

## Clinical estimation of the TAPP laparoscopic surgery versus the conventional procedure for inguinal hernia and the efficacy of reducing the number of tacking fixations of intra-abdominal devices

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**Objectives:** Laparoscopic surgery, especially the transabdominal preperitoneal (TAPP) surgery, has become more common for the treatment of inguinal hernias. We investigated the advantages of the TAPP procedure and the relationship between postoperative complaints and the number of tacks made.

**Methods:** Forty-five conventional open procedures and 89 TAPP procedures were included in the present study. The TAPP cases were separated into the first-half group and the second-half group. For the mesh fixation, 10–15 tacks were made in the first-half group and reduced to 5–10 tacks in the second-half group.

**Results:** In the conventional group, 13.3% of the patients experienced chronic pain. In the first-half group undergoing the TAPP procedure 4.5% of the patients resulted in chronic pain, but not in the second-half group; however, the difference was not statistically significant. Chronic pain in patients who underwent the TAPP procedure was significantly less than that in the conventional group ( $P < 0.01$ ). In the conventional group 13.3% of the patients complained of discomfort. The first- and second-half groups undergoing the TAPP procedure experienced discomfort in 9.1% and 2.2% of the patients, respectively. Discomfort in the second group undergoing the TAPP procedure was less than that in cases in the conventional group and among those in the first-half group. But there was no statistical significance.

**Conclusion:** Using the TAPP procedure, chronic pain was significantly reduced. It was also made evident that fewer tack points made for mesh fixation in hernia repairs would further reduce discomfort.

**Key words:** laparoscopic surgery, TAPP, chronic pain, discomfort, tack

### Introduction

Previous reports comparing laparoscopic surgery and conventional open procedures for inguinal hernias have indicated that laparoscopic surgery was superior for contralateral occult hernias with reduced chronic pain.<sup>1,2</sup> It was also reported that if the number of tacks used in laparoscopic surgery was decreased, chronic pain would be further reduced.<sup>3</sup> Patients occasionally complained of postoperative discomfort other than chronic pain. However, there is scant literature regarding the relationship between discomfort and the quantity of tacks. The rationale for the present study was to clarify the relationship between discomfort and the quantity of tacks used in hernia repair. Therefore, the conventional

open procedure and laparoscopic surgery were compared to assess their similarities and to examine and suggest a reduction in the number of tacks used in the transabdominal preperitoneal approach (TAPP) with a view not only to reduce pain but also to examine the risk of other complications.

### Materials and Methods

A total of 134 patients including recurrent cases underwent either a conventional open procedure or TAPP from March 2011 through November 2015 in the Asoka Hospital performed by 3 surgeons who each had 10 or more years experience as a board-certified surgeon. Each of them had performed over 300 operations using the

Received 21 June 2018, accepted 29 August 2018

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conventional open procedure for inguinal hernias. TAPP was used when patients elected to undergo laparoscopic surgery and when it was acceptable for them to receive general anesthesia. TAPP was not used when the patient preferred the conventional open procedure. Prostatectomy cases were not included in this study, because prostatectomies often create strong adhesion in the preperitoneal space and TAPP has a lengthy operative time. We experienced 45 conventional cases (32 Bilayer cases; 9 mesh-plug cases; 3 Kugel cases; 1 Lichtenstein case) and 89 TAPP cases. Polypropylene mesh, such as the Ultrapro Hernia System (Ethicon, Sumerville, NJ, USA), the PerFix Light Plug (C.R. Bard Davol, Providence, RI, USA), and the Kugel Patch (Bard Davol) was used in the conventional group after spinal anesthesia. These meshes were sheeted into an overlay and/or underlay of the preperitoneal space by the anterior approach and were fixed with stitches. TAPP patients received 3D MAX Light Mesh (Bard Davol) under general anesthesia. The 3D MAX Light Mesh (Bard Davol) was sheeted into the preperitoneal space and fixed. PermaFix (Bard Davol) or SorbaFix (Bard Davol) was used for mesh fixation in TAPP which was tacked to the Cooper's ligament, the rectus sheath, and the transvers muscle. The TAPP cases were separated into 2 groups. In the first-half group, 10–15 tacks were made to fix the mesh and decreased to 5–10 tacks in the second half. Each characteristic, such as operation time and intraoperative solid organ damage was compared between the 2 groups. Wound infection, subcutaneous hematoma, and seroma were compared as early stage complications. Chronic pain and discomfort were compared as late stage complications. Chronic pain was defined as a stabbing sensation in the groin lasting longer than 3 months. Discomfort was defined as an unusual sensation including fever and a numbness sensation in the groin originating from a foreign substance for more than 1 month, which differs from stabbing pain. These cases were monitored directly for at least 3 months postoperatively to determine

if complications developed. This time period was lengthened until the complications subsided, which was  $\leq 6$  months.

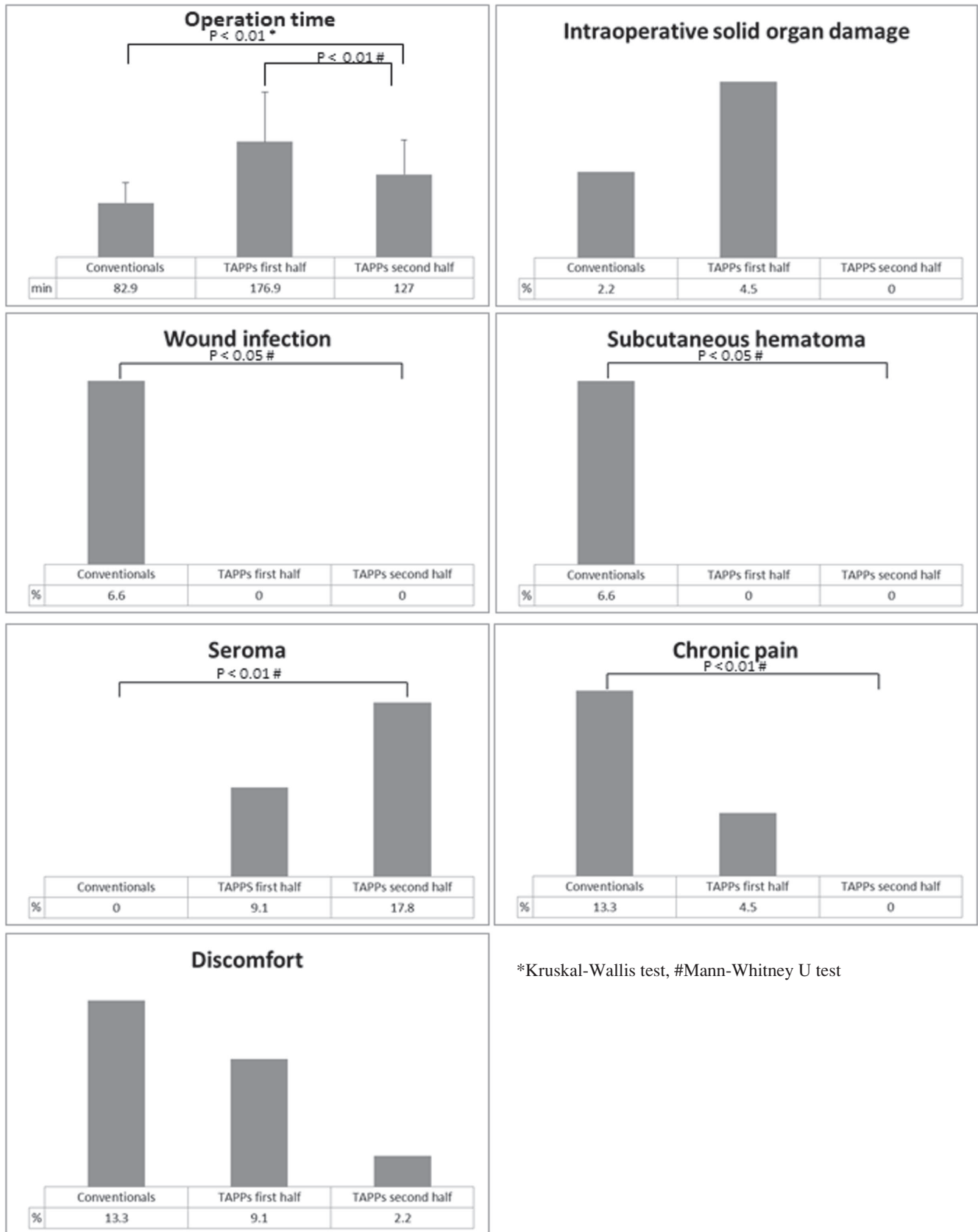
## Results

The mean age was  $72.0 \pm 12.6$  years in the conventional group and  $68.2 \pm 14.3$  years in the TAPP group; no significant difference was observed in this respect (Table 1). The ratio of men to women was 43:2 in the conventional group and 77:12 in the TAPP group; there was no significant difference. The unilateral-to-bilateral ratio was 43:2 in the conventional group and 81:8 in the TAPP group; there was no significant difference. The ratio of primary cases and recurrent cases was 41:4 in the conventional group and 86:3 in the TAPP group; there was no significant difference. Eight conventional cases and 13 TAPP cases presented with anamnesis from a previous lower abdominal surgery; there was no significant difference. The Japanese Hernia Society Inguinal Hernia Classification (I:II:III:IV)<sup>4</sup> was 40:6:0:1 and 69:22:1:2 in the conventional and TAPP group, respectively; there was no significant difference. When patients experienced bilateral hernias, they were counted as 2 lesions in this classification. Regarding the number of tacks,  $11.8 \pm 1.5$  were used for fixing the mesh in the first half of the TAPP cases and  $5.9 \pm 1.4$  tacks were used in the second half ( $P < 0.01$ , the Mann-Whitney U test).

There was a statistically significant difference in the length of the operation ( $P < 0.01$ , the Kruskal-Wallis test; Figure 1). The operation time in the conventional group was  $82.9 \pm 31.4$  minutes, which was shorter than in the TAPP group. However, the second half of TAPP was  $127.0 \pm 53.1$  minutes, which was significantly shorter than that of the first half undergoing the procedure ( $176.9 \pm 76.3$  minutes;  $P < 0.01$ , the Mann-Whitney U test). There was no difference in the intraoperative solid organ damage. A corona mortis injury occurred in the

**Table 1.** Patients' background data

	Opens	TAPPs	P value
Number of cases	45	89	
Age	$72.0 \pm 12.6$	$68.2 \pm 14.3$	ns
Male:Female	43:2	77:12	ns
Unilateral: Bilateral	43:2	81:8	ns
Primary: Recurrence	41:4	86:3	ns
Anamnesis of previous lower abdominal surgery	8/45	13/89	ns
JHS Classification (I:II:III:IV)	40:6:0:1	69:22:1:2	ns



\*Kruskal-Wallis test, #Mann-Whitney U test

Figure 1

conventional group. In TAPP, intraoperative solid organ damage occurred in the first half. A testicular artery injury occurred in the 27th case, and a bladder injury occurred in the 30th case, which was complicated by a paraperitoneal-type bladder hernia. Minimal damage occurred in the second half of the procedure. When comparing the 2 groups in terms of early complications, the conventional group showed a wound infection rate of 6.6%, no wound infections occurred in TAPP; this difference was significant ( $P < 0.05$ , the Mann-Whitney U test). Similarly, in the conventional group, a subcutaneous hematoma occurred in 6.6% of the patients, but no instances occurred in the TAPP group; the difference was significant ( $P < 0.05$ , the Mann-Whitney U test). Seromas developed only in the TAPP group and not in the conventional group; the difference was statistically significant ( $P < 0.01$ , the Mann-Whitney U test). When comparing late stage complications, chronic pain was observed in 13.3% of the patients in the conventional group. In the first half of the TAPP procedure, chronic pain occurred in 4.5% of patients but not in the second half. The number of patients with chronic pain in the TAPP group was significantly less than that in the conventional group ( $P < 0.01$ , the Mann-Whitney U test). There were fewer patients with chronic pain in the second half than that in the first half, but there was no statistical significance. Discomfort occurred in 13.3% of patients in the conventional group. In the TAPP group, discomfort occurred in 9.1% of patients in the first half and 2.2% the second half. Discomfort in the second half of the TAPP procedure tended to be less than that in the first half and that in the conventional group. However there was no statistical significance.

## Discussion

Laparoscopic surgery for inguinal hernia was first reported in 1982 by Ger.<sup>5</sup> TAPP was an advantageous procedure because it decreased neurogenic pain and discomfort, and allowed an overview of the entire myopectineal orifice.<sup>6</sup> The intention of contralateral occult inguinal hernias can be determined,<sup>7</sup> as they help to prevent nerve injury using the intra-abdominal approach.<sup>8</sup> Laparoscopic surgery can facilitate the procedure by two major methods: TAPP and TEP (total extraperitoneal inguinal hernia repair). LPEC (laparoscopic percutaneous extraperitoneal closure) for infantile hernias was added later as the third method in 1995 by Takehara et al.<sup>9</sup> Each method could be performed on request. We often used the 3DMax™ Light Mesh because it is easily managed. We found that TAPP was

commonly problematic because of the prolonged operation time associated with laparoscopic surgery. When TAPP was initiated, it required the supervision of experienced laparoscopic surgeons, which was a major problem. It was only performed by surgeons who had completed more than 250 surgeries.<sup>10</sup> However, now, only 80 surgeries are required for surgeons to perform TAPP. In the present study, the occurrence rate of intraoperative solid organ damage in laparoscopic surgery was not higher than that in the conventional open procedure. Each procedure had its own associated complications. Seromas were the most common complication in the TAPP procedures.<sup>11</sup> In our study, seromas were observed in 10%–20% of laparoscopic surgeries. Most cases did not require drainage and symptoms disappeared naturally within a few months. Muscle and transversalis membrane destruction in the conventional open procedure could not be prevented, which caused hematomas and wound infections.<sup>12</sup> This complication was not observed in patients who underwent TAPP. Seromas in the second half were more common when compared with the first half, but it was not statistically significant. Seromas are created by remnant sacs and discharge effusion. In the second half, the presence of increasing seromas may have occurred because the dissection area was wider in the second half and discharge effusion was increased. If the remnant sac was smaller, it would be able to decrease the presence of seromas. Chronic pain was significantly less in patients who underwent the TAPP procedure than that in patients who underwent the conventional procedure. There was no significant difference between the two groups of patients who underwent the TAPP procedure. It became apparent that if the quantity of tacks was decreased during the laparoscopic surgery, chronic pain would be reduced further.<sup>3</sup> This tendency was also seen in the present study. Another study compared the discomfort between laparoscopic and open surgery, which occurred in 1.4% and 5.3% of the patients, respectively, and the difference was statistically significant ( $P < 0.01$ ).<sup>13</sup> However, there was no apparent concern about the number of tacks. We considered that chronic pain and discomfort occurred because of tacking, which injured the ilioinguinal nerve in the muscle. If the number of tacks was decreased, nerve injuries could be reduced. The complaints decreased in the second half compared to the first half, but there was no statistical significance. This might be caused by a learning curve, but it was likely due to the decreased number of tacks. We considered that the number of tacks should be decreased to reduce patient complaints. The absorbability of tacks appeared to be

minute in our observation period. Therefore, the difference of each tack was not considered. Additionally, there have so far been no recurrences. Therefore, we determined that less fixation would not cause recurrence. If fibrin glue can be used for mesh fixation,<sup>14</sup> pain may further be reduced. Moreover, Parietex ProGrip Mesh (Covidien, Tokyo) for laparoscopic surgery has been on the market since 2015.<sup>15</sup> It has a self-gripping function with numerous processes on the surface, which might prove less discomforting than with tacking.

The present study showed that the TAPP procedure could reduce chronic pain and discomfort more than the conventional open procedure and that discomfort after the TAPP procedure was influenced by the number of tacks. Therefore, we recommend fewer tacks in the fixation of intra-abdominal mesh in hernia repair operations.

**Conflicts of interest:** None

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