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Retrospective study of anterior lesion clearance and posterior bone graft fusion internal fixation surgery for treatment of misdiagnosis lumbar vertebra tuberculosis

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Abstract: *To investigate the clinical efficacy of gelatin sponge-embedded streptomycin to construct an anti-tuberculosis sustained-release vector combined with primary anterior lesion clearance and post-bone grafting fusion internal fixation in patients with thoracic and lumbar tuberculosis after mistreatment. Retrospective analysis was made on 23 patients with thoracolumbar tuberculosis who were wrongly treated as (percutaneous vertebroplasty) fractures in our Hospital from March 2018 to January 2022. Four combination antituberculosis drugs were used for 2-4 weeks before operation, and standardized antituberculosis therapy was used for 12-18 months after operation. The main outcome measures included the visual analog scale (VAS), the Japanese Orthopedic Association (JOA), the Oswestry disability index (ODI), 36 short form health surveys (SF-36 scores), erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) and bone graft fusion assessed by patients before operation, one week after operation, and 12 months after operation. All 23 patients successfully completed the operation. The average operation time was (364.26±20.149) min, the average intraoperative blood loss was (864.21±54.81) mL, the average hospital stay was (21±1.9) days, and the bone graft fusion time was (6±0.62) mon. The VAS score of chest and back pain in the first week after operation was lower than that before operation (all $P<0.001$), which was further reduced in follow-up. The JOA score, ODI score and SF-36 score after operation were significantly different from those before operation ($P<0.05$). At the last follow-up, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) of all patients returned to normal. The satisfaction rate was 86.9% one week after operation and 95.7% 12 months after operation. The rates of significant and effective clinical effects 1 week and 12 months after operation were 21.7% and 69.6%. Respectively, the use of gelatin sponge-embedded streptomycin to construct an anti-tuberculosis sustained-release vector combined with a stage I anterior lesion combined with posterior bone graft fusion internal fixation has a good clinical effect in the treatment of mistreated lumbar vertebra tuberculosis, which is a safe technique for spine surgeons to choose.*

Keywords: *Spinal tuberculosis; Anterior and posterior surgery; Gelatin sponge; Bone graft fusion*

1. Introduction

The incidence rate of spinal tuberculosis has risen steadily in developing countries and has become a common orthopedics disease. Spine is more common in the thoracolumbar region, often involving the vertebral body and intervertebral space [1].The initial clinical symptoms lack characteristic manifestations, and the imaging manifestations are similar as other lumbar diseases. Laboratory examinations also have limitations. Therefore, it is easy to miss or misdiagnose early spinal tuberculosis [2] .Delayed diagnosis and treatment can lead to catastrophic consequences such as severe kyphosis, paraplegia, and even death [3]. Surgical intervention is one of the important measures for treating spinal tuberculosis.

In clinical practice, the choice of the best surgical method is still controversial. In the past, simple anterior and posterior approaches, combined anterior and posterior approaches, and minimally invasive surgery gradually developed in recent years were often used to treat spinal tuberculosis. Among them, the combination of anterior and posterior approaches is highly praised by most scholars, which can simultaneously achieve the goal of lesion clearance and spinal stability reconstruction[4]. But the surgical

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difficulty is high, the surgical process is long, and there is a large amount of intraoperative bleeding. Most patients have undergone surgery without a complete cure. Spinal tuberculosis is a special infectious disease with clear therapeutic bacteria, and its root is the standardized treatment of drugs. The application of anti-tuberculosis drugs needs to run through the entire treatment process [5].

Maroun B et al [6] .showed that the combination of drugs and surgical techniques can optimize the treatment effect in the treatment of spinal tuberculosis. There have been some reports on improving the local anti-tuberculosis effect through methods such as catheter administration and local placement of anti-tuberculosis drugs after lesion clearance [7]. However, local catheterization can cause inconvenience to the patient's movement and carry a risk of infection; After the local tuberculous focus is cleared, the local simple spraying of streptomycin powder will be diluted with the exudate and drained, and it is difficult to reach the long-term effective local blood concentration. Constructing a method that can release anti tuberculosis drugs in tuberculosis focus for a long time will not only help control local infection, but also reduce postoperative recurrence of spinal tuberculosis.

Gelatin sponge is a biopolymer material composed of collagen as the matrix, with good adsorption, high density porosity, and non-toxic biocompatibility [8]. It is easy to cut and fill local surgical sites, and can quickly control capillary and venous bleeding, forming stable adhesive clots. Promote wound healing, reduce bleeding, and prevent wound infection [9]. And, streptomycin, as a commonly used aminoglycoside antibiotic, can act on the DNA helicase of Mycobacterium tuberculosis and inhibit the DNA replication of pathogenic bacteria, and play an antibacterial role by destroying the integrity of bacterial cell membrane. But streptomycin cannot be taken orally. Long term intramuscular injection after surgery leads to poor local allergic reaction, pain, [10]and compliance of patients, which cannot continue to complete the whole course of treatment [11].

Therefore, we try to use gelatin sponge embedding streptomycin to construct an anti-tuberculosis sustained release carrier and combine anterior and posterior surgery to treat patients with post mistreatment Lumbar vertebra tuberculosis. To make up for the deficiency of routine use of streptomycin, it will also strengthen the repair and consolidation of spinal stability. The purpose of this study is to observe the safety of this innovative method and determine its clinical efficacy. This is the first time a new combination method has been used to treat Lumbar vertebra tuberculosis.

2. Materials and methods

2.1 General data

A case series analysis was conducted on 23 patients diagnosed and treated in our hospital from March 2018 to January 2022 who were mistakenly diagnosed as spinal fractures (PKP) due to Lumbar vertebra tuberculosis. After formal anti-tuberculosis treatment before surgery, a one-stage anterior lesion clearance combined with posterior bone grafting fusion internal fixation surgery was performed.

Inclusion criteria: (1) Patients with Lumbar vertebra tuberculosis were definitely diagnosed by X-ray, CT, MRI and other imaging signs, combined with clinical symptoms, preoperative erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), tuberculosis T-spot, polymerase chain reaction (PCR), metagenomics next generation sequencing (m NGS) and other laboratory results; (2) Patients who have received standardized anti-tuberculosis treatment after diagnosis [12], have persistent pain, progressive lesions, and enlarged abscesses; (3) Patients previously diagnosed with Lumbar vertebra vertebral osteoporotic fractures underwent L2 or L4 single vertebral body reconstruction surgery, but their postoperative symptoms did not improve; (4) Streptomycin skin test negative.

Exclusion criteria: (1) Patients with other severe heart and lung diseases who cannot tolerate surgery; (2) Patients with brucellosis or other spinal infections or tumors; (3) Lesions involving more than 3 or jumping vertebrae; (4) Severe liver and kidney function damage; (5) Patients with concomitant mental and cognitive impairments are unable to cooperate with postoperative treatment; (6) Patients with incomplete clinical data.

2.2 Preoperative preparation

Before the operation, patients were instructed to rest in bed, strengthen nutrition support treatment, correct anemia and hypoproteinemia, take anti osteoporosis treatment, actively treat hypertension, diabetes and other basic diseases, and strengthen anti tuberculosis treatment. All patients were treated with internationally standardized quadruple anti tuberculosis drugs (isoniazid, rifampicin, pyrazinamide

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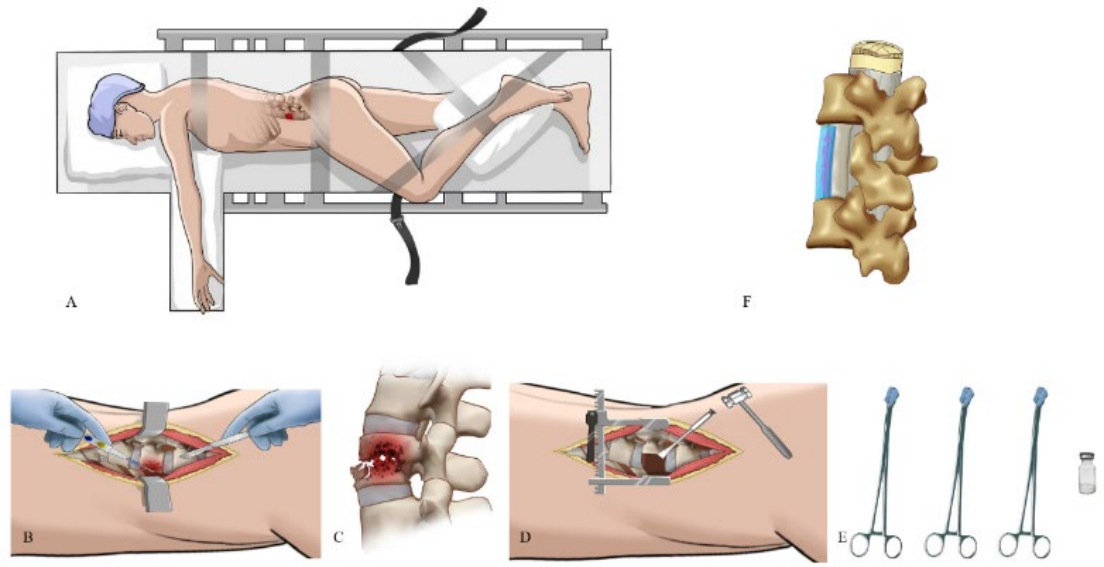
and ethambutol) for 2-4 weeks (anti tuberculosis treatment ATT). When the symptoms of systemic tuberculosis poisoning are relieved, ESR and CRP indicators are in a downward trend, and liver and kidney functions are good and can tolerate surgery, surgical treatment should be carried out.

2.3 Operative method

The patient first takes a lateral position, undergoes general anesthesia, and undergoes electromyography and somatosensory evoked potential testing throughout the surgery. Use X-ray fluoroscopy machine to determine the site of the surgical incision, take the left upper ventrolateral oblique incision, and cut downward along the lower edge of the ribs 1cm to the direction of the pubic symphysis to the outer edge of the rectus abdominis. Cut the skin layer by layer, subcutaneous, fascia, and blunt dissection of ribs that hinder exposure. Use rib scissors to remove most of the ribs. Continue to dissect the abdominal muscles and perform extraperitoneal separation. Separate the retroperitoneal fat, expose the diaphragm, and partially detach it. Fully expose the psoas major muscle downward, puncture the abscess, aspirate the pus and send it to smear for examination, tuberculous bacteria culture and drug sensitivity test, drug resistant tuberculosis detection, and thoroughly remove the abscess, caseous granulation tissue of the thoracolumbar segment, bone cement mass, necrotic discs and dead bones. Thoroughly stop bleeding, repeatedly rinse the thoracolumbar surgical area with hydrogen peroxide and physiological saline, and isolate the lesion incision with saline gauze.

Replace gloves and surgical instruments, disinfect and drape again, take three skin bones from the left iliac bone, use bone wax to stop bleeding, and implant the iliac bone and trimmed ribs into the thoracolumbar space. The compression bone graft is stably embedded, and the fluoroscopy shows that the position of the bone graft is good, and the vertebral body sequence and curvature are satisfactory. Thoroughly stop bleeding, repeatedly and fully flush with hydrogen peroxide solution and normal saline again, no active bleeding and foreign matter remained, check the dressing and instruments, place one closed thoracic drainage tube, and locally use gelatin sponge to embed 1g of streptomycin to construct anti tuberculosis sustained-release carrier.



Schematic diagram of combined operation of rubber sponge embedding streptomycin and anterior and posterior approaches. Intraoperative position (A). Cut open the skin, subcutaneous tissue, and fascia layer by layer to expose the infected vertebral lesion (B). Lesion display (C). Thoroughly remove the lesion (D). Gelatin sponge was prepared to embed streptomycin carrier (E). Schematic diagram of gelatin sponge landfill (F).

Figure 1: Steps of anterior lesion clearance and posterior bone graft fusion surgery

Suture the wound layer by layer. Remove the drape and adjust the patient's position to a prone position. Disinfect, lay sheets, and apply knife edge film. Take a longitudinal incision at the center of the affected vertebral body, and slice the skin, subcutaneous tissue, and the attachment of the paraspinal muscles on the spinous process layer by layer. Peel the paraspinal muscles under the periosteum. Expose bilateral spinous processes, vertebral lamina, and transverse processes, determine the insertion point of the pedicle, and implant Shandong Weigao titanium alloy screws. The perspective shows that the screw position is

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good. Install a longitudinal connecting rod with appropriate pre bending length for fixation, and the fluoroscopy shows that the bone graft and internal fixation positions are in good condition. Treat bilateral zygapophysial joint. Thoroughly rinse the wound, carefully stop bleeding, observe that there is no active bleeding inside the wound, trim the bone particles obtained during the surgery to a suitable size and soak them in gentamicin solution before implanting them into the prepared bone graft bed. Count the number of dressings and instruments correctly, place a drainage tube inside the wound, sew the wound layer by layer, and apply sterile dressing pressure to wrap it. The surgery is completed, as shown in Figure 1.

2.4 Postoperative treatment

Postoperative drainage tube placement for 24-72 hours. Routine use of antibiotics for 3-5 days to prevent infection, continued preoperative standardized quadruple anti tuberculosis treatment (ATT), and given liver protection medication. When the drainage volume is less than 50ml, the drainage tube is removed, and after 3 days of bed rest, a chest and lumbar brace can be worn to start moving down to the ground. Discharged one week after surgery, followed by X-ray examination before discharge. Standardize ATT treatment for 12-18 months after discharge, and adjust chemotherapy drugs based on drug sensitivity results for some patients confirmed to be drug-resistant tuberculosis after surgery. Review CRP, ESR, liver and kidney function indicators once a month, and review X-ray, 3D CT reconstruction, and MRI every 1, 3, 6, 9, and 12 months to observe the fusion of bone grafts, whether the internal fixation device is broken, loose, and local lesions, to prevent tuberculosis recurrence.

2.5 Observation indicators and efficacy evaluation

Collect basic clinical data of patients, including symptom duration, body mass index, surgical time, intraoperative blood loss, hospital stay, and bone graft fusion time. Follow up observation was conducted on all patients after surgery, and clinical, laboratory, and imaging data were collected, including preoperative, postoperative 1 week, and postoperative 12 months assessed chest and back pain visual analog score (VAS), Japanese Orthopedic Association score (JOA), Oswestry Disability Index (ODI), 36 Short Form Health Survey (SF-36) scores, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP). Calculate the improvement rate of JOA at 1 week and 12 months after surgery [improvement rate (%) = (post treatment score – pre-treatment score)/ (29 pre-treatment score)] × 100%. Efficacy criteria: The recovery and improvement rate is100%, with a rate of more than 60% being significantly effective, 25% -60% being effective, and less than 25% being ineffective. Record the satisfaction questionnaire for short-term and long-term postoperative surgery and potential complications, and observe the safety and effectiveness of this method. The patient was followed up independently by a research assistant for 1 year and relevant data were collected. This study was approved by the Hospital Ethics Committee (2018-2022).

2.6 Statistical analysis

Apply SPSS 28.0 (Inc, Chicago, IL, USA) statistical software for data analysis, and measure the data with (x±s) represents the use of one-way analysis of variance to compare preoperative and postoperative data, followed by paired t-tests (LSD-t). The counting data was tested using χ^2 test, and $P<0.05$ indicates a statistically significant difference.

3. Result

3.1 General information

A total of 23 patients who met the criteria were included in this study. There are 12 males and 11 females, with an average age of (31.73±3.94) years. The duration of symptoms ranged from 4 to 13 months, with an average of (7.739 ± 3.875) months. There were 13 cases of L2 vertebral infection and 10 cases of L4 vertebral infection. All patients received gelatin sponge embedding streptomycin to construct anti tuberculosis sustained release carrier combined with anterior revision focus removal and posterior iliac bone graft fusion and internal fixation. The average surgical time was (364.26± 20.149) minutes, the average intraoperative blood loss was (864.21 ± 54.81) mL, and the average hospital stay was (21 ± 1.9) days, as shown in Table 1.

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Table 1: General information and some clinical situations of patients

baseline information	numerical value (average value ±standard deviation)
Number of patients(*n*,*%*)	23
Male(*n*,*%*)	12(52.17)
Female(*n*,*%*)	11(47.82)
Age($\bar{X}$±s,year)	31.73±3.94
Body Mass Index(BMI $\bar{X}$±s, kg/m^2)	21±2.29
Duration of symptoms($\bar{X}$±s,month)	7.739±3.875
Infected vertebral body L_2	13
Infected vertebral body L_4	10
Operative time($\bar{X}$±s,min)	364.26±20.149
Intraoperative blood loss($\bar{X}$±s,ml)	864.21±54.81
Postoperative hospitalization days($\bar{X}$±s,d)	21±1.9
Bone graft fusion time($\bar{X}$±s,month)	6±0.62
Postoperative complications(*n,%*)	1(4.35)

3.2 Follow up results

All patients were followed up for 12 months. The VAS score of chest and back pain one week after surgery decreased compared to before surgery (all P<0.0001), and further decreased in subsequent follow-up (Table 2). At 12 months after surgery, the visual analog score for chest and back pain was (1.48±0.51), the ODI score was (12.70±1.52), the JOA score was (27.39±1.80), which increased compared to the preoperative value (8.26±2.82) (P<0.0001), the ESR was (7.13±1.46), the CRP was (8.13±2.75), and the total psychological and physiological scores of the SF-36 score were (49.70±6.41) and (55.43±8.02). At the last follow-up, the patient's emotional function (MCS) and physical function (PCS) were significantly higher than before surgery (Figure 2), and these indicators showed statistically significant differences compared to before surgery (P<0.05). As shown in (Table 3), the improvement rates of JOA at 1 week and 12 months after surgery were (47.8 ± 16.0) % and (91.5 ± 8.2) %, respectively. According to the improvement rate of JOA, the proportion of clinical efficacy significantly effective at 1 week and 12 months after surgery was 21.7% and 69.6%, respectively. The early postoperative satisfaction rate was 86.9%, with a very satisfactory rate of 56.5%. The satisfaction rate at 12 months after surgery was 95.7%, with a very satisfactory rate of 78.3% (Table 4). One year after surgery, outpatient follow-up X-ray showed that all patients had formed good intervertebral fusion.

Table 2: Comparison of clinical indicators before and after surgery ($\bar{X}$±s)

time	VAS (Chest and back)	ODI(score)	JOA(score)	ESR(mm·h^{-1})	CRP(mg/dL)	SF-36(score)	
						PCS	MCS
Preoperative (1)	7.91±1.16	69.17±6.64	8.26±2.82	42.43±4.90	65.26±18.38	29.17±5.65	30.96±4.93
1 week after surgery (2)	5.26±0.92	42.65±15.53	16.13±2.72	28.67±4.60	43.43±16.45	-	-
12 months after surgery (3)	1.48±0.51	12.70±1.52	27.39±1.80	7.13±1.46	8.13±2.75	49.70±6.41	55.43±8.02
F	248.741	191.430	343.536	461.125	93.077	132.674	155.432
P	<0.05*	<0.05*	<0.05*	<0.05*	<0.05*	<0.05*	<0.05*
Pairing comparison	T P	T P	T P	T P	T P	T P	T P
(1): (2)	10.678 <0.05*	10.747 <0.05*	-10.349 <0.05*	26.193 <0.05*	6.787 <0.05*	- -	- -
(1): (3)	29.763 <0.05*	46.838 <0.05*	-28.842 <0.05*	41.805 <0.05*	15.986 <0.05*	-10.676 <0.05*	-14.644 <0.05*

*P<0.05 vs Preoperative: "—" : Indicates no data ; VAS : visual analogue scale ; JOA score : Japanese Orthopaedic Association Scores ; ODI : Oswestry disability index ; SF-36 : 36-item Short-Form ; PCS : Physiological total score ; MCS : psychological Total score.

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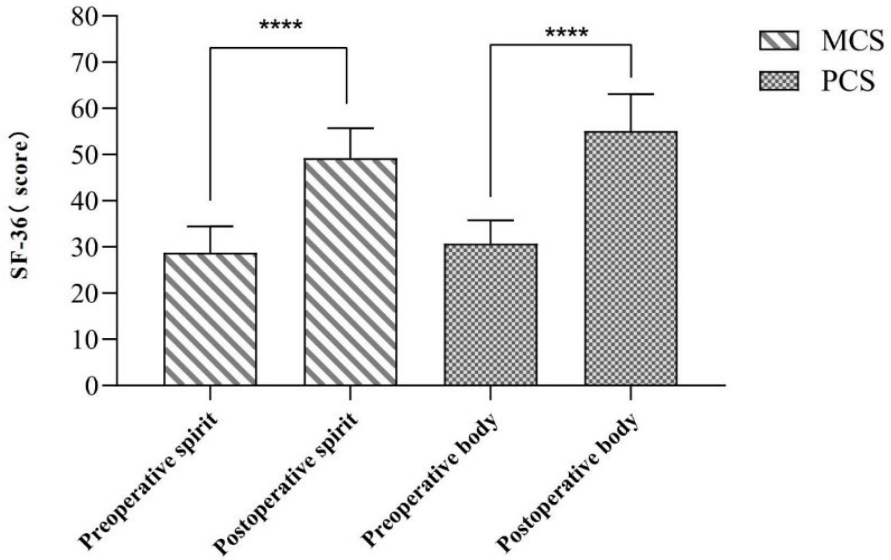

SF-36 (score):36-item short-form; The total psychological and physiological scores of SF-36 were (49.70±6.41) and (55.43±8.02), respectively. At the last follow-up, the patient's emotional function (MCS) and physical function (PCS) were significantly higher than before surgery (Figure 2). These indicators showed statistically significant differences compared to preoperative levels (P<0.05).

Figure 2: 36-item Short-Form (SF-36)

Table 3: Comparison of Clinical Efficacy Follow-up Observations ($\bar{X}$±s)

Follow-up time	Improvement Rate($\bar{X}$±s)		Clinical effects	(*n* / %)
		significantly effective	effective	invalid
1 week after surgery	47.8±16.0	5(21.7)	17(73.9)	1(4.3)
12 months after surgery	91.5±8.2	16(69.6)	7(30.4)	0(0.0)

Table 4: Comparison of patient satisfaction follow-up results ($\bar{X}$±s)

Follow-up time			Satisfaction	(*n* / %)
	super satisfied	satisfied	kind	Dissatisfied
1 week after surgery	13(56.5)	7(30.4)	1(4.3)	2(8.6)
12 months after surgery	18(78.3)	4(17.4)	0(0.0)	1(4.3)

3.3 Typical cases

Patient Li, male, 19 years old, was admitted due to low back pain for 1 week. The pain in the lower back is unbearable and cannot be relieved after rest. For further diagnosis and treatment, come to our hospital for treatment. Physical examination: Sensory and motor disorders in the L3-L5 nerve root innervated area, resulting in a decrease in muscle strength to level IV. Imaging examination: The DR anterolateral position and over flexion over extension position (Figure A-D) showed the presence of physiological curvature of the lumbar spine, but with varying degrees of bone destruction. Magnetic resonance imaging (Figure 3E,F) Flaky long T1 and T2 signals can be seen in the lumbar 2, 3, and 5 vertebral bodies and the lumbar 3 appendages, with high signal intensity in the liposomal sequence. The Lumbar 3 vertebral body become flattened and the dural sac at the same level is under pressure. CT (Figure G,H) indicates osteosclerosis in lumbar 3 and lumbar 5, with visible areas of bone destruction and dead bone shadows at the edges. Infectious lesions are considered. Laboratory examination: The T cell test for Mycobacterium tuberculosis is positive. Consider hospitalization diagnosis: L3 and L5 lumbar tuberculosis infection. According to the patient's condition, gelatin sponge embedding streptomycin combined with anterior and posterior combined surgery was performed. During the operation, the focus area was exposed by peeling under the periosteum, and abscess, caseous granulation tissue and dead bone were completely removed. (Figure 3I-K). Postoperative relief of patient symptoms. The X-ray examination after discharge showed that the position of bone grafting and internal fixation was good (Figure 3L, M).

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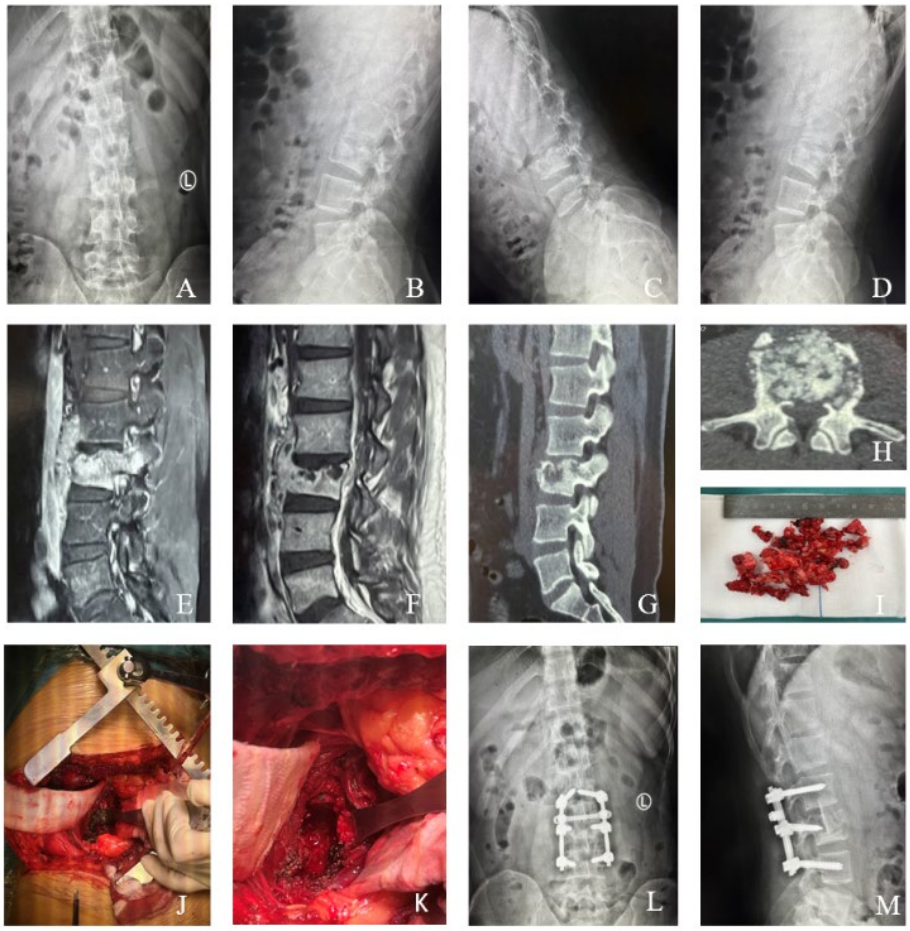

Lumbar spine X-ray position (A). Lumbar X-ray lateral position (B). Lumbar X-ray over flexion position (C). Lumbar X-ray overextension position (D). Lumbar magnetic resonance liposuppression imaging (E). Lumbar magnetic resonance sagittal position (F). Lumbar CT sagittal position (G). Intraoperative lesion display (J). Thoroughly remove the lesion and dead bone during surgery (K). Postoperative lumbar spine x-position (L). Postoperative lumbar X-ray lateral position.

Figure 3: Typical Case

4. Complication

One patient (4.35%) had complications, abnormal liver and kidney function and the patient gradually recovered after adjusting the chemotherapy regimen. No superficial or deep infection, cerebrospinal fluid leakage, and complications related to internal fixation (such as screw loosening and detachment).

5. Discussion

The advantages of gelatin sponge embedding streptomycin to construct anti tuberculosis sustained release carrier combined with anterior focus clearance and posterior bone graft fusion and internal fixation technology in this study are as follows: first, short-term lumbar and back pain relief; second, good performance in spine stability repair, disability index (ODI), quality of life score (JOA) improvement, patient satisfaction and complication rate. These results are satisfactory and have achieved the goal of improving the cure rate of tuberculosis while ensuring efficacy.

Although simple anterior surgery is an effective method that prioritizes the treatment of spinal tuberculosis and is considered the “gold standard” by most scholars. However, anterior internal fixation requires extensive exposure and relative integrity of residual vertebral bone, which can lead to screw graft erosion and fusion failure due to the destruction of the target infected vertebral body. Therefore, simple anterior lesion clearance, bone graft fusion, and internal fixation may require further optimization for patient functional recovery and spinal stability repair. A retrospective study by I TEOMAN et al [13].

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Also showed that patients who underwent only anterior debridement and fusion surgery had a correction rate of only 8.6% during follow-up, a correction loss rate of 23.6 °, and 29% of patients had pain symptoms that did not disappear at the last follow-up. In addition, the anterior approach can also easily damage important organs and blood vessels, which can cause the possibility of Mycobacterium tuberculosis spreading in the abdominal cavity during operation. Compared to simple posterior surgery where the exposure of the surgical field is not as sufficient as the anterior approach. A prospective randomized study by Ramakrishnan RK, et al [14]. Showed that posterior surgery (only posterior stabilization or overall reconstruction) is an effective method for the treatment of tuberculosis that affects thoracic vertebrae and TL vertebrae. The clinical (including neurological), functional, and radiological outcomes of these two surgeries (only posterior stabilization and overall reconstruction) are comparable. However, many scholars believe that it is difficult to completely remove the lesion through posterior surgery. Some operations need to be performed in the blind area of the field of vision, and there is also a risk of bringing the lesion into the normal posterior column of the spine, which may lead to complications such as dura mater and nerve damage, and can easily adhere to surrounding tissues after surgery. According to the long-term follow-up of Emel E et al [15].15% of the patients experienced back pain caused by incomplete clearance of tuberculosis foci in the last follow-up of conventional posterior surgery, and 66% of the patients finally received a second revision surgery to further alleviate the pain. Therefore, the combination of lesion clearance with thorough debridement and posterior bone graft fusion internal fixation under good exposure of the anterior lesion can achieve good therapeutic effects, maximizing lesion clearance and restoring spinal stability.

Garg B et al [16]. Reported that the functional improvement rates of 28atient evaluated by simple anterior lesion clearance, autologous bone graft fusion internal fixation, and simple posterior lesion clearance, bone graft fusion internal fixation surgery were as high as 94.4% and 88.23%, respectively. However, this study did not use commonly accepted evaluation criteria such as VAS, JOA, ODI, and SF-36 scores. The characteristic of this study is to construct a local sustained-release carrier to increase blood drug concentration so that the concentration and duration of action of anti-tuberculosis drugs do not decrease due to drainage. Subsequent follow-up for a long period of time has shown that the long-term clinical efficacy, safety, and reliability of the evaluation are satisfactory.

In summary, the first stage anterior lesion removal and posterior bone graft fusion internal fixation surgery resulted in complete removal of the lesion and dead bone, and stable structural bone grafting. Local application of anti-tuberculosis drugs has precise, long-lasting, and sustained-release efficacy, reducing potential recurrence of stubborn tuberculosis bacteria. The accurate interpretation of preoperative patients' X-ray films, CT and MRI optimized [17]the treatment of tuberculosis [18]. The combination of these advantages has improved the long-term JOA score of patients after surgery, even surpassing the combination of pre and post-surgery without the construction of sustained-release carriers in terms of patient satisfaction [19].

In clinical practice, combined with molecular biomaterials such as bone cement embedded in gelatin technology, other anti-tuberculosis drugs embedded in gelatin have also shown good therapeutic effects[20]. In the future, robots can also be combined to improve the speed of intraoperative cleaning of tuberculosis erosive vertebral bodies, reduce surgical difficulty, reduce operator fatigue and operational errors, and improve surgical efficiency [21]. In terms of experiments, the addition of tuberculosis drug resistance gene testing involves taking samples from patients' bodies, comparing gene bank data, amplifying RNA [22]and adding fluorescence for diagnosis [23]. Provide new ideas for the prognosis and treatment of tuberculosis [24].

The limitations of this study lie in the small sample size and the lack of a control group in clinical practice. Although this method can be used to significantly reduce the number and virulence of local tuberculosis bacteria adhering to host cells at certain times after surgery, the specific duration of action of the sustained-release carrier is still unknown. The maintenance of long-term clinical outcomes still relies on intravenous or oral anti tuberculosis drugs. Further research is needed to further confirm the correlation between anterior and posterior combined surgery combined with gelatin sponge embedding streptomycin in the treatment of mistreated thoracolumbar tuberculosis. In order to improve the satisfaction of tuberculosis patients with surgery and improve the quality of life of tuberculosis patients, efforts should be made to promote the early recovery of patients.

6. Conclusion

It is safe and effective to use gelatin sponge to embed streptomycin to construct anti tuberculosis

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sustained release carrier, and to combine anterior debridement with posterior bone graft fusion and internal fixation to treat lumbar vertebra tuberculosis after vertebroplasty. Compared with previous studies, it seems to be a feasible technique for treating spinal tuberculosis, which is beneficial for bone fusion in the bone graft area and the cure and improvement of spinal tuberculosis, correcting patients' kyphosis deformity, and restoring spinal biomechanical stability.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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