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Is open surgery still part of the current treatment of inguinal hernias?

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ABSTRACT



Inguinal hernia repair represents one of the most frequent pathologies with surgical addressability. From the multitude of surgical procedures, a limited number still keep their indication in the current treatment of hernias. Open surgery, the exclusive repair method until recently, is associated with laparoscopic techniques with benefits that are at least superposable on those in open repair. We conducted a study, analyzing several types of procedures in open surgery and comparing them to each other, but also with the TAPP approach, which is still at the beginning in our service. The non-mesh procedures scored poorly in terms of recurrence, the duration of the surgical intervention, and complications of the pain type, the Lichtenstein procedure was frequently associated with non-infectious inflammatory complications, and the TAPP, which is still in the learning curve, presented a prolonged duration of the surgical intervention. The Lichtenstein procedure maintains its usefulness and represents the most frequent technique for sanctioning inguinal hernia, the non-mesh processes, less used lately, are more frequently preferred in situations where hernia strangulation is associated with a septic complication. Open surgery hernia repair remains a feasible option in the era of minimal invasiveness, especially under the conditions of performing a tension-free technique, for specific categories of patients or surgical services remaining the first intention solution.

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Introduction

Hernias represent the protrusion of the abdominal viscera through anatomically predisposed openings. Inguinal hernias have a lifetime risk of 27% for males and 3% for females [1]. The incidence of surgical interventions places this pathology on the 1st place in terms of planned, non-emergency surgeries and on the 2nd place when referring to all surgeries performed in general surgery services. Over 1 000 000 inguinal hernia surgeries are performed annually in the United States. This type of complaint was described for the first time in Antiquity in the Ebers Papyrus, over time describing numerous treatment attempts, from orthopedic restraint measures to castrations, unilateral orchiectomies and saccular resections without strengthening the abdominal wall.

In the 19th century, Bassini revolutionized the surgical treatment of inguinal hernia by using a retrofunicular tissue procedure, a procedure that represented the main therapeutic method for almost a century. The high recurrence rate

required adjustments or adaptations of the procedure, thus appearing the McVay, Shouldice procedures and the modification of the last-mentioned procedure, Berliner. Hundreds of technical procedures for the surgical cure of hernia are described in the specialized literature, their multitude and the still high recurrence rate proving either the inefficiency of the procedure itself, or the non-adaptation of the procedure to the patient's particularities.

Herniology experienced a revolution with the introduction of textile allografts, Lichtenstein being the one who succeeds in proposing an easily reproducible "tension free" technique, with minimal postoperative complications and low recurrence [2,3]. The procedure has become the main method of surgical approach for this pathology. Later, the laparoscopic approach in the TAPP or TEP variant challenged the well-established Lichtenstein procedure in terms of cosmetic aspect, recurrence and postoperative pain.

Due to the existence of some complications related to the prosthetic material both in the laparoscopic variant and in the Lichtenstein variant, a revitalization of tissue

techniques (without mesh) was noticed, especially of those that propose the realization of "tension less" or "tension free" mechanisms: Shouldice, Bassini, Desarda. Open hernia surgery is the most used treatment modality, with the prosthetic variant remaining the primary therapeutic option.

Materials and Methods

Over a 3 year-period we carried out a retrospective study (2020-2022), on the patients admitted for inguinal hernia in County Emergency Hospital Sibiu. Strict pandemic regulations were observed, including social distancing, wearing masks and frequent disinfection of the surfaces. Patients admitted in emergency, with poor medical condition were excluded (HTA, diabetes, colorectal cancers, ophthalmologic conditions, etc.) [4-7]. Statistical analysis was carried out with SPSS software, v13.0.

Surgical procedures

Taking into account the multitude of the studied procedures as well as the original character of some, we consider a brief review to be of use.

Lichtenstein

After inguinoscopy is performed, the procedure continues with the sectioning of the subcutaneous cellular tissue, Scarpa and Camper's fascia. The vasculo-nervous elements are preserved, the aponeurosis of the external oblique is noted and incised from the level of the external inguinal ring, exceeding the internal inguinal ring by 1-2 cm. Identification and dissection of the spermatic cord are performed, while highlighting the 2 borders represented by the inguinal ligament and the plane of the deep muscles (internal oblique and transverse abdominal muscles). After dissecting the spermatic cord, the hernia sac is being identified, dissected, ligated and subsequently excised. Up to this point, the intervention largely follows all the steps postulated by Bassini, being common to the other techniques that we are going to mention. At this operative moment the cremaster can be excised in the area of the internal inguinal ring or preserved. A textile allograft of approximately 12/8 cm is tailored and fitted, which needs to exceed the pubic bone by 2 cm. The mesh is medially anchored to the rectus abdominis aponeurosis and on the internal oblique muscle, and inferiorly fixed to the inguinal ligament. Two lateral slits will be made that are going to encircle the internal inguinal hole and the spermatic cord, anchoring them to the musculoaponeurotic plane cranial to the internal inguinal hole.

Bassini

After entering the inguinal canal and pulling the spermatic cord, the posterior wall (fascia transversalis) is incised along its entire length, up to the pubic tubercle. In this way, 2 borders are created that will superiorly include fascia transversalis, transverse muscle, internal oblique

muscle and external part of the rectus abdominis, and inferiorly will be consisted of fascia transversalis and inguinal ligament. The suture of the rectus abdominis sheath, the pubic tubercle and the inguinal ligament is practiced, continuing to suture cranially towards the entire upper portion and bringing it and suturing it to the inguinal ligament. The internal inguinal hole is recalibrated with one last thread.

Shouldice

The intervention respects the already established principles but requires the resection of the cremaster muscle with the formation of 2 borders that will be used in the suture layers. The fascia transversalis is incised making 2 margins. First layer encircles the pubic tubercle, rectus abdominis and inguinal ligament. It continues by suturing the inguinal ligament, the upper flap of the transversalis fascia and the transversus abdominis muscle. The second layer starts from the internal inguinal foramen to the pubic tubercle, by including the superior flap of the transversalis fascia, and the inguinal ligament. With a second thread, third layer is made by knotting the internal oblique and aponeurosis of the external oblique, and continued with the fourth layer which includes the remaining part of the inguinal ligament and aponeurosis of the external oblique.

Berliner

Derived from the Shouldice operation, it performs the closure of the abdominal wall in 3 layers.

McVay

After exposing the anatomical elements of the inguinal and femoral canal, the defect is closed by bringing the transversalis fascia, rectus abdominis sheath and transversus abdominis to Cooper's ligament.

Modified Postemsky/Kimbarovsky Tissue Procedure

The first thread grasps the aponeurosis of the external oblique, rectus sheath, anchors the pubic tubercle, Gimbernat ligament and inguinal arch. The second thread and the following will anchor the aponeurosis of the external oblique, pierce the deep muscles, and turning to the aponeurosis of the external oblique and finally to the opposite side of the inguinal ligament.

Desarda

Restoration of the posterior wall follows the steps of the Bassini technique by first making a relaxation incision at the level of the aponeurosis of the external oblique, obtaining 2 borders: the lower one being anchored to the muscle plane, and the upper one being reunited with the aponeurotic part through suture at the inguinal ligament.

Results

The patients underwent surgical treatment in order to correct the parietal defect, as follows: in 221 cases

(61.73%) the Lichtenstein-type tissue allograft procedure was used, in 23 cases (6.42%) laparoscopic surgery was performed using the TAPP (transabdominal properitoneal) procedure, and in 114 cases (31.84%) non mesh procedures such as Berliner (11 cases), Bassini (29 cases), McVay (13

cases), Desarda (10 cases), Shouldice (17 cases), tissue procedure that sutures the deep muscles in a muff also called modified Postemsky/Kimbarovsky procedure (34 cases) were performed. The choice of the type of operation is presented in the Table 1.

Table 1. Surgical procedure in relation with operative timing

Surgical procedure	Lichtenstein	Modified Postemsky/ Kimbarovsky	Bassini	McVay	Shouldice	Desarda	Berliner	TAPP
Programed	186	22	16	5	17	10	11	23
Emergency	35	12	13	8	0	0	0	0

From the total of 358 patients, 22 patients (6.14%) were female and the remaining 336 (93.8%) were male patients. The minimum age of the patients included in the study was 18 years, and the maximum 96 years, with an average age of 59.4 years. In 22 cases (6.14%) the patients were diagnosed with bilateral inguinal hernia, the remaining 336 (93.8%) presented unilateral parietal defect (unilateral inguinal hernia).

Regarding the classification of hernias, out of 336 cases encountered in males, 241 were external obliques hernias, 57 direct hernias and 38 mixed inguinal hernias; compared to the female gender where from the total of 22 cases, 10 external oblique hernias, 10 direct hernias and 2 mixed hernias were detected. Cases of strangulated inguinal hernia were found in 66 male patients (of which 64 external oblique hernias) and 2 female patients (both strangulated cases being external oblique hernias) (Table 2).

Table 2. Hernia types representation according to EHS classification

Type of Hernia	NUMBER	%
L1	52	14.52
L2	157	43.85
L3	42	11.73
M1	19	5.30
M2	25	6.98
M3	23	6.42
L1M1	6	1.67
L1M2	8	2.23
L2M1	12	3.35
L2M2	14	3.91

According to the European Hernia Society (EHS) classification, the most frequent form of hernia was the L type (n=251), followed by the M type (n=67) and the LM association (n=40). The interrelationship between the type of hernia, depending on the affected parietal fossa and the

option for a certain type of surgical solution is highlighted with statistical significance (p=0.005974).

Out of 358 cases, 68 patients (19%) were hospitalized and underwent emergency surgical treatment with strangulated inguinal hernia as a preoperative diagnosis, and confirmed intraoperatively. From the total of strangulated inguinal hernias, small bowel necrosis was found in 10 cases, requiring an intraoperative enterectomy, epiploic necrosis was found in 7 cases and partial omentectomy was performed, and in 2 cases an Amyand hernia was detected with a viable appendix, but with a necrotic omentum. For the surgical solution of cases with epiploic or intestinal necrosis, tissue procedures were preferred in 12 cases (1 McVay, 3 Bassini, 8 tissue procedure with modified Postemsky/Kimbarovsky procedure) and the Lichtenstein prosthetic procedure in 7 cases.

When surgical cure of the 68 strangulated hernias was practiced, Lichtenstein procedure was used in 35 cases (51.47%), the remaining 33 (48.52%) being solved by tissue procedures. Of 49 cases of strangulated hernias that did not require intraoperative resection, Lichtenstein was used in 28 cases, tissue procedures being used in 21 cases. In situations that required the practice of bowel resections or partial omentectomies, tissue procedures were preferred, Lichtenstein technique being preferentially used in cases that did not require a resection.

From the total of 358 surgical interventions, Lichtenstein technique was preferred in 61.73% of cases (221 cases), TAPP in 6.42% of cases (23 operations), tissue procedures totaling 31.84% (114 operations). Of the 114 surgical interventions that used tissue procedures, the Bassini technique was found in 25.43% of cases, McVay in 11.40% of cases, Desarda in 8.7% of cases, Shouldice in 14.91% of cases, Berliner in 9.64% of cases, and the tissue procedure with modified Postemsky/Kimbarovsky procedure in 29.82% of cases. Contrary to the specialized literature that highlights the Shouldice, Desarda and Bassini variants as the tissue procedures of choice, in our study the use of the procedure taken from the prefunicular surgery and originally transformed into a retrofunicular procedure prevailed (Table 3).

Table 3. Surgical procedure in relation with EHS classification.

	Lichtenstein	Modified Postemsky/ Kimbarovsky	Bassini	McVay	Shouldice	Desarda	Berliner	TAPP
L1	26	6	3	2	3	3	2	7
L2	120	10	5	2	7	2	2	9
L3	26	6	4	1	3	1	1	0
M1	12	3	0	0	2	2	0	0
M2	9	3	0	2	2	2	1	6
M3	12	3	4	2	0	0	1	1
L1M1	2	1	1	1	0	0	1	0
L1M2	2	1	3	1	0	0	1	0
L2M1	4	1	5	1	0	0	1	0
L2M2	8	0	4	1	0	0	1	0

The average duration of the surgical intervention was 56.5 minutes for the Lichtenstein procedures, extended to 73 minutes in the approach for the strangulated variants. The tissue procedures had an average completion time of 54.3 minutes, extending to 86 minutes in the strangulated variants. The difference regarding the duration of the surgical intervention for the strangulated forms lies in the predilection for using this type of procedure in the strangulated hernia forms that required resection, followed by anastomosis.

Among the immediate postoperative complications, 7 cases (1.95%) of hemorrhage with hematoma were encountered, of which 3 cases required reintervention, this complication occurring in 2.06% (n=6) of all chronic cases admitted by appointment (290 cases). The late postoperative complications that appeared more than 48 h after the surgical intervention were represented by 7 cases of hematoma (1.95%), reintervention being necessary in 4 cases managed with tissue procedure.

Wound suppuration was found in 11 out of 358 cases, $p = 0.01$, 2 of them being in the case of the Lichtenstein technique (1 case of strangulated hernia requiring intraoperative enterectomy and 1 scheduled case), and the other 9 cases occurring after the tissue procedure (6 strangulated hernias, of which 3 required resection and 3 were chronic cases).

There were 30 complicated cases with wound seroma, 19 detected after Lichtenstein-type intervention but without statistical significance ($p > 0.05$), 9 during tissue procedures and 2 after TAPP laparoscopic procedure. Suture granulomas were noted in Lichtenstein-type tissue allograft interventions - 6 cases.

In terms of recurrence, this was evaluated through the postoperative follow-up of 211 cases, noting 9 cases of recurrence (4.26%) with the following results: 2 recurrences in cases with Lichtenstein operations (0.9%), 6 recurrences in the case of tissue procedures (5.26%) and 1 recurrence after the TAPP laparoscopic procedure (4.34%) (Table 4).

Considering pain as a postoperative complication and the NRS (Numeric Rating Pain Scale) classification, there were 31 patients without postoperative pain, 240 patients with "mild" pain (0-3 points), 61 patients with moderate pain (4-6 points), and 26 patients with severe postoperative pain (7-10 points), all these patients receiving different anti-algetic depending on the intensity of the pain (Table 5).

Of the 31 patients who did not experience postoperative pain, 11 were operated using the Lichtenstein procedure, 15 using the laparoscopic TAPP procedure and 5 of them using tissue procedures. Out of 240 cases that accused mild pain, 190 were solved by the Lichtenstein technique, 5 by the TAPP procedure and 45 by tissue procedures. Of 61 cases with moderate postoperative pain, 14 were Lichtenstein type interventions, 3 TAPP and 44 tissue procedures.

Although apparently Lichtenstein associates a high number of cases with mild pain in the immediate postoperative period, we cannot speak of a significant statistical value ($p > 0.05$), the same situation being valid for tissue procedures.

The severe pain found postoperatively in 26 cases occurred in 6 cases solved by the Lichtenstein procedure and in 20 cases resolved by non-mesh procedures. Postoperative inguinodynia was present in 3 patients (1 case after tissue procedure and 2 cases after Lichtenstein-type intervention).

Table 4. Postoperative complications related to surgical technique

Type of complication	Lichtenstein group	Management of Lichtenstein complication	Non mesh group	Management of non-mesh complications	TAPP group	Management of TAPP complications
Bleeding (intraoperative)	2	Haemostasias	3	Haemostasias	2	Haemostasias
Hematoma	2	Conservatory	5	Reintervention (n=4)/Conservatory (n=1)	-	-
Wound infection	2	Conservatory	9	Conservatory	-	-
Seroma	19	Punction (n=5)/conservatory	9	Punction (n=1)/conservatory	2	Conservatory
Granulomas	6	Conservatory	-	-	-	-
Recurrence	2	Deep inguinal ring calibration (n=1)/TAPP (n=1)	6	Lichtenstein procedure	1	Lichtenstein procedure

Table 5: Relation between postoperative pain and surgery type

		Lichtenstein	Non-Mesh	TAPP
Immediate postoperative pain	No pain	11	5	15
	Mild pain	190	45	5
	Moderate pain	14	44	3
	Severe pain	6	20	-
Postoperative inguinodynia	Mild pain	2	-	-

Discussions

Although many advances have been made over time for the most effective treatment of inguinal hernia, there is still no consensus regarding the optimal technique. The European Society of Herniology recommends the Lichtenstein approach or TAPP as the first intention with the primary indication for TAPP in bilateral hernias or recurrence after Lichtenstein. The Lichtenstein operation was considered the gold standard in the treatment of inguinal hernia, being recommended both by the European Association of Herniology and by Western national institutions, due to its low recurrence rate and a low learning curve. With a recurrence rate between 0 and 1.3%, it is preferable to other prosthetic procedures used in open surgery (Kugel, Stoppa), being superior in terms of the number of postoperative complications, but scoring less in terms of immediate postoperative pain and professional reintegration [5].

Currently, in the surgical treatment of hernia, the success of the operation is not only measured in the

absence of a recurrence or in a favorable postoperative course (without severe complications), but the recurrence rate remains the most important point of comparison that measures the effectiveness of a procedure, its value being evaluated at 5 or 10 years. In addition to this, a number of less objective elements are taken into account, which are more or less related to the patient's perception in relation to the surgical intervention. The cosmetic aspect, the immediate and remote postoperative pain, the duration of contact with the medical service, the frequency of dynamic re-evaluation and the speed of "ad integrum" reintegration into society are elements that must be met to satisfy the patient's needs.

Moreover, the choice of a specific procedure has to do with the patient's preferences and associated comorbidities [6], being patients who only want tissue procedures, laparoscopic or robotic procedures. Our opinion is that for the treatment of this kind of pathology to be of successful it has to be largely individualized and that the decision to choose a particular technique should be made after an honest consultation regarding the benefits and disadvantages of a particular procedure in relation to the characteristics of each patient [7]. Another element that is taken into account is the socio-economic impact both in terms of the actual cost of a surgical intervention, but also the implicit costs related to the length of hospital stay, post-operative complications as well as the length of time before the socio-professional reintegration can be completed. Such criteria explain why in developed countries robotic, laparoscopic or even Lichtenstein procedures enter the usual practice, with the cost of allografts, or even that of robotic surgery being supported by the health system, while in developing countries these techniques are less used, preferring tissue procedures.

Another element in choosing a particular technique is the surgeon and his preference for a specific procedure.

Either because of the speed with which a certain technique is performed, or personal experience with a certain type of procedure, or because his training was predominantly or exclusively made in one technique, the surgeon may subjectively opt for a certain type of procedure. Last but not least, the procedure itself, its learning curve and the surgeon's accessibility to training or the technique required for its application, is another important factor. A process that does not require a large learning curve, is easily reproducible, and does not require special technical materials will often be the first choice.

A comparative analysis of the most frequently used surgical procedures in current practice is thus justified. The laparoscopic and robotic approach, although used predominantly in developed countries, does not yet represent the critical mass of surgical interventions for inguinal hernia. The Lichtenstein technique is the most used worldwide in many surgical services, being the exclusive hernia repair technique [8,9]. Compared to TAPP, it is superior in terms of recurrence rate, postoperative seromas and operative time [10-12]. However, it more frequently associates postoperative pain and longer hospitalization as well as more complications such as postoperative hematomas [8,12].

Since the use of the TAPP laparoscopic approach is still in its infancy in our service, we will not insist with the comparative discussion on this procedure. Referring to our analysis, a higher incidence of the Lichtenstein technique is observed compared to tissue approaches. Lockhart *et al.* in a large comparative study between mesh vs non mesh inguinal hernia repair, a study that included 6293 patients, concludes that the Lichtenstein approach is less prone to hernia recurrence compared to the tissue one [1]. Of all the factors that measure the success rate of a procedure, the recurrence rate is the most frequently taken into account when assessing the effectiveness of a technique. In the non-mesh era, postoperative hernia recurrence values of 15% were widely accepted. With the introduction of mesh, the incidence of relapses decreased significantly [13,14].

Thus, the accepted incidence of relapses for prosthetic procedures varies between 1%-2% the closest to these results being Shouldice, for which relapses between 2.2% and 4.8% were reported. Analyzing the other tissue variants (Bassini, modified Bassini, McVay) a recurrence frequency of 7.7% was found [13]. Neurovascular lesions were less frequent in the prosthetic approach, but tissue procedures had fewer suppurative complications or seromas [1].

The most frequently factors involved in the occurrence of recurrence are divided into factors related to the surgical intervention, general factors and local factors. The experience of the surgeon and especially the volume of hernia pathology operated on annually is another factor involved in recurrence. The statement is especially valid for Shouldice, the center that promotes this type of repair

reporting lower incidences compared to the general recurrence recorded for this procedure [15].

Perhaps the most important factor related to relapse is tension. Tissue sutured in tension will mathematically evolve towards a high risk of relapse, through ischemia and tissue necrosis. Lichtenstein in particular, but also Shouldice and Desarda manage to pay off this desire for "tension free" or "tension less" repair. The McVay and Bassini technique using translation of the conjoint tendon to the Cooper ligament or the inguinal ligament achieves the highest tissue tensions. The type of material used in the suture, the type of mesh and the suture technique influence the healing process and local integration. Absorbable sutures maintain their peak strength up to 14-18 days postoperatively, while the healing of an operative wound is completed on average at 6 months. The modality recommended by some authors is the continuous suture, which usability is explicable for the Shouldice or Berliner variants, but not for the other procedures, except for obtaining a shorter operative time [16]. Wound infection especially in the Lichtenstein approach increases the risk of recurrence by 50% [13].

The general status of the patient, smoking, chronic cough, hernia sizes or inapparent hernias, incomplete dissections can be factors predicting recurrence. Immediate and late postoperative pain are more common in tissue procedures with laborious dissections compared with the Lichtenstein variant, pain of varying intensities being present in 67% of Lichtenstein patients in the first two postoperative days and in 5% at two months postoperatively. These values are superior to the tissue procedures with the exception of Shouldice, but inferior to the TAPP variant in terms of pain at two months [17].

Postoperative seroma is more frequent in allograft hernias compared to tissue hernias; fact that is also supported by the results obtained in our study [18]. Comparing the Lichtenstein procedure with the Shouldice technique, some authors note that the mesh variant is superior to the non-mesh one in terms of recurrence, the average duration of the surgical intervention and socio-professional reintegration, and even when talking about the need for postoperative analgesia. Regarding immediate postoperative complications, no significant statistical differences were found [19,20]. Analyzing the Lichtenstein technique compared to Desarda, the two are equal in terms of recurrence rate and socio-professional reintegration, with better results when operative time is taken into account and a plus for the Desarda variant in terms of late postoperative pain and postoperative seromas [21-23].

Being a relatively recent method of inguinal hernia treatment with limited applicability, applicable to selected cases, but also due to the small number of studies on restricted population groups, we cannot conclude that this method has additional advantages over the prosthetic variant.

Comparing the non-mesh procedures with each other, with the exception of the Desarda procedure, it was shown that Shouldice presents fewer recurrences, fewer postoperative complications, better socio-professional reintegration, less postoperative pain, but with a longer operative time [24-26].

In a large study that included 2791 patients, the Desarda procedure was observed to require a shorter intraoperative time with a shorter postoperative recovery period compared to Shouldice. Outcomes regarding seroma, hematoma, infection, recurrence and chronic pain were similar between these 2 procedures [27,28].

Although strictly reserved for tissue procedures due to the risk of infection of the prosthesis, strangulated hernias can also be safely approached in the Lichtenstein variant, encountering rare postoperative complications especially when effective local asepsis and administration of systemic antibiotherapy are practiced [29]. In terms of costs, the laparoscopic approach involves higher costs in terms of unilateral hernia treatment, but is more efficient for bilateral hernia treatment. The duration of the surgical intervention analyzed on the Lichtenstein vs TAPP procedure is shorter for Lichtenstein, but lasts less in the TAPP variant for bilateral inguinal hernia [30-32]. The laparoscopic approach achieves better postoperative recovery and socio-economic reintegration compared to any of the procedures in open surgery, a relapse rate comparable to the Lichtenstein procedure, the deficits in terms of costs and duration being the reason of why this procedure has not entered the current practice yet.

Conclusions

The open surgical approach in the prosthetic version remains the most used surgical technique in inguinal hernia repair, being superior to non-mesh techniques in terms of recurrence and superior to TAPP in terms of operative timing and the costs related to the surgical intervention.

The open mesh and non-mesh approach maintains its indications for elderly patients and for those with comorbidities and high anesthetic-surgical risk, as well as in services where the laparoscopic approach cannot be applied due to the equipment, costs or training of the operating team. Open surgery maintains its usefulness in the treatment of inguinal hernias even in the conditions of the increasingly frequent use of the laparoscopic approach, noting, however, a decrease in the preference for techniques that do not use "tension free" principles.

Compliance with ethical standards

Any aspect of the work covered in this manuscript has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript. Informed consent was obtained from all subjects involved in the study.

Conflict of interest disclosure

There are no known conflicts of interest in the publication of this article. The manuscript was read and approved by all authors.

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