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Research Article

Quality-of-Life Post-TEP Inguinal Hernia Repair with Fibrin Sealant Polyester Mesh Fixation

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Abstract

Background: To evaluate the short-term benefit of endoscopic inguinal hernia repair using anatomical polyester mesh secured with fibrin glue.

Material and methods: Over an 8-year period, 435 patients underwent elective TEP inguinal hernia repair. Mesh fixation was achieved using exclusively fibrin sealant. Patients were reviewed at 2, 6 weeks and thereafter if judged necessary. QoL was assessed using the preoperative Modified Carolina Comfort Scale (MCCS) and post-surgical CCS score.

Results: A total of 133 associated pathologies in 112 patients (25.7%) were simultaneously treated. Male patients had a 6.7% risk having an associated occult femoral and/or obturator hernia. This incidence was significantly higher in female at 52.1%. At Week2, 83.4% of the patients had no pain and at Week6, average CCS score was 0.14 with 97.6% being <1. This improvement was significant (P<0.0001).

Conclusions: TEP inguinal hernia repair, using anatomical polyester mesh and fibrin sealant, offers excellent short-term benefit, irrespective of associated pathologies.

Keywords: Fibrin glue; Inguinal hernia; Fibrin sealant; TEP; TAPP

Introduction

Producing a good quality surgical research study can be challenging as inherent confounding variables, such as surgical technique used or level of surgical expertise, can result in a misrepresentation of the true relationship between the 'purpose' and the 'end-result' of the study. Also considered the gold standard in clinical research, most Randomized Controlled Trials (RCTs) and prospective studies are both, time-consuming and often too costly to be conducted without relying heavily on private funding. As such, any potential conflict of interest in the study design, choice of outcome measures, inability to blind the operating surgeons involved, inadequate completeness of reporting and extent of exclusion criteria could all potentially create unnecessary bias in favor of the sponsoring industry, thus producing "anticipated" positive results [1]. Those findings may also prove to be somewhat less relevant for many surgeons who are generally dealing with heterogeneous patient populations and for whom, attempting to reproduce the same type of results or adhere to new directives might be difficult or even unrealistic.

For example, international guidelines recommend no mesh fixation for most of the patients undergoing endoscopic TEP or laparoscopic TAPP groin hernia repair [2]. Interestingly, this is probably the least adopted directive from this comprehensive document, demonstrated by most worldwide surgeons still fixing meshes irrespective of the size of the groin hernia defect. In comparison, despite its recognized weaknesses retrospective analysis of prospectively maintained database rarely relies on

external funding and is easily conductible over a longer period, meaning that larger sample size of unselected patients can be analyzed. This methodology may also potentially offer meaningful answers to surgeons seeking improvement in their professional skills, as it is more representative of reality [3].

Several studies have demonstrated the superiority of fibrin sealant for mesh fixation over tacks with regards to chronic groin pain following laparoscopic inguinal hernia repair [4]. It is still considered the fixation device of choice in recently updated guidelines on laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal hernia [5]. The main objective of this study was to re-evaluate the short-term benefit of endoscopic (TEP) repair of inguinal hernia with regards to pain and satisfaction index, using anatomical polyester mesh secured with fibrin sealant [6].

Material and Methods

This is a retrospective review of a prospectively maintained observational cohort study with consecutive patients undergoing elective Totally Extraperitoneal (TEP) mesh repair of inguinal hernia. Exclusion criteria were age <18 years old and non-English speaking patients. No urinary catheter was inserted, sequential calf compressors and subcutaneous 20 mg enoxaparin were routinely used for deep venous thrombosis prophylaxis. CO_2 insufflation pressure was set at 8 mmHg. Whenever necessary, presence of a low arcuate line was divided laterally to improve vision and further mesh implantation [7].

In the presence of a moderate or large size direct hernia (M2, M3), the weakened Transversalis Fascia (TF) was plicated with a pre-tied loop of 2/0 Polydioxanone (PDS) (Endoloop® Ligature, Ethicon Endo-Surgery, Cincinnati, OH) as previously described [8]. The procedure included systematic wide exposure of the myopectinal orifice of Fruchaud and obturator canal, looking for possible associated femoral and/or obturator hernias. An anatomical pre-shaped polyester mesh (Parietex™ Anatomical Mesh 15x10 cm, TECT 1510ADP2, Medtronic, Mansfield, MA) was selected due to its softness, the fact that it is hydrophilic and naturally sticking to the abdominal wall, and can be adequately secured around the spermatic cord structures in men due to its ingenious lateral slit that allows generous mesh overlapping. Fibrin sealant (Tisseel, Baxter, Deerfield, IL) was solely used for mesh fixation as it can be safely applied to the triangles of 'doom' and 'pain', thus significantly reducing the risk of hernia recurrence as inadequate inferior mesh fixation is the most common cause [9,10].

Patients were reviewed at 2- and 6-weeks postoperative, and subsequently on an ad hoc basis if judged necessary, until complete resolution of their symptoms. The evaluation of pain and satisfaction index was achieved using the Carolinas Comfort Scale™ (CCS), a specifically designed post-hernia surgery assessment tool, also found to be more accurate than the generic SF-36 survey [11]. Pain scores were averaged for all activities and compared to the preoperative modified CCS (MCCS) [12]. Average postoperative CCS score >1 was considered symptomatic, as defined by Belyansky, et al. [13]. All results were analyzed using IBM SPSS v26 software. Preoperative MCCS and postoperative CCS scores were compared using Wilcoxon Sign rank test, change in mean pain scores were calculated using paired T-test, and Chi-square test was used to test relationships between categorical variables. Finally, Mann-U Whitney test was used to compare the characteristics of asymptomatic vs symptomatic patients. Statistical significance level was set at $P < 0.05$.

This project was supported by our institutional review board but exempted from Ethical Review as it involved the use of a prospectively maintained and secured database that only contained de-identified information. Written consent was not required. All procedures performed were in accordance with the 1964 Helsinki declaration and its later amendments of comparable ethical standards.

Results

Over an 8-year period (2011-2019), 476 consecutive unselected patients underwent elective TEP inguinal hernia repairs. Forty-one of them who didn't speak English and were therefore unable to comprehend the study purpose were excluded from this study, leaving 435 eligible candidates for further analysis.

There were 387 (89%) males and 48 (11%) females included with a median age of 52 years old (range: 18-88). Baseline demographics are summarized in Table 1. A total of 633 inguinal hernia repairs were performed, 237 patients (54.5%) had Unilateral Inguinal Hernias (UIH) and 198 patients (45.5%) Bilateral Inguinal Hernias (BIH). Of those 633 inguinal hernia repairs, 489 (77.2%) were indirect (lateral), 77 (12.2%) were direct (medial) and 67 (10.6%) had mixed defects. Forty-one out of those 633 repairs (6.5%) were for recurrent inguinal hernia.

Demographic characteristics	
Total number of patients, N	435
Male (%)	387 (89)
Female (%)	48 (11)
Median age, years (range)	52 (18-88)
Clinical characteristics	
Total number of inguinal hernias, N	633
Left side (%)	112 (25.75)
Right side (%)	125 (28.75)
Bilateral (%)	198 (45.5)
Type of hernia, N	633
Indirect (%)	489 (77.2)
Direct (%)	77 (12.2)
Mixed (%)	67 (10.6)
Recurrent hernia, N	41[a]
Left	11
Right	18
Bilateral	6
Previous TEP repair (contralateral), N	11 (8[b])
Previous robotic prostatectomy, N	1
Conversion to open herniorrhaphy, N	0
Conversion to TAPP, N (%)	5 (1.1)
Associated pathologies[c] (133 in 112 patients)	
Total femoral hernia, N	42[d]
Left	11
Right	21
Bilateral (BFHs)	5
Male patients (% of 387 males)	20 (5.2[e])
Female patients (% of 48 females)	17 (35.4[f])
Total obturator hernia, N	21[g]
Left	9
Right	6
Bilateral (BOHs)	3
Male patients (% of 387 males)	6 (1.6[h])
Female patients (% of 48 females)	12 (25[i])
Total patent processus vaginalis, N	40
Left	14
Right	24
Bilateral	1
Umbilical hernia, N	17
Gimbernat's (Laugier's) hernia, N	4[j]
Lumbar hernia, N	1
Spigelian hernia, N	1
Removal of tacks (previous TEP), N	1
Excision cyst (hydrocele) canal of Nück, N	2
Orchidectomy (atrophic undescended testis), N	2
Bilateral vasectomy, N	2

Table 1: Baseline demographics, clinical characteristics and associated pathologies of the overall patient cohort.

TEP - totally extraperitoneal *TAPP*- trans-abdominal pre-peritoneal

[a]41 recurrent hernias in 35 patients

[b]Three ipsilateral recurrent TEP repairs of previous TEP

[c]All associated pathologies treated at the same time as TEP repair

[d]Three femoral hernias with obturator hernias

[e]Corresponds to 22 femoral hernias found in 20 male patients (two bilateral)

[f]Equals 20 femoral hernias found in 17 female patients (three bilateral)

[g]One obturator hernia with BFHs

[h]Seven obturator hernias in 6 male patients (one bilateral)

[i]14 obturator hernias in 12 female patients (two bilateral)

[j]Two Gimbernat's hernias associated with one BFHs & one BOHs

Hernia Repair Defects

Hernia defects as per the European Hernia Society (EHS) classification are summarized in Table 2. In total, 700 defects were identified in those 633 inguinal hernia repairs. Indirect inguinal hernias were the most common with 302 L1, 187 L2 and 67 L3, whereas direct hernia defects accounted for: 34 M1, 81 M2, and 29 M3. The 67 mixed inguinal hernia defects were as follows: 9 L1M1; 25 L1M2; 12 L1M3; 6 L2M1; 8 L2M2; 5 L2M3; one L3M1 and one L3M2. An Endoloop of PDS was used to plicate the attenuated TF of 110 moderate and large size direct defects (81 M2, 29 M3), before securing the mesh with fibrin glue.

	Indirect			**Direct**			**Total (M)[#]**
	L1	**L2**	**L3**	M1	M2	M3	
	256			-	-	-	
		168		-	-	-	
			65	-	-	-	
M1	9[a]	6[d]	1[g]	18	-	-	**34**
M2	25[b]	8[e]	1[h]	-	47	-	**81**
M3	12[c]	5[f]	0[i]	-	-	12	**29**
Total (L)[#]	**302**	**187**	**67**				

302 L1 (indirect defect ≤ 1.5 cm), 187 L2 (defect >1.5 cm <3 cm), 67 L3 (defect ≥3 cm): 556 indirect (L) defects

34 M1 (direct defect ≤ 1.5 cm), 81 M2 (defect >1.5 cm <3 cm), 29 M3 (defect ≥3 cm): 144 direct (M) defects

67 mixed hernia defects: [a,b,c] 9 L1M1; 25 L1M2; 12 L1M3 - [d,e,f] 6 L2M1; 8 L2M2; 5 L2M3 - [g,h,I] 1 L3M1; 1 L3M2; 0 L3M3 #Total number of hernia defects (556L + 144 M): 700.

Table 2: Classification of 700 hernia defects from 633 inguinal repairs (67 mixed hernia defects) as per the European Hernia Society.

Associated Pathologies

A total of 133 associated pathologies in 112 patients were simultaneously treated and are summarized in Table 1. Thirty-nine patients presented with 40 patent processus vaginalis (one bilateral) that were all divided and closed at the proximal end with an Endoloop of PDS [14]. During surgery, 42 associated occult femoral (5 bilateral) and 21 obturator (3 bilateral) hernias were also identified, reduced, and simultaneously repaired with mesh. Overall, 22 femoral hernias were found in 20 male patients (5.2%) and 20 in 17 female patients (35.4%). Similarly, 7 obturator hernias were synchronously found in 6 male patients (1.6%) and 14 in 12 female patients (25%). Interestingly, 3 female patients had concurrent unilateral inguinal, femoral and obturator hernias (Figure 1), whilst one female patient had unilateral inguinal and obturator hernias combined with bilateral femoral defects (Table 1). In this series, the risk for a male patient to have an associated occult femoral and/or obturator hernia was calculated at 6.7%, whereas this incidence was significantly increased in the other gender at 52.1%. Although quite rare, we simultaneously treated four incidental Gimbernat's (or Laugier's) hernias (Figure 2) and performed orchidectomy on two occasions for atrophic undescended testis (Figure 3).

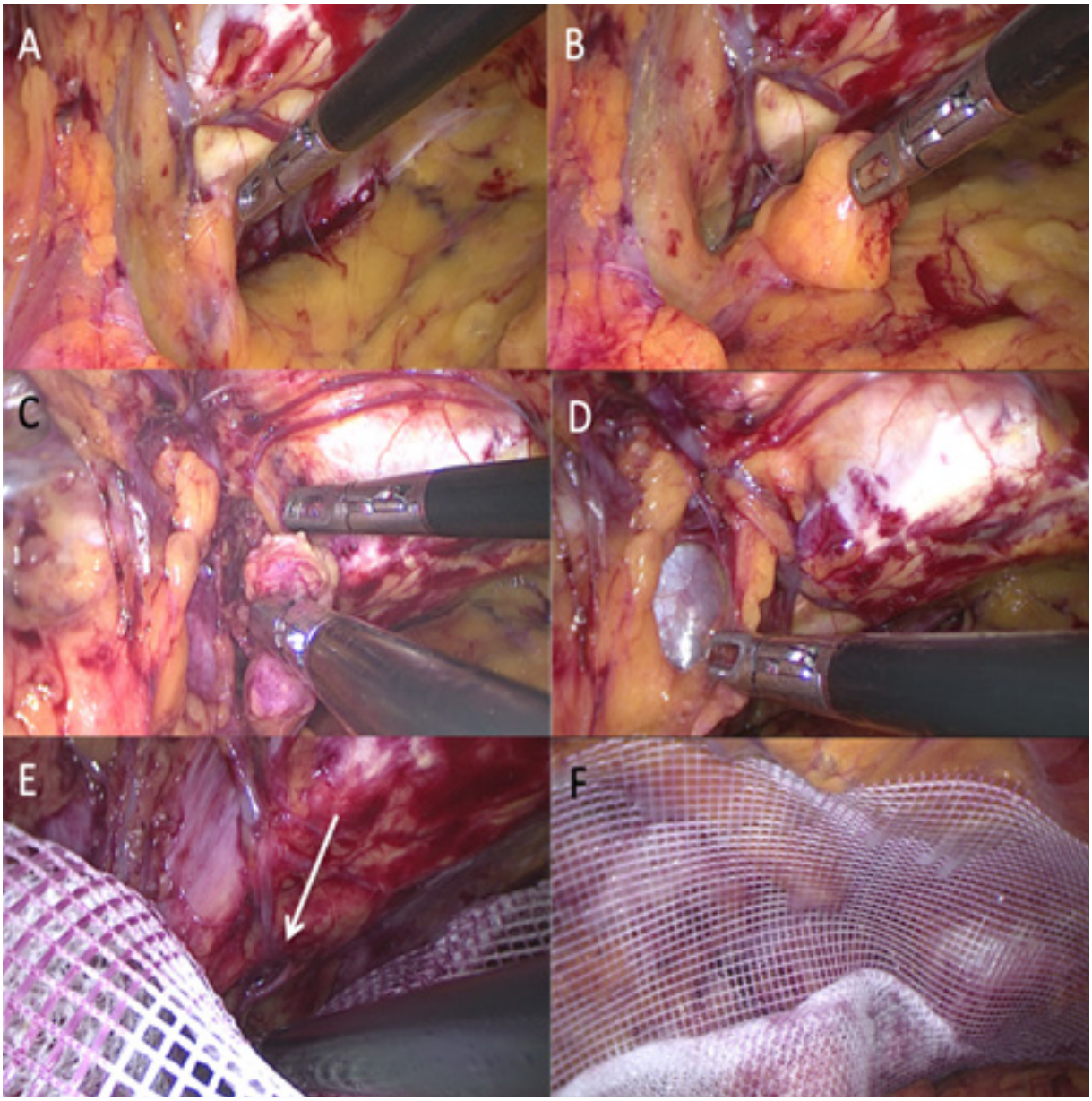
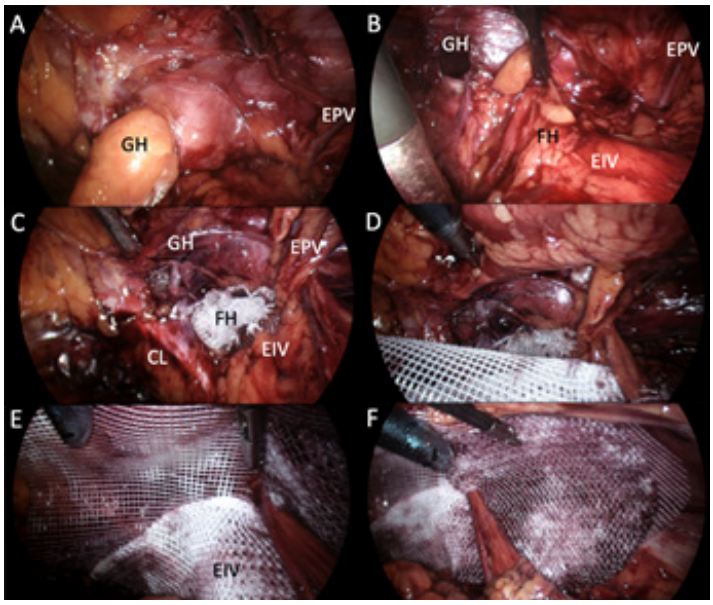
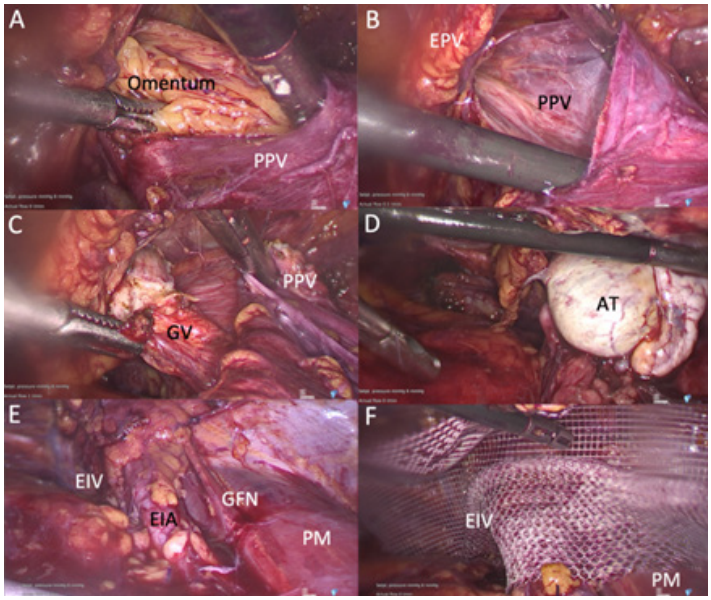


Figure 1: TEP view left groin **A)** occult left obturator hernia, **B)** reduced occult left obturator hernia (pre-peritoneal fat), **C)** reduced occult left femoral hernia, **D)** exposed medial aspect left external iliac vein, **E)** positioning ADP2 polyester mesh covering left obturator foramen (arrow), **F)** fixed mesh with fibrin glue.



H: Gimbernat's Hernia; EPV: Epigastric Vessels; FH: Femoral Hernia; EIV: External Iliac Vessels; CL: Cooper's Ligament

Figure 2: TEP view right groin **A)** incarcerated Gimbernat's hernia (pre-peritoneal fat), **B)** reduced Gimbernat's hernia and exposed femoral hernia, **C)** plugged femoral canal (medial to external iliac vein) and Gimbernat's hernia defect closed with Endoloop PDS, **D)** positioning ADP2 polyester mesh covering both femoral and Gimbernat's hernia defects, **E)** medial view fibrin glued mesh covering the external iliac vessels (triangle of doom) **F)** lateral view mesh wrapped around spermatic cord structures and covering the deep inguinal ring and the triangle of pain.



PPV: Patent Processus Vaginalis; EPV: Epigastric Vessels; GV: Gonadal Vessels; AT: Atrophic Testicle; EIV: External Iliac Vein; EIA: External Iliac Artery; PM: Psoas Muscle; GFN: Genitofemoral Nerve.

Figure 3: TEP view right groin **A)** incarcerated omentum in opened patent processus vaginalis, **B)** reduced omentum, **C)** divided patent processus vaginalis and exposed gonadal vessels, **D)** reduced atrophic right testicle from deep inguinal ring, **E)** exposed major structures (excluding spermatic cord that has been divided) before mesh placement; **F)** medial view fibrin glued mesh covering the external iliac vessels ("triangle of doom") as well as the psoas muscle inferio-laterally, with adequate coverage of the deep inguinal ring and "triangle of pain".

No intraoperative complications were observed and there was no conversion to open surgery, but 5 cases (1.1 %) had to be completed using a Transabdominal Preperitoneal (TAPP) approach.

Postoperative Complications

Overall, 21 postoperative morbidities were recorded (4.8 %) and are summarized in Table 3. No one complained of chronic groin pain, but 5 out of our 387 male patients (1.3%) included in this study were still experiencing mild intermittent testicular discomfort after 3 months post-surgery. No one required regular analgesic. When looking at the incidence of preoperative testicular pain/discomfort, this symptom was already present in 32 out of the 387 male patients (8.3%). This partly explains why transient testicular discomfort was still recorded in 12.6% of the male subgroup at the 1st post-op. visit and went down to 3.7% at 6 weeks postoperative (2nd visit).

Type	N	Observations
Minor		
Chronic groin pain (>3 months)	0	
Testicular discomfort (>3 month)	5	Not requiring antalgics
Numbness		
Lateral femoral cutaneous nerve	2	
Genitofemoral nerve	1	
Superficial wound infection	1	Treated with oral antibiotics
Hematoma		
Superficial	3	
Extraperitoneal	1	Rectus sheath treated conservatively
Urinary retention	5#	One required TURP one week later
Orchi-epididymitis	1	Treated with oral antibiotics
Supraventricular Tachycardia (SVT)	1	Transitory
Vas deferens injury	1	Endoloop PDS
#: 5 out of 387 male patients (1.3%) developed post-operative urinary retention; N, number of patients		

Table 3: Summary of the 21 post-operative complications (4.8%) observed.

Five out of 435 patients required catheterization for urinary retention (1.1%), they were all males and one of them underwent TURP one week later. One patient (0.2%) developed transitory numbness in the territory of the genitofemoral nerve and two others (0.4%) in the lateral femoral cutaneous nerve of the thigh. We also reported three cases of superficial and one rectus sheath hematomas that were all treated conservatively. One patient had an accidental injury of his vas deferens during dissection that was ligated. One superficial wound infection was successfully treated with oral antibiotics and a female patient developed transitory SVT that was successfully treated by the cardiology team. She was discharged from hospital the following day.

Patients' Satisfaction Index

Preoperative MCCS Score: A total of 422 patients (97%) completed their preoperative MCCS questionnaire and 225 of them (53.3%) had a calculated MCCS score >1, for an average MCCS score of 1.74 (standard deviation SD: 1.66), as summarized in Table 4.

Parameters		
	Week 2	**Week 6**
Total number of patients, N	422	328
Average CCS score (range)	0.54 (0-5.5)	0.14 (0-3)
Average CCS score <1, Pts No. (%)	352 (83.4)	320 (97.6)#
Average CCS score >1, Pts No. (%)	**70 (16.6)**	**8 (2.5)**
- CCS 1.1 - 1.5 (minimal discomfort)	+ 35 (8.3%)	+ 6 (1.9%)
- CCS 1.51 - 3 (mild pain)	+ 28 (6.65%)	+ 2 (0.6%)
- CCS 3.1 - 6 (moderate pain)	+7 (1.65%)	+ 0 (0%)
- CCS >6 (severe pain)	+ 0 (0%)	+ 0 (0%)
Average Pre-op. MCCS (range)	1.74 (0-7.2)	
Average MCCS score >1, Pts No. (%)	225 (53.3)	
#320 (97.6%) patients with a CCS score <1: 199 (62.2%) - total CCS score of 0 out of 115 points 32 (10%) - total CCS score 1 out of 115 points 55 (17.2%): - total CCS score <0.3 (2-4 out of 115 points) 20 (6.25%): - total CCS score <0.6 (5-8 out of 115 points) 14 (4.35%): - total CCS score <1.0 (9-14 out of 115 points)		

Table 4: Average pre-operative MCCS and post-operative CCS scores at Week 2 and Week 6.

2-Weeks postoperative: At the 1st postoperative visit (Week2), satisfaction index was assessed in 422 out of the 435 patients (97%) initially included in this study using the CCS comprehensive score system. The average CCS score was 0.54 (SD: 0.72) with 352 (83.4%) of them having a score <1 and therefore considered asymptomatic. Overall, patients were experiencing significantly less pain at 2-weeks post-surgery than preoperatively (MCCS vs CCS 2/52: P<0.0001). The remaining 70 symptomatic patients (16.6%; CCS score >1) had an average CCS score of 1.8 (SD: 0.89). This was still significantly lower than their matched modified preoperative score (average MCCS score 2.61, SD: 1.91: P<0.0001). Out of those 70 symptomatic patients, 50% (35/70) and 40% (28/70) of them were only experiencing minimal discomfort (CCS 1.1-1.5) or mild pain (CCS 1.51-3) respectively. The remaining seven patients did complain of moderate pain (CCS 3.1-6) and no one experienced severe pain (CCS>6; Table 4). Interestingly, 58.6% (41/70) of those with CCS>1 was treated for BIH repairs as compared to 43.2% in the other 352 patients with a CCS<1 (P=0.018; Table 5). Furthermore, this subgroup of patients was also significantly younger (median age 48 vs 53 years old; P<0.001). Both merged variables (BIH and younger age) are likely to have influenced the increased incidence of early post-surgical groin pain. Finally, also not significant there was a small trend towards slightly higher female ratio (12.9% vs 10.7%; P=0.36) and associated pathologies (40% vs 28.7%; P=0.18) in the CCS>1 subgroup, as compared to the 352 asymptomatic patients (CCS<1). When looking at the mean CCS scores, individually, they all remained very low and calculated at 0.05 when laying or sitting, 0.06 for stairs, 0.07 for walking, 0.08 for daily living activities, 0.09 for coughing, and 0.11 for bending and exercising. Those low scores account for most patients (83.4%) who were already asymptomatic at 2 weeks postoperative.

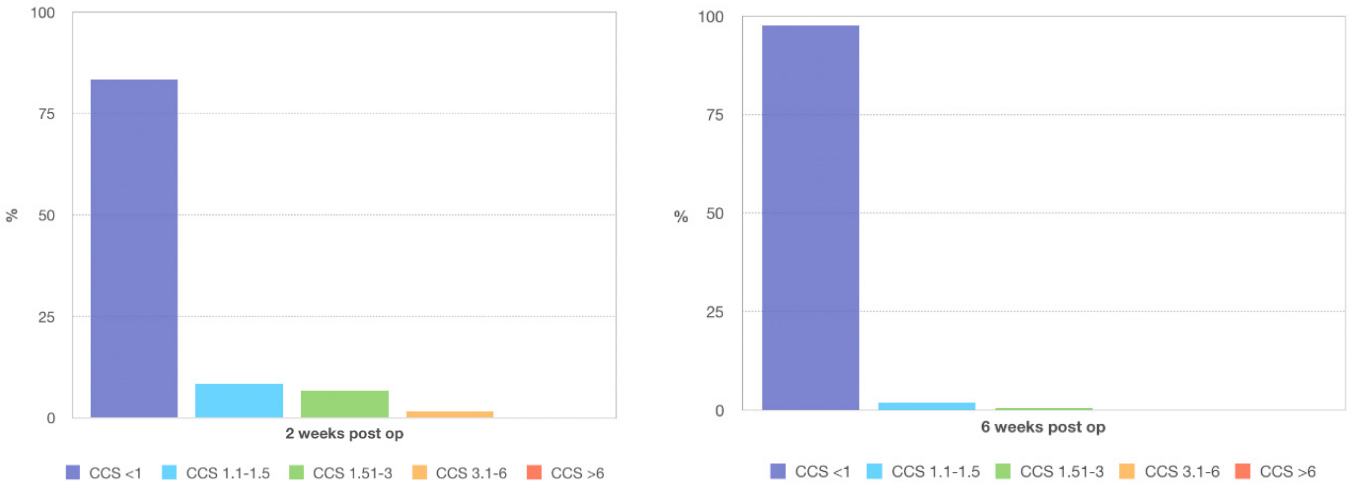


Figure 4: CCS scores at Week 2 and Week 6 post-operative.

Demographic characteristics	
Total number of patients, N	70
Male (%)	61 (87.1)
Female (%)	9 (12.9)
Median age, years (range)	48 (20-76)
Clinical characteristics	
Total number of inguinal hernias, N	111
Left side (%)	10 (14.3)
Right side (%)	19 (27.1)
Bilateral (%)	41 (58.6)
Recurrent hernia, N	5
Left	3
Right	2
Associated pathologies[a] (28 in 70 patients)	
Total femoral hernia, N	9
Bilateral (BFHs)	1
Total obturator hernia, N	5
Bilateral (BOHs)	1
Total patent process vaginalis, N	8
Umbilical hernia, N	2
Gimbernat's hernia, N	1
Orchidectomy (atrophic undescended testis), N	1
[a]all associated pathologies treated at the same time as TEP repair	

Table 5: 70 patients with CCS score>1 at 2-Weeks post-operative.

6-Weeks postoperative: At the 2nd postoperative visit (Week 6), satisfaction index was assessed in 328 out of the 435 patients (75.4%) initially included in this study. The average CCS score was 0.14 (SD: 0.3), with 320 (97.6%) of them having a score <1 (Table 4). When comparing patient's satisfaction index between Week2 and Week6 postoperative, we were once again able to demonstrate a significant improvement (CCS 2/52 vs CCS 6/52: P<0.0001) as illustrated in Figure 4. Out of those 8 cases (2.4%) who had a CCS score>1, six of them experienced minimal discomfort (CCS 1.1-1.5) and two were only complaining of mild residual groin pain (CCS 1.51-3), not requiring any analgesic. Finally, out of those 320 patients with no pain, 62.2% of them (199 cases) had an absolute CCS score of 0 (out of a maximum 115 points score) and another 10% (32/320) had a calculated score of 1/115. In 17.2% (55/320) the score was between 2-4/115, 6.25% (20/320) between 5-8/115, and 4.35% (14/320) had a calculated CCS score of 9-14 out of 115 points (Figure 5).

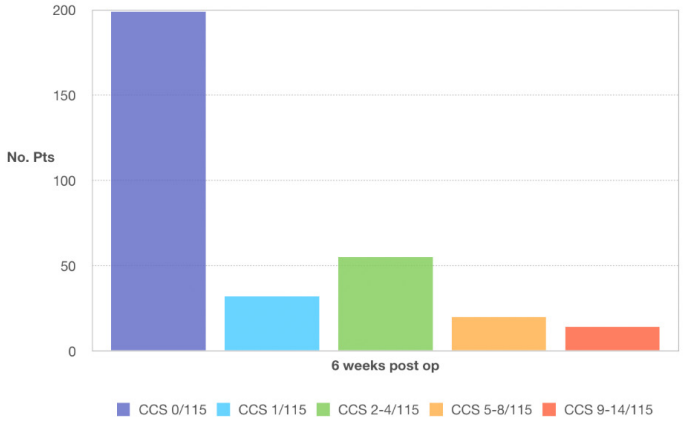


Figure 5: CCS scores <1 at Week 6 post-operative.

Discussion

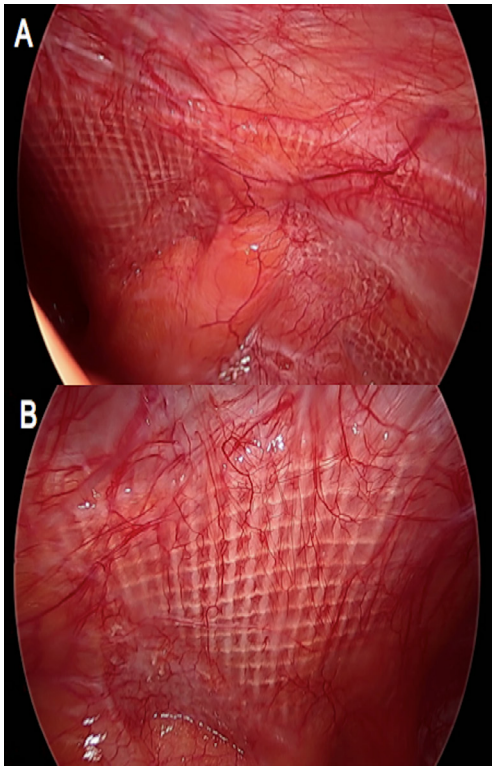
Retrospective cohort studies may have several advantages relative to prospective RCTs as they can potentially add more meaningful values to the surgeons in their everyday practice. Those benefits include: no exclusion criteria so the data collected are unselected and truly representative of the overall population [for instance, excluded: complicated bilateral, scrotal or recurrent hernias, hernia size (L3,M3), history of previous laparotomy and/or preperitoneal surgery, associated femoral/obturator defect, patients with severe cardiopulmonary risk factors, or high BMI], with longer follow-up availability and larger sample size, but also with a significantly reduced risk of creating medical industry-induced bias.

We found in this cohort study that male patients had a 6.7% risk of having an associated occult femoral and/or obturator hernia, whereas this incidence was significantly higher in female at 52.1%, which seems quite elevated when compared to previously published studies [15]. This difference is largely explained by the fact that we routinely expose the medial aspect of the external iliac vein as well as the obturator foramen during dissection, which are important anatomic landmarks and indicative of an adequate infero-medial dissection of the preperitoneal space. Around 10-years ago, we already established that female patients had 37% chance of having an associated occult femoral hernia during TEP inguinal hernia repair versus 3% in males [16]. At that time, we were not specifically looking for potential coexistent occult obturator defect, which explains why this condition has been previously underreported. Interestingly, Susmallian et al demonstrated that when systematically exploring the obturator foramen during TEP repair an associated defect could be identified in 6.8% of patients, which supports our findings [17]. In most of our cases, there wasn't a peritoneal hernia sac per se but rather the

presence of preperitoneal fat protruding through the pelvic orifice of the obturator canal and forming a fat plug, which is considered by some as the early stage of obturator hernia formation [18]. Being able to diagnose and simultaneously repair an unexpected occult defect (in our series: 42 femoral and 21 obturator hernias) provides a clear benefit of TEP repair over conventional open herniorrhaphy. Interestingly, identical findings were reported by others meaning that if you are looking for it, you will be more likely to find it [19,20].

How can we justify operating someone with either minimal discomfort or no pain from his/her hernia(s), such as in this study? Indeed, 32% of our patients had a calculated MCCS of ≤0.5. This decision can only be justified based on the expertise of the hernia surgeon and his demonstrated low risk incidence of chronic groin pain. We have already shown in previous studies that the utilization of fibrin glue for mesh fixation during TEP inguinal hernia repair could offer excellent postoperative outcome with extremely low risk of developing chronic groin pain [6,21].

We demonstrated that at Week2, 83.4% of our patients denied any pain (CCS<1), 8.3% were experiencing minimal discomfort and 6.65% mild pain. This also means that only 7 patients (1.65%) complaint of moderate pain at the first postoperative visit. This result Figure 6 seems acceptable considering that this is a case series of unselected patients and out of which, 45.5% of them underwent BIH repair, 25.7% (112/435) were simultaneously operated for coexistent pathologies, 8% had recurrent inguinal hernia repairs and 2.5% had already undergone previous TEP repair on the same or contralateral side. Those inclusions would have undoubtedly negatively influenced overall pain score. For instance, we previously demonstrated that undergoing bilateral hernia repair, as opposed to unilateral, was predictive of persisting discomfort at the 6 weeks follow-up visit [12]. In comparison, it is likely that RCTs on the same subject would have included a more homogenous low-risk group of selected patients, thus skewing overall results towards better outcome. Interestingly, those 70 symptomatic patients (16.6%) had an average CCS score of 1.8 that was still significantly lower than their matched modified preoperative score calculated at 2.61 (P<0.0001).



Both images demonstrating harmonious prosthetic integration within surrounding tissues without any evidence of mesh migration, shrinkage of folding.

Figure 6: Laparoscopic pelvic view post TEP inguinal hernia repair with Parietex™ mesh fibrin glue fixation **A)** right-side extraperitoneal mesh, **B)** left-side extraperitoneal.

We noticed a further significant improvement at the 2nd postoperative visit (Week 6), with 97.6% of the patients averaging a score <1. Out of the remaining eight cases (2.4%) with a CCS score>1, six of them mentioned minimal discomfort whereas only two were still experiencing mild intermittent groin pain and not requiring any analgesic. Most importantly, none of those eight patients developed chronic pain (>3 months duration). Those

results confirm the short-term benefit of this technique in terms of reduced postoperative pain and high satisfaction index. We believe that both, biodegradable fibrin glue and macroscopic polyester mesh offer an ideal combination with easily reproducible outcome. Tisseel is known to promote tissue ingrowth and wound healing, while still retaining its haemostatic property [21]. Additionally, due to the unique softness and hydrophilic characteristic of Parietex™, this prosthesis has a natural tendency to stick to the abdominal wall, which significantly helps trans-porous mesh fixation when spraying fibrin sealant.

Mesh integration into the surrounding tissues with minimum shrinkage or folding is also essential to avoid chronic pain from "meshoma" formation [22]. Its incidence varies depending on the type and structural properties of the selected mesh, as well as the choice of the anchoring device [23]. Unlike fibrin glue, another important limiting factor with all stapled fixation tools is that none of them can be safely applied inferiorly onto both triangles of "doom" and "pain" during mesh fixation, thus increasing the risk of rolling up of the prosthesis with exposure of the Hesselbach triangle. This may potentially lead to hernia recurrence as inadequate inferior mesh fixation is the most common cause of recurrence in experienced hands [9,10,24].

We have been able in the past to objectively demonstrate a long-term harmonious incorporation of the polyester mesh in the groin, when fixed with fibrin glue, even several years following previous TEP inguinal hernia repair. An example of mesh integration is illustrated in Figure 6. Maintenance of mesh integrity that can offer permanent coverage of the Hesselbach triangle is therefore essential to maintain a very low risk of hernia recurrence. In a recently published long-term (median 5.9 years) follow-up study on TEP inguinal hernia repair and fibrin glue mesh fixation, we did not report any case of hernia recurrence [20].

Over the last decade there has been growing interest in the self-gripping mesh technology that offers the unique advantage of not requiring any fixation device. Law et al published the first prospective study comparing fibrin sealant fixation vs ProGrip™ alone in TEP inguinal hernia repair [25]. Although well designed, the authors only used the VAS score for pain assessment, which is unfortunate as this subjective measure lacks "hernia" specificity to be able to draw any relevant conclusion. Looking more specifically at the satisfaction index, Wu et al reported a CCS>1 in only 6% of cases at 2 weeks post TEP in a small prospective cohort study [26], while others mentioned a 1.7% risk of developing chronic pain and requiring analgesia [27]. With only 2.4% of our patients having a CCS>1 at Week 6 post-operative and none of them necessitating any pain killer, our findings compare well with both study results and validate the short-term benefit of fibrin sealant with regards to pain and satisfaction index following endoscopic inguinal hernia repair. Similarly, we only reported 1.3% incidence of chronic groin pain after a median follow-up of almost 6 years [20].

The next question will be to evaluate and compare the long-term benefit of ProGrip™ versus fibrin glue, with regards to hernia recurrence. What we already know is that Stavert et al. documented a 0.51% recurrence rate post TEP repair using this mesh after a median follow-up of 2.83 ±26 weeks [27], whilst others mentioned a hernia recurrence rate of 1.9% post TAPP after a mean follow-up of 22.8 months [28]. Consequently, we plan to design a new prospective study comparing long-term clinical outcome following simultaneous implantation of both the ProGrip™ and Parietex™ Anatomical ADP2 Meshes (one per side) during TEP bilateral inguinal hernia repairs. The fact that both meshes being simultaneously inserted on all patients should significantly reduce sample bias and theoretically help us authenticate which of the two techniques offers better outcome.

Conclusions

Our results confirm previous initial findings that endoscopic TEP inguinal hernia repair, using hydrophilic anatomical polyester mesh secured with fibrin sealant, offers excellent short-term benefit with regards to pain and overall satisfaction, irrespective of the heterogeneity of the patient populations.

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