

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

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### Keywords:

Percutaneous transformational endoscopy; Intraspinous gout; Treatment; Intraspinous gout

## 1. Abstract

**1.1. Introduction:** Reporting a case series of using transformational endoscopic decompression for the symptomatic intraspinal gout treatment.

**1.2. Methods:** In the past three years, the technique of transformational endoscopic decompression has been applied to the treatment of symptomatic intraspinal gout, and 8 consecutive patients' detailed information pre- and post-operation has been recorded for the further research.

**1.3. Results:** Here, we present a consecutive series of 8 patients who were performed with transformational 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-follow-up, the modified Japanese Orthopedic Association (m-JOA) score and the MOS item short form health survey (SF-36) score were significantly improved comparing with symptom before operation. All patients were satisfied with the results of the operation and no complication was experienced.

**1.4. Conclusion:** Transformational endoscopic decompression may be a unique approach to the treatment of intraspinal gout because of its small trauma, rapid recovery and reliable effect.

## 2. Introduction

Tophaceous gout is a common metabolic disease, which is caused by the abnormal deposition of monosodium urate crystals in various tissues [1]. Symptomatic intraspinal gout is the gout that affects spine with neurological compressive and stimulating symptoms. Symptomatic intraspinal gout is rare and there is no consensus of treatment yet. The majority of relevant literatures demonstrated that the open laminectomy is the prior choice for selected patients, but it often accompanies with large incision and spinal instability post operation [2-5]. Recently, we firstly applied the percutaneous transformational endoscopy for intraspinal gout and the symptoms of neurological deficits and pain immediately relieved without complications post-operatively, and the follow-up also showed a satisfying outcome. Here, we report a case series of 8 consecutive patients profile about applying percutaneous transformational endoscopy for intraspinal gout.

## 3. Case Description

### 3.1. Case 1:

(Table 1) A 72-year-old woman was admitted with low back pain accompanying with 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 serum uric acid level was 281  $\mu\text{mol/L}$  and blood sedimentation

was 36.0 mm/h. After 5 days of operation, she felt much better and discharged from hospital. One-year follow-up showed no pain or other discomfort.

**Table 1:** SUA: serum uric acid ( $\mu\text{mol/L}$ ). In this table we can see the characteristics of the case series.

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

### 3.2. Case 2 :

A 64-year-old man complained of a 11-month history of low back pain and progressive left lower limb pain with numbness. No relevant medical history. Physical examination showed tenderness around the L4/5 spinous process, mild weakness (4/5) and hypoaesthesia of left leg, and the right straight leg raising test was positive. Images demonstrated intraspinal suspicious lesions at L4/5(which was confirmed as tophaceous gout later). Laboratory examination revealed that the serum uric acid level was 374  $\mu\text{mol/L}$ . Neurological function deficits rapidly relieved and patients left hospital 6 days after the operation. No relevant symptom was experienced at 14 months' follow-up.

### 3.3. Case 3 :

A 66-year-old man had low back pain associated with right lower limb pain and numbness for 10 years and aggravated 1 year ago. He had a history of gout for 5 years and took colchicine in treating acute exacerbation. Physical examination showed the muscle strength and sensation of the right lower limb were decreased. Images revealed intervertebral disc degeneration and protrusion and multiple intraspinal calcification (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 the minimally invasive surgery of L5/S1.

Although the patient's lower limb numbness did not resolve completely, it was dramatically relieved when he leave hospital. 1-year follow-up showed a satisfied feedback.

### 3.4. Case 4 :

A 65 years old man presented with 8-year history of recurrent low back pain. The symptom aggravated and associated with radiating pain to bilateral lower limbs. He had been an alcoholic for 30 years. Physical examination revealed significant tenderness in his low back. Joint swelling was found over the right knee. The spine imaging examination displayed intraspinal diffuse lesion at 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  $11.3 \times 10^9/L$ , respectively. A mass of sodium urate crystal was confirmed in the effusion of right knee cavity. The pain resolved rapidly after operation of L4/5 and L5/S1, and allopurinol was prescribed to decrease the serum uric acid. One-year follow-up showed occasional mild low back pain.

### 3.5. Case 5 :

A 73-year-old man presented with intractable low back pain. He had a history of gout for which he received colchicine on acute exacerbation. Physical examination revealed percussion pain of the low back and mild numbness of calf. straight leg raising test was positive. Images of lumbar spine showed bulging of intervertebral

disc at L3/4, L4/5 and L5/S1. Laboratory examination demonstrated proteinuria urine erythrocyte and serum uric acid level was 477  $\mu\text{mol/L}$ . Histopathologic findings were consistent with tophaceous gout. Patients was satisfied with the minimally invasive surgery of L4/5 and no relapse within one-year follow-up.

**3.6. Case 6 :**

A 71-year-old man had a history of recurrent pain of right leg for 2 years, and the pain aggravated for 4 days at admission. He had smoked and drunk for 40 years, and took a mass of meat and liquor 5 days ago. Physical examination revealed that right straight leg raising test was positive. Imaging showed intraspinal changes at L4 level. Laboratory examination revealed that serum uric acid was 465  $\mu\text{mol/L}$ . Stopping drinking and starting allopurinol were recommended to control uric acid level after operation of L4/5. the patient recovered to normal activity after 1 week and experienced no low back pain in 2-year follow-up.

**3.7. Case 7 :**

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

**3.8. Case 8 :**

A 73-year-old woman presented with a 3-month history 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 L5 level. Laboratory investigations showed serum uric acid level was 443  $\mu\text{mol/L}$ . The pain and numbness disappeared after the operation of L4/5, and there was no complaint one year after.

**4. Treatment**

In all the cases, a similar surgical technique was performed The

patients were placed prone on a radiolucent table with appropriate local analgesia and intravenous sedation, so the patients could communicate with the surgeon throughout the surgical procedures. After routine marked and disinfected, under fluoroscopic guidance by 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 being deflected ventrally. Then sequential reamers were used to remove the ventral aspect of the superior facet. After a 7-mm beveled tubular retractor was placed in, the working channel endoscope was then 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 tophus to completely decompress till the nerves changed in appearance from firm, white, tense to a relaxed, pink, well- decompressed and the freed dural sac and transverse nerve could be visualized to mobile with the heart rate. After the patient confirmed the relief of radiculopathy, then working channel and endoscope were removed. Finally, the wound was closed with a single interrupted suture.

**5. Results**

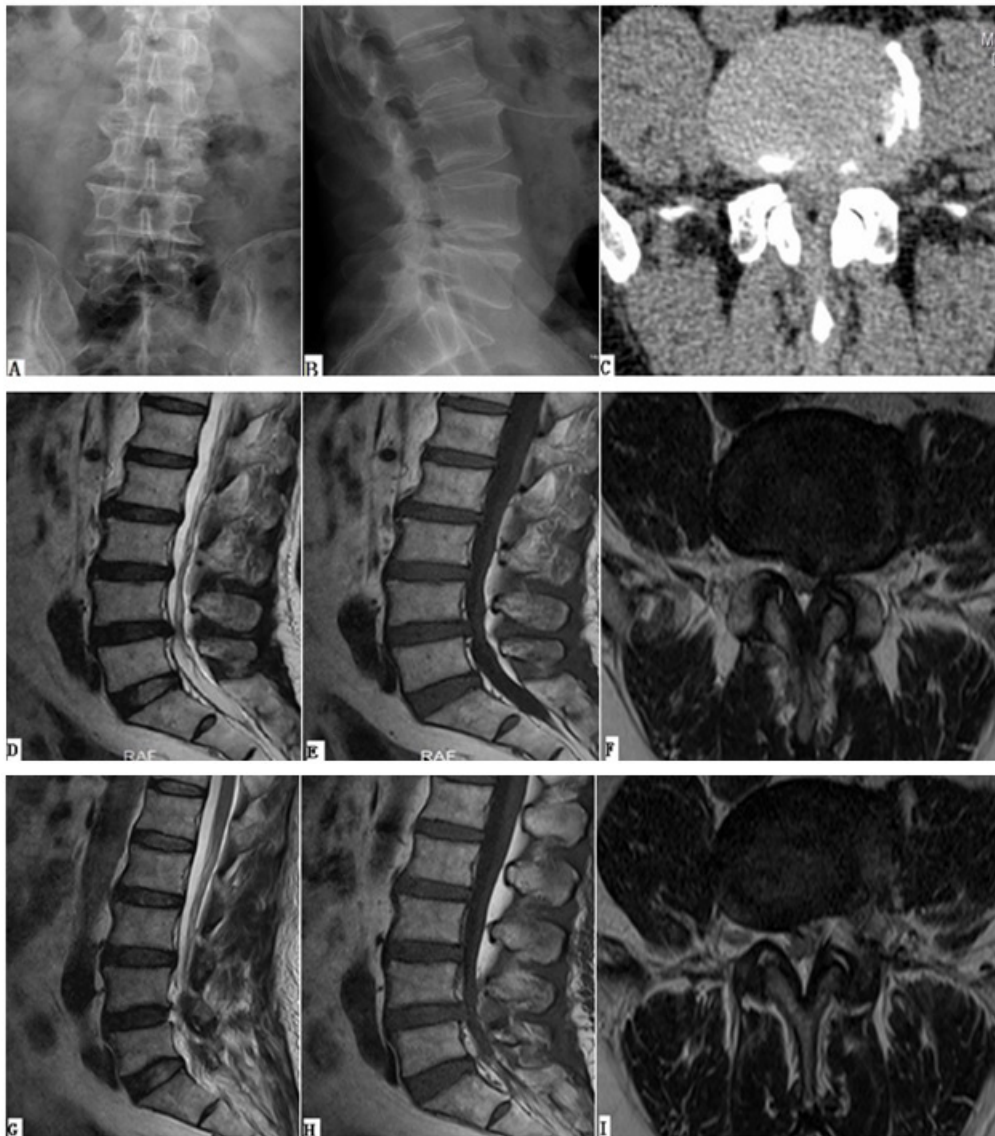
Amorphous white chalky tophus was found in the spinal canal during the operation and histopathologic findings was consistent with tophaceous gout of all 8 patients. The tophi could invade facet joint, herniated disc, ligamentum flavum and the epidural space of spinal canal, and then be encapsulated by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

**Table 2:** PF: Physical Functioning, RP: Role-Physical, BP: Bodily Pain, GH: General Health, VT: Vitality, SF: Social Functioning, RE: Role-Emotional, MH: Mental Health, HT: Health Transition. Pre-op: Preoperation, Post-op: Postoperation. In this table we can see that patients benefited much from pain relief, physiologic function, emotional function and subjective health changes.

SF-36									
	PF	RP	BP	GH	VT	SF	RE	MHf	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 score showed a significant improvement of lumbar function after the minimally invasive surgery.

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



**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, H) and axial (I) view of MRI scan 2 days after operation showed that intraspinal lesions were removed. CT=computed tomography, MRI=magnetic resonance imaging.

## 6. 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, the frequency is much higher with almost 4% of population is affected [6-7]. Gout mostly affects joints, such as metatarsal-phalangeal joint, elbow and knee, and the main symptoms are locational-specific swelling and pain resulting from the stimulation and compression of the tophus [1].

Risk factors, contributing to the development of gouty, include hyperuricemia, local hypothermia, local low pH and the presence of a nucleating agent within the synovial fluid [8-10]. However, the intraspinal gout is uncommon, despite the high incidence rate of gout. The etiology of the axial skeleton-affected gout is not clear yet. Obesity, sedentary habit 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 the damaged

microcirculation leads to a lower-PH condition locally, which promotes the monosodium urate crystallization and deposition [11]. The imaging findings of our 8 patients confirmed this hypothesis, showing degeneration in spine during operation. According to a review, after the first spinal gout case was described in 1950, only 133 relevant cases about spinal gout were reported by the year of 2015 [12,13]. Including two asymptomatic cases which were confirmed in autopsy [14,15]. It means that the number of spinal gout patients can be underrated, because of non-symptoms and signs in the early or quiescent stage of spinal gout.

Nonspecific pain and neurological deficits in the lower extremities can be the only performance of the intraspinal gout, and it is hard to differentiate the gout from other diseases by routine imaging tests and laboratory tests. Adding its rarity, spinal gout is difficult to diagnose precisely in clinical practice. Laboratory examinations, such as C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), blood uric acid (BUA), are non-specific. These indicators are often in the normal range when gout at resting stage. Furthermore, BUA levels even remain normal during the progression of gout in some patients. Routine radiological examinations, including MRI, CT, DR, could 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, epidural infection and so on. Both of which lead to a false diagnosis and treatment.

The clinical manifestations show regional-specific diversity as all segments of the spine could be affected. The majority of the tophi are located in the lumbar spine (44-54%), followed by cervical and thoracic vertebrae [12,16]. In a review by Top rover 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 quadriplegia [13]. The spinal gout is usually diagnosed during surgery due to the inconsistency among laboratory, radiological and clinical findings. And 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 diagnosed as epidural abscess primarily. The intraspinal gout was not taken into consideration until the amorphous white material was observed during the surgery. Subsequently, we searched relevant literatures and began to pay attention to this ignored disease. In this article, all patients suffered from varying de-

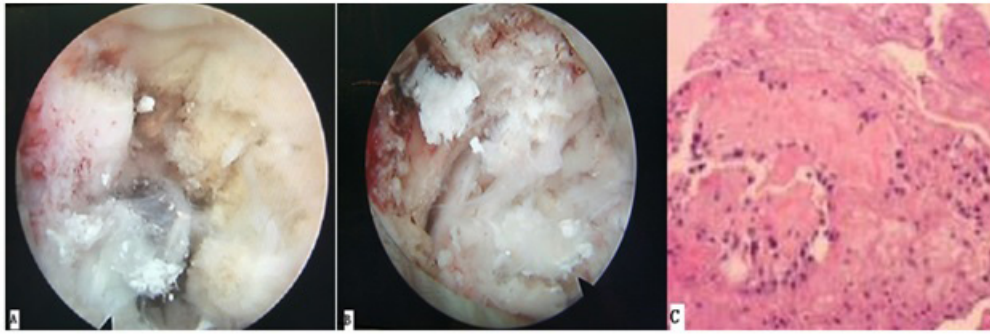
grees of back pain, lower limbs pain and numbness combined with intermittent claudication, which mimic the symptoms of lumbar spinal stenosis, epidural abscess and ligament ossification. By performing percutaneous transformational endoscopy, all 8 patients were diagnosed as lumbar intraspinal gout and received the proper treatments eventually. We reviewed previous reports on intraspinal gout. Although there are no guidelines for the treatment of intraspinal gout yet, open laminectomy and decompression is regarded as the prior choice, which can avoid further neurological impairment and relieve pain and numbness rapidly [17]. Symptoms of nerve compression and stimulation were mostly relieved after operation, and with the use of allopurinol, the follow-up showed no sign of recurrence. However, this kind of open surgery was often accompanied by huge incision, spinal instability, intractable back pain and other shortcomings.

The technique of percutaneous transformational endoscopy has many advantages, such as less blood loss, less soft tissue disruption and better spinal stability, as well as the smaller incision, faster recovery and lower cost. After studying and discussing the first case of intraspinal gout, our team tried to introduce percutaneous transformational 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 (Figure 2).

Compared with the routine surgical option of open laminectomy and decompression, percutaneous transformational endoscopic decompression and resection has the distinct advantage of smaller incision, less soft tissue disruption, better preservation of spinal stability. It shows to be effective in relieving the neurological compressive and irritative symptoms, as well as being well tolerated by the old patients for minimal blood loss, postoperative pain and complication. What's more, all 8 patients who undertaken this minimally invasive surgery experienced no complication or recurrence in our follow-up, all patients' mental and physical condition were significantly improved after the 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 large randomized study is hard to be performed. We advocate that minimally invasive technique, percutaneous transforaminal endoscopy, could be used in the diagnose and treatment of symptomatic spinal gout, basing on the satisfied outcomes from the 8 patients in this article.

**Table 4:** PCS: physical component summary, MCS: mental component summary. This data was from the further processing of SF-36 score.

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



**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 $\times$ .

## 7. Conclusion

Although symptomatic tophaceous spinal gout is a “uncommon” disease, clinicians should take spinal gout into the consideration of differential diagnosis when dealing with patients who suffer from axial pain with or without neurologic deficits, especially the laboratory examinations reveal hyperuricemia or other uncommon information about gout. Maybe the incidence of spinal gout is not low as reported. We think percutaneous transformational endoscopic decompression and resection can be an effective alternative for the diagnosis and treatment of intraspinal gout. And this minimally invasive technique may contribute to find out more patients with spinal gout which could open a new chapter for related study about spinal gout.

## 8. Funding

None.

## 9. Competing Interest

None Declared.

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