

# Influence of learning curve and surgeon experience on postoperative pain after laparoscopic treatment of inguinal hernias



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## Influence of learning curve and surgeon experience on postoperative pain after laparoscopic treatment of inguinal hernias

**INTRODUCTION:** Laparoscopic approach for inguinal hernia offers considerable advantages. Several risk factors for postoperative pain have been investigated, but few articles can be found about learning curve and surgeon's influence on postoperative pain after inguinal herniorrhaphy.

**PATIENTS AND METHODS:** A prospective study was conducted including 105 patients. Surgical procedures were performed by two general surgeons performing TAPP procedure. Follow up was realized at one and three months after surgery.

**RESULTS:** Majority of investigated data were without significant differences. In case of the Senior Surgeon we registered higher SEI (surgeon experience index), increased proportion of bilateral inguinal hernias ( $P = 0.0309$ ) and higher percentage of longer surgical procedures ( $P = 0.0309$ ). Meantime in case of the Junior Surgeon we recorded operations with intermediate duration ( $P = 0.0232$ ) in a greater manner. During the follow up period, similar incidence of pain sensation was remarked among patients, without statistical significance.

**CONCLUSION:** With adequate learning program and supervision TAPP procedure can be a safe technique when performed by young specialist too, presenting similar postoperative results with those of experienced surgeons.

**KEY WORDS:** Inguinal hernia, TAPP, Selfgripping surgical mesh, Postoperative pain

### Introduction

Nowadays inguinal hernias still correspond a major medical issue, affecting a significant part of the population, making treatment of these abdominal wall defects one of the most commonly performed surgical procedures around the world. The feasibility of minimal invasive treatment has been demonstrated by many researchers, laparoscopic approach of the abdominal wall defect presents considerable advantages, with shorter hospitalization, faster recovery and lower postoperative pain which are probably the most important aspects to mention.

Although the complexity of surgical procedure and the anatomy of posterior inguinal wall, make the learning curve of these interventions steep. Abdominal wall reinforcement with synthetic mesh has become the gold standard of hernia therapy, with a large variety of surgical prosthesis. Self-adherent mesh proved to be an excellent and comfortable choice for inguinal herniorrhaphy.

Postoperative pain after inguinal hernia repair represents an unwanted complication, with functional limitations and decrease in quality of life, which occurs in approximative 8-16% of patients<sup>1-5</sup>.

### Materials and Methods

#### DEFINITION

Postoperative pain is defined as pain persisting after surgical intervention, localized at the surgical site, which was not present before surgery and other causes of pain

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are excluded. Regarding the length of postoperative pain there are still controversies to find because some authors argue that inflammatory tissue reactions after mesh based hernioplasty may lead to a prolonged healing process that could last longer, even up to six months<sup>6,7</sup>.

Learning curve is defined as number of surgical interventions needed in order to master a certain surgical procedure safely. Regarding this aspect, different opinions can be found in the literature of specialty, but there seems to be a consensus that learning curve of laparoscopic transabdominal preperitoneal procedure requires around 50 cases<sup>8,9</sup>.

## AIM OF STUDY

Several potential causes and risk factors for post herniorraphy pain have been investigated, but few relevant research can be found in the literature of specialty about surgeon's influence on development of postoperative pain. Therefore the present research has been started from the hypothesis that surgeons could practice important influence on the development of postoperative pain after minimal invasive inguinal hernioplasty. Primary goal of the present article was to investigate whether a relationship exists between general surgeon's experience and postoperative pain development after TAPP repair for inguinal hernia.

## Exclusion criteria

Exclusion criteria contained inguinal hernia repair in emergency conditions; complicated inguinal hernias (irreducibility, incarceration, giant inguinoscrotal hernias), other laparoscopic treatment options than TAPP procedure; open surgical techniques; patients who presented any kind of chronic pain or complained about pain sensation in the inguinal region at the time of hospital admission; severe obesity or cardiovascular disease, which contraindicated minimal invasive approach with general anesthesia.

## PATIENT SELECTION, ESTABLISHMENT OF STUDY GROUPS AND STUDY PROTOCOL

In order to analyze the above mentioned data, we conducted, between March 2018 and March 2020, a prospective comparative study, involving two general surgeon's with different professional status and experience. During the research we compared the results of a general surgeon consultant (senior surgeon) with twenty years of surgical experience from the 2<sup>nd</sup> Department of General Surgery of Mureş County Emergency Clinical Hospital, respectively a general surgeon special registrar (junior surgeon) with three years of surgical experience

from Surgical Department of Emergency Hospital of Odorheiu Secuiesc. Both surgeons attended minimal invasive training programs and laparoscopic suture courses. Furthermore, the junior surgeon performed the first cases of TAPP procedure under the supervision of the senior doctor. Patients were selected and divided into two groups, based on the surgeon who performed the hernioplasty: *Group of Junior Surgeon* – including 49 patients, respectively *Group of Senior Surgeon* – including 56 patients. In the referred period patients diagnosed with inguinal hernia were evaluated for study incorporation. After careful selection, the remaining one hundred and five patients were assessed and carefully examined. At hospital admission blood tests were performed in order to evaluate biologic status, cardiologic and anesthetic consultations were fulfilled for estimating operative risk, after which patients underwent elective laparoscopic surgical intervention. TAPP procedures were realized exclusively in order to treat abdominal wall defects with implantation of self-adherent synthetic mesh.

Postoperative medication was administrated according to established treatment protocol. Administration of painkillers were personalized for each patient in function of their pain intensity, tolerance, and necessity. On the day of surgery (Day 0), every patient benefitted of three dose analgesic medication (Metamizole Monohydrate). From postoperative day one, through the hospital stay, analgesic treatment was applied only at personal request, depending on the intensity of pain felt by the patient.

Antibiotics were utilized mainly in prophylactic manner (Ceftriaxone), while anticoagulant treatment (Fraxiparine) was applied during the whole hospital stay in order to avoid thromboembolic events. Early mobilization was urged in case of all patients. Complications occurred in the postoperative period were also monitored and registered. After hospital discharge, all patients benefitted of short and long term follow up, at one and respectively three months succeeding surgical intervention.

## Data collection

Assessment of clinical and surgical characteristics followed patient's gender, age, nature, side and type of the abdominal wall defect, length of surgical intervention and nature of postoperative complications. In order to categorize age, the following subcategories were established: *Young adults* were interpreted as patients between eighteen and forty years old, *middle-aged adults* represented patients between forty one and sixty years old, while *elderly adults* referred to those above sixty years old. In order to analyze surgical time, there were distinguished three subgroups: short (< 60 minutes), average (60 - 90 minutes) and prolonged surgical intervention (> 90 minutes). Pain sensation in different postoperative periods represented the next investigated theme. During all three segments of the study (immediate postoperative period,

early follow up and late follow up) mostly similar aspects were followed: presence and nature of pain, pain intensity and necessity of analgesic treatment. Furthermore, resuming physical effort also represented an important aspect to elucidate. Effect of learning curve and surgeon's experience on postoperative pain intensity was also investigated. In order to estimate the above mentioned, patients completed a questionnaire after surgical intervention on postoperative day one and at one, respectively three months after surgery as well. Pain Detect is a widely used, easy and reliable questionnaire, according to which nature of pain, most frequent irradiation regions and also intensity of pain could be determined. Furthermore, pain intensity was represented with numerical scale and highlighted in the article as Pain Index. According to the questionnaire, we defined chronic postoperative pain, signifying pain persisting more than three months, localized at the surgical site which was not present before surgical intervention and presenting an intensity index higher than 18.5 points. In order to evaluate general surgeons, a questionnaire focused on surgical experience was accomplished, based on which numerical scoring (SEI – Surgical Experience Index) was applied. While analyzing general comparison, surgeons were evaluated according to the following aspects: professional experience in the field of general surgery; number of surgical interventions in a year; number of surgical inter-

ventions for abdominal wall defects and diversity of minimal invasive surgical procedures. Throughout specific comparison, number of inguinal hernia interventions in a year; experience in laparoscopic herniorrhaphy; duration of TAPP procedure; postoperative complications rate; length of hospital stay after TAPP repair; esthetic considerations and recurrence rate after TAPP procedure were the aspects interpreted.

### *Statistical analysis*

Collected information was processed using Microsoft Excel. The statistical analysis of the database was performed using GraphPad InStat software (GraphPad Software, Inc., San Diego, United States of America). Quantitative variables were presented by mean and median, while qualitative and categorical variables were expressed both as integer and percentage values. A normality test was applied for all variable groups in order to determine the distribution of values. Furthermore, for the quantitative statistical analysis, Student's t-test was applied for groups with Gaussian distribution of values, while Mann-Whitney nonparametric test was used for groups with non-Gaussian distribution. Inferential statistical analysis involving odds ratios determination for mentioned clinical, surgical and postoperative factors was

TABLE I - *Clinical and surgical aspects.*

	Group of Junior Surgeon (N = 49)	Group of Senior Surgeon (N = 56)	P value
Gender			
Male	41 (83.67)	52 (92.86)	0.4008
Female	8 (16.32)	4 (7.14)	0.4008
Age			
Young adults	9 (18.37)	18 (32.14)	0.2126
Middle aged adults	27 (55.10)	23 (41.07)	0.2104
Older adults	13 (26.53)	15 (26.79)	0.9842
Average age	50.78	49.92	-
Nature of abdominal wall defect			
Primary	47 (95.92)	48 (85.71)	0.3462
Recurrent	2 (4.08)	8 (14.29)	0.3462
Localization of abd. wall defect			
Right	27 (55.11)	19 (33.93)	0.0587
Left	17 (34.69)	18 (32.14)	0.8210
Bilateral	5 (10.20)	19 (33.93)	0.0309
Type of abdominal wall defect			
Direct	11 (22.45)	10 (17.86)	0.6786
Indirect	26 (53.06)	34 (60.71)	0.4951
Mixt	12 (24.49)	12 (21.43)	0.7838
Durations of surgery			
Short (< 60 minutes)	30 (61.23)	35 (62.50)	0.9114
Intermediate (60 – 90 minutes)	14 (28.57)	2 (3.57)	0.0232
Prolonged (> 90 minutes)	5 (10.20)	19 (33.93)	0.0309
Postoperative complications			
Hemorrhage	0 (0)	1 (1.78)	-
Abscess	0 (0)	2 (3.57)	-
Trocar hematoma	2 (4.08)	0 (0)	-

Young adults:18-40 years; Middle aged adults: 41-60 years; Older adults: >60 years

performed using Fisher's Exact Test. Independent sample t-test was performed in order to analyze relationship between surgeon type and the pain indices. The level of statistical significance for the present research was set at a p value of 0.05, while the confidence interval was 95% for all the calculated parameters.

## Results

A total of 105 patients met the necessary criteria for inclusion in the present research. Comparison of clinical and surgical aspects are presented in Table I. In the Junior Surgeon's Group predominantly male (83.67 %, n = 41) and middle aged (55.10 %, n = 27) patients were present. The mean age inside the group was found to be 50.78 years. Regarding abdominal wall defects, primary (95.92%, n = 47), right sided (55.11%, n = 27) and external oblique (53.06%, n = 26) type hernias were present in a higher proportion. In terms of length of surgical intervention, short (61.23 %; n = 30) and intermediate (28.57 %, n = 14, P = 0.0232) surgeries were characteristic. In the postoperative period two cases of trocar hematomas were recorded and treated via evacuation. In case of Group of the Senior Surgeon, similarly male (92.86%, n = 52) and middle aged (41.07 %, n = 23) patients were present, while mean age was found to be 49.92 years. Primary (85.71 %, n = 48) and external oblique (60.71 %, n = 34) type hernias were present in a higher proportion, meantime localization of the

abdominal wall defect showed proportional distribution. Mainly shorter surgical interventions were identified (62.50 %, n = 35), but prolonged surgeries were also performed due to the higher incidence of bilateral abdominal wall defects (33.93 %, n = 19, P = 0.0309). Regarding complications, an intraoperative hemorrhagic event and two cases of abscesses formation were recorded. Bleeding was resolved by placement of hemostatic clips, while abscess formation was diagnosed in the second week after hospital discharge, respectively in the third month after discharge. In both cases, evacuation and drainage were performed from a classic, anterior approach.

Aspects related to postoperative pain are presented in Tables II. In case of the Junior Surgeon: in the immediate postoperative period, all patients complained of different degree of pain sensation (100 %, n = 49). Regarding the nature of postoperative pain, persistent subtype occurred in the highest proportion (55.11 %, n = 27). The average pain index (Pain Index I) was found to be 20.87. Analgesic treatment showed a declining trend throughout the postoperative evolution, resulting in an average treatment period of 2.20 days. During the early follow-up, 57.14% (n = 28) of patients reported varying degrees of pain sensation. At this stage of the study, intermittent pain (60.71 %, n = 17) occurred in the highest proportion, mostly after physical effort. The mean pain index (Pain Index II) was found to be 5.73. During late follow-up, only 36.73% (n = 18) of patients complained of variable intensity pain sensation at the

TABLE II - Pain sensation in different postoperative periods.

	Group of Junior Surgeon (N = 49)	Group of Senior Surgeon (N = 56)	P value
<b>Immediate postoperative period</b>			
Complained about pain	49 (100)	56 (100)	-
Nature of accused pain			
Persistent	27 (55.11)	33 (58.92)	0.7342
Intermittent	15 (30.61)	18 (32.15)	0.8929
Irradiating	7 (14.28)	5 (8.93)	0.6247
Average Pain Index I	20.87	21.51	0.4054
Average antalgic treatment (day)	2.20	2.17	0.9854
<b>Early follow up</b>			
Complained about pain	28 (57.14)	40 (71.42)	0.2010
Nature of accused pain			
Persistent	10 (35.72)	12 (30)	0.7927
Intermittent	17 (60.71)	27 (67.5)	0.6127
Irradiating	1 (3.57)	1 (2.5)	1.0000
Average Pain Index II	5.73	5.80	0.4510
<b>Late follow up</b>			
Complained about pain	18 (36.73)	11 (19.64)	0.1245
Nature of accused pain			
Persistent	1 (5.56)	2 (18.18)	0.5394
Intermittent	17 (94.44)	9 (81.82)	0.5394
Irradiating	0 (0)	0 (0)	-
Average Pain Index III	1.65	1.55	0.2191
<b>Resuming physical effort</b>			
Average (weeks)	4.25	4.19	0.4018

TABLE III - Surgeon and postoperative pain relationship – Group statistics.

	Surgeon type	N	Mean	Std. Deviation	Std. Error Mean
Immediate postoperative pain (Pain Index I)	Senior surgeon	56	21.52	5.288	.707
	Junior surgeon	49	20.88	7.721	1.103
Early follow up pain (Pain Index II)	Senior surgeon	56	5.80	6.708	.896
	Junior surgeon	49	5.73	7.402	1.057
Late follow up pain (Pain Index III)	Senior surgeon	56	1.55	4.740	.633
	Junior surgeon	49	1.65	3.800	.543

TABLE IV - Surgeon and postoperative pain relationship – Independent Samples Test

		Levene's test for equality of variances		t-test for equality of Means			95% confidence interval of the difference			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Im. postoperative period (Pain Index I)	Equal var. assumed	9.859	.002	.501	103	.618	.640	1.278	-1.895	3.176
	Equal var. not assumed			.489	83.25	.626	.640	1.310	-1.965	3.246
Early follow up (Pain Index II)	Equal var. assumed	1.452	.231	.050	103	.960	.069	1.377	-2.662	2.800
	Equal var. not assumed			.050	97.73	.960	.069	1.386	-2.682	2.820
Late follow up (Pain Index III)	Equal var. assumed	.324	.571	-.118	103	.907	-.099	.847	-1.778	1.579
	Equal var. not assumed			-.119	102.25	.905	-.099	.834	-1.754	1.555

surgical site. By nature, mainly intermittent pain (94.44 %, n = 17) was reported, occurred occasionally after physical exercise.

The mean pain index (Pain Index III) measured at this stage of the study was 1.65, while physical effort was resumed after an average healing period of 4.25 weeks. In case of the Senior Surgeon: similarly, in the immediate postoperative period all patients (100 %, n = 56) accused different degree of pain sensation at the surgical site. Persistent subtype occurred in most of the cases (58.92 %, n = 33), with an average Pain Index (Pain Index I) of 21.51, while analgesic treatment was applied for a mean period of 2.17 days. During the early follow up 71.42 % (n = 40) of patients complained about varying degrees of pain sensation, predominantly intermittent type (67.5 %, n = 27), mostly appearing after physical effort. The average Pain Index (Pain Index II) resulted to be 5.80. Evaluating late follow up resulted only 19.64 % of patients (n = 11) with pain sensation at the surgical site, mainly intermittent type (81.82 %, n = 9), predominantly after physical exercise.

The average Pain Index (Pain Index III) resulted to be 1.55 and patients resumed physical effort after a mean healing period of 4.19 weeks. Statistical analysis of postoperative pain related data did not result significant differences between the two studied groups.

Multivariate analysis of the collected data intended to elucidate the relationship between surgeon and postoperative pain, these result are presented in Tables III-IV. The processed results showed no significant difference between the expected value of the surgeon and different pain indices. Only the variance of immediate postoperative pain (Pain Index I) shows a significant difference between the two surgeons studied, which are more scattered in the case of the junior surgeon (the difference between the largest and the smallest indicator is larger), while the values show greater continuity in the case of the more experienced senior surgeon.

To map the surgical experience and its influence on postoperative pain, a scoring system was developed (Table V), based on which the junior surgeon achieved 20 points and the senior physician 28 points. Based on the results, we analyzed the relationship between the Surgeon Experience Index (SEI) and postoperative pain (Table VI). One month after surgery, five patients operated by the less experienced surgeon complained of pain with index > 18.5, whereas only two patients with similar postoperative pain indexes were identified among cases of the senior surgeon.

Apart from the higher odds ratio and relative risk of the analyzed data (OR = 3.068, RR = 1.929), no significant differences were found. In terms of late follow-up, one

TABLE V - Surgical Experience Index - SEI

	Junior Surgeon	Senior Surgeon	Points
<i>General aspects</i>			
Seniority on the field of surgery			
< 5 years	Yes	No	1 point
5-15 years	No	No	2 points
> 15 years	No	Yes	3 points
<i>Nr. of surgical interventions performed annually</i>			
< 200 operations	183	-	1 point
> 200 operations	-	343	2 points
<i>Nr. surgeries performed annually in order to treat abdominal wall defects</i>			
< 100 operations	73	-	1 point
> 100 operations	-	130	2 points
<i>Minimal-invasive procedures</i>			
Basic level operations			
Cholecystectomy	Yes	Yes	1 point
Appendectomy	Yes	Yes	
<i>Intermediate level operations</i>			
Treatment of inguinal hernia	Yes	Yes	2 points
Treatment of umbilical hernia	Yes	Yes	
Treatment of ventral hernia	Yes	Yes	
Treatment of hiatus hernia	Yes	Yes	
<i>Advanced level operations</i>			
Splenectomy			
Treatment of colorectal cancer	No	Yes	3 points
<i>Specific aspects</i>			
Nr. of elective inguinal hernia treatments annually			
< 50 interventions	-	-	1 point
> 50 interventions	52	79	2 points
<i>Experience in laparoscopic inguinal hernia repair</i>			
< 5 years	1	0	1 point
years	0	1	2 points
<i>Average surgery duration (TAPP)</i>			
Around 90 minutes	0	0	1 point
Around 60 minutes	1	0	2 points
Around 45 minutes	0	1	3 points
<i>Postoperative complication rate after TAPP repair (%)</i>			
Average	4.87%	5.35%	1 point
<i>Length of hospital stay after TAPP repair (days)</i>			
1-2 days	1	1	3 points
3-4 days	0	0	2 points
More than 4 days	0	0	1 point
<i>Esthetic considerations after TAPP repair</i>			
Use of simple surgical suture	0	1	1 point
Use of intradermic suture	1	0	2 points
<i>Recurrence rate after TAPP repair (%)</i>			
Without recurrence during study	1	1	3 points
One case of recurrence	0	0	2 points
More cases of recurrence	0	0	1 point
	<b>20</b>	<b>28</b>	<b>Score</b>

patient complained of significant pain (pain index > 18.5) in case of the less experienced surgeon and two patients in case of the surgeon with higher experience index. It should be emphasized that in case of the chief

physician, these are the two cases complicated by abscess formation.

The statistical calculations did not result significant differences.

TABLE VI - SEI and postoperative pain relationship.

	Patients with pain Index > 18.5	Patients with pain Index < 18.5	P value	OR	RR
Early follow up					
SEI = 28	2 (3.57)	54 (96.43)	0.2473	0.325	0.518
SEI = 20	5 (10.20)	44 (89.80)	0.2473	3.068	1.929
Late follow up					
SEI = 28	2 (3.57)	54 (96.43)	1.0000	1.778	1.750
SEI = 20	1 (2.04)	48 (97.96)	1.0000	0.562	0.571

SEI = Surgical Experience Index.

## Discussion

### TAPP HERNIORRAPHY AND SELF-GRIPPING SURGICAL PROSTHESIS

There is currently no consensus on the ideal surgical treatment for groin hernias, while open procedures are widely used, meantime the practice of minimally invasive techniques is on the rise. More and more specialists are choosing laparoscopic treatment, with several studies highlighting the benefits of these interventions, of which shorter hospital stays, faster postoperative recovery, better aesthetic outcomes, low recurrence rates, and less postoperative pain are perhaps the most important considerations<sup>10</sup>. Financial factor remains an important issue, with laparoscopic interventions costing higher than open hernioplasty<sup>11,12</sup>. On the other hand, minimally invasive treatment of inguinal hernias requires special training. The unusual anatomy of the posterior inguinal wall and the longer learning curve confer these interventions a complexity<sup>13</sup>. Regarding postoperative evolution, many researchers state that laparoscopic treatment of inguinal hernias is at least as safe as the open procedure, and complications are more likely to be related to poor surgical technique than to a certain procedure [14]. Although it has many advantages, one of the main problems in the field of minimally invasive treatment of abdominal wall defects remains the way in which the synthetic mesh is fixed. Several studies underlined that traumatic fixation of the surgical mesh increases the potential for development of postoperative pain. Non-traumatic fixation of the prosthesis with surgical adhesive or self-gripping synthetic mesh is strongly recommended. The self-adhesive synthetic mesh provides adequate attachment to the entire posterior wall structure, including the area under the ligamentum inguinale, where conventional techniques do not provide coverage. The relatively higher cost of the mesh may seem a bit disadvantageous at first, but since it requires no additional fixation, it combines the functionality of a surgical prosthesis and fixation in one device. Furthermore, several studies support that patient satisfaction was found to be better in chronic pain compared to other tech-

niques<sup>15-17</sup>. Pielacinski K et al.<sup>18</sup> and Birk D et al.<sup>19,20</sup> highlighted that the use of the ProGrip mesh is fast, effective, and safe with low postoperative pain and recurrence rates. Logan T Mellert et al.<sup>21</sup> evaluated the technical learning curve for the use of ProGrip self-adhesive mesh. In the analysis of the medium-term results, it was concluded that surgeons with usual experience in laparoscopic treatment will be proficient in the use of self-gripping mesh after 15-20 treatment of abdominal wall defects.

In addition, low levels of postoperative pain, intra- and postoperative complications have been reported.

### POSTOPERATIVE PAIN

Postoperative pain remains an unwanted complication of hernioplasty, which can affect up to 8-16% of patients. Depending on the intensity of the pain, it can have a significant impact on daily activities and socio-professional reintegration<sup>22</sup>. The mechanism by which this unpleasant complication develops is not fully understood, but it is likely to be multifactorial. Over the past decade, a number of risk factors that may contribute to the development of chronic postoperative pain have been elucidated. Several studies have shown that female gender, young age, increased intensity of early postoperative pain, and recurrent hernia are strong risk factors<sup>23,24</sup>. The type of synthetic mesh has also been a central theme in many studies, highlighting that these data are difficult to interpret due to the variety and characteristics of surgical prostheses (weight, pore size, strength, flexibility, etc.)<sup>25</sup>. As for the fixation of the synthetic mesh, there seems to be a growing consensus that the types of mesh that require fixation may have a negative effect on postoperative pain levels. According to Quyn AJ et al.<sup>26</sup> and Tarchi P et al.<sup>27</sup>, the use of self-adhesive prosthesis result in significantly less postoperative pain. Various studies emphasize that surgical intervention and technique can also influence the development of pain related complications. Furthermore, it is highlighted that minimally invasive approach may result in less postoperative pain compared to an open surgical technique<sup>28</sup>.

In other studies, we can read about unusual potential triggers, Darin Correll highlighted the importance of psychological factors (anxiety, depression) in the development of postoperative pain<sup>29</sup>. Also, more and more researchers claim that the most important factor in the development of chronic pain may be immediate postoperative pain and emphasize the importance of post-surgical analgesia<sup>30,31</sup>.

### *Learning curve and surgical experience*

There is little data in the literature of specialty about the effect of learning curve and surgical experience on postoperative pain. The concept of learning curve is to quantify the degree of individual adaptation and to study the real-time adjustment process of laparoscopic surgery. [32] Regarding this aspect there are still contradictions: according to some authors, a surgeon with a basic laparoscopic qualification initially needs about 13-15 cases to master the TAPP technique. Other authors have been more cautious, estimating the learning curve for minimally invasive hernioplasty at 30-50 cases<sup>33,34</sup>.

However, there seems to be a consensus that training, learning curve, and supervision are important aspects in the outcome of hernia surgeries. The studies currently available clearly demonstrate that consistent supervision of trainees by experienced counselors plays a crucial role in mastering the learning curve<sup>35</sup>. The European Society of Endoscopic Surgery has shown significant reductions in surgery time, conversion rate, and complication rates following 30-100 TEP and 50-75 TAPP procedures<sup>36,37</sup>. A comparative study based on the TAPP procedure was conducted by Bokeler U et al., Which did not find a significantly higher rate of postoperative complications or recurrence in patients operated by supervised trainees compared to patients operated by experienced surgeons<sup>38,39</sup>. Reviews of the surgical literature underline the association between higher surgical volume and better postoperative outcomes<sup>40</sup>. A study of 125,342 patients identified a higher rate of postoperative complications in surgeons who underwent fewer laparoscopic hernioplasty procedures<sup>41</sup>. Similarly, a laparo-endoscopic study (TAPP and TEP) of 16,240 patients identified significantly higher recurrence rates and higher postoperative pain values in surgeons who performed less than 25 laparo-endoscopic procedures per year for the treatment of primary groin hernia<sup>42</sup>.

### **Conclusion**

In addition to the well-known risk factors that impact the outcome of hernia surgery, the influence of surgeons under different aspects can be demonstrated. There is now also an increasing public awareness with social media, whereby optimal treatment results are demanded

by patients. Thereby, well-structured training opportunities, simulation-based training, supervision and surgical volume are important and necessary. Our study found TAPP procedure a safe technique when performed by young specialist too, presenting similar postoperative results with those of experienced, consultant surgeons. With an adequate program, the technique can be learned quickly, skillfully, and safely when a standardized technique is used.

### **Riassunto**

**INTRODUZIONE:** L'approccio laparoscopico per l'ernia inguinale offre notevoli vantaggi. Sono stati studiati diversi fattori di rischio per il dolore postoperatorio, ma si possono trovare pochi articoli sulla curva di apprendimento e sull'influenza del chirurgo sul dolore postoperatorio dopo l'erniorrafia inguinale.

**PAZIENTI E METODI:** è stato condotto uno studio prospettico su 105 pazienti. Le procedure chirurgiche sono state eseguite da due chirurghi generali che hanno eseguito la procedura TAPP. Il follow-up è stato realizzato a uno e tre mesi dopo l'intervento chirurgico.

**RISULTATI:** la maggior parte dei dati studiati non presentava differenze significative. Nel caso del chirurgo senior abbiamo registrato un SEI (indice di esperienza del chirurgo) maggiore, una maggiore percentuale di ernie inguinali bilaterali ( $P = 0,0309$ ) e una percentuale più alta di procedure chirurgiche più lunghe ( $P = 0,0309$ ). Nel frattempo nel caso del Junior Surgeon abbiamo registrato interventi di durata intermedia ( $P = 0,0232$ ) in maniera maggiore. Durante il periodo di follow-up, è stata osservata un'incidenza simile di assenza di dolore tra i pazienti, senza significatività statistica.

**Conclusione:** Con un adeguato programma di apprendimento e supervisione, la procedura TAPP può essere una tecnica sicura anche se eseguita da uno specialista giovane, presentando risultati postoperatori simili a quelli di chirurghi esperti.

### **References**

1. Bittner R, Montgomery MA, Arregui E: *Update of guidelines on laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal hernia* (International Endohernia Society) *Surg Endosc.* 2015; 29(2):289-321.
2. Shakya VC, Sood S, Bhattarai BK, Agrawal CS: Adhikary S: *Laparoscopic inguinal hernia repair: A prospective evaluation at Eastern Nepal.* *Pan Afr Med J,* 2014; 17:241. doi: 10.11604/pamj.2014.17.241.2610. PMID: 25170385; PMCID: PMC4145269.
3. Zendejas B, Ramirez T, Jones T: *Trends in the utilization of inguinal hernia repair techniques a population-based study.* *Am J Surg,* 2012; 203(3):313-17.
4. Claus CM, Rocha GM, Campos AC: *Prospective, randomized and controlled study of mesh displacement after laparoscopic inguinal*



- repair fixation versus no fixation of mesh. *Surg Endosc*, 2016; 30(3):1134–1140. doi: 10.1007/s00464-015-4314-7.
5. Pedroso LM, DE-Melo RM, DA-Silva NJ, Jr: *Comparative study of postoperative pain between the lichtenstein and laparoscopy surgical techniques for the treatment of unilateral primary inguinal hernia*. *Arq Bras Cir Dig*, 2017; 30(3):173-76.
6. Abbas AE, Abd Ellatif ME, Noaman N: *Patient-perspective quality of life after laparoscopic and open hernia repair a controlled randomized trial*. *Surg Endosc*, 2012; 26(9):2465-470.
7. Donati M, Brancato G, Giglio A, Biondi A, Basile F, Donati A: *Incidence of pain after inguinal hernia repair in the elderly. A retrospective historical cohort evaluation of 18-years' experience with a mesh & plug inguinal hernia repair method on about 3000 patients*. *BMC Surg*. 2013; 13 Suppl 2(Suppl 2):S19. doi:10.1186/1471-2482-13-S2-S19
8. Bracale U, Merola G, Sciuto A, Cavallaro G, Andreuccetti J, Pignata G: *Achieving the Learning Curve in Laparoscopic Inguinal Hernia Repair by Tapp: A Quality Improvement Study*. *J Invest Surg*, 2019; 32(8):738-745. doi: 10.1080/08941939.2018.1468944. Epub 2018 Jun 14. PMID: 29902096.
9. Kuge H, Yokoo T, Uchida H, Yamaoka K, Yoshikawa S: *Learning curve for laparoscopic transabdominal preperitoneal repair: A single-surgeon experience of consecutive 105 procedures*. *Asian J Endosc Surg*, 2020; 13(2):205-210. doi: 10.1111/ases.12724. Epub 2019 Jul 7. PMID: 31282102.
10. Octavian Andercou, Gabriel Olteanu, Bogdan Stancu, Florin Mihaileanu, Stefan Chiorescu, Marian Dorin: *Risk factors for and prevention of chronic pain and sensory disorders following inguinal hernia repair*. *Ann Ital Chir*, 2019; 90; 5.
11. Pahwa HS, Kumar A, Agarwal P, Agarwal AA: *Current trends in laparoscopic groin hernia repair: A review*. *World J Clin Cases*, 2015; 3(9):789-92. doi: 10.12998/wjcc.v3.i9.789. PMID: 26380826; PMCID: PMC4568528.
12. Eklund A, Carlsson P, Rosenblad A, Montgomery A, Bergkvist L, Rudberg C: *Long-term cost-minimization analysis comparing laparoscopic with open (Lichtenstein) inguinal hernia repair*. *Br J Surg*, 2010; 97:765-71.
13. Lim JW, Lee JY, Lee SE, Moon JI, Ra YM, Choi IS, Choi WJ, Yoon DS, Min HS. *The learning curve for laparoscopic totally extraperitoneal herniorrhaphy by moving average*. *J Korean Surg Soc*, 2012; 83(2):92-6. doi: 10.4174/jkss.2012.83.2.92. Epub 2012 Jul 25. PMID: 22880183; PMCID: PMC3412190.
14. Mayer F, Lechner M, Adolf D, Öfner D, Köhler G, Fortelny R, Bittner R, Köckerling F: *Is the age of >65 years a risk factor for endoscopic treatment of primary inguinal hernia? Analysis of 24,571 patients from the Herniamed Registry*. *Surg Endosc*, 2016; 30(1):296-306. doi: 10.1007/s00464-015-4209-7. Epub 2015 Apr 22. PMID: 25899813; PMCID: PMC4710662.
15. Simons MP, Aufenacker T, Bay-Nielsen M, Bouillot JL, Campanelli G, Conze J, et al. *European Hernia Society guidelines on the treatment of inguinal hernia in adult patients*. *Hernia*, 2009; 13:343-403.
16. Klobusicky P, Feyerhard P: *Innovation in laparoscopic inguinal hernia reparation. Initial experiences with the Parietex ProGrip Laparoscopic – mesh*. *Front. Surg*. 2:28. Doi: 10.3389/fsurg.2015.00028.
17. Kolbe T, Hollinsky C, Walter I, Joachim A, Rulicke T: *Influence of a new self-gripping hernia mesh on male fertility in a rat model*. *Surgical Endoscopy*, 2010; 24: 455-61.
18. Pielaciński K, Dabrowski W, Szczepanik AB, Misiak A: *Zastosowanie samomocującego się implantu ProGrip w technice całkowitej pozaotrzewnowej w operacji naprawczej przepukliny pachwinowej [Self-fixating ProGrip implant used in the laparoscopic totally extraperitoneal technique for inguinal hernia repair]*. *Pol Merkury Lekarski*, 2011; 31(186):345-7. Polish. PMID: 22239003.
19. Birk D, Pardo CG: *Self-gripping Parietene and Parietex ProGrip mesh laparoscopic hernia repair: Have we found the ideal implant?* *Surg Technol Int*, 2012; 22:93-100. PMID: 23292669.
20. Birk D, Hess S, Garcia-Pardo C: *Low recurrence rate and low chronic pain associated with inguinal hernia repair by laparoscopic placement of Parietex ProGrip™ mesh: Clinical outcomes of 220 hernias with mean follow-up at 23 months*. *Hernia*, 2013; 17(3):313-20. doi: 10.1007/s10029-013-1053-3. Epub 2013 Feb 15. PMID: 23412779.
21. Logan T Mellert, Maureen E Cheung, John G Zografakis, Adrian G Dan: *Laparoscopic inguinal hernia repair using ProGrip self-fixating mesh: Technical learning curve and mid-term outcomes*. *Surg Technol Int* 2019; 15(34): 235-40.
22. Calo PG, Pittau MR, Contu P, D'Aloja E, Nicolosi A, Demontis R: *Chronic pain following inguinal hernia repair: Assessment of quality of life and medico-legal aspects*. *Ann Ital Chir*, 2013; 84: 357-63.
23. Sevoni D, Montgomery A, Smedberg S, Sandblom G: *Chronic groin pain, discomfort and physical disability after recurrent groin hernia repair: Impact of anterior and posterior mesh repair*. *Hernia*, 2016; 20(1): 43-53.
24. Bittner R, Arregui ME, Bisgaard T, et al.: *Guidelines for laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal hernia [International Endohernia Society (IEHS)]*. *Surg Endosc*, 2011; 25(9):2773-2843. doi:10.1007/s00464-011-1799-6
25. Miserez M, Peeters E, Aufenacker T, et al.: *Update with level I studies of the European Hernia Society guidelines on the treatment of inguinal hernia in adult patients*. *Hernia*, 2014; 18:151-63.
26. Quyn AJ, Weatherhead KM, Daniel T: *Chronic pain after open inguinal hernia surgery: Suture fixation versus self-adhesive mesh repair*. *Langenbecks Arch Surg*, 2012; 397(8): 1215-218.
27. Tarchi P, Cosola D, Germani P, Troian M, De Manzini N: *Self-adhesive mesh for Lichtenstein inguinal hernia repair. Experience of a single center*. *Minerva Chir*, 2014; 69(3):167-76.
28. Kargar S, Shiryazdi SM, Zare M, Mirshamsi MH, Ahmadi S, Neamatzadeh H: *Comparison of postoperative short-term complications after laparoscopic transabdominal preperitoneal (TAPP) versus Lichtenstein tension free inguinal hernia repair: a randomized trial study*. *Minerva Chir*, 2015; 70(2):83-9. Epub 2014 Jul 14. PMID: 25017958.
29. Correll D: *Chronic postoperative pain: recent findings in understanding and management*. *F1000Res*. 2017;6:1054. Published 2017 Jul 4. doi:10.12688/f1000research.11101.1
30. Andresen K, Rosenberg J: *Management of chronic pain after hernia repair*. *J Pain Res*, 2018; 11:675-681. doi:10.2147/JPR.S127820
31. Pasquale Sansone, Maria Caterina Pace, Maria Beatrice Passavanti, Vincenzo Pota, Umberto Colella, Caterina Aurilio:

*Epidemiology and incidence of acute and chronic post-surgical pain.* Ann Ital Chir, 2015; 86: 285-92.

32. Seo K, Choi Y, Choi J, Yoon K: *Laparoscopic appendectomy is feasible for inexperienced surgeons in the early days of individual laparoscopic training courses.* J Korean Surg Soc, 2009; 76:23-27.

33. Bansal VK, Krishna A, Misra MC, Kumar S: *Learning curve in laparoscopic inguinal hernia repair: Experience at a tertiary care centre.* Indian J Surg, 2016; 78(3):197-202. doi: 10.1007/s12262-015-1341-5. Epub 2015 Sep 12. PMID: 27358514; PMCID: PMC4907907.

34. Lim JW, Lee JY, Lee SE, Moon JI, Ra YM, Choi IS, Choi WJ, Yoon DS, Min HS: *The learning curve for laparoscopic totally extraperitoneal herniorrhaphy by moving average.* J Korean Surg Soc, 2012; 83(2):92-6. doi: 10.4174/jkss.2012.83.2.92. Epub 2012 Jul 25. PMID: 22880183; PMCID: PMC3412190.

35. Bracale U, Sciuto A, Andreuccetti J, Merola G, Pecchia L, Melillo P, Pignata G: *Laparoscopic recurrent inguinal hernia repair during the learning curve: it can be done?* Ann Ital Chir, 2017; 88: 62-66.

36. Kockerling F: *What is the influence of simulation-based training courses, the learning curve, supervision, and surgeon volume on the outcome in hernia repair? A systematic review.* Fron Surg, 2018; 5:57. Doi: 10.3389/fsurg.2018.00057

37. Eyvaz K, Gokceimam M: *Crucial points in phases of totally extraperitoneal hernia repair. Learning curve analysis.* Ann Ital Chir 2021; 92; (6): 720-27.

38. Bökeler U, Schwarz J, Bittner R, Zacheja S, Smaxwil C: *Teaching and training in laparoscopic inguinal hernia repair (TAPP): impact of the learning curve on patient outcome.* Surg Endosc, 2013; 27:2886-93. doi: 10.1007/s00464-013-2849-z

39. Robson AJ, Wallace CG, Sharma AK, Nixon SJ, Paterson-Brown S: *Effects of training and supervision on recurrence rate after inguinal hernia repair.* Br J Surg, 2004; 91:774-77. doi: 10.1002/bjs.4540

40. Amato L, Fusco D, Acampora A, Bontempi K, Rosa AC, Colais P, et al.: *Volume and health outcomes: Evidence from systematic reviews and from evaluation of Italian hospital data.* Epidemiol Prev, 2017; 41(5-6 (Suppl. 2)):1-128. doi: 10.19191/EP17.5-6S2.Poo1.100

41. El-Dhuwaib Y, Corless D, Emmett C, Deakin M, Slavin J: *Laparoscopic versus open repair of inguinal hernia: A longitudinal cohort study.* Surg Endosc, 2013; 27:936-45. doi: 10.1007/s00464-012-2538-3

42. Kockerling F, Bittner R, Kraft B, Hukauf M, Kuthe A, Schug-Pass C: *Does surgeon volume matter in the outcome of endoscopic inguinal hernia repair?* Surg Endosc, 2016; 31:573-85. doi: 10.1007/s00464-016-5001-z