

# Preliminary study of transforaminal endoscope in the treatment of spinal metastasis

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**Abstract: Objective:** To investigate the therapeutic effect of transforaminal endoscope in patients with spinal metastases. **Methods:** Clinical data of 28 patients with spinal metastases admitted to our hospital from May 2015 to May 2019 were retrospectively collected. According to different surgical methods, they were divided into control group (20 cases) and experimental group (8 cases), among which control group was treated with traditional open palliative decompression, while the experimental group was treated with transforaminal endoscopic decompression. The surgery and recovery indicators were compared between the two groups, including surgery time, incision length, postoperative drainage volume, out of bed activity time, length of hospital stay, the Japanese Orthopaedic Association (JOA) scores of 7 days after surgery, pain degree, complications (wound infection, transient reduction of muscle strength, hypoproteinemia with wound drainage and delayed healing), and activity of daily living. **Results:** The surgery time, incision length, postoperative drainage volume, out of bed activity time, and postoperative length of hospital stay of the experimental group were all less than those of the control group, and the JOA score of 7 days after surgery was higher than that of the control group, showing statistically significant differences ( $P < 0.05$ ). VAS scores of the experimental group on the day 1 and day 7 after surgery were lower than those of the control group, with statistically significant differences ( $P < 0.05$ ). The incidence of complications in the experimental group was slightly lower than that in the control group, but the difference was not significant ( $P > 0.05$ ). **Conclusions:** Transforaminal endoscope used

in suitable patients with spinal metastases can greatly reduce the incision length, soft tissue and bone tissue damages, and postoperative drainage, promote early mobilization and early discharge, and reduce a series of complications due to hemorrhage and hypoproteinemia, which has a better early clinical effect in comparison with the traditional open palliative decompression.

**Keywords:** Spinal metastasis; Transforaminal endoscope; Clinical efficacy

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## 1 Introduction

Spinal metastasis is the common bone metastasis in clinic, which often occurs in the thoracolumbar vertebrae and leads to symptoms such as pain and restricted movement in the lesion, or severe pain caused by compression of spinal cord and nerve roots in patients<sup>[1]</sup>. Patients with spinal metastases are already in tumor advanced-stage, and often have poor general conditions and great mental stress. According to Tomita scores, most of the patients belong to the scope of palliative surgical treatment. Modern medical treatment has been paid more and more attention to alleviate the pain of patients with malignant tumors and improve their quality of life. At present, surgery has become one of the main methods for the treatment of spinal metastasis. The traditional open surgery has a large trauma, slow postoperative recovery and poor application effect<sup>[2]</sup>. Some patients have indications

of palliative resection, but they cannot bear the traditional open surgery. The purpose and starting point of this study is to investigate whether transforaminal endoscope can be used to relieve the nerve compression of patients in a minimally invasive way, so as to relieve the pain and improve the quality of life.

Transforaminal endoscope is a new technology for minimally invasive treatment of the spine, which can maintain the stability of the spine to a great extent, reduce the damage to the spine structure, and directly remove nerve compression under the direct view of minimally invasive, relieve compression with minimal trauma and ease pain, and improve the patient's quality of life. However, at present, clinical research on its treatment of spinal metastases is rare. In the view of this, the purpose of this study was to investigate the efficacy of transforaminal endoscopic treatment in patients with spinal metastases. Details have been shown as follows.

## 2 Materials and Methods

### 2.1 General data

Clinical data of 28 patients with spinal metastases admitted to our hospital from May 2015 to May 2019 were retrospectively collected. According to different surgical methods, they were divided into control group (20 cases) and experimental group (8 cases). The control group included 18 males and 2 females aged 35-75 years, with the average age of  $(60.12 \pm 1.26)$  years; primary lesions included 3 cases of liver cancer, 13 cases of lung cancer, 4 cases of prostate cancer, 1 case of thyroid cancer, and 2 cases of breast cancer. The experimental group included 7 males and 1 female aged 36-75 years, with the average age of  $(60.26 \pm 1.20)$  years; primary lesions included 1 case of liver cancer, 3 cases of lung cancer, 2 cases of prostate cancer, 1 case of breast cancer, and 1 case of thyroid cancer. The baseline data of the two groups were statistically analyzed, and the difference was not significant ( $P > 0.05$ ), which were comparable.

### 2.2 Inclusion criteria

(1) Inclusion criteria: patients who met the diagnostic criteria of Modern Oncology<sup>[3]</sup>, and diagnosed as malignant tumors by puncture biopsy; those with complete clinical data and clear imaging data; those with Tomita score of 6-8 points for palliative surgery range; those with focal compression of metastasis in front of the dura; and those with single compression

were included.

(2) Exclusion criteria: patients who combined with other malignancies; those who were intolerant; those with coagulation dysfunction; those with cervical spine metastasis; those with non-dural anterior focal compression; those with multiple compressions; and those with Tomita score for non-palliative surgery range were exclude from the study.

### 2.3 Methods

Control group: Patients in the control group were treated with traditional open palliative decompression, and the specific surgical method can be referred to the reference (the traditional open palliative resection for spinal metastasis - this can be referred to the reference)<sup>[4]</sup>.

Experimental group: All patients underwent preoperative embolization with DSA for spinal metastases, and the tumor was measured according to the preoperative image, so as to determine the location of tumor compression nerve, design the surgical scheme, and adopt different approach methods according to different tumor locations. The patient was intubated under general anesthesia and placed in the prone position. The imaging system, radio frequency, light source, transforaminal endoscope and G arm were placed, and a large amount of normal saline was prepared for flushing. A 6-12cm approach was adopted in the lumbar spine, a 4-8cm approach in the thoracic vertebra, and a posterior approach in the sacral vertebra. First, 18G puncture needle was used to reach the preoperative design position under G arm X-ray fluoroscopy, which was generally located in the safe triangle area and the upper edge of the vertebral pedicle to avoid entering the abdominal cavity and the thoracic cavity. After confirming that the puncture needle is in a predetermined position, the guide wire was changed and a 0.8cm incision was made and expanded with the guide rod and sleeve until the red sleeve could enter and finally stay in the 7.5mm working sleeve to complete the establishment of the working channel. In individual patients, a trephine can be used to remove part of the bone to ensure the effective establishment of working channels. After the working sleeve was established, the anatomical structure and tumor tissue were identified under the transforaminal endoscope, and the radiofrequency ablation was performed and nucleus pulposus forceps were used to remove the tumor tissue. For the metastatic tumor tissue with ossification, a trephine was used during the surgery

from outside to inside, from top to bottom, from shallow to deep, and the whole process must be performed under G-arm monitoring. It is better to use CT monitoring for the hospitals with intraoperative CT. Bipolar electrocoagulation was used for careful hemostasis in the presence of intraoperative bleeding. For diffuse bleeding, gauze and fluid gelatin were used for hemostasis until the dural sac and corresponding nerve root were relaxed under the microscope and there was no large active bleeding in the surgical field. After the surgery, the endoscope was removed and a drainage tube was placed in the channel, or the incision was sutured directly. Mannitol and methylprednisolone were routinely used after surgery for anti-infection and postoperative analgesia.

## 2.4 Evaluation indicators

(1) Surgical and recovery indicators were recorded and compared between the two groups, which mainly included: surgery time, incision length, postoperative drainage volume, out of bed activity time, length of stay, the Japanese Orthopaedic Association (JOA) scores of 7 days after surgery, pain degree, complications, activity of daily living, etc. Among them, JOA was used to assess the improvement of lumbar function of the two groups on day 7 after surgery. The scale included subjective symptoms, clinical signs, and restricted movement of daily life, with a total score of 0-29 points. Lower scores indicate more obvious dysfunction.

(2) Visual analogue scale (VAS)<sup>[5]</sup> was used to assess the pain degree of patients in the two groups

on day 1, day 7 and day 30 postoperatively, with the total score of 10 points. Higher scores indicate more severe pain.

(3) The ECOG was used to evaluate the patients' activity of daily living before and 3 months after surgery, with 5-point method (0-5 points) for the evaluation. Higher scores indicate worse activity of daily living<sup>[6]</sup>.

(4) The complications of the two groups were recorded, including wound infection, transient reduction of muscle strength, hypoproteinemia with wound drainage and delayed healing.

## 2.5 Statistical methods

SPSS 18.0 software was used for data processing, and " $\bar{x} \pm s$ " and n (%) were used to represent the measurement data and enumeration data, which were adopted with *t* test and  $\chi^2$  test. *P* < 0.05 was considered statistically significant.

## 3 Results

### 3.1 Comparison of surgery and recovery indicators

The surgery time, incision length, postoperative drainage volume, out of bed activity time and postoperative length of hospital stay of the experimental group were all less than those of the control group, whereas the JOA score of 7 days after surgery was higher than that of the control group, showing statistically significant differences (*P* < 0.05, Table 1).

**Table 1.** Comparison of surgery and recovery indicators ( $\bar{x} \pm s$ )

Group	Surgery time (min)	JOA score of 7 days after surgery (points)	Incision length (cm)	Out of bed activity (d)	Postoperative drainage volume (ml)	Postoperative length of hospital stay (d)
Control group (n=20)	248.25±10.21	16.52±2.03	18.11±1.01	5.12±2.03	624.56±63.65	12.32±1.36
Experimental group (n=8)	239.14±9.13	21.56±2.14	0.75±0.05	1.35±0.26	20.52±3.27	4.65±1.06
<i>t</i>	2.193	5.848	48.042	5.178	26.525	14.256
<i>P</i>	0.038	0.000	0.000	0.000	0.000	0.000

### 3.2 Comparison of pain degree

VAS scores of the two groups on day 1 and day 7 after surgery were significantly different (*P* < 0.05). There

was no significant difference in VAS scores between the two groups at day 30 after surgery, showing no significant difference (*P* > 0.05, Table 2).

**Table 2.** Comparison of VAS scores in two groups ( $\bar{x} \pm s$ , points)

Group	Day 1	Day 7	Day 30
Control group (n=20)	5.21±1.10	4.23±1.02	2.25±1.03
Experimental group (n=8)	3.20±1.06	2.23±1.04	2.02±0.98
<i>t</i>	4.442	4.662	0.541
<i>P</i>	0.000	0.000	0.593

### 3.3 Comparison of activity of daily living

There was no significant difference in preoperative ECOG score between the two groups ( $P > 0.05$ ). Three months

after surgery, the ECOG score of the experimental group was lower than that of the control group, and the difference was statistically significant ( $P < 0.05$ , Table 3).

**Table 3.** Comparison of ECOG scores in two groups ( $\bar{x} \pm s$ , points)

Group	Before surgery	3 months after surgery	<i>t</i>	<i>P</i>
Control group (n=20)	3.70±1.01	2.61±0.68	4.004	0.000
Experimental group (n=8)	3.68±1.02	1.56±0.48	8.410	0.000
<i>t</i>	0.047	5.642	-	-
<i>P</i>	0.963	0.002	-	-

### 3.4 Comparison of incidence of complications

The experimental group had 1 case of transient reduction of muscle strength and no case of wound infection, with the incidence of 12.50%. The control group had 2 cases of transient reduction of muscle strength, 1 case of wound infection, 2 cases of hypoproteinemia with wound drainage and delayed healing, with the incidence of 25.00%. The incidence of complications in the experimental group was slightly lower than that in the control group, but the difference was not significant ( $\chi^2=0.530$ ,  $P=0.466$ ).

## 4 Discussion

Patients with spinal metastasis are mostly in terminal stage, often accompanied by poor general conditions, great mental stress, even cachexia and other factors, especially the patients with recurrence after open surgery. When spinal cord nerve compression, severe neuralgia and neurological dysfunction occur in metastatic tumors, surgery is needed to save nerve function and improve the quality of life of patients. Here, it is necessary to point out that patients with advanced tumors have been paid more and more attention to alleviate pain and improve the quality of life, which is also in line with contemporary medical humanity ideas.

Spinal metastases have a serious impact on the

activity of daily living and quality of life of patients, so it is very important to give them active and effective treatment. In the past, non-surgical treatment methods such as radiotherapy, chemotherapy and biological treatment have been used to alleviate the pain of patients to a certain extent, but the treatment course is long, the side effects are large and the efficacy is uncertain, and the patients and clinical acceptance are low.

With the continuous development of surgical techniques, surgical methods such as tumor en bloc and palliative subtotal resection have been continuously applied in clinical practice. Although they can effectively remove the lesions, they are traumatized, and the bleeding is often thousands to tens of thousands of milliliters. Many patients need to stay in intensive care units after surgery, and they suffer from hypoproteinemia, malnutrition, wound infection, or delayed healing. The starting point of this surgical method is whether there is a more minimally invasive way to help patients cope with the impact of open surgery and relieve their pain.

Percutaneous transforaminal endoscopic technique is the least invasive spinal surgery at present. With the improvement of equipment and instruments and the continuous progress of optical technology, this technique has been continuously developed and gradually applied in clinical practice<sup>[7]</sup>. In addition to

the treatment of lumbar intervertebral disc herniation and now expanded to lumbar spinal canal soft and bone stenosis, lumbar intervertebral space infection, para-lumbar abscess, lumbar intervertebral disc calcification, cervical disc herniation, cervical spinal stenosis, etc., were all confirmed that spinal soft and bony decompression could be performed well under endoscope. The soft and bony compression caused by spinal metastases can be reduced by decompression through the transforaminal endoscope.

Holding the idea, in May 2015, we launched the first transforaminal endoscopic treatment of recurrent metastases of the sacrum. At that time, we looked up the literature at home and abroad and meeting and found no reports on it. The case was published in media such as Shenzhen TV station and business newspaper, and it was also reported in numerous academic conferences in the following years, the 2016 International Spinal Minimally Invasive Academic Conference, and the 2019 international ISOLS.

The application of transforaminal endoscopic technique in spinal metastasis can not only perform foraminotomy, but also cause no damage to the important bone and joint ligament structure of the lumbar spine, which will not affect the stability of the lumbar spine, so as to reduce the pain of patients and facilitate their postoperative recovery. In addition, for some weak patients with vertebral metastases, single segment spinal nerve root compression may cause nerve root pain. In clinic, single-channel percutaneous transforaminal technique can be used to remove the tumor, which is a relatively safe and effective method<sup>[8]</sup>. The results of this study showed that the postoperative drainage volume, incision length, out of bed activity time and length of hospital stay of the experimental group were all less than those of the control group, whereas the JOA score of 2 days after surgery was higher than that of the control group; VAS scores at 2 days and 7 days after surgery in the experimental group were lower than those in the control group, and ECOG scores at 3 months after surgery were lower than those in the control group, and the incidence of complications in the experimental group was slightly lower than that in the control group, which suggested that the transforaminal endoscope not only had small incision, small trauma and less postoperative drainage volume, but also promoted postoperative recovery, early mobilization and early discharge, and significantly reduced postoperative pain and incidence of complications of

patients with spinal metastases, which has better early clinical effects.

Because of the rinsing under the endoscope, it was impossible to accurately record the amount of intraoperative bleeding, but none of the patients in the experimental group needed blood transfusion, and the postoperative drainage volume was greatly reduced; the patient's face was ruddy after surgery, and there was no significant change in the blood routine hemoglobin after surgery. These all indicated that there was not much bleeding during the surgery, which had a larger clinical difference than traditional open palliative decompression.

In conclusion, transforaminal endoscope used in suitable patients with spinal metastases can greatly reduce the incision length, soft tissue and bone tissue damages, and postoperative drainage volume, promote early mobilization and early discharge, reduce complications, and improve their early mobility, which not only has the advantages of minimally invasive surgery, but also has the immediate effects that radioactive particles, embolization, freezing and other methods do not have.

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