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Original Article

Quality of life after open versus laparoscopic preperitoneal mesh repair for unilateral inguinal hernias

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ABSTRACT

Background: Both the open transinguinal preperitoneal repair (TIPP) and the laparoscopic total extraperitoneal mesh repair (TEP) show excellent outcomes. Direct comparative data between these 2 preperitoneal techniques is lacking. The aim of this study was to assess postoperative outcomes and quality of life (QoL) for these open and laparoscopic preperitoneal repair techniques.

Methods: Between 2014 and 2016, 204 male patients underwent unilateral inguinal hernia repair through TIPP (n = 135) or TEP (n = 69). Data recorded include demographic profile, preoperative and intraoperative variables, postoperative complications and postoperative quality of life. Two validated hernia-specific QoL questionnaires, the Carolinas Comfort Scale (CCS) and the European Registry for Abdominal Wall Hernias Quality of Life score (EuraHS QoL) were used to assess postoperative QoL.

Results: The TIPP group consisted of 135 patients, the TEP group of 69 patients. The mean age of patients was significantly higher in TIPP (64.07 ± 17.10 years) than in TEP (59.0 ± 15.53 years) ($p = 0.022$). A total of 96 patients (47.1%) responded to our invitation for longterm follow-up: 58 in the TIPP group (43%) and 38 in the TEP group (55.1%). There was no difference in mean follow-up time between the surgical procedure and filling in the questionnaires: 37.4 ± 12.8 months for TIPP and 33.5 ± 11.3 months for TEP group ($p = 0.13$). No significant differences in quality of life were found between TIPP and TEP for all explored domains.

Conclusion: TIPP and TEP show equivalent results considering postoperative quality of life. Compared to existing literature on mesh repair for unilateral inguinal hernias, we may conclude that the preperitoneal location of the mesh probably is a more decisive factor for quality of life than the surgical approach used.

1. Introduction

Inguinal hernia repair is among the most often performed surgical procedures. Over 20 million operations are performed worldwide annually. Today, mesh repair has taken over the landscape as mesh-based techniques are strongly recommended in the recent guidelines formed by HerniaSurge.[1]

As cited by these guidelines, current evidence suggests that preperitoneal mesh placement is preferred over anterior mesh placement because of the physiologic mesh location and placement of the mesh away from the groin nerves. Koning et al explained the 'upstream principle' in pre-peritoneal mesh placement: the intra-abdominal pressure causes the mesh to be pressed against the abdominal wall, rather than being pushed away as in onlay placement.[2]

When comparing preperitoneal techniques to the established open Lichtenstein repair, literature provides evidence favoring the laparoscopic transabdominal preperitoneal repair (TAPP) and total extraperitoneal repair (TEP) over Lichtenstein. When comparing TAPP to Lichtenstein, TAPP is associated with less early or late postoperative pain, less chronic pain, faster recovery time and better quality of life.[3,4] However, similar complication rate and higher hospital costs are reported in TAPP patients.[4,5] Similar to TAPP, literature suggests superiority of TEP over Lichtenstein.[3–5] TEP is associated with less postoperative pain, faster recovery

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time and higher patient satisfaction. Lower complication rate is also reported in TEP patients alongside similar recurrence rate.[6–8] The recent guidelines conclude that considering postoperative pain, recovery time and chronic pain, the laparoscopic techniques are superior, despite a well-documented difference in learning curve and initial costs favoring Lichtenstein.[2]

Less studies have been conducted comparing the transinguinal preperitoneal (TIPP) technique versus Lichtenstein. Especially in Asian countries the open preperitoneal mesh techniques seem more popular and several studies reported favorable outcomes.[9–11] According to the available literature, both techniques show similar low recurrence rates. Some studies have reported less acute and chronic postoperative pain in TIPP patients, as well as less persisting numbness. This supports the hypothesis for the anatomic involvement of the inguinal nerves in the Lichtenstein repair, favoring the preperitoneal TIPP repair. As the mesh is fixated in Lichtenstein's repair, forces and tractions in the inguinal region may put the inguinal nerves at risk causing chronic pain.[12–14]

When comparing cost-effectiveness and health benefits between TEP and Lichtenstein, literature shows that direct costs are higher for TEP than for Lichtenstein. However, when including community costs, TEP was not more expensive than Lichtenstein.[15] Koning et al analysed costs of TIPP and Lichtenstein, finding no differences in direct costs, but showing that TIPP patients had a quicker recovery of 6.5 days on average. Taking this difference into account, TIPP was seen as a cost-saving technique compared to the Lichtenstein repair.[16]

At present, preperitoneal mesh placement is recommended, but hardly any data is available comparing the open versus the laparoscopic preperitoneal approach. This study is conducted to address patient outcome after TEP versus TIPP repair for unilateral inguinal hernias in men.

2. Methods

Setting. The study was conducted at a University Medical Center. The ethical committee of the hospital approved the study protocol, Trial number: B670201734087. Date of approval: 27 November 2017.

Ethical approval. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (B670201734087) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent. Informed consent was obtained from all individual participants included in the study.

Study design. This is a retrospective analysis of an observational cohort study. Two cohorts of patients were formed based on the inguinal hernia procedure they underwent between 1st of January 2014 and 31st of December 2016. Patients consulted a senior surgeon at their preoperative visit and each surgeon performed his/her main technique: if a patient visited a TIPP surgeon, a TIPP procedure was scheduled, while if the patient visited a TEP surgeon a TEP procedure was planned. So all patients were treated according to the preferred technique of the surgeon they consulted.

A letter containing an opting-out form, an opting-in form and both standardized questionnaires (Carolina Comfort Scale (CCS) and EuraHS-QoL) was sent to the patients. If patients wished to take part in the study, they were asked to return the filled in opting-in form and the completed questionnaires. If they did not wish to participate, they were asked to return the completed opting-out form. Patients who did not respond within 6 weeks after sending the letters, received one reminder by phone. If they did not return the opting-in form and the questionnaires after the reminder, this was considered 'did not answer'. When patients refused participation by phone they were considered 'opting out'.

Patients. Inclusion criteria were as follows: adult male patients, age >18 years with a primary, unilateral inguinal hernia who underwent TIPP or TEP repair between 1st of January 2014 and 31st of December 2016 at the Ghent University Hospital and signed the informed consent form.

Exclusion criteria were as follows: recurrent or bilateral hernias, patients choosing not to participate by signing the opting-out form or communicating telephonically.

Operative technique. All the TIPP procedures were performed by one single surgeon (FB) and all TEP procedures were performed by another surgeon (AV). None of both ever performed the other's surgical procedure. The TIPP was performed as described by our group in previous studies.[17] In short, a 3–4 cm incision was performed under spinal or general anesthesia, depending on the patients' preference. The incision starts halfway the line between the superior anterior iliac spine and the pubic tubercle. The preperitoneal space was entered bluntly through the internal ring. The epigastric vessels were then identified and retracted upwards. Thereafter, the lateral space was freed in the direction of the superior anterior iliac spine. A malleable retractor was then introduced into the free preperitoneal pocket and a memory containing mesh (Rebound shield mesh™ (Minnesota MMDI)) is then inserted. The memory frame of the device deployed the mesh completely in the created pocket without the need for any fixation.

The TEP was performed as a 3-trocar technique as described by Muysoms et al.[18] The first incision was infra-umbilical. Dissection was performed up to the anterior fascia of the rectus muscle and opening of the fascia. A blunt tip 11 mm trocar was placed in the preperitoneal space. The preperitoneal space was insufflated with CO2 and was bluntly dissected up to the pubic symphysis. The Retzius space was freed. A second 5 mm trocar was placed under vision at the midline at the level of the superior anterior iliac spine. The Bogros space was dissected and another 5 mm trocar was placed superiorly and laterally of the superior anterior iliac spine contralateral to the side of the inguinal hernia. The preperitoneal space was further dissected until the hernia sac was identified and fully reduced. A polypropylene mesh BD 3D Max™ (Davol Inc., Warwick, United Kingdom) was inserted and positioned with adequate overlap. All meshes were additionally fixated with synthetic glue (Glubran™, GEM, Viareggio, Italy).

Variables. Data recorded include demographic profile, preoperative and intraoperative variables, postoperative complications and postoperative quality of life. The preoperative and intraoperative data of all patients were used for descriptive statistics.

Quality of life instruments. Two quality of life instruments were sent to the patients. The Carolinas Comfort Scale (CCS) is a hernia specific questionnaire. It consists of 23 questions divided in 3 domains: sensation of mesh, pain and movement limitations. Each question is scored on a 6-point scale from 0 to 5. A 0 represents 'no symptoms' and a 5 represents 'disabling symptoms'. The EuraHS-QoL score is the second validated hernia specific questionnaire with 9 questions divided in 3 domains: pain, restriction of activities and cosmetic discomfort. This questionnaire was validated for inguinal hernia repair by Muysoms et al.[18] Each question is scored on a 11-point scale from 0 to 10. A 0 represents 'no symptoms' and a 10 represents 'worst pain imaginable', 'completely restricted' or 'extremely ugly' for the 3 domains respectively.

Statistical analysis. Statistical analysis was performed using SPSS version 25.0 (SPSS, Chicago, Illinois, USA). First, a comparison was made between responders and non-responders. Secondly, the differences between the TIPP and TEP groups were analysed. Quality of life data from both questionnaires was assessed. The sum of scores within a domain was made. These numbers are reported as such. The quality of life data was assessed through a

dichotomous scale for the comparison of both surgical techniques. Patients having a score of zero on a certain domain formed a first group. The second group consisted of patients having a score above zero. Scores of the different domains were compared between TIPP and TEP. 'Missing' or 'not applicable' values were considered missing.

The normal distribution of the parameters age, BMI and the numbers of months between the operation and filling in the quality of life questionnaires (only for TIPP responders versus TEP responders) had to be assessed in order to perform the correct statistical test. This normal distribution was assessed for the comparison of responders and non-responders and the comparison of TIPP responders and TEP responders. The Kolmogorov–Smirnov test of normality was performed and the normal Q–Q plot used as graphic representation of the Gaussian fit. Patients' demographics, preoperative and postoperative data were compared using student's t-test, Chi square test and Fisher's Exact test for qualitative and quantitative parameters as appropriate. This was done in the first comparison (responder versus non-responder) and in the second (TIPP versus TEP). Continuous variables were reported as mean ± standard deviation (SD). Categorical variables were reported as frequency counts and percentages. The CCS and EuraHS-QoL questionnaires data were analysed using Chi square tests with correction through logistic regression for the variable 'age' were used for data analysis. A p-value of <0.05 was considered significant.

3. Results

Participants. A total of 173 male patients who were operated for a primary, unilateral inguinal hernia between the 1st of January 2014 and the 31st of December 2016 were included in this study. 112 TIPP patients and 61 TEP patients were sent a letter with the questionnaires and information on the study. The mean time of follow-up between the surgical procedure and filling in the quality of life questionnaires was 37.4 ± 12.8 months for the TIPP group and 33.5 ± 11.3 months for the TEP group ($p = 0.13$). The median time of follow-up was 36.5 months for the TIPP group and 32 months for the TEP group ($p = 0.27$). Twenty-eight patients (16.2%) could not be contacted, and 49 (28.3%) did not answer the letter sent to them nor the phone call afterwards. The non-responder group consisted of 77 patients.

A total of 96 patients (55.5%) responded: 58 in the TIPP group (51.8% of the total TIPP group) and 38 in the TEP group (62.3% of the total TEP group) (Fig. 1). Demographic parameters, risk factors and postoperative complications were well matched between the responders and the non-responders. The responder group showed a higher amount of direct hernia components compared to the non-responder group: 37 (51.4%) versus 19 (32.8%). This difference was statistically significant ($p = 0.03$). Other clinical features and postoperative complications between responders and non-responders were well matched (Tables 1 and 2).

3.1. TIPP versus TEP

The mean age of patients in the TIPP group was 64.1 ± 17.1 years and 59.0 ± 15.5 years in the TEP group. The mean age was higher in the TIPP group, which was statistically significant ($p = 0.02$). This statistical difference in age was taken into account and adjusted for in the statistical calculation of the quality of life data. In the patients that underwent TIPP repair, 29 (26.6%) used anticoagulation medication prior to the surgical procedure. For the TEP group, this was 5 (8.2%) of the 61 patients ($p = 0.004$). Probably, this is due to the younger population age in the TEP group. Other demographic parameters, clinical features and risk factors were well matched (Table 3). Both groups showed no significant differences in postoperative complications either (Table 4).

Considering the outcomes for quality of life, no significant differences could be observed between the 2 groups, neither using the CCS, nor using the EuraHS QoL evaluation (Table 5).

In short, the non-dichotomous of the CCS showed lower scores for pain, movement restriction and mesh sensation in the TIPP group, while the dichotomous data of the CCS also showed a somewhat higher percentage of patients without pain in the TIPP group versus the TEP group (75.9% versus 72.2% respectively). After correction for age through logistic regression, still no statistically significant association was found between the type of procedure and the pain domain in CCS. For movement restriction equal results could be observed for TIPP and TEP, while somewhat less mesh sensation was observed after TEP than TIPP (80% had no mesh sensation after TEP versus only 70.9% after TIPP, $p = 0.46$). Data from the CCS questionnaire is summarized in Fig. 2.

Evaluation using the **EuraHS Quality of Life Score** showed similar outcomes, with equal pain and restriction scores for both techniques (Fig. 3), and a somewhat better cosmetic score after TIPP (71.4% reported no cosmetic hindrance after TIPP versus only 54.3% after TEP, $p = 0.165$). However, correction for age through logistic regression showed age to be a confounder in this domain: for every 1-year increase in age, the odds on experiencing cosmetic hindrance decrease with 4.9% ($p = 0.003$).

4. Discussion

Postoperative complications as well as quality of life after surgery are now considered the main and most important parameters in patient outcome assessment. This makes quality of life questionnaires the best tools to assess and compare surgical techniques.[17–20]

This retrospective study of 173 unilateral inguinal hernias in men is the first published comparing the TEP versus TIPP technique. The policy of the Ethical Committee demanded an opting-in consent from the patients before being allowed to include their data. This private data protection (GDPR) poses a significant challenge, especially concerning a retrospective analysis. This decreases both response rate and affects the quality of the retrospective research. In this study, patients were phoned when no questionnaire was received 6 weeks after the deadline. By contacting the patients in a second round and asking them whether they sent the questionnaires back or why they did not answer, the response rate was maximized and the response bias minimalized. Data from non-responders was used for descriptive statistics only.

The TIPP group participating in this study contains 58 patients and the TEP group 38 patients. The relatively higher amount of TIPP patients can be explained by the fact that in total 112 patients underwent TIPP versus only 61 patients that underwent TEP in the study period. As both TIPP and TEP procedures had to strictly be performed by two experienced surgeons only, 1 surgeon operated on twice as much inguinal hernia patients compared to the other. The TIPP surgeon only performed TIPP procedures and the same applies to the TEP surgeon, as to increase standardization and achieve possibly best outcomes for each technique. Three recurrences were identified in the TIPP group versus none in the TEP group, and no mesh-related complications occurred.

In our study we found no significant differences between the responders and non-responders in demographic parameters, risk factors and postoperative complications. As per clinical features, a higher amount of direct hernias was noted in the responder group. A population-based study on 2421 patients showed that direct hernias could be a risk factor for postoperative pain interfering with daily activity. However, no explanation for this finding was given.[21]

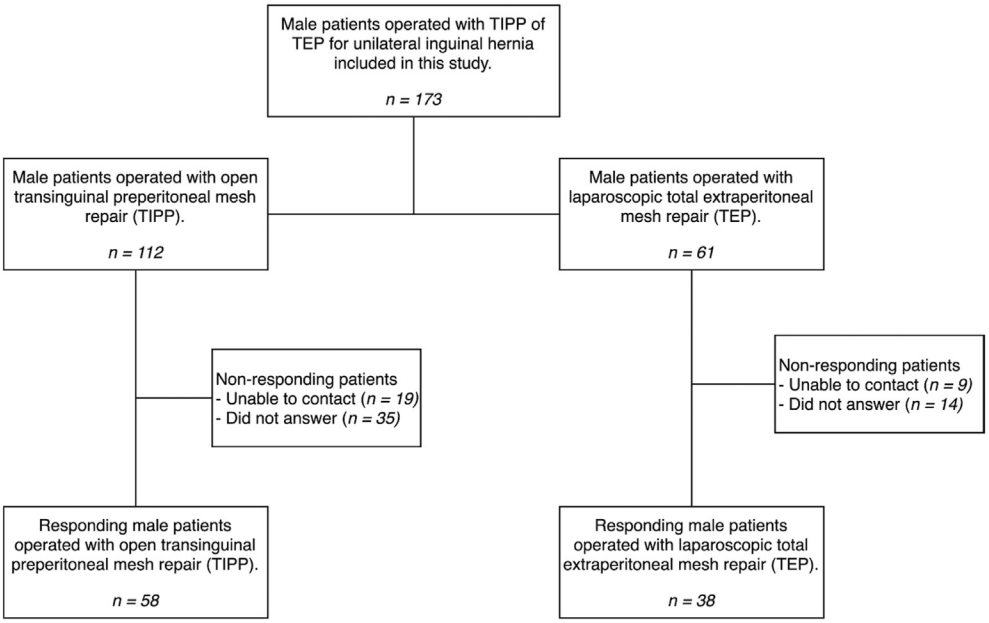

Fig. 1. Flowchart of patients included in this study.

Table 1
Comparison of patient and hernia characteristics between responders and non-responders.

	Responders	Non-Responders	
	n = 96	*n* = 77	*p* value
Age			
Mean ± SD	63.67 ± 15.06	60.23 ± 18.57	0.363 [a]
Range	23–88	25–91	
BMI (Kg/M^2)			
Mean ± SD	25.09 ± 2.99	24.45 ± 3.72	0.244
Range	19.5–36.3	15.4–32.9	
Hernia side			
Left (%)	52 (54.2%)	38 (49.4%)	0.529 [b]
Direct hernia component (%)	37 (51.4%)	19 (32.8%)	0.033
Indirect hernia component (%)	71 (81.6%)	61 (85.9%)	0.468
Obesity (BMI ≥ 25) (%)	27 (29.7%)	23 (31.1%)	0.845
COPD (%)	7 (7.4%)	8 (10.4%)	0.499
Diabetes mellitus (%)	5 (5.3%)	5 (6.5%)	0.755 [c]
Antico medication (%)	17 (18.3%)	17 (22.1%)	0.538

[a] Student's t-test.
[b] Chi square test.
[c] Fisher's Exact test.

Table 2
Comparison of postoperative complications between responders and non-responders.

	Responders	Non-Responders	
	n = 96	*n* = 77	*p* value
Seroma (%)	4 (4.2%)	2 (2.7%)	0.698 [a]
Hematoma (%)	3 (3.1%)	2 (2.7%)	1
Wound infection (%)	1 (1.0%)	0 (0.0%)	1
Urinary retention (%)	1 (1.0%)	0 (0.0%)	1
Hernia recurrence (%)	1 (1.0%)	2 (2.7%)	0.582

[a] Fisher's Exact test.

No difference in amount of direct hernias was present when comparing TIPP to TEP in our study.

The use of only one time point in the postoperative assessment of quality of life ±33 months post-surgery is an aspect that should be taken into account. Literature shows that quality of life doesn't change significantly after 12 months.[18] Nevertheless, the HerniaSurge guidelines state that preoperative and 7-day postoperative pain are independent risk factors for chronic pain.[1] The retrospective nature of this study did not allow a preoperative baseline evaluation with both validated hernia-specific questionnaires and thus affects the assessment of the postoperative evolution of quality of life.

Table 3
Comparison of patient and hernia characteristics between TIPP and TEP patients (responders and non-responders included).

	TIPP	TEP	
	n = 112	n = 61	*p* value
Age			
Mean ± SD	64.07 ± 17.10	59.0 ± 15.53	0.022 [a]
Range	25–91	23–86	
BMI (Kg/M^2)			
Mean ± SD	24.76 ± 3.62	24.91 ± 2.75	0.779
Range	15.4–36.3	19.5–31.7	
Hernia side			
Left (%)	56 (50.0%)	34 (55.7%)	0.470
Direct hernia component (%)	36 (43.4%)	20 (42.6%)	1 [b]
Indirect hernia component (%)	87 (84.5%)	45 (81.8%)	0.660
Obesity (BMI ≥ 25) (%)	32 (30.2%)	18 (30.5%)	1
COPD (%)	11 (10.0%)	4 (6.6%)	0.577
Diabetes mellitus (%)	7 (6.4%)	3 (4.9%)	1
Antico medication (%)	29 (26.6%)	5 (8.2%)	0.004 [c]

[a] Student's t-test.
[b] Chi square test.
[c] Fisher's Exact test.

Table 4
Comparison of postoperative complications between TIPP and TEP patients (responders and non-responders included).

	TIPP	TEP	
	n = 119	n = 61	*p* value
Seroma (%)	2 (1.8%)	4 (6.6%)	0.189
Hematoma (%)	3 (2.7%)	2 (3.3%)	1
Wound infection (%)	0 (0.0%)	1 (1.6%)	0.357 [a]
Urinary retention (%)	0 (0.0%)	1 (1.6%)	0.353
Hernia recurrence (%)	3 (2.7%)	0 (0.0%)	0.553

[a] Fisher's Exact test.

Table 5
Comparison of quality of Life outcomes between TIPP and TEP patients.

	Total score	TIPP	TEP	*P*
Caroline Comfort Scale				
Non-dichotomous				
Pain	40	1.4	2.8	
Movement	35	0.89	2.9	
Mesh sensation	40	1.8	2.3	
Dichotomous				
No Pain		41/54	26/36	0.81
No Movement restriction		46/55	30/36	0.97
Mesh sensation		41/57	28/5	0.46
EuraHS Quality of Life Scale				
Non-dichotomous				
Pain	30	1.6	1.8	
Restriction	40	3.4	2.7	
Cosmetic	20	1.3	1.5	
Dichotomous				
No Pain		37/52	27/35	0.62
No Movement restriction		31/46	19/27	0.80
No Cosmetic hindrance		35/49	19/35	0.165

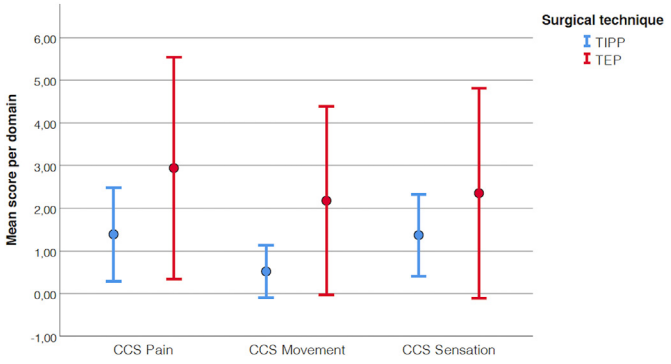

Fig. 2. Carolina Comfort Scale quality of life data, error bars represent confidence intervals.

When comparing the TIPP versus the TEP technique, several differences must be taken into account. TIPP is performed under spinal or general anesthesia, as opposed to the general anesthesia in TEP. This makes the inability to tolerate general anesthesia a relative contraindication for TEP. Moreover, prior lower abdominal surgery is also seen as a relative contraindication for TEP. This may explain the significant age difference between both cohorts. Older patients support general anesthesia less because of a higher prevalence of cardiopulmonary insufficiency, other comorbidities or previous lower abdominal surgery and thus are more eligible for TIPP repair.[7,22] Indications to perform an endoscopic TEP repair for an inguinal hernia are almost identical to those to perform an open TIPP repair. TEP might mainly have advantages in case of bilateral inguinal hernia repair or for recurrent inguinal hernias after a previous anterior repair.[7]

The use of a memory containing mesh in TIPP is helpful, as the memory ring offers an easy deployment of the mesh in the preperitoneal space. The stiffness provides an additional stabilization and the elasticity allows an easy adjustment to the human anatomy. TEP repair does not require memory containing meshes. Concerns about these surgical techniques may exist regarding both cost and long-term safety for some of these mesh devices. Questions could rise about the impact of the memory ring on the sensation of the mesh in TIPP.1[17] Problems with the initial recoil ring might result in pain and even bowel perforation.[23] However, in our analysis no mesh related complications were observed. Mesh devices are also

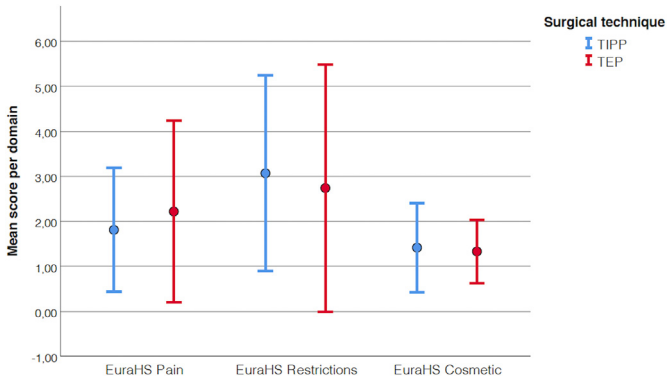

Fig. 3. EuraHS quality of life data, error bars represent confidence intervals.

more costly than flat meshes. However, a 2013 study found no differences in hospital costs between TIPP and Lichtenstein repairs. When productivity gains were included in the analysis, significant differences in cost favoring the TIPP modality were noted ($p = 0.037$).[16] The other concern mentioned in the recent HerniaSurge guidelines was that some of these open preperitoneal approaches use both anterior and posterior anatomical planes, which might be a theoretical disadvantage when a recurrence needs repair.[1] The advantage, however, for using a memory containing mesh, is the lack for mesh fixation. This reduces the potential risk of entrapment, damaging or stretching the ilioinguinal and iliohypogastric nerves causing discomfort or chronic pain postoperatively. In this study no mesh fixation was used in the TIPP technique.

The majority of complications after inguinal hernia repair involve seroma, hematoma and urinary retention. In the TIPP group, our study reports seroma, hematoma and urinary retention in 1.8%, 2.7% and 0% of the patients respectively. In the TEP group, our study reports seroma, hematoma and urinary retention in 6.6%, 3.3% and 1.6% of the patients respectively. Recurrence rates with experienced surgeons range between 1% and 4%.[6,24,25] In our study, hernia recurrence is reported in 2.7% of TIPP patients. These rates are in line with those reported in the literature,[14,26] while no recurrent hernias were observed in the TEP group after a mean follow-up of 33.5 months.

Considering the quality of life results in our study, we showed that 72.2%, 83.3% and 80% of the patients reporting no symptoms or hinder regarding pain, movement limitations and mesh sensation. A prospective study by Gitelis et al evaluating 293 patients (mean age 56 years, 93% male, 27% bilateral hernias, 20.5% asymptomatic, 15% recurrent hernias) after TEP repair used the CCS to evaluate postoperative quality of life. At 1 year postoperatively, 89% of the patients had no pain symptoms, 95% experienced no movement limitations and 90% perceived no sensation of the mesh. At 2 years postoperatively, these percentages were 88%, 92% and 91% respectively.[25] Muysoms et al showed that quality of life does not change significantly after 1 year. Thus, reported quality of life scores at 12 or 24 months postoperatively could be compared to those in our study registered at ± 33 months postoperatively. They studied both CCS and EuraHS-QoL scores for unilateral inguinal hernia repairs after TEP and transabdominal preperitoneal approach (TAPP) in their *LIQUOR* study. In that study, 64% of the patients underwent TEP. The median scores for all domains in CCS and EuraHS-QoL were 0.0 with all IQR being (0-0). Reported 90th percentiles were: 2, 1 and 1 for pain, movement and mesh sensation domains using the CCS respectively. For the EuraHS-QoL score, the 90th percentiles were 2, 4 and 2 for the pain -, restrictions - and cosmetic domains respectively.[18] The mean scores and IQR reported in our study are comparable to those cited above. No explanation for the higher 90th percentiles scores in our study could be found.

Wennergren et al performed a prospective study evaluating the quality of life of 48 patients undergoing TEP with the CCS as one of the report measures. The average age of these patients was 43.2 years, 24 underwent bilateral hernia repair and 28 patients completed the surveys at 1 year postoperatively. At 1 year postoperatively, this study reports a mean CCS pain score of 0.2 and a mean movement limitation score of 0. Scores of the sensation domain are not reported.[27] Our study reports mean CCS scores of 2.8, 2.9 and 2.3 for these three respective domains. However, the authors did not report on the unilateral treated patients separately, so comparison with our results remains difficult.

Less studies have been conducted evaluating quality of life after TIPP repair using QoL questionnaires. Koning et al used the SF-36 form to compare health status after TIPP repair versus Lichtenstein repair. Better patient outcomes were reported after TIPP compared with Lichtenstein, but these numbers are difficult to compare to the results in our study.[13] Their initial study was continued to evaluate long-term results. The mean duration of follow-up in this study was 85 months (range 74–117). Ninety-two percent of TIPP patients had no chronic pain complaints. In our study the CCS score reports no pain in 71.2% of the patients and in 75.9% using the EuraHS QoL score. But again, the SF-36 numbers are difficult to compare with the outcome measurements in our study.[28]

When comparing TIPP and TEP using the CCS and the EuraHS-QoL score, no differences between both procedures could be shown in all explored domains. No significant differences were found for the pain, movement and sensation domain in the CCS questionnaire. Nor were any significant differences found for the pain, restrictions and cosmetic domain of the EuraHS-QoL questionnaire.

The HerniaSurge guidelines state that age and open surgery are independent risk factors for chronic postoperative pain.[1] Further analysis in our study showed no correlation between younger age and the pain scores in both questionnaires. A significantly lower age in the TEP patients, a known risk factor for chronic pain, did not lead to higher pain scores compared to TIPP with older patients. This might be a certain selection bias in our study. However, age wasn't found to be a confounder or risk factor when performing further assessment through logistic regression. The TIPP technique is an anterior approach. This means the entrance through the inguinal canal during the procedure could affect inguinal nerves in the nearby anatomical region. More sensational discomfort and restrictions, examined in the movement, restriction and sensation domains of the questionnaires could be expected in the TIPP group. Secondly, questions could rise about the impact of the memory ring on the sensation of the mesh in TIPP repair. The stiffness of the memory ring in meshes in TIPP repair could cause additional sensational discomfort when compared to TEP, as stated earlier.[17] Combining these two aspects, higher scores would be expected in the movement and restriction domain of the CCS and EuraHS-QoL score, but certainly in the CCS sensation domain. In our study, no differences were found between TIPP and TEP in all domains mentioned above. This could indicate that the memory ring does not have a negative impact on postoperative quality of life. In our experience, if patients experience discomfort or pain by the memory ring early after surgery, this often remains problematic; if they do not experience early complaints, long-term follow-up will not show an increased number of memory ring problems either. Moreover, our findings suggest that the surgical approach to achieve mesh placement in the preperitoneal plane, by open or laparoscopic/endoscopic technique, does not affect quality of life.

Further analysis in the cosmetic domain showed age to be a confounder. Older patients perceived less cosmetic hindrance

compared to younger patients. Therefore, the absence of statistically significant differences in cosmetic hindrance can be considered surprising. The incision in the TIPP procedure is 3–4 cm long but is located a few centimeters cranial to the inguinal ligament. The TEP has 3 small incisions (5–12 mm) according to the laparoscopic approach, but more visible on the belly. This could be a first explanation for these findings. On the other hand, less cosmetic hindrance could be expected with the TEP repair given the size of the incisions. The age difference between the TIPP and TEP group could explain the fact that older patients are less bothered with possible scars. A patient's perception of cosmetic hindrance being influenced by the number of scars and not the size could be a third possible explanation for these findings.

Indeed, there are some important limitations regarding our study design that should be emphasized: as a retrospective comparative observational study and with limitations opposed by our ethical committee, the response rate of our study was only 55.5% and logically this is an important bias of the study. However, both complications and factors involving quality of life appear early after surgery, rather than late. If they occur, patients have been followed up for a longer postoperative period, so we believe the impact of this low response rate on the final interpretation of our results is low. Secondly, as all patients were operated on by one surgeon per technique, this might have an influence on outcome and not all findings can be attributed to the surgical technique alone.

In conclusion, despite these limitations, TIPP and TEP show equivalent results in outcome measurements for quality of life using 2 separate validated questionnaires after almost 3 years of follow-up. In the absence of randomized controlled trials comparing these surgical techniques, preperitoneal placement of the mesh during unilateral inguinal hernia repair shows excellent outcomes, regardless of the surgical approach used.

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Ethics approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (B670201734087) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to participate

Informed consent was obtained from all individual participants included in the study.

Availability of data and material

The data that support the findings of this study are available at the corresponding author, upon reasonable request.

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection was performed by all authors. Data analysis was performed by Simon Corthals. The first draft of the manuscript was written by Simon Corthals and Frederik Berrevoet. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Declaration of competing interest

All authors declare that they have no conflict of interest.

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