

Percutaneous Transforaminal Endoscopic Foraminoplasty and Decompression for the Treatment of Intraspinous Tophaceous Gout: A Case Series

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Abstract

Background: This study reports a case series of transforaminal endoscopic decompression for symptomatic intraspinal gout treatment.

Methods: In the past three years, the technique of transforaminal endoscopic decompression has been applied for the treatment of symptomatic intraspinal gout, and detailed information on 8 consecutive patients pre- and postoperatively has been recorded for further research.

Results: Here, we present a consecutive series of 8 patients who underwent transforaminal endoscopic decompression for the treatment of intraspinal gout in our hospital from 2016 to 2019. These 8 patients all suffered from low back and leg pain and varying degrees of neurologic deficits. After at least 1 year of follow-up, the modified Japanese Orthopedic Association (m-JOA) score and the MOS 36-Item Short-form Health Survey (SF-36) score were significantly improved compared with before surgery. All patients were satisfied with the results of the operation, and no complications were experienced.

Conclusion: Transforaminal endoscopic decompression may be a unique approach to treat intraspinal gout because of its small trauma, rapid recovery, and reliable effect.

Background

Tophaceous gout is a common metabolic disease caused by the abnormal deposition of monosodium urate crystals in various tissues¹. Symptomatic intraspinal gout is a form of gout that affects the spine and causes neurological compressive and stimulating symptoms. Symptomatic intraspinal gout is rare, and there is no consensus on its treatment to date. The majority of relevant studies have demonstrated that open laminectomy is the first choice for selected patients, but it is often accompanied by a large incision and a spinal instability postoperation^{2–5}. Recently, we first applied percutaneous transforaminal endoscopy for intraspinal gout, and the symptoms of neurological deficits and pain were immediately relieved without complications postoperatively. The follow-up also showed a satisfying outcome. Here, we report a case series of 8 consecutive patients who received percutaneous transforaminal endoscopy for intraspinal gout.

Case description (Table 1):

Table 1
Characteristics of The Case Series

Patient	Sex	Age	Symptom	Level	Serum uric acid before operation($\mu\text{mol/L}$)	Follow up
1	Female	72	Low back pain Intermittent claudication	L4/5	281	1 year
2	Male	64	Low back pain Left lower limb pain with numbness	L4/5	374	14 months
3	Male	66	Low back pain Right lower limb pain and numbness	L5/S1	507.8	1 year
4	Male	65	Low back pain Radiating pain to bilateral lower limbs	L4/5 L5/S1	516.3	1 year
5	Male	73	Low back pain Numbness of calf	L4/5	477	1 year
6	Male	71	Recurrent pain of right leg	L4/5	465	2 year
7	Male	68	Acute pain of low back and left lower limb	L4/5	485	18 months
8	Female	73	pain and numbness in both lower extremities	L4/5	408	1 year

Case 1

A 72-year-old woman was admitted with low back pain accompanied by intermittent claudication for 10 days. Her medical history included diabetes and hypertension. Physical examination revealed paraspinal tenderness on L4, and the right straight leg raising sign was positive. Imaging examination showed lumbar disc herniation at L4/5. Laboratory investigations showed that her serum uric acid level was 281 $\mu\text{mol/L}$ and blood sedimentation was 36.0 mm/h. Five days after the operation, she felt much better and was discharged from the hospital. She described no pain or other discomfort at the one-year follow-up.

Case 2

A 64-year-old man complained of an 11-month history of low back pain and progressive left lower limb pain and numbness with no relevant medical history. Physical examination showed tenderness around the L4/5 spinous process, mild weakness (4/5), and hypoesthesia of the left leg. The right straight leg

raising test was positive. Images demonstrated suspicious intraspinal lesions at L4/5 (which were later confirmed as tophaceous gout). Laboratory examination revealed that the serum uric acid level was 374 $\mu\text{mol/L}$. Neurological function deficits were rapidly relieved, and the patient left the hospital six days after the operation. No relevant symptoms were reported at the 14-month follow-up.

Case 3

A 66-year-old man had lower back pain associated with right lower limb pain and numbness for 10 years that was aggravated 1 year ago. He had a history of gout for five years and took colchicine to treat acute exacerbations. Physical examination showed that the muscle strength and sensation of the right lower limb were decreased. Images revealed intervertebral disc degeneration and protrusion and multiple intraspinal calcifications (L2/3 and L5/S1). Laboratory evaluations revealed that the serum uric acid level was 507.8 $\mu\text{mol/L}$. He was diagnosed with intraspinal gout and took allopurinol regularly after minimally invasive surgery of L5/S1. Although the patient's lower limb numbness did not resolve completely, it was dramatically relieved when he left the hospital. The 1-year follow-up showed satisfactory feedback.

Case 4

A 65-year-old man presented with an 8-year history of recurrent low back pain. The symptoms were aggravated and associated with radiating pain to the bilateral lower limbs. He had a 30-year history of alcoholism. Physical examination revealed significant tenderness in his lower back. Joint swelling was found over the right knee. The spine imaging examination displayed an intraspinal diffuse lesion at the L5 level. Laboratory investigations revealed that the serum urate level and white blood cell count were elevated at 516.3 $\mu\text{mol/L}$ and $11.3 \times 10^9/\text{L}$, respectively. A mass of sodium urate crystal was confirmed in the effusion of the right knee cavity. The pain resolved rapidly after surgery of L4/5 and L5/S1, and allopurinol was prescribed to decrease serum uric acid. The one-year follow-up showed occasional mild low back pain.

Case 5

A 73-year-old man presented with intractable low back pain. He had a history of gout for which he took colchicine for acute exacerbations. Physical examination revealed percussion pain of the low back and mild numbness of the calf. The straight leg raising test was positive. Images of the lumbar spine showed bulging of the intervertebral disc at L3/4, L4/5, and L5/S1. Laboratory examination demonstrated proteinuria, urine erythrocytes, and serum uric acid levels of 477 $\mu\text{mol/L}$. The histopathologic findings were consistent with tophaceous gout. He was satisfied with the results of minimally invasive surgery of L4/5 and no had relapse at the one year follow-up.

Case 6

A 71-year-old man had a history of recurrent pain of the right leg for 2 years, and the pain was aggravated for 4 days at admission. He had a 40-year history of smoking and alcohol consumption and injected a mass of meat and liquor 5 days prior to admission. Physical examination revealed that the right straight

leg raising test was positive. Imaging showed intraspinal changes at the L4 level. Laboratory examination revealed serum uric acid was 465 $\mu\text{mol/L}$. Cessation of alcohol consumption and starting allopurinol were recommended to control his uric acid levels after surgery of L4/5. The patient recovered to normal activity after 1 week and experienced no low back pain at the 2-year follow-up.

Case 7

A 68-year-old man was admitted with acute pain of the low back and left lower limb for 3 days. He drank alcohol heavily for 20 years. Physical examination revealed that the right straight leg raising test was positive. Imaging examination revealed intraspinal diffuse lesions at the L4 level. Laboratory results showed that the serum urate level was 485 $\mu\text{mol/L}$. His symptoms were rapidly relieved after surgery, and regular outpatient review showed a good outcome at the 18-month follow-up.

Case 8

A 73-year-old woman presented with a 3-month history of pain and numbness in both lower extremities. There was no relevant medical history. Physical examination showed reduced sensation to the bilateral calf. Lumbar imaging demonstrated lumbar disc herniation and stenosis at the L5 level. Laboratory investigations showed that the serum uric acid level was 443 $\mu\text{mol/L}$. The pain and numbness disappeared after surgery of L4/5, and there was no complaint one year later.

Treatment

In all cases, a similar surgical technique was performed.

The patients were placed prone on a radiolucent table with appropriate local analgesia and intravenous sedation, so they patients could communicate with the surgeon throughout the surgical procedures. After routine marking and disinfection, under fluoroscopic guidance by a C-arm, a needle was advanced and placed on the superior endplate of the responsible vertebral body first by touching the superior articular process and deflecting it ventrally. Then, sequential reamers were used to remove the ventral aspect of the superior facet. After a 7-mm beveled tubular retractor was placed, the working channel endoscope was placed in the tubular retractor, and we could clearly observe the tissue in the spinal canal, such as nerves, herniated disc and intraspinal tophus. Endoscopic grasping forceps were used to resect some of the posterior longitudinal ligament, ligamentum flavum and herniated disc as well as the tophus to completely decompress until the nerves changed in appearance from firm, white, tense to a relaxed, pink, well-decompressed appearance. The freed dural sac and transverse nerve were observed moved with the heartbeat. After the patient confirmed relief of radiculopathy, the working channel and endoscope were removed. Finally, the wound was closed with a single interrupted suture.

Results

An amorphous white chalky tophus was found in the spinal canal during the operation, and the histopathologic findings were consistent with tophaceous gout in all 8 patients. The tophi could invade the facet joint, herniated disc, ligamentum flavum and epidural space of the spinal canal and then be encapsulated by fibrous tissue. Gout stones were removed, and compressed nerves were decompressed. Postoperative pathology confirmed the presence of monosodium urate crystals. Imaging examinations showed significant improvement after the operation (Fig. 1). Symptoms such as pain and numbness were relieved quickly without intraoperative or postoperative complications, and patients were able to perform mild daily activities the day after surgery and leave the hospital 4 days after the procedure. The one-year follow-up showed a satisfying outcome, and the m-JOA and SF-36 scores were significantly improved (Tables 2 and 3).

Table 2
SF-36

	PF	RP	BP	GH	VT	SF	RE	MH	HT
Pre-op	52.50 ± 15.58	12.50 ± 13.36	38.00 ± 18.11	41.00 ± 19.04	46.88 ± 14.13	50.00 ± 20.05	24.99 ± 23.57	54.50 ± 14.17	25.00 ± 18.90
Post-op	79.38 ± 9.04	59.38 ± 35.20	74.00 ± 5.35	51.88 ± 16.68	72.50 ± 8.02	82.81 ± 13.26	75.02 ± 15.41	78.50 ± 5.63	71.88 ± 20.86
t	-5.48	-3.91	-5.62	-2.32	-4.26	-4.02	-4.59	-4.58	-4.71
p	0.001	0.006	0.001	0.054	0.004	0.005	0.003	0.003	0.002

Table 3
M-JOA

Pre-op	16.88 ± 3.04
Post-op	24.75 ± 1.83
t	-5.7
p	0.001

Table 4
Further Processing of SF-36

	PCS	MCS	Total
Pre-op	144.00 ± 52.90	176.36 ± 67.41	320.36 ± 113.47
Post-op	264.63 ± 57.37	308.84 ± 33.92	573.46 ± 86.54
t	-5.405	-4.875	-5.746
p	0.001	0.002	0.001

Discussion

Tophaceous gout is a common metabolic disease. The incidence of gout is estimated to be 0.2–0.4% worldwide, but in some developed countries, such as the US, its frequency is much higher, with almost 4% of the population affected^{6–7}. Gout mostly affects joints, such as the metatarsal-phalangeal joint, elbow and knee, and the main symptoms are localized swelling and pain resulting from stimulation and compression of the tophus⁸. Risk factors contributing to the development of gout include hyperuricemia, local hypothermia, local low pH and the presence of a nucleating agent within synovial fluid^{9–11}.

However, intraspinal gout is uncommon, despite the high incidence rate of gout. The etiology of axial skeleton-affected gout is not yet clear. Obesity, sedentary habits and degenerative disc disease may initiate and promote the formation of spinal tophus. Volkov A. and his colleagues suggested that intraspinal gout is associated with spinal degenerative disease because they found that damaged microcirculation leads to a lower-pH condition locally, which promotes monosodium urate crystallization and deposition¹². The imaging findings of our eight patients confirmed this hypothesis, showing degeneration in the spine during the operation.

According to a review, after the first spinal gout case was described in 1950, only 133 relevant cases of spinal gout were reported by 2015^{13,14}. Two asymptomatic cases were confirmed in autopsy, which means that the number of spinal gout patients may be underrated because of nonsymptoms and signs in the early or quiescent stage of spinal gout^{15,16}.

Nonspecific pain and neurological deficits in the lower extremities can be the only indicators of intraspinal gout, and it is difficult to differentiate gout from other diseases by routine imaging tests and laboratory tests. Adding to its rarity, spinal gout is difficult to diagnose precisely in clinical practice.

Laboratory examinations, such as C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), and blood uric acid (BUA), are nonspecific. These indicators are often in the normal range when gout is at the resting stage. Furthermore, BUA levels even remain normal during the progression of gout in some patients.

Routine radiological examinations, including MRI, CT, and DR, can hardly distinguish the tophi from other lesions, and spinal gout is easily confused with other diseases in imaging, such as disc herniation, primary or metastatic epidural tumors, and epidural infection. Both issues lead to a false diagnosis and treatment.

The clinical manifestations of spinal gout show regional-specific diversity, as all segments of the spine could be affected. The majority of tophi are located in the lumbar spine (44–54%), followed by cervical and thoracic vertebrae^{13,17}. In a review by Toprover et al. of 131 patients with spinal gout, the most common complaint was back pain, followed by loss of sensation, motor weakness, bowel/bladder dysfunction and quadriparesis¹³.

Spinal gout is usually diagnosed during surgery due to inconsistencies among laboratory, radiological and clinical findings. We believe that the incidence of spinal gout is greatly underestimated, with a number of asymptomatic or misdiagnosed patients.

In fact, the first case of intraspinal gout in our group was misdiagnosed, and the patient was primarily diagnosed with epidural abscess. Intraspinal gout was not taken into consideration until an amorphous white material was observed during surgery. Subsequently, we searched the relevant literature and began to pay attention to this ignored disease.

In this article, all patients suffered from varying degrees of back pain, lower limb pain and numbness combined with intermittent claudication, which mimics the symptoms of lumbar spinal stenosis, epidural abscess and ligament ossification. By performing percutaneous transforaminal endoscopy, all eight patients were diagnosed with lumbar intraspinal gout and eventually received the proper treatment.

We reviewed previous reports on intraspinal gout. Although there are no guidelines for the treatment of intraspinal gout to date, open laminectomy and decompression is regarded as the first choice, which can avoid further neurological impairment and relieve pain and numbness rapidly¹⁸. Symptoms of nerve compression and stimulation were mostly relieved after surgery, and with the use of allopurinol, the follow-up showed no sign of recurrence. However, this kind of open surgery is often accompanied by a large incision, spinal instability, intractable back pain and other shortcomings.

Compared to other techniques, the technique of percutaneous transforaminal endoscopy has many advantages, such as less blood loss, less soft tissue disruption and better spinal stability, as well as a smaller incision, faster recovery and lower cost. After studying and discussing the first case of intraspinal gout, our team tried to introduce percutaneous transforaminal endoscopy into the diagnosis and treatment of intraspinal gout. In practice, we found that the tophus in the spine could be observed more clearly during the operation with magnified vision, and since the tophus was only slightly attached to the tissues, it could be completely removed with mild damage (Fig. 2).

Compared with the routine surgical option of open laminectomy and decompression, percutaneous transforaminal endoscopic decompression and resection has the distinct advantage of a smaller incision, less soft tissue disruption, and better preservation of spinal stability. The technique is effective in relieving neurological compressive and irritative symptoms, as well as being well tolerated by older patients due to its minimal blood loss, low postoperative pain and few complications. Moreover, all eight patients who underwent this minimally invasive surgery experienced no complications or recurrence in our follow-up. All patients' mental and physical conditions were significantly improved after surgery, and they were all perfectly satisfied with the treatment (Table 4).

Due to the low incidence and diagnosis rate of spinal gout, we think that a large randomized study is difficult to perform. We advocate that a minimally invasive technique, percutaneous transforaminal endoscopy, could be used in the diagnosis and treatment of symptomatic spinal gout based on the satisfactory outcomes of the eight patients described in this article.

Conclusions

Although symptomatic tophaceous spinal gout is an “uncommon” disease, clinicians should take spinal gout into consideration for differential diagnosis when dealing with patients who suffer from axial pain with or without neurologic deficits, especially when laboratory examinations reveal hyperuricemia or other uncommon information about gout. The incidence of spinal gout may not be low, as reported.

We believe percutaneous transforaminal endoscopic decompression and resection can be an effective alternative for the diagnosis and treatment of intraspinal gout. This minimally invasive technique may contribute to identifying more patients with spinal gout, which could open a new chapter for related studies about spinal gout.

Abbreviations

m-JOA

modified Japanese Orthopaedic Association

SF-36

short form health survey

CRP

C-reactive protein

ESR

erythrocyte sedimentation rate

BUA

blood uric acid

Declarations

Ethics approval and consent to participate

The study protocol has been approved by the Clinical Research Ethics Committee of the Zhejiang provincial people's hospital and has been registered. All patients signed an informed consent form.

Consent to publish

Written consent was provided for images of the patients and techniques, clinical details and identifying information such as age, profession and gender to be included and published

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Competing interests

The authors declare that they have no competing interests.

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Authors' Contributions

HYS, ZMY, XJC and JZ participated in drafting the manuscript, and provides the original idea of the work. TXZ participated in drafting the manuscript and in designing the protocol. JYZ, YXW, YZH and MRJ participated in revising the manuscript critically. All authors have read and approved the final manuscript and agreed to be accountable for all aspects of the work.

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Figures

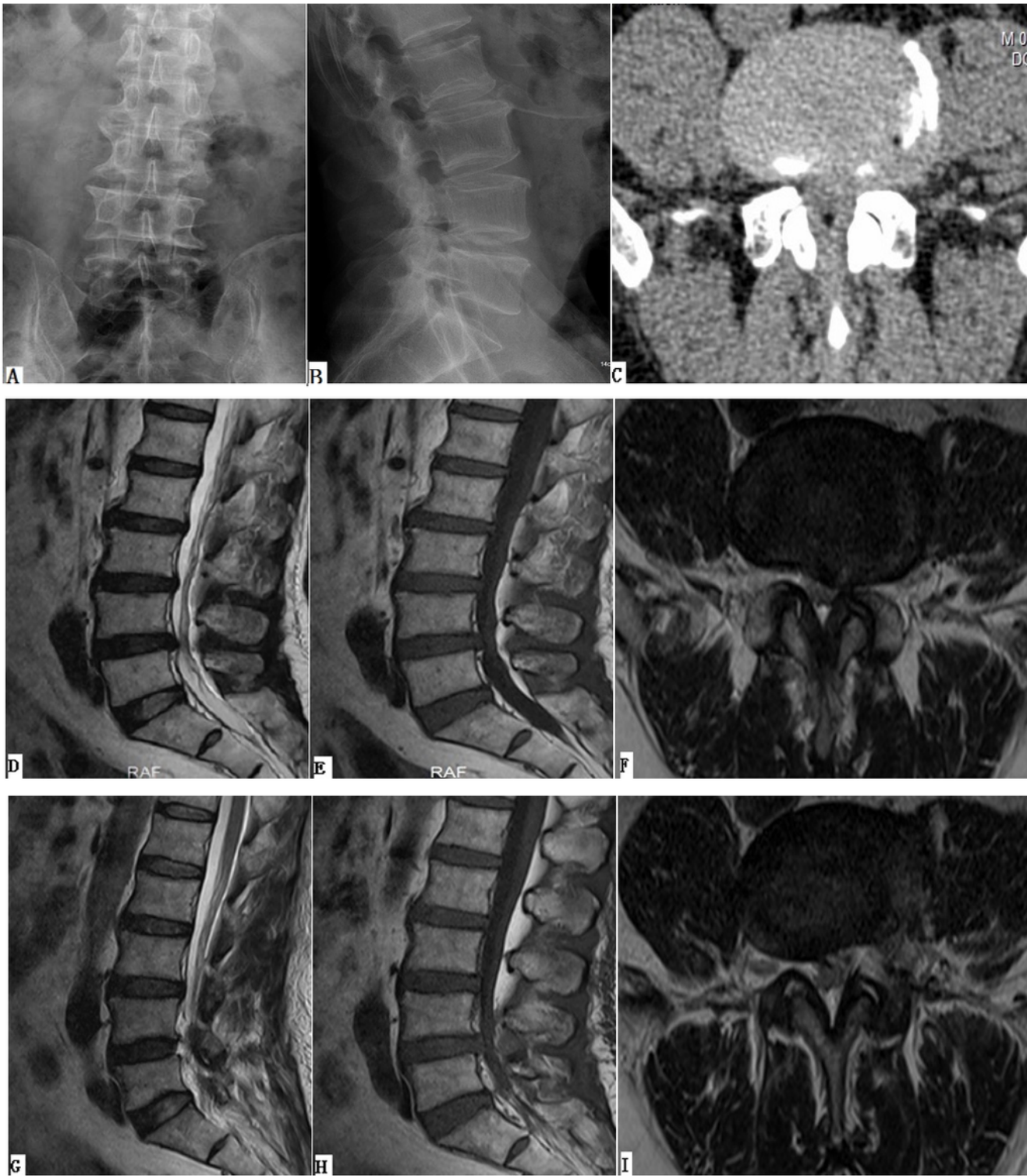


Figure 1

Case example. A-F: A 64-year-old man complained of low back pain and progressive left lower limb pain with numbness. Anterior-posterior(A) and lateral (B) view showed mild degenerative lumbar scoliosis. Axial CT scan showed lateral recess stenosis on the left side at the level of L4/5 (C). Sagittal (D-E) and axial (F) view of MRI scan before operation showed L4/5 suspicious disc herniation and lateral recess

stenosis on the left side. Sagittal (G) and axial (I) view of MRI scan 2 days after operation showed that intraspinal lesions were removed. CT=computed tomography, MRI=magnetic resonance imaging.

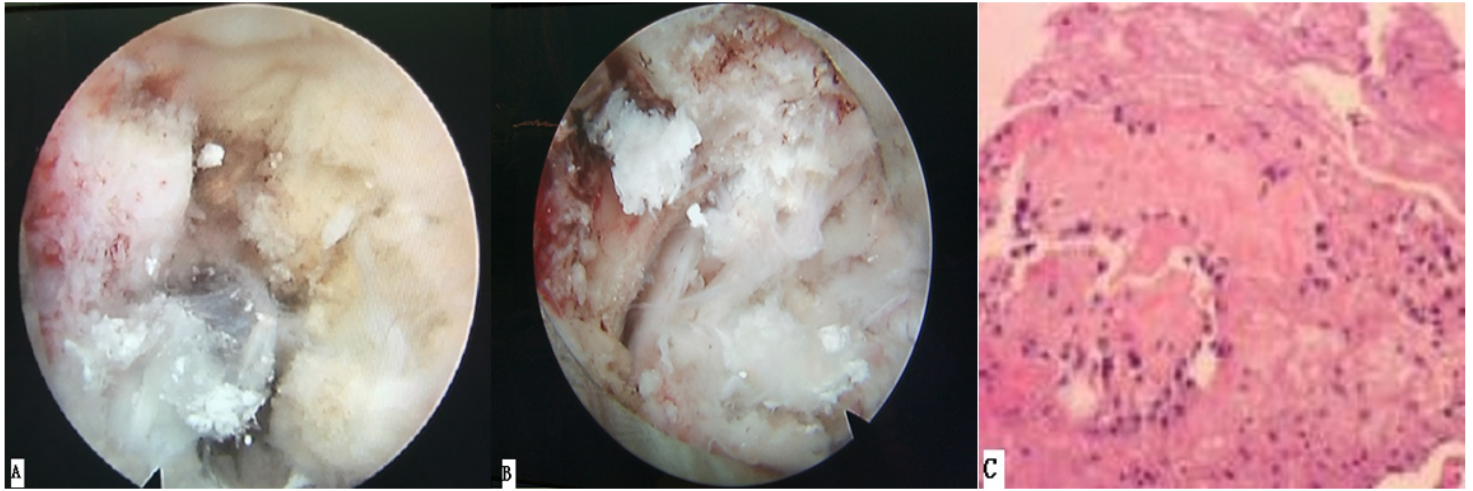


Figure 2

Tophus under the magnified vision of percutaneous transforaminal endoscopy (A-B) . Intraoperative view showed the chalky white material was occupying the epidural space and infiltrating the soft tissue. Pathology examination revealing abundant deposited crystals surrounded by a foreign body-type giant cell reaction (C). H & E, 100×.