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Review Article

Comparison Between Uniportal and Biportal Endoscopic Techniques in Spine Surgeries

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Abstract

Endoscopic spine surgery are minimally invasive alternatives to conventional open surgery for degenerative spinal diseases, actually two techniques are available. Uniportal full endoscopy (UFE) and Unilateral Biportal Endoscopy (UBE), the two techniques are used in spinal surgeries. Both methods aim to reduce tissue damage, shorten recovery times, and improve patient outcomes.

UFE involves a single portal through which both the visualization and instruments are introduced, typically offering reduced scarring.

On the other hand, UBE utilizes two portals on the same side of the body, one for visualization with endoscope, and the other for instruments insertion.

Studies comparing the two techniques highlight differences in surgical approaches and outcomes. UFE is generally considered more challenging due to the complexity of operating with a single portal, requiring advanced skill and precision. However, it offers superior cosmetic results with a smaller incision, potentially leading to less postoperative pain and quicker recovery, no differences in many studies.

UBE, while involving two incisions, less than 1 cm, due to the use of two portals, allows for better instrument maneuverability control and visualization, making it advantageous for more complex procedures. UBE also provides greater flexibility, more then UFE, during the surgical manipulation.

In terms of clinical outcomes, both techniques show comparable results about complications, recovery times, and postoperative pain.

The choice between UFE and UBE often depends on the surgeon's experience, the complexity of the procedure, and patient-specific factors.

Overall, both methods represent significant advancements in minimally invasive surgery, providing safer alternatives to traditional open procedures with distinct advantages and limitations.

Keywords : spine surgery ; minimal invasive;endoscopy; uniportal; biportal; degenerative diseases

Introduction

The Uniportal Full Endoscopy (UFE) and Unilateral Biportal Endoscopy (UBE) are advanced minimally invasive techniques that allow surgeons to perform procedures through small incisions, channels, one or two respectively.

In this manuscript we explain the use of both techniques, attempting to make an objective evaluation their respective advantages, disadvantages and limitations.

These techniques have their advantages and limitations, but with time and constant development the limitations are less.1

Globally, we can dived the endoscopic spine surgery in two main groups, one working channel and two working channels. In cases of multilevel pathologies to treated in the same surgery both techniques use multi channels. The materials in those thecniques are different, but the goal it's

the same, decompress the nerve root with a minimal invasive approach. Also both techniques could be associated with fusion process if necessary.

Both techniques present different approaches, in case of UFE offer two primary techniques: interlaminar and transforaminal, each with its own advantages for different pathologies.

In case of UBE, this thecnique use two approaches, the most common is interlaminar with uni or bilateral access. The other option is extraforaminal approach for nerve root compressions outside the medular canal, as in cases of foraminal or extraforaminal disc herniation.

Before the tricks and trucks of both endoscopic techniques it's important clarify, especially for all those professionals who are starting to contact with the spinal endoscopy, that since the emergence of the two major endoscopic techniques for spinal treatment, their names have changed. Many studies that refer to them by different names.

The uniportal technique over the years it has been called "full endoscopy", "microendoscopy" involves a single working channel, but the size is large enough to allow for multiple instruments to be used concurrently, and independent of the endoscope "one-hole split endoscopy" (OSE)

The biportal technique at the beginning named Biportal Endoscopic Spine Surgery (BESS), posteriorly Unilateral Biportal Endoscopy (UBE) or two-portal endoscopic spinal surgery.

A. Uniportal Endoscopy for Spine Surgeries:

Uniportal full spine endoscopy is an emerging technique in spinal surgery that leverages a minimally invasive approach to access the entire spine through a single incision, combining endoscopic technology with traditional surgical principles. It is a technique that is currently used in the 3 levels of the spine (cervical, thoracic, lumbar).

Is considered an advancement over previous spinal procedures due to its potential for less tissue disruption, faster recovery and reduced complications.

History and Development of Uniportal Full Spine Endoscopy:

1. Origins in Minimally Invasive Spine Surgery:

The development of minimally invasive spine surgery (MISS) dates back to the late 20th century, with a focus on reducing the invasiveness of traditional spinal procedures. Early approaches aimed to minimize muscle and tissue disruption while still providing effective treatment for spinal conditions.

The 1990s saw the introduction of endoscopic spinal surgery, particularly for lumbar discectomy. These techniques utilized small incisions and endoscopes to visualize the spine, facilitating procedures without the need for large incisions.

2. Advancements in Endoscopic Spine Surgery:

Over the next two decades, there were significant advancements in endoscopic equipment and techniques, particularly focusing on lumbar and cervical spine surgeries.

By the early 2000s, endoscopic spine surgeries began to be used for a variety of conditions, including spinal stenosis, herniated discs, and decompression procedures. Surgeons also started using percutaneous techniques for facet joint injections, biopsies, and other minimally invasive interventions.

3. The Emergence of Uniportal (Single-Incision) Spine Surgery:

In the mid-2010s, there was a shift toward uniportal or single-incision spine surgery, inspired by the principles of minimal access surgery. Surgeons aimed to reduce the number of incisions, focusing on improving patient outcomes through a single access point.

Early studies demonstrated that uniportal procedures allowed for faster recovery, reduced muscle disruption, and a decrease in post-operative pain.

4. General concepts in Uniportal Full Spine Endoscopy:

The concept of uniportal full spine endoscopy emerged as a way to address spinal conditions in the entire spine (cervical, thoracic, lumbar) through a single incision, using advanced endoscopic systems.

Surgeons began employing full spine endoscopy for spinal conditions such as disc herniation, spinal deformities, and stenosis. The use of high-definition cameras and specialized instruments made it possible to perform decompressions, discectomies, and even spinal fusions with minimal access.

5. Current Trends and Research:

Research on uniportal full spine endoscopy is ongoing, with a focus on understanding the benefits and challenges associated with this technique. Studies emphasize that the technique can lead to faster recovery times, reduced blood loss, and lower complication rates compared to traditional open spinal surgeries.

Some key studies in the literature that explore uniportal full spine endoscopy and minimally invasive techniques include those published in journals such as Spine, The Journal of Neurosurgery: Spine, and The European Spine Journal.

For instance, discussing innovations in endoscopic techniques for minimally invasive spine surgery and providing insights into their potential for future applications in complex spinal conditions.

Indications:

Uniportal endoscopy is increasingly being utilized for a range of spinal procedures, particularly for patients who would benefit from less invasive approaches. Common indications for UFE in spine surgery include:

1. Discectomy: removal of herniated disc material to alleviate pressure on spinal nerves, typically for patients with lumbar disc herniation.
2. Spinal Decompression: treatment of conditions like stenosis where there is narrowing of the spinal canal, leading to nerve compression.
3. Foraminotomy: opening of the intervertebral foramen to relieve nerve root compression, commonly used in cases of radiculopathy.
4. Spinal Fusion: in certain cases, UFE is used to perform minimally invasive fusion of vertebrae, which is less common but becoming more feasible due to advancements in technique and equipment.
5. Biopsy: removal of tissue samples for diagnostic purposes, particularly in cases where tumors or infections are suspected.
6. As UFE technology advances, its indications are expanding to include more complex procedures like lumbar fusions and spinal tumor resections, although these remain less common compared to simpler decompressive procedures.

Recommendations:

For successful implementation of uniportal endoscopy in spine surgery, several key recommendations should be followed:

1. Surgeon experience: surgeons must have specialized training and experience with endoscopic techniques. Given the complexity of the procedure, there is a steep learning curve.
2. Patient selection: ideal candidates for this technique are those with relatively straightforward spinal pathology, such as herniated discs, degenerative disc disease, or stenosis. Patients with extensive spinal deformities or complex pathologies may not be ideal candidates for UFE.
3. Appropriate equipment: the use of high-quality, specialized endoscopic instruments, including miniaturized cameras, tools, and access systems, is also crucial the patient position for the success of the procedure.
4. Preoperative imaging: detailed preoperative imaging such as MRI and CT scans are critical in planning the surgery and guiding the surgeon during the procedure. This point is important for all procedures and approaches. Prepare a planning before the surgery's is mandatory and can reduce the complications.

Advantages:

UFE offers several distinct advantages in spine surgery:

- Minimally invasive: the key advantage of this technique is its minimally invasive nature, as it requires only a single portal, reducing muscle and soft tissue dissection.
- Reduced recovery time: patients typically experience shorter hospital stays and faster recovery times compared to traditional open surgery. This is particularly beneficial for elderly patients or those with comorbidities.
- Less postoperative pain: due to the smaller incision and reduced soft tissue disruption, patients generally report less pain postoperatively, leading to reduced reliance on pain medications.
- Minimal scarring: the single incision is often located in a less noticeable area, leading to better cosmetic results compared to traditional open surgeries.
- Enhanced visualization and precision: modern endoscopic technology offers high-definition visualization, enabling surgeons to perform delicate procedures with greater accuracy.
- Lower risk of complications: lower incidence of complications such as infections, blood loss, and nerve damage due to the smaller incision and reduced tissue trauma.

Disadvantages:

• Limited instrument mobility: using only one portal for both visualization and operation can limit the mobility of instruments.

• Challenges in ergonomics: surgeons might struggle with optimal angles and views, especially in complex surgeries.

• Skill requirement: a high level of expertise and experience is required for the surgeon to achieve optimal outcomes.

• Visualization depth: limited depth of view compared to multi-portal techniques, which could affect visibility of deeper structures.

• Limited for complex cases: in more intricate procedures, UE might not provide the necessary maneuverability for complex dissection.

Limitations:

• Technical demands: requires specialized equipment and proficiency.

• Learning curve: Surgeons need specific training to effectively use uniportal techniques, as improper technique may compromise surgical outcomes.

B. Unilateral Biportal Endoscopy for Spine Surgeries:

Unilateral Biportal Endoscopy (UBE) has emerged as another minimally invasive technique for various types of spinal disease.2

By adhering to these recommendations, surgeons can leverage UBE to achieve favorable clinical outcomes, including significant improvements in pain relief and functional recovery.

UBE is a useful technique where two small incisions are made, both, on the same side (unilateral) of the body. Permit unilateral or bilateral decompression for the treatment of spinal canal stenosis, foraminal stenosis, ossification of the ligament flavum, low-grade spondylolisthesis, and adjacent segment degeneration.

This floating surgical technique has several advantages over conventional spine surgery, including less tissue damage, less blood loss, shorter hospital stays, and faster recovery.

In addition, the early clinical outcomes are favorable, and present a low rate of complications, such as dura tearing, nerve traction injury, and postoperative hematoma.

It has been successfully used in spinal surgery, particularly for lumbar discectomy and other decompressive surgeries. Currently, this technique is expanding and is used at all three levels (cervical, thoracic, lumbar) of the spine and in different pathologies, especially in degenerative spinal pathologies.

In UBE is essential the patient positioning, portals creation, endoscopic visualization, decompression, and fusion when recommended associated with the decompression.

Recommendations:

1. Patient positioning and surgical approach

Proper patient positioning is crucial for optimal surgical access and visualization. The interlaminar approach is commonly used for lumbar disc herniation, central or lateral recess stenoses, in cases of bilateral stenosis this technique permit a contralateral approach.3

The paraspinal/extraforaminal approach is effective for foraminal or specially extraforaminal disc herniations or foraminal stenosis, particularly at the L5–S1 level.4

2. Minimizing bone resection

UBE allows for less bone resection compared to traditional methods, reducing the risk of complications such as pars fractures. This approach enhances visualization and preserves spinal stability. In patients with lumbar disc herniation, treated with UBE interlaminar approach its mandatory don't resect bone except if it's really necessary. As in microdiscectomy respect the facet joint it's recommended for prevent instability after the surgery and during the follow-up period.

3. Enhanced visualization and precision

The dual-portal system of UBE provides superior illumination and magnification, facilitating precise decompression and minimizing soft tissue damage. Continuous irrigation helps maintain a clear surgical field and reduces the risk of infection. The high range of movements it's a important advantage of this technique when compared with uniportal or with microscopic surgeries.

4. Training and certification

Surgeons should undergo comprehensive training to master UBE techniques. A tutor that help to progress in the technique, anatomic study, and select the most "easy cases" at the beginning (example, lumbar disc herniation L4-L5 or L5-S1 in a fit patient). For simulate the real surgeries the participations in cadaveric courses or more recently technical box with hyper-realistic simulation systems and mixed reality can accelerating skill development.

The European Society of Unilateral Biportal Endoscopy (ESUBE) offers a certification program, requiring a minimum of 100 successful UBE cases, including lumbar disc herniations and spinal stenosis.

Advantages:

- Visualization and mobility: the use of two separate portals for visualization and instrument manipulation provides better depth perception and maneuverability.
- Better ergonomics: surgeons have more flexibility with instruments and with the endoscope, permit more easily reposition them for better angles of operation. If necessary, we can use 30º endoscope, especially for bilateral decompressions.
- The majority of the surgical instruments are the same for that in cases released under microscopic approaches.5
- Increased surgical precision: Because the surgeon has separate portals for visualization and action, they can more precisely target the pathology.
- Reduced complications: the technique can reduce the risk of nerve damage due to improved precision and more controlled instrument manipulation.
- Minimally invasive: like UFE, it is a minimally invasive procedure, resulting in less pain, quicker recovery, and smaller scars.

Disadvantages:

- Requires two incisions: while small, two incisions might result in slightly more tissue disruption compared to UFE.6
- Possible postoperative pain: the second portal might cause more postoperative pain than the single portal of UE, although the pain is generally mild.
- Potential for scar formation: the second incision, though small, could lead to additional scarring.
- Higher complexity: the technique may be more complex for surgeons who are not well-trained or experienced with dual-portal techniques. Coordination of the movements it's important and mandatory to do the procedure easy and safely.
- Learning curve: Surgeons need specialized training to adapt to the biportal technique, especially for complex cases. During this period the patient selection is mandatory and also including a tutor for help you knowledge and progression in the technique.

Limitations:

- Risk of complications: the use of two incisions can increase the risk of complications such as wound infections or hematomas, although these are still rare. For prevent the hematomas we recommend a lumbar drainage, 12-24h after the surgery.
- Requires some special equipment: surgeons may need specialized instruments, including high-definition cameras and articulated tools, to ensure success.
- Not ideal for all patients: May not be suitable for patients with certain anatomical limitations or for very complex cases that require more than two portals.

Personally, I believe that UBE are a great and positive development in minimal invasive spine surgeries and particularly in endoscopic surgery. I consider it to be a a natural evolution of UFE, and although it may seem like a more invasive technique than uniportal surgery, to date, there's no study demonstrating a statistically significant difference at this level. We must take into account all the advantages and evolution that this technique presents.

Recent relevant publications of each of the techniques and comparison between them or older techniques:

• UFE relevants manuscripts:

The first reference that we use related with this technique is a Meta-analysis with 6 RCTs involving a total of 646 patients. The study compared microscopic and full-endoscopic spinal decompression. The authors of this meta-analysis concluded, with statistically significant results of P value that Full-

endoscopic spinal decompression is a better treatment for lumbar spinal stenosis with more effective leg pain improvement, shorter operative time, and fewer complications than microscopic decompression. This study is supported by a statistical power of 98.57%, 99.97%, and 81.88%, respectively.7

Another study described that Uniportal endoscopic technique are growing in popularity and they are safe and effective. And also allow for rapid functional recovery with reduced morbidity compared to open and other MIS techniques.While there is increasing interest in endoscopic lumbar decompression, widespread adoption has been slowed in part due to the steep learning curve and lack of exposure in many formalized training programs. Finally, they concluded that endoscopic interlaminar and transforaminal techniques are safe and effective with at least non-inferior long-term outcomes and faster recovery compared to traditional open and MIS counterparts.8

Another comprehensive literature search across multiple databases identified a total of 418 records. After a screening process for eligibility, finally the meta-analyses incorporated 10 of the 14 RCTs and 25 of the 30 cohort studies. The inclusion criterion, used, ensured a comprehensive aggregation of data, providing a robust foundation for the analysis. Further exploration was dedicated to identifying case reports detailing complications, resulting in the discovery of three pertinent articles. In addition to the case reports, our search also unveiled two review articles addressing complications, which included descriptions of atypical complications. This further enriched the understanding of the diverse range of adverse outcomes associated with this technique.9

The results of the meta-analyses for complication-related insights, all studies conducted a systematic examination of complications. 8 of these studies calculated the incidence rates of complications, with only 1 making a distinction between the transforaminal and interlaminar approaches. 5 meta-analyses categorized complications by type, enabling us to identify the most reported complications across the studies.9

The comparative analysis of complication rates among different lumbar discectomy techniques—specifically transforaminal endoscopic lumbar discectomy (TELD), interlaminar endoscopic lumbar discectomy (IELD),

and microscopic lumbar discectomy (MLD), with percutaneous endoscopic lumbar discectomy (PELD) encompassing both TELD and IELD techniques as one group—revealed distinct statistical significance in safety and complication rates.9

In the cases of TELD, notably, was found to be significantly safer than IELD, as indicated by a $p < 0.0001$. In contrast, no significant difference in safety was observed between TELD and MLD, with a p value of 0.18, suggesting that these techniques have comparable safety profiles. The comparison between IELD and MLD resulted in a p value of 0.04, indicating that MLD is statistically safer than IELD.9

Furthermore, when comparing both endoscopic approaches as a single group under PELD, it demonstrated a higher safety profile compared to MLD, with a p value of 0.0092, underlining PELD as the safer option among the techniques evaluated. This inclusion of both TELD and IELD under the umbrella of PELD highlights the overall safety benefits of endoscopic approaches when considering the risk of complications.9 This study described also the uncommon complications documented within the scope of endoscopic spine surgery. The authors included in this section cases of hematoma in the iliopsoas, incorrect positioning of the endoscopic access system, instrument entrapment in the working channel, segmental artery injury, pneumothorax, pseudomeningocele with nerve root entrapment, discal pseudocyst, and arachnoid cyst.9

Only 3 meta-analyses indicated a significant difference in the frequency of complications favoring endoscopy, while the remaining studies did not demonstrate statistically significant differences.10,11,12

Another meta-analysis that included a total of 9 articles with 522 patients in the UPFE (Uniportal Full Endoscopy) group and 367 patients in the MIS (minimal invase surgery) group were included. The authors concluded that the UPFE decompression is associated with shorter hospital stay time and lower intraoperative blood loss and wound-related complications compared with MIS decompression for treatment of lumbar spinal stenosis patients. The postoperative clinical scores, satisfaction rate, operation time, complication rates for dural injury, epidural hematoma, and postoperative transient dysesthesia and weakness did not differ significantly between two groups.13

Other recent meta-analysis with 6 RCTs including 646 patients met selection criteria. The authors concluded with P vale < 0,05 that full-endoscopic spinal decompression (UPFE) is a better treatment for lumbar spinal stenosis with more effective leg pain improvement, shorter operative time, and fewer complications than microscopic decompression. The results was supported by a statistical power of 98.57%, 99.97%, and 81.88%, respectively.14

We included in this section other reference about 4 retrospective observational and 1 prospective observational study, with a total of 423 patients (183 Endo-LIF and 241 MIS-TLIF). The authors reported that the pooled data analysis revealed low heterogeneity between the studies evaluated. For the baseline characteristics including age and sex they don't found different between the two groups. Respected to the operation time was significantly longer in Endo-LIF group with mean difference of 23.220 minutes 95% confidence interval, 10.669-35.771; p=0.001. The authors described that relative to MIS-TLIF, immediate outcomes were favorable in Endo-LIF in terms of blood loss and immediate VAS back pain. On the other hand, no statistically significant group difference in complication rate, hospital stay, and pseudoarthrosis rate were found. Actually Endo-LIF present a challenge, longer operation time which means a difficult learning curve and limited surgical indication.15

To increase the statistical power of the results of this studies it will be necessary larger-scale, well-designed study with long-term follow-up and randomized controlled trials are needed to confirm and update the results of this systematic review.

• Studies that release the comparison of both techniques:

The first reference that we present in this section is a Meta-Analysis that included a total of 7 studies, with 198 patients in a uniportal endoscopy group and 185 patients in a biportal endoscopy group. The results demonstrated that the biportal endoscopy group experienced less intraoperative estimated blood loss, with statistically significant results ($p = 0.01$). The uniportal endoscopy group displayed significantly better recovery results in Visual Analog Scale (VAS) assessments of the back within 3 days of surgery ($p = 0.04$).

However, no significant differences in operation time, length of hospital stay, complication rates, Oswestry Disability Index (ODI) (within 3 months), ODI (last follow-up), VAS for back (within 3 months), VAS for back (last follow-up), and VAS for leg (within 3 days, within 3 months, last follow-up) were identified between the two groups. The study concluded that both surgical techniques are safe and effective.16

The second meta-analysis presented in this section included 9 articles, showed that UPFE was associated with shorter operative time, less intraoperative bleeding and shorter hospital stay, whereas UBE was associated with a greater increase in postoperative dural sac area. Postoperative visual analog scale (VAS) scores, Oswestry Disability Index (ODI) scores, satisfaction rates, complications, and mean number of fluoroscopic views were not dramatically dissimilar in UBE and UPFE for Lumbar degenerative disease (LDD). In the Lumbar disc herniation (LDH) subgroup, postoperative hospital stay and operative time were significantly lower in the UPFE group than in the UBE group.17

Other recent meta-analysis with 513 patients across 5 studies, comprising 246 patients in the one-hole split endoscopy (OSE) group and 267 patients in the Unilateral biportal Endoscopy (UBE) group. The findings of this meta-analysis indicated that the incision length in the OSE group was significantly shorter than that in the UBE group with a value $P = 0.001$. However, no statistically significant differences were observed between the two groups regarding operative duration, intraoperative blood loss, length of hospital stay, Visual Analog Scale (VAS) scores at various postoperative time points, Oswestry Disability Index (ODI) values at various postoperative time points, rates of excellent and good outcomes, sagittal translation (ST), range of motion (ROM), and complication rates. The authors of this study concluded that both techniques are safe and effective for the management of Lumbar degenerative disease (LDD), demonstrating comparable treatment outcomes. However, OSE techniques offer the advantages of smaller surgical incisions and potentially reduced trauma.18

We included also a recent meta-analysis, the authors after a preliminary selection of 388 studies from electronic databases applied the full inclusion criteria. Finally, 3 studies were included, with a total of 184 patients from 3 unique studies. Meta-analysis of visual analog scale score for low back pain and leg pain showed no significant difference at the final follow-up ($P = 0.51$ and $P = 0.66$). Oswestry disability index (ODI) score after biportal surgery was lower than uniportal surgery with a value $P = 0.02$. The mean operation time was similar in both groups with a $P = 0.53$. The UBE group was associated with a shorter length of hospital stay ($P = 0.05$). Complications were similar in both groups ($P = 0.89$). The authors of this meta-analysis concluded that with the current evidence shows no significant differences in most clinical outcomes between uniportal and biportal surgery. UBE may present in this study a better ODI score at the end of the follow-up compared to the uniportal group.19

The last study present in this section it's also a recent meta-analysis with 5 studies including a total of 314 patients after applying the determined inclusion criteria. The UBE-TLIF group comprised 154 patients, and the Endo-TLIF group comprised 160 patients. In this meta-analysis the group of UBE-TLIF was superior to Endo-TLIF in terms of the operative time and fusion rate. There were no significant differences in the intraoperative blood loss, hospital length of stay, complication rate, visual analogue scale scores, or Oswestry disability index between the two groups.20

• UBE relevants manuscripts:

This recent meta-analysis with a total of 5 studies included in the analysis, providing 6 datasets to elucidate the UBE learning curve. 3 of the 5 studies included analyzed the learning curves using the Cumulative Sum method and identified cutoff points. 1 study plotted learning curves and determined cutoff points based on surgical time analysis, while the remaining one study (providing two datasets) plotted learning curves using the phased analysis method. The mean value of the cutoff point in terms of the number of cases required to reach proficiency in time to surgery was calculated at 37.5 cases, with a range spanning from 14 to 58 cases. The authors present a statistically significant difference in time to surgery between the late group and the early group, with the late group demonstrating a significantly reduced time to surgery ($P < 0.0001$). Additionally, the determined cutoff points exhibited significant variations when applied to patient outcome parameters, including postoperative hospitalization, postoperative drainage, and surgical complications ($P < 0.05$). In conclusion the analysis indicates that UBE surgery's learning curve is associated with surgical time, the limited focus on this metric and potential discrepancies in cutoff point determination highlight the need for a more comprehensive understanding.21

Other recent meta-analysis that selected 9 studies, included a total of 823 patients with a single Lumbar Spinal Stenosis (LSS) segment. All the studies included comparing UBE clinical outcomes and micro-endoscopic unilateral laminotomy for bilateral decompression (M-ULBD). The meta-analysis revealed that the UBE group had better VAS-leg and back scores in the first week postoperatively with statistically significant p value for both parameters, 1st month postoperatively $p = 0.01$; total $p = 0.005$, at the 6th month postoperatively $p = 0.002$; total $p = 0.005$, and UBE group also performed better in ODI score at 1st month postoperatively with $p < 0.00001$. There was no significant difference in VAS-leg and -back scores between both groups at the 3rd and 12th month postoperatively, and ODI scores did not significantly differ between both groups at 3, 6, and 12 months postoperatively all with a p value not statistically significant.22

In this systematic review and meta-analysis, a total of 7 studies were included. The authors concluded that the intraoperative bleeding was higher in the control group than in the UBE group with a P=0.14. The improvement of ODI score in the UBE group was significantly better with a P=0.17. There was no statistical heterogeneity in terms of postoperative complications with a P=1.00. The complication rate in the UBE group was lower with a P=1.00. In the postoperative period the VAS improvement in UBE group was significantly better with a P=0.11. The length of hospital stay in UBE group was shorter with a P<0.05. The t value of hospitalization length, VAS, intraoperative bleeding, ODI and complications were 0.000-0.081, v was 20-26, all P>0.05, suggesting that this conclusion was stable.23

Another recent meta-analysis that compared Unilateral biportal endoscopy and Microdiscectomy (MD) included 7 studies. The results showed that the operation time of UBE group was shorter than that of MD with a P= 0,02. Compared with MD, the patients' back pain was slighter on the 1st day, 1–2 months and 6 months after UBE. During the long-term follow-up, there was no significant difference in back pain between both groups. There was no significant difference in lower limb visual analogue score (VAS) score between UBE decompression and MD with P= 0.412. The results were statistically significant for the C-reactive protein (CRP) level of UBE was lower than that of MD P= 0,02. There was no significant difference in other clinical effects between the 2 groups.24

In this systematic review and meta-analysis, they began by preliminary screening 239 studies from electronic databases and, after applying the inclusion criteria, found 16 studies eligible for inclusion. These studies included a total of 1488 patients, of which 653 were in the UBE group, 570 were in the microendoscopic discectomy group, 153 were in the percutaneous endoscopic lumbar discectomy group, and 70 were in the posterior lumbar interbody fusion group. UBE was superior to microendoscopic discectomy in terms of daily Visual Analog Scale (VAS) back pain scores ($p<0.00001$). No difference was found between UBE and microendoscopic discectomy regarding 1-day VAS leg pain scores, long-term VAS back pain scores, long-term VAS leg pain scores, Oswestry Disability Index scores or complications. Pooled analysis indicated that UBE was similar to percutaneous endoscopic lumbar discectomy regarding 1-day VAS back pain scores, 1-day VAS leg pain scores, long-term VAS back pain scores, long-term VAS leg pain scores, Oswestry Disability Index scores and complications. One study reported no difference between UBE and posterior lumbar interbody fusion regarding long-term VAS back pain, long-term VAS leg pain, or Oswestry Disability Index scores. In resume of this meta-analysis the UBE technique is superior to microendoscopic discectomy to relieve back pain 1 day postoperatively. However, these two procedures are similar regarding 1-day leg pain relief, long-term effects, and safety. UBE and percutaneous endoscopic lumbar discectomy are similar regarding 1-day pain relief, long-term effects and safety.25

A meta-Analysis included a total of 10 papers, including 2 randomized controlled trials. In this study was included 710 patients, 348 in the UBE-LIF group and 362 in the Endo-LIF group. The results showed that the UBE-LIF group was superior to the Endo-LIF group in terms of operative time and rate of progress of surgical time for beginners. In contrast, the Endo-LIF group was superior to the UBE-LIF group in terms of hospitalization time, hidden blood loss, and TBL. They found no statistical differences between the two procedures for intraoperative bleeding, postoperative drainage, visual analog score for low back pain, Oswestry Disability Index, complications, fusion rates, and modified MacNab score excellence rates. The authors of this study concluded that postoperative pain and safety were comparable between the two endoscopic procedures. They also mention that the UBE-LIF procedure was shorter, while the Endo-LIF had less TBL and a shorter recovery time.26

Another meta-analysis included 6 high-quality case–control trials (CCTs) involving 621 patients. In this study the clinical outcomes assessment showed no statistical differences in complication rates, fusion rates, leg pain VAS scores, or ODI scores. They described that after UBE-TLIF, VAS scores for low back pain improved significantly, with less intraoperative blood loss and a shorter hospital stay. However, UBE-TLIF required a longer procedure. Even with the various limitations observed in the study as a lack of sufficient high quality randomized controlled trials (RCTs), the results of this meta-analysis suggest that UBE-TLIF is more effective than open surgery in terms of length of stay, blood loss reduction during surgery, and improved low back pain after surgery.27

Features	Uniportal Full Endoscopy (UFE)	Unilateral Bilateral Endoscopy (UBE)
Number of Incisions	1	2
Portal Usage	One portal for both viewing and operation	Two portals for viewing and operation
Cosmesis (Scarring)	Better (only one incision)	Slightly more scarring due to two incisions
Postoperative Recovery	Faster due to less tissue disruption	Slightly longer recovery time than UFE
Ergonomics	Can be challenging due to limited angles	Better ergonomics with two portals
Complexity of Surgery	Best for simpler, less complex procedures	Suitable for more complex procedures
Learning Curve	Steeper, due to single-port technique	Steeper due to need for precision with dual portals
Surgeon Experience	Requires significant training	Requires advanced skill in spine surgeries, but offers better maneuverability
Cost	Fewer tools needed, exclusive for one surgery	Use common materials

Table 1: Comparison Summary of both endoscopic thecniques:

Conclusion:

Uniportal and biportal spine endoscopy techniques are a minimally invasive procedures that in recent years, both techniques continue to gain recognition for its potential to improve outcomes and they are safe. They presented good clinical application prospects and efficacy, with many studies reported no statistical differences in the incidence of postoperative complications between the thecniques.

The endoscopic spine surgeons can learn either method according to the surgeon's preference and the clinical situation.

The choice between UFE and UBE often depends on the surgeon's experience, the complexity of the procedure, patient-specific factors, or available conditions.

Nevertheless, for both thecniques the evidence will be supplemented in the future by more and better quality multicenter randomized controlled trials.

Part of present and in the near future, the combination of UFE and UBE techniques with Neuronavigation, intelligent medical and surgical robotics technology is expected to promote the further development of spinal surgery.

Further technical optimization and large-scale clinical research are still needed to ensure the safety and effectiveness.

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Conflict of interest:

Not applicable.

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