mesh (arrow) is attached to the margin of the direct defect.

TAPP group comprised 39 patients, and the TAPP + IPTR group comprised 58 patients. There were no significant differences in age, sex, or hernia laterality between these 2 groups. Key metrics such as mean operation time, hospital stay duration, complication rates, VAS pain scores, and the average time to resume normal activities were comparable between the groups. Postoperative complications such as hematomas and wound infections were managed conservatively. Reoperations were performed only in the TAPP group (TAPP vs. TAPP + IPTR: 10.3% [4 of 39] vs. 0% [0 of 58], $P = 0.048$). Reoperations were necessitated by recurrence in 2 patients, mesh bulge in 1 patient, and chronic seroma in 1 patient. Recurrences were noted at 6 months and 12 months after surgery, attributed to mesh migration toward the direct hernial defect of Hesselbach's triangle (Fig. 5). One patient with chronic seroma underwent hydrocelectomy 4 months postoperatively, and another with pseudorecurrence underwent laparoscopic exploration to verify mesh integrity 1 year after the initial operation.

DISCUSSION

Inguinal hernia is a common condition necessitating surgical treatment; however, the occurrence of a PH is considerably less common, with a reported incidence ranging from 0.22% to 12.8% among all inguinal hernias [6,16]. The laparoscopic approach for treating PHs typically involves the implantation of a large mesh. The recurrence rates following TAPP hernioplasty in PH cases have been infrequently reported. Compared with non-PHs, PHs present a risk of hernia recurrence [11]. TAPP hernioplasty encompasses the entire myopectineal orifice using synthetic mesh, but it does not include the closure of the hernial defect. Nyhus demonstrated the efficacy of IPTR

in open surgery [9]. Although IPTR is traditionally employed in open hernia repair, it is posited that IPTR could be a viable surgical technique for laparoscopic hernioplasty in complicated cases.

TAPP hernioplasty offers the advantage of enhanced visualization of all of the relevant areas and allows for the simultaneous repair of concurrent hernias. Despite performing concurrent repairs in this study, the mean operative duration for the PH group, at 36 minutes, did not exceed that reported in other studies examining laparoscopic surgery outcomes for unilateral or bilateral hernia repairs [17,18].

In this study, a comparative analysis of TAPP hernioplasty and TAPP + IPTR was conducted for the treatment of PH. Currently, the majority of PH repairs involve overlaying the entire myopectineal orifice with a large mesh without defect closure. This technique requires an extensive dissection of the preperitoneal space, and the preparation of a large mesh can be labor-intensive. The cause of recurrence may be related to mesh size or fixation. Theoretically, a larger mesh size can be used. However, the mesh was already 15 cm, which is considered to be large. If the mesh size was increased further, more invasive wide dissection would be required. Furthermore, it is not feasible to provide such a large variety of different mesh types. Using a mesh larger than 15 cm would result in the dissection being too wide, and tack fixation was not performed due to the possibility of causing chronic pain [19]. To the author's knowledge, no existing literature has detailed the use of laparoscopic TAPP + IPTR in PH repair, although IPTR has been documented as a primary method in the management of non-PHs and recurrent inguinal hernias, both in laparoscopic and open hernia repair contexts [1,12,13].

For inguinal hernias, the International Endohernia Society

recommends a minimum overlap of 3 cm in every direction of the mesh implant over the hernia defect [20]. In this study, the suture line post-repair was approximately ± 2.0 cm. The author employed an anatomical mesh of about 13×10 cm (Fig. 3). This allowed for an overlap exceeding 5 cm in all directions following IPTR, which was sufficient to cover the entire myopectineal orifice. A potential issue is the tension induced by suture closure; however, one study indicated no significant difference in 1-week postoperative VAS scores among adolescent patients who underwent suturing during indirect inguinal hernia repair compared with those who did not [14]. In this study, the VAS pain scores did not significantly differ between the TAPP group and the TAPP + IPTR group. Prior research on TAPP hernioplasty reported that 3.6% of patients (7 of 196) experienced a VAS score between 6 and 10 on postoperative day 7 [21]. In the present study, the mean 1-week VAS score was below 3.0, and the mean time for resuming daily activities was less than 8 days in both PH subgroups. In addition, no patients reported a 1-week VAS score exceeding 6. The average duration of postoperative hospital stays did not differ between the 2 groups. Notably, 92.8% of patients (90 of 97) underwent day surgery. Factors affecting a patient's hospital stay include hospitalization costs; but in Korea, a diagnosis-related group billing system is employed, ensuring that costs do not increase with prolonged hospitalization.

After laparoscopic hernia repair, both true recurrence and pseudorecurrence can occur. True recurrence typically results from technical errors, such as inadequate mesh size or mesh migration, whereas pseudorecurrence commonly arises from conditions like cord lipomas, mesh bulging, or intractable seromas unresponsive to needle aspiration [22]. In this study, the TAPP group had 2 cases of true recurrence, 1 instance of mesh bulging, and 1 chronic seroma. Conversely, the TAPP + IPTR group exhibited no recurrences or pseudorecurrences. Despite differences in mesh sizes between the TAPP group (15×12 cm) and the TAPP + IPTR group (13×10 cm), the recurrence rates were comparable. The use of IPTR appears to mitigate the risk of mesh migration into hernial defects, with no increase in recurrence rates even with the use of a smaller mesh size (13×10 cm), identical to that in the non-PH group.

This study has several limitations. It included only 97 patients with a PH, a sample size insufficient to robustly support improved outcomes. However, given the low incidence of PH and the scarcity of detailed studies on this condition,

these findings offer significant insights. Conducted as a single-center study, it highlights the need for future multicenter studies. This study also employed chronological grouping of PH cases, though the varying follow-up periods are unlikely to significantly affect the results. Importantly, there were no changes in the surgical team or facilities during the study period. However, a longer follow-up is needed to determine the long-term recurrence rate. A crucial outcome of this study is the suggestion that TAPP combined with IPTR may be an effective surgical approach, potentially reducing the need for reoperation without increasing complication rates in PH treatment. Extended observation of patients is necessary to accurately assess long-term recurrence rates.

This study evaluated the characteristics of PHs and the safety and efficacy of adding IPTR to TAPP hernioplasty for the treatment of PHs, wherein the hernia defects are sealed laparoscopically via IPTR prior to mesh implantation. TAPP + IPTR hernioplasty proved to be an acceptable surgical approach for treating PHs, not only maintaining safety but also reducing the need for reoperation.

ACKNOWLEDGEMENTS

The author expresses gratitude to Hyejin Park for her contribution to the English grammar correction of this manuscript. Additionally, the author acknowledges the assistance of Beom Seok Oh from the research center of Damsoyu Hospital and Young Hyun Lee from the Graduate School of Engineering, Ewha Womans University for assisting with the statistical analysis and data organization.

Fund/Grant Support

None.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Author Contribution

All work was done by SRL.

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