

Comparison of Mesh fixation techniques in Laparoscopic Inguinal Hernia Repair

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Abstract:

Background: Mesh fixation technique may influence postoperative pain, recovery and complications following laparoscopic inguinal hernia repair. Non-penetrating fixation with fibrin glue may reduce tissue and nerve injury compared with absorbable tackers.

Objective: To compare fibrin-glue and absorbable-tacker mesh fixation in laparoscopic transabdominal preperitoneal inguinal hernia repair.

Methods: This prospective randomized comparative study included 60 patients with primary unilateral inguinal hernia. Patients were equally allocated to fibrin-glue or absorbable-tacker fixation. Operative time, postoperative pain, analgesic requirement, hospital stay, return to normal activities and work, complications, chronic groin pain and recurrence were evaluated over six months.

Results: Total operative time was comparable between the techniques ($p=0.125$), although mesh-fixation time was longer with fibrin glue ($p<0.001$). The fibrin-glue group had significantly lower pain scores from six hours to one month; at 48 hours, the scores were 2.5 ± 0.7 and 3.1 ± 0.8 , respectively ($p=0.003$). Fibrin glue was also associated with fewer analgesic doses ($p=0.001$), shorter hospital stay ($p=0.040$), earlier return to normal activities ($p<0.001$) and earlier return to work ($p=0.001$). Early complications and chronic groin pain were less frequent with fibrin glue, but the differences were not statistically significant. No mesh migration or recurrence occurred in either group.

Conclusion: Fibrin-glue fixation provided better postoperative pain control and faster recovery than absorbable tackers without increasing complications or short-term recurrence.

Keywords: Absorbable tackers; fibrin glue; inguinal hernia; laparoscopic hernia repair; mesh fixation; postoperative pain; TAPP.

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Introduction

Inguinal hernia is one of the most frequently encountered conditions in general surgical practice, and surgical repair remains its definitive treatment. The introduction of prosthetic mesh markedly reduced tension at the repair site and lowered recurrence rates compared with traditional tissue-based repairs. Subsequently, minimally invasive procedures—particularly the totally extraperitoneal (TEP) and transabdominal preperitoneal (TAPP) approaches—became widely accepted because they provide good visualization of the myopectineal orifice, permit placement of a large preperitoneal mesh and support early postoperative recovery.

An important technical consideration during laparoscopic inguinal hernia repair is whether the mesh should be fixed and, if fixation is performed, which technique provides the best balance between stability, postoperative comfort, safety and cost. Mesh fixation is intended to prevent folding or displacement during the initial period of tissue incorporation, thereby reducing the risk of recurrence. However, penetrating fixation devices such as metallic or absorbable tackers may injure the periosteum, muscles, vessels or regional nerves. Such tissue trauma has been associated with acute postoperative pain, paraesthesia and chronic groin pain. Mechanical fixation devices also add substantially to the cost of laparoscopic repair.

Different techniques have therefore been developed, including metallic tackers, absorbable tackers, transfascial sutures, fibrin glue, cyanoacrylate glue, self-fixating meshes and mesh placement without fixation. Each technique has potential advantages and limitations. Tackers provide rapid and reliable mechanical anchoring but may cause greater tissue trauma. Sutures are relatively inexpensive and offer secure fixation, although their application may increase operative time and produce pain at the suture site. Tissue adhesives provide non-penetrating fixation and may reduce nerve and tissue injury, but their availability and cost can limit routine use. Non-fixation eliminates device-related trauma and expense; however, concerns remain regarding mesh migration and recurrence, especially in large direct hernias.

Several Indian studies have evaluated these alternatives. Chandra et al. compared fibrin-glue fixation with tacker fixation in 100 patients undergoing laparoscopic TEP repair at a centre in Pune. They reported less postoperative pain, shorter hospital stay and earlier return to normal activities with fibrin glue, without a corresponding increase in short-term recurrence or other major complications [1]. Similarly, an Indian randomized controlled study by Nizam et al. found that fibrin-glue fixation was associated with lower pain scores, a shorter hospital stay and earlier resumption of routine activities than tacker fixation, while operative time and postoperative complication rates remained comparable [2].

The usefulness of alternative mechanical fixation has also been investigated in India. Kumar et al. compared transfascial suture fixation with tack fixation in TEP repair and observed comparable immediate postoperative pain and complication rates. During follow-up, pain was lower in the suture group at selected intervals, and the authors concluded that transfascial sutures could offer a safe and cost-effective alternative to tackers [3]. Shukla et al., in a three-group Indian study involving 210 patients, compared tackers, cyanoacrylate glue and fibrin glue. Cyanoacrylate fixation was associated with reduced postoperative pain, earlier return to daily activities and a substantial cost advantage, while both glue-based techniques demonstrated favourable outcomes compared with tackers [4].

The necessity of routine mesh fixation has also been questioned. Garg et al. conducted a randomized controlled trial at a rural centre in India and showed that non-fixation during laparoscopic TEP repair did not adversely affect recurrence, pain or postoperative morbidity when compared with fixation [5]. Kumar et al. similarly reported that non-fixation of mesh could be safely performed in selected TEP repairs, with outcomes comparable to fixation in terms of recurrence and chronic groin

pain, while potentially reducing operative time and procedural cost [6].

More recent Indian evidence from TAPP repair has also examined non-penetrating fixation. Manish et al. compared fibrin glue with absorbable tackers and found that fibrin sealant produced favourable short-term outcomes regarding postoperative pain, return to normal activities and haematoma formation [7]. Nevertheless, variations in operative approach, hernia size, fixation material, surgeons' experience, duration of follow-up and outcome assessment make it difficult to identify a universally superior technique. Recurrence prevention must also be considered alongside postoperative pain, complications, recovery, quality of life and affordability.

Therefore, a systematic comparison of mesh-fixation techniques in laparoscopic inguinal hernia repair is clinically relevant, particularly in the Indian healthcare setting, where cost-effectiveness and early return to work are important considerations. The present study was undertaken to compare selected mesh-fixation techniques with respect to operative time, postoperative pain, analgesic requirement, hospital stay, complications, return to normal activities, cost and recurrence. The findings may help determine a fixation method that provides adequate mesh stability while minimizing postoperative morbidity and financial burden.

Materials and Method

A prospective, randomized comparative study was conducted in the Department of General Surgery at Government Medical College, Mancherial, Telangana, for a period of one year. Adult patients undergoing elective laparoscopic repair of a primary unilateral inguinal hernia were included. The study compared two methods of mesh fixation during laparoscopic transabdominal preperitoneal (TAPP) repair:

- Group A: mesh fixation using absorbable tackers.
- Group B: mesh fixation using fibrin glue.

The study was conducted after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from every participant before enrolment.

Study Population: Patients attending the General Surgery outpatient department with a clinical diagnosis of inguinal hernia were assessed for eligibility. The diagnosis and type of hernia were established through clinical examination. Ultrasonography was performed when the clinical diagnosis was uncertain.

Sample Size: The sample size was calculated based on the postoperative pain scores reported by Manish et al. [7] In their Indian study, the mean pain score at

48 hours was 4.63 ± 0.49 in the fibrin-glue group and 4.07 ± 0.87 in the absorbable-tacker group. Considering a 95% confidence level, 80% statistical power, 5% level of significance and equal allocation between the groups, the minimum sample size was calculated as 25 patients per group. After accounting for a 10% possible loss to follow-up, the adjusted sample size was 28 patients per group. The sample size was rounded to 30 patients in each group. Therefore, a total of 60 patients were included, with 30 patients allocated to the fibrin-glue group and 30 to the absorbable-tacker group.

Inclusion Criteria: Patients meeting the following criteria were included:

1. Age between 18 and 70 years.
2. Primary unilateral inguinal hernia.
3. Reducible and uncomplicated hernia.
4. Patients scheduled for elective laparoscopic TAPP repair.
5. American Society of Anesthesiologists physical status I or II.
6. Patients willing to participate and provide written informed consent.

Exclusion criteria

The following patients were excluded:

1. Recurrent or bilateral inguinal hernia.
2. Irreducible, obstructed or strangulated hernia.
3. Large inguinoscrotal hernia.
4. Previous major lower abdominal or pelvic surgery.
5. Patients with bleeding disorders or receiving anticoagulant therapy that could not be discontinued.
6. Severe cardiac, respiratory, renal or hepatic disease.
7. Active infection at or near the operative site.
8. Known allergy to fibrin glue or any of its components.
9. Patients unfit for general anaesthesia.
10. Patients unwilling to participate or unable to complete follow-up.

Preoperative Assessment: A detailed medical history was recorded, and a complete general and systemic examination was performed. The side, type, duration and reducibility of the hernia were documented. Routine preoperative investigations included:

- Complete blood count
- Blood glucose
- Renal and liver function tests
- Coagulation profile
- Urine examination
- Electrocardiography
- Chest radiography, when clinically indicated
- Ultrasonography of the inguinal region, when required

All patients received standard pre-anaesthetic evaluation. Prophylactic intravenous antibiotics were administered approximately 30–60 minutes before skin incision.

Surgical Procedure: All operations were performed under general anaesthesia by surgeons experienced in laparoscopic hernia repair. The same standardized TAPP technique and a similar type and size of polypropylene mesh were used in both groups.

After creation of pneumoperitoneum, the abdominal cavity was inspected, and the hernial defect was identified. A peritoneal flap was created, and the preperitoneal space was dissected. The hernial sac was separated from the surrounding structures, and the myopectineal orifice was adequately exposed. A polypropylene mesh of approximately 10×15 cm was placed over the defect with sufficient overlap.

In Group A, the mesh was fixed using absorbable tackers at safe anatomical points, such as Cooper's ligament and the upper medial abdominal wall. Tacks were not applied in the triangle of pain or triangle of doom to avoid nerve and vascular injury.

In Group B, fibrin glue was applied at selected points over Cooper's ligament and along the medial, superior and lateral margins of the mesh. Care was taken to achieve adequate fixation without folding or displacement of the mesh.

After fixation, the peritoneal flap was closed to cover the mesh completely. Port sites were closed using the same standard technique in both groups.

Postoperative Management: All patients received a standardized postoperative treatment protocol. Postoperative pain was managed using the same analgesic medication in both groups. Oral fluids were initiated after recovery from anaesthesia, followed by a normal diet as tolerated. Patients were encouraged to mobilize early.

Patients were discharged when they were haemodynamically stable, tolerated oral food, passed urine independently, could walk without assistance and had adequately controlled pain.

Follow-up: Patients were followed at 7 days, 1 month, 3 months and 6 months after surgery. During each visit, the operative site was examined for pain, seroma, haematoma, infection, numbness and recurrence. Ultrasonography was performed when recurrence or another postoperative complication was suspected.

Data Collection: Information was recorded using a predesigned case-record form. The following details were collected:

- Age and sex
- Body mass index
- Occupation

- Comorbidities
- Side and type of hernia
- Duration of symptoms
- Operative and mesh-fixation time
- Postoperative pain scores
- Analgesic consumption
- Hospital stay
- Postoperative complications
- Return to normal activities and work
- Cost of fixation
- Recurrence during follow-up

Statistical Analysis: Data were entered into Microsoft Excel and analysed using SPSS version 25. Continuous variables were expressed as mean

and standard deviation or median and interquartile range, depending on the distribution of data. Categorical variables were presented as frequencies and percentages.

The independent-samples Student's t-test was used to compare normally distributed continuous variables between the groups. The Mann-Whitney U test was used for variables that did not follow a normal distribution. Repeated pain measurements were analysed using repeated-measures analysis of variance or an appropriate non-parametric test. Categorical variables were compared using the chi-square test or Fisher's exact test. A p-value of less than 0.05 was considered statistically significant.

Observation and Results

Table 1: Baseline characteristics of the Study Population

Characteristic	Group A: Fibrin glue (n=30)	Group B: Absorbable tackers (n=30)	p-value
Age, years, mean $\pm$ SD	45.8 $\pm$ 11.2	46.9 $\pm$ 10.6	0.697
BMI, kg/m ² , mean $\pm$ SD	24.7 $\pm$ 2.8	25.1 $\pm$ 3.0	0.595
Male sex, n (%)	28 (93.3)	27 (90.0)	1
Female sex, n (%)	2 (6.7)	3 (10.0)	
Right-sided hernia, n (%)	17 (56.7)	18 (60.0)	1
Left-sided hernia, n (%)	13 (43.3)	12 (40.0)	
Indirect hernia, n (%)	20 (66.7)	19 (63.3)	1
Direct hernia, n (%)	10 (33.3)	11 (36.7)	
Diabetes mellitus, n (%)	3 (10.0)	4 (13.3)	1
Hypertension, n (%)	5 (16.7)	6 (20.0)	1

The mean age was 45.8 $\pm$ 11.2 years in the fibrin-glue group and 46.9 $\pm$ 10.6 years in the absorbable-tacker group. Both groups were comparable regarding age, BMI, sex, side and type of hernia, diabetes and

hypertension, as all p-values were greater than 0.05. Thus, the baseline characteristics were similar between the groups.

Table 2: Comparison of operative parameters

Operative parameter	Group A: Fibrin glue	Group B: Absorbable tackers	Test value	p-value
Total operative time, minutes	67.4 $\pm$ 8.5	64.1 $\pm$ 7.9	t=1.558	0.125
Mesh-fixation time, minutes	6.8 $\pm$ 1.4	4.9 $\pm$ 1.1	t=5.845	<0.001
Intraoperative bleeding, n (%)	1 (3.3)	1 (3.3)		1
Conversion to open surgery, n (%)	0	0	NA	NA
Intraoperative complications, n (%)	0	0	NA	NA

The mean total operative time was slightly longer with fibrin glue than with absorbable tackers (67.4 $\pm$ 8.5 versus 64.1 $\pm$ 7.9 minutes), but the difference was not significant (p=0.125). Mesh-fixation time was significantly longer in the fibrin-

glue group (6.8 $\pm$ 1.4 versus 4.9 $\pm$ 1.1 minutes; p<0.001). Intraoperative bleeding was observed in one patient from each group, while no conversion to open surgery or other intraoperative complication occurred.

Table 3: Postoperative pain measured using the visual analogue scale

Assessment time	Group A: Fibrin glue, mean $\pm$ SD	Group B: Absorbable tackers, mean $\pm$ SD	t-value	p-value
6 hours	5.1 $\pm$ 0.9	5.8 $\pm$ 1.0	2.85	0.006
12 hours	4.3 $\pm$ 0.8	5.0 $\pm$ 0.9	3.184	0.002
24 hours	3.5 $\pm$ 0.8	4.2 $\pm$ 0.9	3.184	0.002
48 hours	2.5 $\pm$ 0.7	3.1 $\pm$ 0.8	3.092	0.003
7 days	1.2 $\pm$ 0.5	1.7 $\pm$ 0.6	3.506	<0.001
1 month	0.3 $\pm$ 0.4	0.6 $\pm$ 0.6	2.279	0.026

Postoperative pain gradually decreased in both groups. Pain scores were significantly lower in the fibrin-glue group at 6, 12, 24 and 48 hours, as well as at seven days and one month, with all p-values

below 0.05. At 48 hours, the mean pain score was 2.5 ± 0.7 with fibrin glue compared with 3.1 ± 0.8 with absorbable tackers ($p=0.003$). Therefore, fibrin-glue fixation provided better postoperative pain control.

Table 4: Analgesic requirement and postoperative recovery

Outcome	Group A: Fibrin glue	Group B: Absorbable tackers	t-value	p-value
Analgesic doses during first 48 hours	2.4 ± 0.8	3.2 ± 1.0	3.422	0.001
Hospital stay, days	1.4 ± 0.5	1.7 ± 0.6	2.104	0.04
Return to normal activities, days	7.6 ± 2.1	10.1 ± 2.7	4.003	<0.001
Return to work, days	12.3 ± 3.2	15.5 ± 4.0	3.422	0.001

Patients in the fibrin-glue group required fewer analgesic doses during the first 48 hours (2.4 ± 0.8 versus 3.2 ± 1.0 ; $p=0.001$). They also had a shorter hospital stay (1.4 ± 0.5 versus 1.7 ± 0.6 days;

$p=0.040$), resumed normal activities earlier (7.6 ± 2.1 versus 10.1 ± 2.7 days; $p<0.001$) and returned to work sooner (12.3 ± 3.2 versus 15.5 ± 4.0 days; $p=0.001$).

Table 5: Early postoperative complications

Complication	Group A: Fibrin glue, n (%)	Group B: Absorbable tackers, n (%)	p-value
Seroma	3 (10.0)	4 (13.3)	1
Haematoma	1 (3.3)	3 (10.0)	0.612
Urinary retention	2 (6.7)	3 (10.0)	1
Surgical-site infection	0	1 (3.3)	1
Groin numbness or paraesthesia	1 (3.3)	4 (13.3)	0.353
Readmission within 30 days	0	0	—

Early complications were numerically less frequent in the fibrin-glue group. Seroma occurred in 10.0% versus 13.3%, haematoma in 3.3% versus 10.0%, urinary retention in 6.7% versus 10.0%, and groin numbness in 3.3% versus 13.3% of patients in the

fibrin-glue and tacker groups, respectively. However, none of these differences was statistically significant ($p>0.05$). No patient required readmission within 30 days.

Table 6: Early postoperative complications

Outcome	Group A: Fibrin glue, n (%)	Group B: Absorbable tackers, n (%)	p-value
Chronic groin pain at 3 months	1 (3.3)	4 (13.3)	0.353
Chronic groin pain at 6 months	0	2 (6.7)	0.492
Persistent paraesthesia at 6 months	0	1 (3.3)	1
Mesh-related infection	0	0	
Mesh migration	0	0	
Hernia recurrence at 6 months	0	0	

Chronic groin pain was less frequent with fibrin glue at three months (3.3% versus 13.3%) and six months (0% versus 6.7%), although the differences were not statistically significant. Persistent paraesthesia occurred in one patient in the tacker group. No mesh infection, mesh migration or hernia recurrence occurred in either group during the six-month follow-up.

Discussion

The present study compared fibrin-glue fixation with absorbable-tacker fixation during laparoscopic TAPP inguinal hernia repair. The groups were comparable regarding age, BMI, sex, hernia characteristics and comorbidities, indicating that differences in postoperative outcomes were unlikely

to have resulted from baseline variations. The principal findings were that fibrin-glue fixation produced significantly lower postoperative pain, reduced analgesic requirements, a shorter hospital stay and earlier return to normal activities and work. Although mesh fixation with fibrin glue required more time, the total operative duration was comparable between the techniques. Early and late complication rates did not differ significantly, and neither group experienced mesh migration or recurrence during six months of follow-up.

The mean total operative time was 67.4 ± 8.5 minutes with fibrin glue and 64.1 ± 7.9 minutes with absorbable tackers, with no statistically significant difference. However, mesh-fixation time was significantly longer with fibrin glue. This finding

may be related to the preparation of the adhesive, controlled application at selected fixation points and the time required for adequate adhesion. Nizam et al. also found no significant difference in total operative time between fibrin-glue and tacker fixation in an Indian randomized study of TEP repair [2]. In contrast, tackers generally provide faster mechanical fixation because they can be rapidly deployed. Nevertheless, the modest increase in fixation time associated with fibrin glue did not significantly prolong the complete operation in the present study.

Postoperative pain was significantly lower in the fibrin-glue group at every assessment from six hours to one month. At 48 hours, the mean VAS score was 2.5 ± 0.7 with fibrin glue compared with 3.1 ± 0.8 with absorbable tackers. This difference may be explained by the non-penetrating nature of fibrin glue. Unlike tackers, glue does not mechanically penetrate the abdominal wall and may therefore cause less tissue injury, periosteal irritation and nerve entrapment.

These findings agree with the Indian study by Nizam et al., in which pain scores at all follow-up assessments were better in the fibrin-glue group than in the tacker group [2]. Chandra et al., in a study of 100 patients undergoing laparoscopic TEP repair in Pune, also reported favourable clinical outcomes with fibrin-glue fixation compared with tacker fixation [1]. Their mean hospital stay was 2.14 days in the fibrin-glue group and 2.38 days in the tacker group.

Manish et al. compared fibrin glue with absorbable tackers in 54 Indian patients undergoing TAPP repair. They reported significant differences in pain at selected postoperative intervals and concluded that fibrin sealant produced better short-term outcomes regarding pain, return to normal activities and haematoma formation [3]. Although the exact pattern of early pain in their study was not identical to the present findings, the overall conclusion supports the clinical benefit of non-penetrating fixation. Differences in anaesthetic protocols, analgesic administration, glue application, number and location of tackers, and timing of pain assessment could explain variations between studies.

The lower analgesic requirement observed in the fibrin-glue group further supports the pain findings. Patients receiving fibrin glue required 2.4 ± 0.8 analgesic doses during the first 48 hours compared with 3.2 ± 1.0 doses among patients receiving absorbable tackers. This difference was statistically significant. Reduced analgesic consumption is clinically beneficial because it may decrease medication-related adverse effects and facilitate early mobilization.

The mean hospital stay was also significantly shorter with fibrin glue (1.4 ± 0.5 days) than with absorbable tackers (1.7 ± 0.6 days). Nizam et al. similarly found a shorter average hospital stay in patients treated with fibrin glue [1]. Shukla et al. compared tackers, cyanoacrylate and fibrin glue in 210 Indian patients undergoing TEP repair. Hospital stay was significantly shorter in both adhesive groups than in the tacker group, supporting the recovery advantage of non-penetrating fixation [4].

Patients in the present study returned to normal activities after 7.6 ± 2.1 days with fibrin glue compared with 10.1 ± 2.7 days with absorbable tackers. Return to work occurred after 12.3 ± 3.2 and 15.5 ± 4.0 days, respectively. Both differences were statistically significant. Nizam et al. reported earlier resumption of daily activities in their fibrin-glue group [1]. Similarly, Manish et al. found significant differences in return to normal activities at one, two and four weeks, favouring fibrin sealant [7]. These findings indicate that reduced postoperative pain may translate into meaningful functional benefits, including earlier mobilization and occupational recovery.

Kumar et al. compared transfascial suture fixation with tack fixation in 69 patients undergoing TEP repair at King George's Medical University, Lucknow. They found less pain in the suture group at several follow-up points and no significant difference in other postoperative complications [3]. Although transfascial sutures differ from fibrin glue, their results support the broader observation that the fixation technique can influence postoperative pain and that alternatives to conventional tacking may provide comparable safety.

Early postoperative complications in the present study were uncommon. Seroma occurred in 10.0% of the fibrin-glue group and 13.3% of the tacker group, while haematoma occurred in 3.3% and 10.0%, respectively. Urinary retention, surgical-site infection and groin paraesthesia were also numerically less frequent with fibrin glue. However, none of these differences was statistically significant. Nizam et al. similarly reported no significant differences in urinary retention, seroma or haematoma between fibrin-glue and tacker fixation [2]. Shukla et al. found comparable rates of seroma and urinary retention among tacker, cyanoacrylate and fibrin-glue groups [4]. Thus, the available Indian evidence suggests that fibrin glue does not increase common postoperative complications.

At three months, chronic groin pain was observed in 3.3% of patients receiving fibrin glue and 13.3% receiving absorbable tackers. At six months, no patient in the fibrin-glue group had chronic pain, compared with 6.7% in the tacker group. Although these differences were clinically suggestive, they

were not statistically significant, possibly because of the small sample and low number of events. Kumar et al. reported chronic groin pain rates of 3.4% after mesh fixation and 2.7% after non-fixation, without a statistically significant difference [6]. Their study nevertheless demonstrated lower immediate pain and shorter operative time with non-fixation.

No mesh migration or hernia recurrence was observed in either group during six months of follow-up. This indicates that fibrin glue provided adequate short-term mesh stability. However, recurrence may develop after a longer period, and the absence of recurrence during six months should not be interpreted as evidence of equivalent long-term durability. Garg et al., in an Indian randomized trial involving 104 patients, found that fixation and non-fixation during TEP repair produced comparable pain, hospital stay, return to normal activity and recurrence outcomes over longer follow-up [5]. These findings suggest that extensive penetrating fixation may not be essential in appropriately selected patients when adequate mesh size, overlap and positioning are ensured.

Conclusion

Fibrin-glue mesh fixation in laparoscopic inguinal hernia repair was associated with significantly lower postoperative pain, reduced analgesic requirement, shorter hospital stay and earlier return to normal activities and work compared with absorbable-tacker fixation. Although fibrin glue required slightly more fixation time, the overall operative duration was comparable. Postoperative complications, chronic groin pain and recurrence were comparable between the groups. Therefore, fibrin glue appears to be a safe and effective alternative to absorbable tackers, offering better short-term postoperative recovery without compromising mesh stability. Longer follow-up and larger multicentre studies are recommended to confirm its long-term effectiveness.

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