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Functional outcome of discectomy (endoscopic vs open) for single level lumbar disc herniation

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ABSTRACT

Background: Lumbar disc herniation is a major cause of low back pain and radiculopathy in the working population. Open discectomy has been the gold standard surgical approach, but with advances in minimally invasive techniques, endoscopic discectomy is increasingly being adopted. This study aimed to compare the functional outcomes of endoscopic and open discectomy in patients with single level lumbar disc herniation.
Methods: A prospective comparative study was conducted on patients with clinically and MRI-confirmed single level lumbar disc herniation refractory to conservative management. Patients were allocated to two groups: Group A underwent conventional open discectomy, and Group B underwent endoscopic discectomy. Outcomes were assessed using the Visual Analog Scale (VAS) for pain and the Oswestry Disability Index (ODI). Patients were followed at 1 month, 3 months and 6 months. Statistical analysis was performed to compare intergroup differences.
Results: A total of 30 patients were enrolled, with no significant difference in baseline demographics. Both groups showed statistically significant improvement in ODI scores at all follow-up points ($p<0.05$). Endoscopic discectomy resulted in shorter hospital stay, less blood loss, and earlier return to work compared with open discectomy. However, there was not much significant difference inn VAS scores ($p>0.05$).
Conclusions: Both open and endoscopic discectomy provide effective pain relief and functional improvement in single level lumbar disc herniation. Endoscopic discectomy, however, offers advantages of minimal invasiveness, faster recovery, and reduced hospital stay, supporting its role as a favorable alternative to conventional open discectomy.

Keywords: Lumbar disc herniation, Open discectomy, Endoscopic discectomy, Functional outcome, VAS, ODI

INTRODUCTION

Lumbar disc herniation is a common cause of low back pain and radiculopathy, significantly affecting the working-age population and contributing to substantial socioeconomic burden.[2,3] It most frequently occurs at the L4-L5 and L5-S1 levels and is associated with symptoms such as radiating leg pain, numbness, and functional limitation.[1] Initial management of lumbar disc herniation is usually conservative, including analgesics, physiotherapy, and lifestyle modifications. However, patients who do not respond to conservative treatment or develop persistent or progressive neurological symptoms may require surgical intervention. Open discectomy has long been considered the standard surgical procedure, offering reliable decompression and good clinical outcomes. In recent years, minimally invasive techniques such as endoscopic discectomy have gained popularity due to advantages like reduced tissue trauma, shorter hospital stay, and faster recovery. Despite these advantages, there remains ongoing debate regarding the comparative effectiveness of endoscopic versus open discectomy in terms of pain relief and functional recovery. The objective of this study was to compare the functional outcomes of endoscopic and open discectomy in patients with single-level lumbar disc herniation using the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) over a 6-month follow-up period.

METHODS

The study was initiated after getting approval from the institutional ethics committee. (Reference No-IGGMC/Pharm/BORS/2050-51/2024) Confidentiality and anonymity of patient information were maintained during and after the study. This prospective cohort study was conducted in the Department of Orthopaedics at Indira Gandhi Government Medical College and Mayo Hospital, Nagpur from August 2023 to February 2025.

Study design

This Prospective Comparative Study was conducted in the OPD and teaching Hospital of a Tertiary Care Centre. A convenience sampling method was used. A total of 30 patients who met the inclusion criteria and presented during the study period (August 2023 to February 2025) were included in the study.

The study design is as follows:

A detailed preoperative evaluation is carried out for all patients. This includes obtaining a comprehensive history regarding age, gender, occupation, and any associated medical illnesses. A thorough clinical examination of the spine and lower limbs is performed, along with a general physical examination to assess the patient's overall condition, vital parameters, and the presence of any life-threatening systemic illnesses. Preoperative analgesics are administered as required. Radiological investigations include X-ray of the lumbosacral spine in anteroposterior and lateral views, flexion and extension views of the lumbosacral spine, and magnetic resonance imaging (MRI) of the lumbosacral spine with whole-spine screening. Routine laboratory investigations comprise complete blood count (CBC), urine routine examination, random blood sugar, kidney function tests (KFT), bleeding time, clotting time, coagulation profile, and liver function tests (LFT). Preoperative fitness clearance is obtained from both the physician and the anesthetist. Patients undergo either open discectomy or endoscopic discectomy, performed by the same team of experienced spine surgeons. The choice of surgical modality is determined by the operating surgeon based on clinical indications and surgical expertise. Postoperatively, patients are followed up at 1 month, 3 months, and 6 months. During these follow-up visits, the primary outcome measure, namely self-reported leg pain, is assessed using a 0-10 Visual Analogue Scale (VAS). Secondary outcome measures include complications, reoperations, and self-reported functional status, which is evaluated using the Oswestry Disability Index (ODI).

Study period

The study was conducted for a period of 18 months on patients with low back ache with lower limb radiculopathy attending orthopaedics OPD in tertiary care and teaching hospital.

Study criteria

The patients were enrolled depending upon the following criteria:

Inclusion criteria

The study includes patients aged between 18 and 75 years with a diagnosis of single-level unilateral lumbar disc herniation presenting with radicular symptoms. Only patients with non-traumatic pathology are considered eligible for inclusion. Patients must have no associated neurological deficits, bowel or bladder involvement, and should be free from any postural spinal deformities. These criteria are used to ensure a homogeneous study population and to minimize confounding factors that may influence surgical outcomes.

Exclusion criteria

Patients younger than 18 years or older than 75 years are excluded from the study. Individuals with multi-level lumbar disc herniation, absence of radicular symptoms, or traumatic lumbar disc pathology are also excluded. Furthermore, patients presenting with neurological deficits, bowel or bladder involvement, or postural spinal deformities are not considered eligible for inclusion in the study. These exclusion criteria are applied to ensure uniformity of the study population and to avoid factors that may affect the assessment of surgical outcomes.

Data collection

The patients attending the Orthopaedics OPD in a tertiary care hospital, with complaints of low back ache with lower limb radiculopathy were selected. Initially radiographs of lumbar spine were done and then MRI of lumbar spine with whole spine screening was done. Those patients who were diagnosed with lumbar PIVD and who fulfilled the inclusion criteria were taken up for the study. Patients were admitted on OPD basis and then they underwent routine investigations. Patients underwent surgery by either of the two modalities- endoscopic discectomy or open discectomy. They were discharged on Post Op Day 3 after a wound check dress. At 1 month, 3 months and 6 months post operative, the patients were followed up and were given a questionnaire which included Visual Analogue Scale for leg pain (Score of 0-10) and Oswestry Disability Index (which mainly identified self-reported functional status). Oswestry Disability Index is made up of 10 questions, scored from 0 to 5 (minimum to maximum). The point total from each section is summed, divided by the total points possible of all sections answered, and multiplied by 100 to create a percentage disability from 0-100%, with a lower percentage indicating less disability. VAS score and percentage disability as calculated from Oswestry Disability Index was identified for each patient, and then compared between the two groups- those undergoing endoscopic discectomy and those undergoing

open discectomy. Few cases MRI of a patient who underwent Open Discectomy- 24-year-old L4-L5 PIVD.

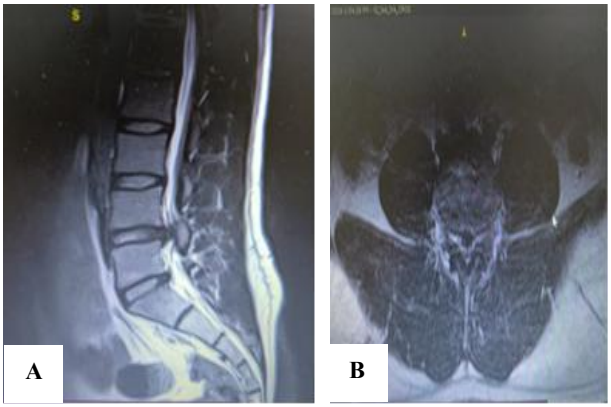

Figure 1: MRI of a patient who underwent open discectomy-24-year-old l4-l5 PIVD: (A) sagittal view and (B) axial view.

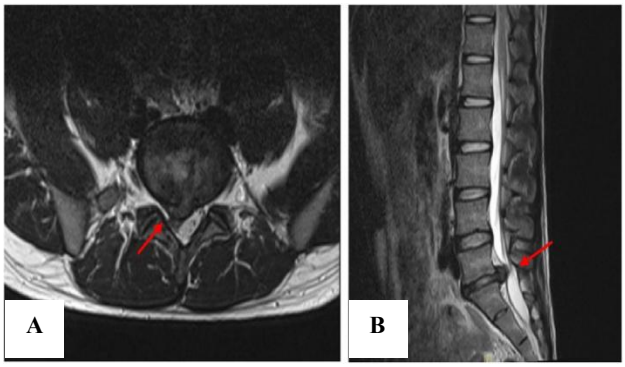

Figure 2: MRI of a patient who underwent endoscopic discectomy-47-year-old female L5-S1 PIVD: (A) axial view and (B) sagittal view.

RESULTS

VAS and ODI scores of patients who underwent open and endoscopic discectomy are compared at 1,3 and 6 months post operative. Statistical analysis was performed using SPSS version XX (IBM Corp., Armonk, NY). Continuous variables were expressed as mean±standard deviation. Intergroup comparisons were performed using Student's t-test or Mann–Whitney U test as appropriate. A p value of<0.05 was considered statistically significant.

Interpretation

Analysis of postoperative outcomes revealed that patients who underwent endoscopic discectomy consistently reported lower Visual Analogue Scale (VAS) pain scores compared to those who underwent open discectomy.

However, these differences did not reach statistical significance at any follow-up interval (p>0.05), although the difference at 1 month was borderline significant (p=0.0537).

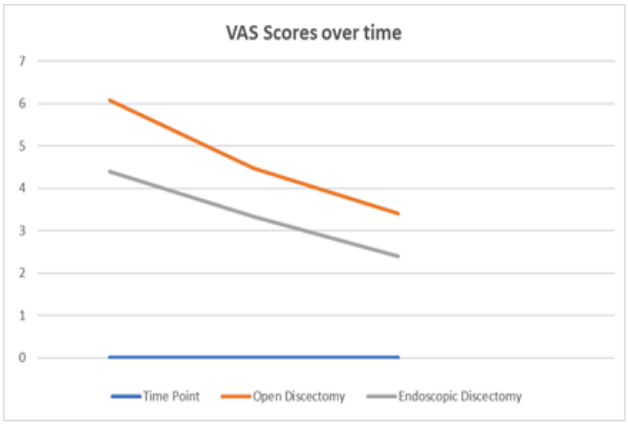

Figure 3: VAS scores over time.

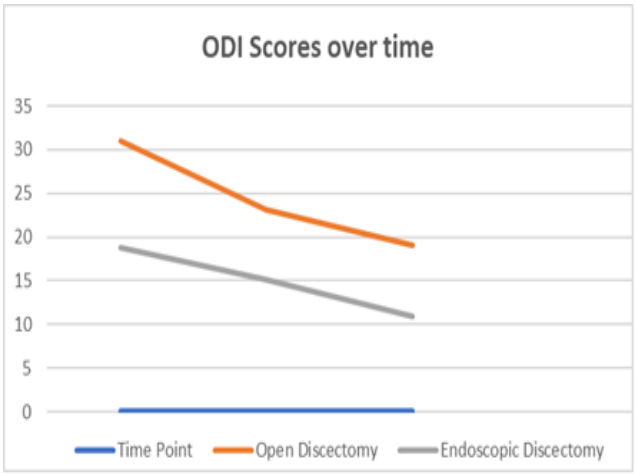

Figure 4: ODI scores over time.

In contrast, assessment of functional outcomes using the Oswestry Disability Index (ODI) demonstrated significantly better results in the endoscopic discectomy group at all follow-up periods. The endoscopic group showed lower ODI scores at 1 month (p=0.0005), 3 months (p=0.0229), and 6 months (p=0.0152), indicating superior postoperative functional recovery compared to the open discectomy group.

Complications

One patient in each group, open discectomy group and endoscopic discectomy group suffered from post operative complications and required another surgery. One 38-year-old female, a case of L4-L5 PIVD underwent open discectomy.

But even after 6 months post operative, she was not satisfied with the results. Her pain was the same, indeed had increased post surgery. So, we did a repeat MRI of this patient, and found that she was operated at the wrong level.

This patient lost to follow up after 6 months and probably opted for alternative forms of medicine for treatment.

Table 1: Summary of the VAS and ODI scores (mean scores).

Time point	Open VAS	Endoscopic VAS	Open ODI	Endoscopic ODI
1 month	6.07	4.40	31.00	18.73
3 month	4.47	3.33	23.07	15.07
6 month	3.40	2.40	19.13	10.87

A p value of <0.05 was considered statistically significant.

Table 2: Comparison table.

Measure	Open discectomy (mean±SD)	Endoscopic discectomy (mean±SD)	Test used	P value
VAS 1 month	6.07±2.81	4.40±1.18	Mann-Whitney U	0.0537
VAS 3 month	4.47±2.56	3.33±1.95	Mann-Whitney U	0.1435
VAS 6 month	3.40±2.69	2.40±2.16	Mann-Whitney U	0.1898
ODI 1 month	31.00±7.62	18.73±6.08	Mann-Whitney U	0.0005
ODI 3 month	23.07±9.12	15.07±9.08	T-test	0.0229
ODI 6 month	19.13±9.61	10.87±9.96	Mann-Whitney U	0.0152

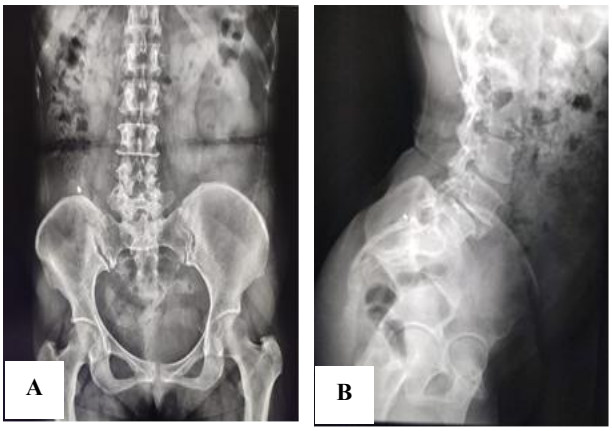

Figure 5 (A and B): Post endoscopic spine surgery (1 year) X-rays showing instability at L4-5 level.

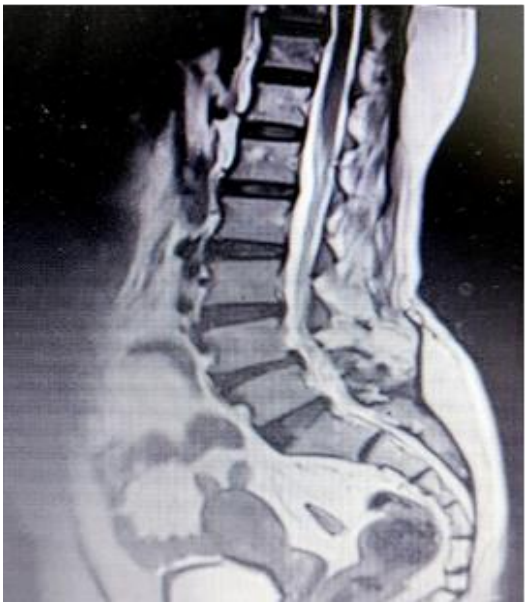

Figure 6: Repeat MRI of this patient showing PIVD at L4-5 and L5-S1 levels.

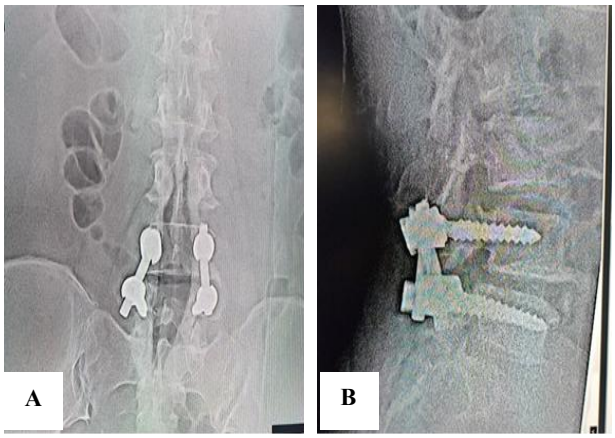

Figure 7(A and B): Post op X-rays showing fixation at L4-5 level with pedicle screws.

Another patient, 47-year-old female a case of L4-L5 PIVD underwent endoscopic discectomy, but even after 6 months post operative, patient was not happy with the results. We did a repeat radiograph and MRI, and found that she had instability at L4-L5 level, and disc prolapse at L4-L5 level and L5-S1 level. Patient needed another surgery in which decompression, reduction of the listhesis and fixation with pedicle screws was done.

DISCUSSION

Studying lumbar disc herniation is crucial due to its high prevalence as a cause of lower back and leg pain, significant socioeconomic impact, and potential for complications like radiculopathy and cauda equina syndrome, necessitating accurate diagnosis and effective management. The lifetime prevalence of sciatica is estimated to be 13-40%, depending on the population and diagnostic criteria used.[5] The annual incidence of lumbar radiculopathy is approximately 2-5%, with peak incidence occurring in the fourth and fifth decades of life.[6,7] Lumbar disc herniation is the most frequent cause of radiculopathy,

accounting for up to 90% of cases.[8] Lumbar disc herniation (LDH) is a common spinal disorder resulting from the displacement of nucleus pulposus material through a tear in the annulus fibrosus. This displacement often leads to compression and irritation of adjacent nerve roots, resulting in symptoms such as low back pain, radiculopathy (sciatica), and neurological deficits.

Herniation most frequently occurs at L4-L5 and L5-S1 levels, which bear the greatest mechanical stress. Degenerative changes in the intervertebral disc—such as dehydration, reduced disc height, and annular fissures—predispose individuals to herniation, particularly with mechanical loading, trauma, or repetitive strain. Common risk factors for sciatica include a sedentary lifestyle or prolonged sitting, poor posture, heavy lifting or repetitive spinal loading, obesity, smoking, genetic predisposition, and occupational exposures such as driving or manual labour. These factors contribute to mechanical stress and degenerative changes in the spine, increasing the risk of nerve root compression.[9,10] The high prevalence and functional impact of low back pain and radiculopathy also have significant socioeconomic consequences, including reduced productivity, increased work absenteeism, higher healthcare costs, and long-term disability in chronic cases.[5] Most of the patients with Sciatica are treated conservatively with muscle relaxants, neurotropic drugs, physiotherapy and epidural steroid injections. However, those who fail to respond to conservative management after 6-12 weeks of treatment are candidates for surgery. Even those who develop progressive neurological deficit, severe pain affecting their daily life or cauda equina syndrome are also candidates for surgical intervention.

The various modes of surgery for lumbar disc herniation include open discectomy, microdiscectomy and endoscopic discectomy. Endoscopic discectomy can be done either via transforaminal or interlaminar approach. Over the past 2 decades, endoscopic discectomy has evolved as a favourable option for patients with sciatica due to lesser operative time, faster recovery and return to work.

The present study aimed to evaluate and compare the functional outcomes of endoscopic versus open discectomy in patients with single-level lumbar disc herniation, based on post-operative Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) scores over a 6-month follow-up period. Our analysis demonstrates that patients undergoing endoscopic discectomy experienced faster and more significant pain relief compared to those who underwent open discectomy. At 1 month post-operatively, the mean VAS score for the endoscopic group was 4.4, versus 6.07 in the open group. This trend continued at 3 months (3.33 vs 4.47) and 6 months (2.40 vs 3.40). These results align with prior literature that attributes reduced tissue trauma and muscle dissection in endoscopic techniques to better early pain outcomes.[11,12] The minimally invasive nature of endoscopic discectomy likely contributes to less post-operative inflammation and faster recovery, allowing patients to mobilize and rehabilitate sooner. While both groups showed steady improvement over time, endoscopic discectomy was clearly associated with better short-to-mid-term pain control. ODI scores, which assess disability and functional impairment, also favoured the endoscopic approach. At 1 month, the mean ODI score in the endoscopic group was 18.73, significantly lower than 31.00 in the open group. At 6 months, endoscopic patients reached an ODI of 10.87 compared to 19.13 in the open group. This represents a 42% functional improvement for the endoscopic group and 38% for the open discectomy group.

These findings suggest that endoscopic discectomy offers a more rapid return to daily activities and work. Previous studies have echoed similar results, with many highlighting that the endoscopic approach preserves more spinal stability and paraspinal musculature, which contributes to improved long-term functionality.[12-14] Open discectomy, though effective, requires more extensive dissection, potentially leading to increased post-operative pain, longer hospital stays, and delayed rehabilitation. In contrast, endoscopic techniques utilize small incisions and muscle-sparing corridors, reducing soft tissue damage, bleeding, and hospital duration. However, endoscopic discectomy is technically demanding, with a steep learning curve, which may affect outcomes during the initial stages of surgical adoption. Surgeons must be thoroughly trained to avoid complications such as inadequate decompression or nerve injury.

In 2019, An International, Multi-Institutional Analysis of Outcomes and Adverse Events by Ryan G Chiu et al " Endoscopic Versus Open Laminectomy for Lumbar Spinal Stenosis" concluded that endoscopically guided approaches to single-level lumbar decompression did not reduce the incidence of adverse events, length of stay or operative time, perhaps due to advances among certain non-endoscopic techniques, such as microsurgery.[15] In 2020, a case series by Jiu-Ya Pang et al "Comparison of micro endoscopic discectomy and open discectomy for single-segment lumbar disc herniation" showed that Micro endoscopic Discectomy (MED) allows patients to get out of bed faster, reduces pain more quickly, and patients can recover sooner.[16] It has a good prognosis and is worthy of all-round promotion and application in the clinic. In 2023, A Comparative Operative Outcome and Clinical Outcome in Rayong Hospital by Phattareeya Pholprajug et al "The Full Endoscopic Discectomy versus Open Discectomy" showed that advantages of endoscopic discectomy overcome open discectomy in lumbar disc herniation.[17] Reduction of intraoperative blood loss, shorter length of hospital stay, and early ambulation are gained. Improvement of clinical score at 6 months and 1year postoperative. Our prospective cohort study reinforces the growing body of evidence supporting endoscopic discectomy as a safe and effective alternative to conventional open discectomy, particularly for early pain relief and faster functional recovery in single-level lumbar disc herniation. While open discectomy remains the

standard in many centres, especially in resource-limited settings, the advantages of minimally invasive approaches suggest a shift in paradigm with proper training and equipment availability.

Limitations

The present study has several limitations that should be considered while interpreting the results. The sample size was relatively small, with only 15 patients in each group, which may limit the generalizability of the findings. Additionally, the follow-up period was restricted to 6 months, making it difficult to assess the long-term durability and sustainability of the observed outcomes. The study also did not evaluate other potentially important outcome measures, such as time to return to work, intraoperative complications, and patient satisfaction scores. Furthermore, variations in surgeon experience and surgical technique may have influenced the results. Another limitation was that the majority of the study participants belonged to a lower socioeconomic background, which posed challenges in ensuring regular follow-up and maintaining adequate postoperative hygiene, potentially affecting postoperative recovery and outcome assessment.

CONCLUSION

Open discectomy has historically been the gold standard surgical treatment for single-level lumbar disc herniation, owing to its high success rates, predictable neurological recovery, and well-established safety profile. It offers direct visualization of neural structures, effective decompression, and reproducible long-term outcomes. Over decades of use, open discectomy has proven its durability in relieving radicular pain, improving functional status, and achieving high patient satisfaction rates. However, the quest for less invasive alternatives with reduced postoperative morbidity has driven the evolution of minimally invasive spine surgery, particularly percutaneous endoscopic lumbar discectomy (PELD). In conclusion, both open discectomy and PELD are safe, effective, and evidence-based procedures for single-level lumbar disc herniation. While open discectomy offers unmatched familiarity and reliability, PELD provides the advantages of reduced surgical morbidity and faster early recovery. The optimal choice should be individualized, factoring in patient expectations, anatomical considerations, surgeon expertise, and institutional resources. With ongoing refinement of endoscopic techniques and expanding surgeon proficiency, PELD is likely to gain a larger role in contemporary spine practice, complementing rather than replacing the established role of open discectomy.

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Ethical approval: The study was approved by the Institutional Ethics Committee (IGGMC/Pharm/BORS/ 2050-51/2024)

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