



Study Of the Surgical Treatment of Synovial Cysts of The Spine: A Systematic Review with Meta-Analysis

OPEN ACCESS

SUBMITTED 24 August 2025

ACCEPTED 10 September 2025

PUBLISHED 28 September 2025

VOLUME Vol.07 Issue 09 2025

CITATION

Jefferson de Melo Santos, Leonardo Oliveira Coelho, Sávio Câmara Vieira de Andrade, & Diego Antônio Moraes e Silva. (2025). Study Of the Surgical Treatment of Synovial Cysts of The Spine: A Systematic Review with Meta-Analysis. The American Journal of Medical Sciences and Pharmaceutical Research, 7(09), 27–34.

<https://doi.org/10.37547/tajmspr/Volume07Issue09-05>

COPYRIGHT

© 2025 Original content from this work may be used under the terms of the creative common's attributes 4.0 License.

Jefferson de Melo Santos.

Ortopedista e traumatologista do Hospital Santo Amaro, GUARUJÁ-SP.

Leonardo Oliveira Coelho.

Ortopedista e traumatologista do Hospital Regional de Santa Maria, Santa Maria-DF.

Sávio Câmara Vieira de Andrade.

Médico residente de ortopedia e traumatologia do Hospital Geral de Fortaleza, Fortaleza-CE.

Diego Antônio Moraes e Silva.

Médico do Hospital Regional de Santa Maria-DF.

Corresponding author - Jefferson de Melo Santos.

This study presents no conflicts of interest.

This study did not receive any financial support from public, commercial, or non-profit sources.

Abstract: Objective: The aim of this study is to evaluate the effectiveness of minimally invasive surgical treatment for patients with synovial cysts of the lumbar spine, comparing the results between the interlaminar and transforaminal routes, according to the post-operative results. Methodology: Systematic review with meta-analysis, registered under the prestigious ID CRD42024557771. The research questions were defined using the PICOS model in accordance with the PRISMA guidelines. Results: 208 patients were included, of whom 25 did not continue and were excluded from the study, and 183 were analyzed. The patients underwent surgery via the interlaminar and transforaminal routes. In the evaluation of MacNab's criteria, most of the patients had excellent and good results; those who had

poor results had some degree of spondylolisthesis and were re-approved, with improvement in their pain. Conclusion: Synovial cysts can be effectively treated with a tubular retractor system in conjunction with an endoscope or microscope. The use of a retractor minimizes soft tissue trauma, incision length and blood loss. In addition, the rupture of ligament and bone structures is minimized with a unilateral approach, which is important in those patients where the synovial cyst is associated with spondylolisthesis, reducing the risk of progressive instability and the need for spinal fusion.

Keywords: Surgical treatment; Lumbar synovial cyst; Spine.

Introduction

In order to facilitate the biomechanical function of joint movement, the endogenous production of synovial fluid through the synovium acts as a cartilage lubricant, reducing friction and slowing down degenerative processes. Stimulating excessive production generates an inflammatory potential which leads to the formation of synovial cysts. Benign tumor, delimited by a soft, rounded nodule, usually visible and palpable and without phlogistic signs.¹

As far as spinal involvement is concerned, lumbar facet cysts are a common source of pain and neurological dysfunction, due to the fact that it is intrinsically linked to the process of facet degeneration; the literature indicates an association in 91% of cases.² The clinical presentation is compatible with that of degenerative diseases such as: low back pain with or without irradiation, paresthesia in the lower limbs, loss of motor strength in the lower limbs, loss of sensation in the lower limbs and/or altered gait.^{2,3}

The diagnosis is made on the basis of clinical manifestations and confirmed by imaging through magnetic resonance and computed tomography. X-rays should also be taken to indicate the degree of degeneration of the facet joints, the existence of pathological fractures and/or dislocations, in order to carry out clinical screening and staging of the pathology and quantification of instability. Since the patient's clinical and functional assessment, combined with the complementary imaging examination, defines the therapeutic approach.

Spinal cysts are anatomically more prevalent at the L4-L5 level, corroborating the instability clinic and emphasizing the preference for a surgical therapeutic approach. The best surgical treatment approach for each particular individual seems to remain speculative. In view of this, our aim was to evaluate the efficacy of minimally invasive surgical treatment of patients with synovial cysts of the lumbar spine by comparing the

results between the interlaminar and transforaminal routes, according to the postoperative results.

Methodology

The systematic review was carried out according to the recommendations of Khan et al considering: 1) framing the questions for a literature review; 2) identifying the relevant research; 3) assessing the quality of the studies; 4) summarizing the evidence; 5) interpreting the results.

The research questions were defined by the PICOS model in accordance with the PRISMA guidelines, as follows:

1. Population: Patients with lumbar synovial cysts
2. Intervention: Surgical treatment
3. Comparator: Comparison between minimally invasive treatment, interlaminar and transforaminal approach
4. Results: Efficacy of surgical treatment
5. Study design: Randomized controlled designs, counterbalanced crossovers or repeated measures designs that investigated the effects of the recovery interval.

Database search method From March to MAY 2024, records were analyzed from 3 electronic databases (Pubmed, Biblioteca Virtual da Saúde BVS, Ebsco Sportdiscus). The keywords were obtained using the PubMed "mesh terms" query. The search was conducted with the English terms for: LUMBAR SYNOVIAL CYST with a combination of "AND" and "OR". The study protocol was drawn up and registered in the Prospective Register of Systematic Reviews (ROSPERO) database under ID CRD42024557771.

Inclusion and exclusion criteria

The inclusion criteria for the articles were:

(01) studies evaluating surgical techniques for the treatment of lumbar synovial cysts (2) studies more than 15 years old (3) studies evaluating minimally invasive treatment (4) studies addressing patients diagnosed with lumbar synovial cysts treated minimally invasively via the interlaminar and transforaminal routes.

Studies with the following criteria were excluded: (1) experimental studies using animal models (2) non-original studies - literature reviews (3) opinion studies (4) studies which dealt with management after infection had been established, i.e. which did not discuss prevention and diagnosis of infection (5) studies published more than seven years ago (6) studies which did not meet the other inclusion criteria mentioned above.

The search and selection of studies was carried out by two reviewers who independently analyzed the studies. Initially, using the aforementioned DECS and Boolean

operators, studies published in the last five years (2017-2022) were selected, followed by an analysis of titles and abstracts. At this stage, studies using animal models, opinion articles and literature reviews were excluded.

Once this stage was completed, the full texts of the articles were retrieved to analyze the other inclusion and exclusion criteria. Duplicate citations and studies not corresponding to the proposed review parameters were also excluded. Possible disagreements were resolved by discussion with a third reviewer, and inclusion was decided after consensus with the two main reviewers.

In order to prioritize methodological quality, studies classified as "Good" after the NIH quality assessment were included, with studies with more than nine items ticked being considered suitable for inclusion.

Epidemiological and demographic data was extracted using a Microsoft Excel spreadsheet, including parameters such as number of patients, surgical approach, risk factors described and infection prevention strategies.

Results

Twelve articles were selected during the search process; after excluding those published more than 20 years ago, 10 remained. Analysis of the title and abstract allowed the exclusion of 03 papers that did not correspond to the objective of this study. Seven articles were read in full, of which three were excluded because they did not meet the inclusion criteria, and finally four were selected for this article (Figure 1).

The four articles selected presented patients with lumbar synovial cysts who underwent minimally invasive treatment via the interlaminar and transforaminal routes, using microscopic and endoscopic tubular retractors. Evaluation was carried out using the MacNab criteria reported in some studies. A total of 166 patients were included, of whom 109 underwent an interlaminar approach and 10 a transforaminal approach, 13 by microscope and 04 by endoscope.

Table 1 shows the selected articles and their results (Table 1). Figure 2 shows the functional assessment with the MacNab score^{7,8,9}.

In the prospective study by Komp et al⁶, 94 patients were included, 85 patients (90%)

were operated on via the interlaminar approach (IN) and 09 (10%) via the transforaminal approach (TR). 72 patients received an average of 06 months of conservative treatment, 07 had undergone previous microscope-assisted surgery at a different level, 22 patients with symptoms of uncontrollable pain or pronounced acute paralysis underwent immediate surgery. However, only 74 patients (79%) were followed

up, the other 20 were excluded for reasons of: undergoing additional surgery on the same segment(02), changing residence(08) and not responding to electronic calls or letters(10). The average operative time was 22 minutes. The average operative time was 22 minutes. Regarding the location of the cyst, 21 interventions were at L5/S1, 52 at L4/L5, 05 at L3/L4, 04 at L2/L3 and 02 at L1/L2. As for the intraoperative findings, in 22 patients there were strong adhesions between the cyst and the dura mater which had to be released, in 17 patients the lateral recess was additionally decompressed and in the remaining patients a complete resection of the cyst was performed. Mobilization was immediate and without rehabilitation measures, except in patients with paresis. Regarding the clinical results, there was a significant improvement in pain ($p<0.001$) in the legs and in daily activities, but no influence on low back pain. After two years, 63 patients (85%) no longer had pain in the legs, 08 (11%) had pain occasionally or the pain was much reduced and 03 (4%) had no significant improvement. No significant deterioration in leg or back pain related to the surgery was recorded. Neurological deficits were significantly reduced ($p<0.001$) with a history of less than 02 weeks, 69 patients (93%) reported subjective satisfaction and stated that they would undergo the procedure again, no patient underwent a new surgery due to persistent leg pain during the follow-up period and 66 patients returned to their professional and sporting activities. Regarding complications, no measurable blood loss or post-operative hemorrhage was recorded, 02 cases of dural tear of less than 2mm, which was covered with a collagen flap after the procedure and no reports of nerve damage or temporary urinary retention, but 04 patients developed transient post-operative dysesthesia (03 from the transforaminal group and 01 from the interlaminar group).

In the multicenter study by Tacconi et al⁷, 54 patients were included, but only 35 (64.8%) met the inclusion criteria and were followed up in the study, while 19 patients (35%) were excluded, because 07 refused to undergo complete endoscopic removal of the cyst, after realizing that there is a slight probability of incomplete resection of the cyst compared to open techniques; 05 had more than one grade I listhesis simultaneously and were selected for open removal and posterior arthrodesis ; 04 had severe spinal stenosis and 03 had previous neurological deficits and were approached with open techniques. However, in 04 patients, 03 from the transforaminal route and 01 from the interlaminar route, it was necessary to convert the totally endoscopic surgery to open surgery, due to significant hemorrhage or inability to dissect the cyst from the dural sac (02 cases), but in the remaining patients total endoscopic resection was achieved. Regarding symptoms, all

patients complained of leg pain lasting at least six weeks, unresponsive to conservative therapy, 26 of them (74%) also reported back pain and 03 had grade I listhesis. Regarding the location of the cyst, 80% of the patients had it at L4/L5, 17.1% at L5/S1 and 2.9% at L3/L4. The average operative time was 78 minutes. In the immediate post-operative period, 31 patients (87%) were pain-free, 04 did not report significant improvement, of these, 02 needed new administrations of NSAIDs and improved; the other 02 were reordered due to radicular pain that had worsened because of a residual cyst confirmed by an MRI scan, both of which underwent open hemilaminectomy and microscopic removal of the cyst and improved immediately after the second surgery. Mobilization was immediate after an average time of 7 hours, and all patients showed no evidence of instability at 6 months of follow-up. Regarding the Numerical Pain Rating Scale (NPRS), the preoperative mean was 6.8 (standard deviation, SD=1.2); in the immediate postoperative period it was 3.4 (SD=1.1; $p<0.001$) and in the 06-month follow-up, 2.1 (SD=1.7; $p<0.001$). With regard to the Numerical Pain Rating Scale (NPRS), the preoperative mean was 6.8 (standard deviation, SD=1.2); in the immediate postoperative period it was 3.4 (SD=1.1 ; $p<0.001$) and in the 6-month follow-up, 2.1 (SD=1.7 ; $p<0.001$). At an average follow-up of approximately 15 months, 28 of the 31 patients were pain-free or better, according to MacNab's criteria: excellent 28.6%, good 48.6% and poor 11.4%. With regard to surgical complications, there were 01 small dural tears of less than 2mm, 01 dural tear of a nerve root, both of which were successfully treated conservatively and resolved without further intervention and occurred during the attempt to dissect the cyst from the dural sac. Apart from a transient dysesthesia that 4 patients developed in the postoperative period, there were no other complications in the perioperative period (<30 days after surgery).

The study by Birch et al⁸ evaluated the results of minimally invasive microscopic resections of synovial cysts using a microscopic tubular retractor. 40 patients underwent the procedure, of whom 72.5% had a cyst between L4/L5, 20% between L5/S1 and 7.5% between L3/L4. In terms of symptoms, 39 patients (97.5%) had lumbar radiculopathy, 01 (2.5%) had neurogenic claudication and 01 (2.5%) had had previous spinal surgery. The primary results involved the Macnab criteria, 70% of the results were excellent, 22.5% good, 2.5% fair and 5% poor. The patients in whom the post-operative results were considered poor underwent subsequent lumbar fusion. One patient performed well after surgery, while the other had persistent back pain even with a solid fusion evident in the post-operative images and was treated with medication. The average time of the surgical procedure was 58 minutes, with a

blood loss of 21 ml. The intraoperative complications recorded were 02 cases of dural rupture, which were repaired at the time of surgery; no postoperative sequelae were recorded. As for length of stay, 07 patients were admitted for observation and discharged the following day and 33 patients were discharged on the same day of surgery, with an average length of stay of approximately 04 hours.

In the study by Sandhu et al⁹, 17 patients underwent surgical resection using the tubular retractor system, 13 with a microscope and 4 with an endoscope. The level most affected in the patients was L4/L5, 82%. 01 patients had bilateral cysts. The most affected level in the patients was L4/L5, 82%. 01 patients had bilateral cysts. In 47% of cases, grade I spondylolisthesis was observed at the same level as the synovial cyst. As for symptoms, all the patients had radicular pain in their legs, while 13 patients also had significant back pain. The average time of the surgical procedure was 98 minutes, with blood loss of 35 ml. The results of the MacNab criteria were 82% excellent, 12% good and 6% poor. The patient whose post-operative result was considered poor had a pre-existing spondylolisthesis and underwent a spinal fusion 4 months after the cyst was approached. The patient whose post-operative result was considered poor had a pre-existing spondylolisthesis and underwent a spinal fusion 4 months after the cyst was approached.

DISCUSSION

The MacNab criterion evaluates functional results in terms of pain and mobility after lumbar synovial cyst excision. The majority of patients had excellent and good results; those who had poor results underwent subsequent lumbar subsequent lumbar fusion with improvement in lumbar pain complaints^{7,8,9}. The use of minimally invasive techniques reduces post-operative infections and bleeding, but there have been some cases of intraoperative dural laceration and cyst recurrence^{6,7,8,9}.

Surgical management for the treatment of spinal synovial cysts (SSC) is recommended after conservative treatment has failed and can provide significant improvements in clinical symptoms. That said, the minimally invasive tubular approach to spinal surgery using a tubular retractor was originally described in 1997 for the treatment of lumbar disc herniation, however, this modality began to be employed in the treatment of synovial cysts in 1999. However, surgical methods for these lesions have evolved, and complete endoscopic surgery has become a trend^{8,10,11}.

Previous publications and studies have reported two different approaches to endoscopic surgery for SCL of the lumbar spine: interlaminar and transforaminal. The interlaminar approach is performed with the patient

positioned in the prone position with pelvic and thoracic rotation after general anesthesia, access is defined based on anatomical landmarks and a 0.8cm vertical incision is made. Surgery is performed through the intraendoscopic channel and once the synovial cyst has been detected, it is removed by puncture and disk forceps. In the transforaminal approach, the patient is positioned in the prone position and fentanyl is administered intravenously to provide analgesia. In this method, general anesthesia is avoided so that the patient feels pain when the nerve root is at risk of being damaged. The entry point into the skin is determined on the basis of intraoperative fluoroscopy and preoperative magnetic resonance imaging, which is reviewed very carefully so that no retroperitoneal organs are damaged during insertion of the endoscope, so the operation is performed through the intraoperative channel using alternating sets of instruments under full vision¹¹.

That said, with the interlaminar approach, the nerve and the cyst can be found at the same time. In order to remove the cyst, the nerve must be manipulated, so the patient needs to be under general anesthesia. However, when the transforaminal approach is performed, the patient is at less risk of nerve damage because the patient's experience of pain - which is possible due to the absence of general anesthesia - alerts the surgeon to the danger of nerve damage¹¹.

The use of minimally invasive techniques has several advantages in the management of synovial cysts, as it allows the preservation of the midline and contralateral structures, which can preserve stability better than open techniques. In addition, studies recognize that the surgical procedure using endoscopy brings an advantage in the areas of surgery, complications, trauma and rehabilitation, reducing the length of the incision, soft tissue trauma, blood loss and the rupture of ligament and bone structures^{10,11,12,13}.

However, despite the many advantages of this treatment, there are some concerns with this technique due to the increased chances of dural injury due to the adherent nature of the synovial cyst to the dura mater, recurrence of cysts and the need for reoperations. These adhesions of the cyst capsule to the dura mater are frequently observed

intraoperatively and can prevent complete removal of the lesion^{10,12}.

According to some studies, patients' operating times and hospital stays were shorter when minimally invasive procedures were used, increasing patient satisfaction and reducing the risk of hospital complications. In addition, other post-operative benefits are a reduction in back pain, leg pain and reticular pain. Therefore, it is important to note that each patient benefits from the effectiveness of pain relief, the short period of

hospitalization and the reduced recurrence rate of the cysts^{8,10,11,12}.

Conclusion

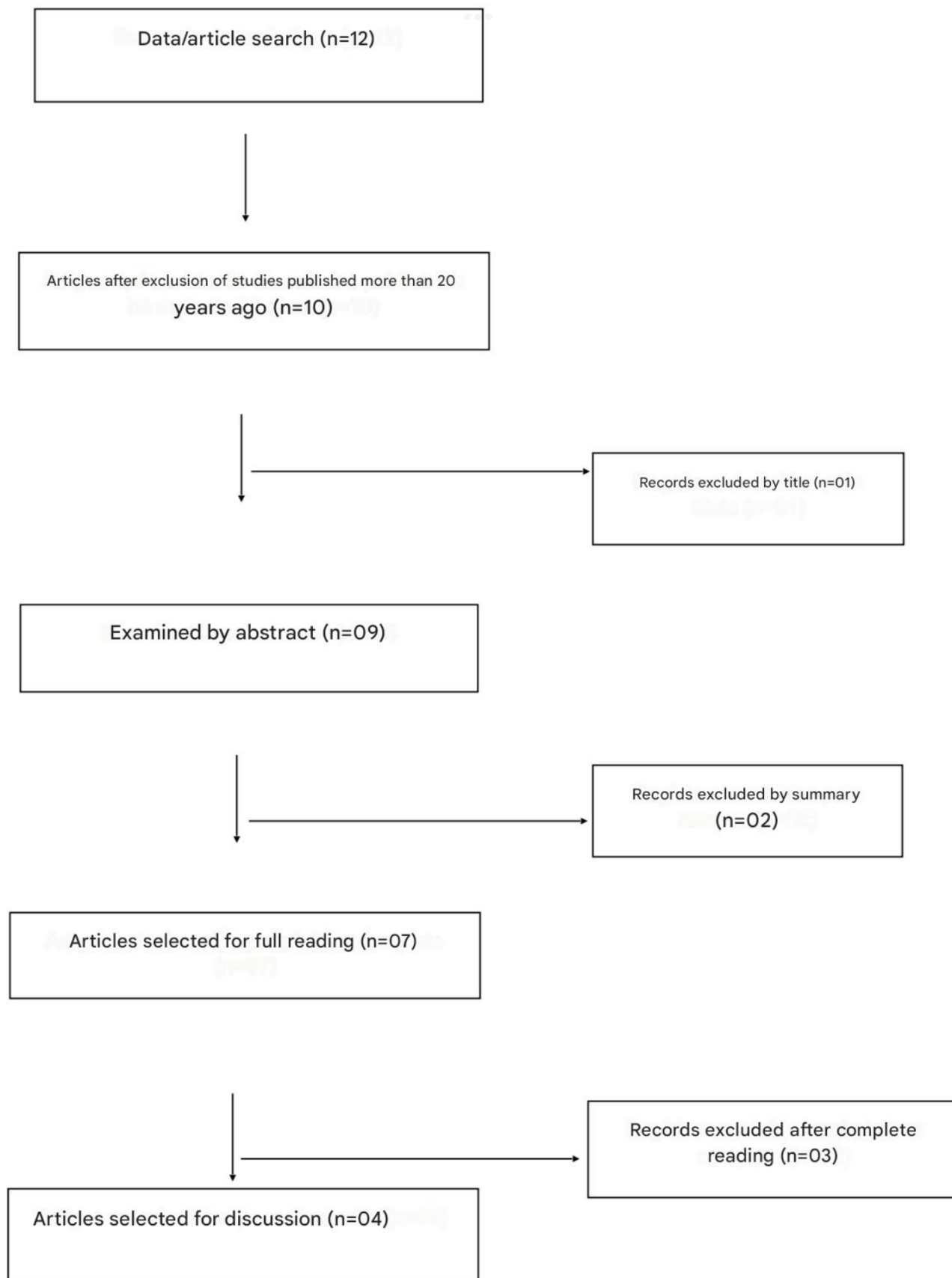
Synovial cysts can be effectively approached with a tubular retractor system in conjunction with an endoscope or microscope. The use of the retractor minimizes soft tissue trauma, incision length and blood loss. In addition, the rupture of ligament and bone structures is minimized with a unilateral approach, which is important in those patients where the synovial cyst is associated with spondylolisthesis, reducing the risk of progressive instability and the need for spinal fusion.

References

- [illegible]

- 10.1016/j.wneu.2020.05.166. Epub 2020 May 24. PMID: 32461174.
8. Birch BD, Aoun RJN, Elbert GA, Patel NP, Krishna C, Lyons MK. Minimally Invasive Tubular Resection of Lumbar Synovial Cysts: Report of 40 Consecutive Cases. *World Neurosurg.* 2016 Oct;94:188-196. doi: 10.1016/j.wneu.2016.06.125. Epub 2016 Jul 9. PMID: 27402437.
9. Sandhu FA, Santiago P, Fessler RG, Palmer S. Minimally invasive surgical treatment of lumbar synovial cysts. *Neurosurgery.* 2004 Jan;54(1):107-11; discussion 111-2. doi: 10.1227/01.neu.0000097269.79994.2f. PMID: 14683546.
10. Garg K, Kasliwal MK. Outcomes and complications following minimally invasive excision of synovial cysts of the lumbar spine: A systematic review and meta- analysis. *Clin Neurol Neurosurg.* 2021 Jul;206:106667. doi: 10.1016/j.clineuro.2021.106667. Epub 2021 May 4. PMID: 33984755.
11. Wu HH, Wang GC, Sun LW, Chang KS, Yang JS, Chu L, Chen CM. Symptomatic Lumbar Juxtafacet Cyst Treated by Full Endoscopic Surgery. *World Neurosurg.* 2019 Oct;130:e598-e604. doi: 10.1016/j.wneu.2019.06.168. Epub 2019 Jun 28. PMID: 31260849.
12. Vergara P, Akhunbay-Fudge CY, Kotter MR, Charles Laing RJ. Minimally Invasive Versus Open Surgery for Lumbar Synovial Cysts. *World Neurosurg.* 2017 Dec;108:555-559. doi: 10.1016/j.wneu.2017.09.039. Epub 2017 Sep 18. PMID: 28923427.
13. Chen Y, Yu P, Xu H, Li S, Wang Q, Wu C, Wang J, Ji F, Huang Q, Lan Q. Efficacy of minimally invasive tubular approaches for management of the lumbar spinal synovial cysts: a meta-analysis. *Eur J Med Res.* 2023 Nov 8;28(1):494. doi: 10.1186/s40001-023-01481-0. PMID: 37941083; PMCID.

Figure 1 - Studies selected according to the PRISMA methodology.



Source: Own authorship (2024).

Table 1. Results obtained by the selected studies.

Study	Approach	F/M patients	Results
Comp and col	Minimally invasive surgical technique, via interlaminar and transforaminal approaches	62/32	Inclusion criteria; Intraoperative findings; Immediate mobilization; Clinical results; Cyst location; Neurological deficits; Operative complications; Recurrence
Tacconi and col	Minimally invasive endoscopic surgical technique, via interlaminar and transforaminal approaches	35* Does not inform the value of each sex!	Symptoms; Cyst location; Average operative time; Immediate postoperative period; Immediate mobilization; Numerical pain rating scale (NPRS); MacNab criteria; Surgical complications; Recurrence
Birch and col	Minimally invasive microscopic resection with microscopic tubular retractor	27/13	Symptomatology; MacNab criteria; Average operative time; Blood loss; Intraoperative complications; Length of hospital stay.
Sandhu and col	Minimally invasive surgical technique with tubular retractor, microscope and endoscope	10/07	Cyst location; Symptoms; Average surgical procedure time; Average blood loss; MacNab criteria; Operative complications; Hospital discharge.

Figure 2- Results of MacNab's criteria after minimally invasive surgery to remove a lumbar synovial cyst

Study	Sample	Middle Ages	Corticosteroid injection
Tacconi and col	35 patients	51 years	Excellent 28.6% Good 48.6% More than 11.4%
Birch and col	40 patients	65 years	Excellent 70% Good 22.5% Regular 2,5% More than 5%
Sandhu and col	17 patients	64 years	Excellent 82% Good 12% More than 6%