Outcome of One-Stage Percutaneous Endoscopic Debridement and Lavage Combined with Percutaneous Pedicle Screw Fixation for Lumbar Pyogenic Spondylodiscitis

Jianquan Chen

Guangzhou University of Chinese Medicine

Zhenyu Li

Guang Dong Province Hospital Of Traditional Chinese Medicine ZHUHAI BRANCH

Yong Li

Guang Dong Province Hospital Of Traditional Chinese Medicine ZHUHAI BRANCH

Shangde Tang

Guang Dong Province Hospital Of Traditional Chinese Medicine ZHUHAI BRANCH

Zhouming Lv

Guang Dong Province Hospital Of Traditional Chinese Medicine ZHUHAI BRANCH

Xian Wang

Guangzhou University of Chinese Medicine

Maoshui Chen (✉ spinecms2020@126.com)

Guang Dong Province Hospital Of Traditional Chinese Medicine ZHUHAI BRANCH

Research Article

Keywords: Spondylodiscitis, Debridement, Percutaneous pedicle screw fixation, Persistent local irrigation, Minimally invasive surgery

Posted Date: June 28th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-639708/v1>

License: This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Version of Record: A version of this preprint was published at Journal of Orthopaedic Surgery on September 1st, 2021. See the published version at <https://doi.org/10.1177/23094990211065579>.

Abstract

Background

This study assessed the therapeutic effect of one-stage percutaneous endoscopic debridement and lavage (PEDL) combined with percutaneous pedicle screw fixation (PPSF) in the treatment of lumbar pyogenic spondylodiscitis.

Methods

From March 2017 to October 2019, 25 patients diagnosed with pyogenic spondylodiscitis underwent PPSF followed by PEDL in our department. Biopsy specimens were examined for microorganisms and evaluated histopathologically. Clinical outcomes were assessed by physical examination, routine serological testing, visual analogue scale (VAS), Oswestry Disability Index (ODI), and imaging studies.

Results

All operations were successful, with no severe surgical complications in any patient and excellent incision healing. Causative bacteria were identified in most cases; *Staphylococcus aureus* was the most prevalent. The mean follow-up was 25.0 ± 3.8 (range: 20–32) months. Inflammatory markers showed that infection was controlled. The VAS and ODI improved significantly. At the last follow-up, magnetic resonance imaging showed that the infected lesions had disappeared.

Conclusion

PEDL supplementing PPSF may be useful for patients with single-level lumbar pyogenic spondylodiscitis, as it is minimally invasive, especially for patients who cannot undergo conventional open surgery due to poor health or advanced age.

Background

Spondylodiscitis is a serious, complex spinal infection of unknown aetiology. It may occur in association with invasive lumbar surgery, long-term hormone use, haemodialysis, and intravenous drug injection[1]. The typical signs and symptoms of spondylodiscitis include spasmodic low back pain with or without radiation to the lower extremity. Infectious spondylitis can lead to the destruction of intervertebral discs, endplates, and vertebral bodies[2]. Delayed diagnosis and treatment are common because of the lack of clinical specificity in the early stage, imaging examinations, and serologic testing, which may lead to the failure to identify tuberculosis, *Brucella*, and other lumbar-specific infections. Patients with advanced age, immunocompromised status, and diabetes are often prone to deterioration and require significant clinical attention[3].

The use of appropriate antibiotics and bedrest can be an effective conservative treatment, with surgical treatment reserved for patients with severe thoracolumbar kyphosis deformity or progressive vertebral column instability, epidural abscess, or significant neurological deficits. Traditional surgical approaches for lumbar pyogenic spondylitis include anterior, posterior, and anteroposterior debridement combined with internal fixation. However, downsides include massive surgical trauma, more bleeding, and slow recovery[4]. The risk of perioperative complications is greatly increased in elderly patients with multiple comorbidities. In recent years, percutaneous endoscopic discectomy has been widely used in spinal disease and proved advantageous. Some scholars also reported using minimally invasive endoscopic surgery to manage lumbar infectious spondylitis satisfactorily[5–7]. Here, we examined whether percutaneous endoscopic debridement and lavage (PEDL) combined with percutaneous pedicle screw fixation (PPSF) is adequate for treating lumbar pyogenic spondylodiscitis, in conjunction with appropriate postoperative antibiotics.

Methods

Study population

The study was conducted after prior written consent was obtained from all patients and approval was received from the Ethics Committee of the Hospital.

From March 2017 to October 2019, 25 patients [10 females, 15 males; average age = 56.3(range:34–75)years] diagnosed with pyogenic spondylodiscitis were retrospectively enrolled in our study. These patients underwent PEDL combined with PPSF in our department. All patients were infected at a single level from L2/3 to L5/S1, including three at L2/3, seven at L3/4, nine at L4/5, and six at L5/S1. Two patients had rheumatoid arthritis, one had dermatomyositis, one had laparoscopic appendectomy, and five had recent lumbar invasive treatment (including acupotomological release and percutaneous subarachnoid root block). All patients presented with intractable back pain that worsened when the position changed, as well as fever and other non-specific infection signs. Eight patients presenting with epidural abscess formation reported radicular pain and numbness in the lower limbs. No patient had cauda equina injury, such as bowel/bladder dysfunction. Five patients had irregular fevers with an average temperature of 38.7°C (range: 38.1–39.2°C) before admission.

Serologic testing, including the white blood cell count (WBC), C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), and procalcitonin (PCT), helped confirm the diagnosis of lumbar pyogenic spondylodiscitis. Imaging examinations comprised X-rays, computed tomography (CT), and magnetic resonance imaging (MRI). For febrile patients, blood cultures were performed.

Our inclusion criteria for surgery were patients with the following: lumbar infectious spondylitis at a single level; consequent intolerable back or radiating pain that cannot be managed conservatively; progressive neurological damage; epidural abscess; and spinal instability caused by significant structural destruction. Patients were excluded from this study for the following reasons: multi-level lumbar

infectious spondylitis; the range of any paravertebral abscess exceeds the affected vertebra; elderly patients in poor general condition; failure to complete follow-up and incomplete clinical medical records; diagnosed with a specific infection, such as *Mycobacterium tuberculosis* or *Brucella*; or severe osteoporosis.

Operative procedure

The surgery was performed at the level where infection was observed on preoperative MRI. Under general anaesthesia, each patient was positioned prone on a radiolucent frame suitable for fluoroscopy. To avoid excessive radiation, a percutaneous pedicle screw guidewire was inserted at the same time as the endoscopic cannulated sleeve was placed.

The target vertebral pedicles and intervertebral space were marked under fluoroscopic guidance. A vertebroplasty needle was inserted toward the pedicle and vertebral body before replacing it with a guidewire. After making a ~ 1 cm stab incision for each screw, dilation along the guidewire and pedicle tapping were done. The pedicle screws were inserted along the prepared trajectory. Fluoroscopic examination was necessary to verify correct pedicle screw placement. Pedicle rods were passed through the relevant trajectories of the screws.

All endoscopic debridement was performed using the system (MaxMoreSpine, Unterföhring, Germany). Yeung's technique was used to access the target site for debriding. The target disc was located and the entry site was marked on the skin under fluoroscopic guidance. All cases were treated using a transforaminal approach. A spinal needle was inserted directly into the target disc through Kambin's triangle. The abscess was aspirated for culture. A guidewire was introduced into the disc space through a spinal needle, which was then withdrawn. The skin was cut off 0.5 cm from the centre of the guidewire, and a dilator and cannulated sleeve were guided over the wire and passed sequentially into the disc space. Fluoroscopic examination was performed in two orthogonal planes to verify the correct position of the dilator tip. The endoscope was then passed through the cannulated sleeve after removing the dilator, and a cutting tool was inserted to harvest a biopsy specimen. Under saline irrigation, the infected disc structures were visible on the camera monitor. Debridement was performed piecemeal by manipulating the forceps, flexible rongeurs, and bipolar coagulation into different positions to withdraw as much necrotic tissue as possible. After biopsy and debridement, about 1,500 mL of physiological saline was used for irrigation. Finally, double-cavity flushing drainage catheters were placed in the debrided segment and connected to negative pressure suction for postoperative irrigation.

Postoperative management

Postoperatively, 1,500 mL of saline containing a broad-spectrum antibiotic was irrigated locally every day via continuous irrigation and flushing. The wound access was monitored closely for 24 hours and any colour change of the drainage fluid was noted. The drainage tube was removed when the results of microbial culture became available and the CRP declined to the normal range, or to the level before spondylodiscitis. Patients with positive blood and tissue cultures were given appropriate antibiotics intravenously for 2–3 weeks, followed by oral antibiotics for 6–8 weeks. The antibiotic regime of choice

covered common Gram-negative and -positive bacteria when there was histopathological pyogenic infection but negative bacterial cultures. A brace was worn for 3 months after surgery.

Outcome assessment

The preoperative status and postoperative clinical outcomes were assessed using a visual analogue scale (VAS) and the Oswestry Disability Index (ODI). Infection control was assessed by changes in the WBC count, CRP, ESR, and PCT. Plain radiographs and CT were done after 1, 3, 6, and 12 months. When necessary, MRI (including enhanced MRI) was done to assess the local condition of the treated vertebral segment and check for the presence of any epidural or paraspinal abscesses.

Statistical methods

The outcomes before and after surgery were compared at various time points using paired *t*-tests. A value of *p* < 0.05 was considered statistically significant. SPSS software (ver. 23.0; IBM Corp., Armonk, NY, USA) was used for the statistical analyses.

Results

All 25 patients were treated successfully; there were no major perioperative complications and incision healing was excellent. The average drainage time was 8 (range: 6–10) days. The mean operating time was 100 ± 12.5 (range: 90–115) min, with intra-operative blood loss of 46.1 ± 11.0 (range: 30–60) mL. The low back pain and lower limb radiation pain largely resolved immediately after the operation. As shown in Table 1, the WBC, CRP, and ESR at 1 week and 1, 3, 6, and 12 months after surgery were lower than before surgery (*p* < 0.05). There were significant (*p* < 0.05) differences in VAS and ODI between pre-treatment and postoperatively.

Table 1
Clinical outcomes and serological detections before and after surgery in successfully treated patients (N = 14, mean ± SD)

Parameter	Pre-OP	1 month post-OP	3 months post-OP	6 months post-OP	12 months post-OP
White blood cell (WBC)(x 10 ⁹ /L)	10.504 ± 1.240	9.127 ± 1.023	5.744 ± 0.542	5.254 ± 0.631	5.359 ± 0.554
C-reactive protein(CRP) (mg/L)	107.191 ± 12.918	89.598 ± 8.388	58.828 ± 8.661	5.360 ± 0.716	4.205 ± 0.797
Erythrocyte sedimentation rate (ESR)(mm/h)	61.680 ± 4.732	55.960 ± 5.397	45.440 ± 4.021	35.360 ± 4.261	11.420 ± 1.698
Visual analog scale (VAS)	7.760 ± 0.732	1.920 ± 0.862	1.160 ± 0.688	0.520 ± 0.510	0.280 ± 0.458
Oswestry Disability Index (ODI)	67.889 ± 5.455	25.410 ± 1.933	17.350 ± 1.797	13.580 ± 2.686	5.143 ± 1.593

Blood cultures grew pathogenic bacteria in two febrile patients: one case of methicillin-resistant *Staphylococcus aureus* and one of *Escherichia coli*. Postoperative pathological results showed tissue degeneration and necrosis, accompanied by significant acute and chronic inflammatory cell infiltration, fibrous tissue, and granulomatous hyperplasia, but no obvious caseous necrosis.

Causative bacteria were identified in the biopsy specimens of 11 (44%) of the 25 patients. *S. aureus* was the most common organism (n = 8), followed by *E. coli* (n = 3) and *Enterococcus faecalis*, *Staphylococcus epidermidis*, and *Streptococcus pneumoniae* (all n = 1) (Table 2).

Table 2
Cultured pathogens detected (n patients)

Cultured pathogens	Number
<i>Staphylococcus aureus</i>	8
<i>Escherichia coli</i>	3
<i>Enterococcus faecalis</i>	1
<i>Staphylococcus epidermidis</i>	1
<i>Streptococcus pneumoniae</i>	1
None identified	11

In the long term, CT showed that the reactive hyperplastic bone around the debrided disc space fused solidly with satisfactory stability (Figs. 1), ensuring a good clinical outcome. X-rays showed no signs of spinal instability in any patient and MRI showed no signs of recurrence in the treated vertebral segment.

Discussion

The incidence of lumbar infectious spondylitis is increasing. Clinically, the elderly and people with diabetes, poor nutrition, and autoimmune diseases are prone to infectious spondylitis. Most infections are blood borne. Pathogenic bacteria spread from the endplate to the intervertebral disc and then invade the adjacent vertebral body, causing severe low back pain and lumbar muscle spasm as a result of increased disc pressure. Nerve root compression by large abscesses may lead to severe radiating lower limb pain[8, 9]. In this study, five (20%) patients had recently undergone lumbar acupotomy release and other aggressive manipulations, and the infection might have been related to the invasive lumbar procedure.

Delayed diagnosis and treatment of spondylitis are common because the early clinical findings are non-specific. Routine laboratory tests (WBC count, ESR, CRP, and PCT), although very sensitive to infection, have poor diagnostic specificity. MRI can detect signs of infection early; however, the false-positive rate is very high. Percutaneous disc biopsy can be used to culture microorganisms and select appropriate antibiotics, but its detection rate is low. Negative microbial cultures do not rule out infection if the patient

has been treated with antibiotics before sampling[10]. A positive intervertebral space tissue specimen culture is the gold standard for diagnosing pathogenic microorganisms. However, the positive rate of microbial culture after a needle biopsy varies greatly among researchers[11, 12]. CT-guided percutaneous biopsy, debridement, and drainage are safe and effective in spondylodiscitis[13]. The diagnosis of lumbar infectious spondylitis is based on the patient's symptoms, imaging examination, serologic testing, pathology, bacteriology, and molecular biology. Preoperative blood cultures serve as a basis for diagnosis. In our series, five patients were febrile preoperatively, and two had positive blood cultures, providing a reliable basis for diagnosis.

The treatment of lumbar intervertebral space infection can be conservative or surgical. Conservative treatment mainly involves bedrest and appropriate antibiotics, and can cure most cases of lumbar infectious spondylitis[14]. However, the intervertebral disc blood supply is poor, and it is difficult to maintain effective antibiotic concentrations in the lesions. Vancomycin, clindamycin, and quinolone can achieve effective concentrations in bone, but the treatment is long and the effect is slow. Good patient compliance is needed to achieve a therapeutic effect. Therefore, some scholars suggest that early surgical treatment is needed to avoid long-term bed rest and improve the quality of life of these patients[15]. In the elderly, the effects of conservative treatment are worse than in young people. We suggest early surgical treatment for debridement, rapid symptom relief, and restoration of spinal stability, and to avoid the complications associated with prolonged bed rest.

In patients undergoing surgery, postoperative antibiotics are important. All our patients received intravenous antibiotics for 2–3 weeks postoperatively, followed by oral antibiotics for 6–8 weeks. The antibiotics can be discontinued when the WBC count, ESR, CRP, and PCT return to normal. Open surgery is recommended if low back pain recurs, the serological indexes rise, there is progressive bone tissue destruction on CT, or MRI indicates that the lesion continues to spread.

Surgical approaches included anterior, posterior, and combined approaches[16]. The anterior approach alone can completely remove lesions from the anterior middle column and retain the posterior ligament complex, but cannot remove spinal canal lesions; its disadvantages include unstable internal fixation, a prolonged bedridden period, and more surgical complications[17, 18]. Posterior open surgery has disadvantages such as incomplete clearance of anterior lesions, easy diffusion of infection to the spinal canal and posterior healthy tissue, and destruction of the normal posterior ligament complex[4, 19]. With either open approach, the infection readily spreads to the internal fixation surface, and it is difficult to kill all bacteria this may lead to internal fixation failure. All of our patients underwent minimally invasive percutaneous pedicle screw internal fixation via the vertebrae and healthy muscle, avoiding contact of the internal fixation with infected areas. Patients with lumbar infectious spondylitis often have many comorbidities and low immune function, and cannot tolerate traditional open surgery[20, 21]. Minimally invasive debridement can achieve good clinical results, with less trauma and rapid recovery[22, 23]. Percutaneous endoscopy allows a bacteriological diagnosis, the identification of suitable antibiotics, and symptom relief[24]. Minimally invasive endoscopic treatment is effective in lumbar pyogenic

spondylodiscitis, with less trauma and lower risk than traditional open surgery; moreover, it does not affect lumbar stability[5, 25].

Early debridement and drainage is preferred for treating lumbar intervertebral infection[26]. Continuous irrigation dilutes and removes pathogens, inflammatory factors, and necrotic tissue. Combined with antibiotics, it kills pathogenic bacteria, inhibits inflammation, and relieves symptoms. Continuous perfusion is used to prevent blockage of the drainage tube. We performed continuous daily postoperative perfusion and irrigation with 0.9% normal saline (1,000 mL) and 6×10^6 U gentamicin. The drainage tube was removed after 7–10 days when the drainage was clear and there were two consecutive negative bacterial cultures. However, the lack of strong internal fixation can lead to vertebral collapse and spinal deformity, which can cause low back pain and poor infection control[27]; percutaneous endoscopic debridement with PPSF for lumbar pyogenic spondylodiscitis can relieve the symptoms and restore spinal stability[28]. In our series, all patients had posterior internal fixation to restore spinal stability and the physiological curvature of the spine, providing a good mechanical environment for spinal fusion and focal immobility. In the long term, CT showed obvious bone bridge formation around the debrided disc space, indicating satisfactory stability.

Conclusions

Lumbar intervertebral space infection requires an early diagnosis and antibiotic treatment based on drug sensitivity results. For patients with surgical indications, one-stage PEDL combined with PPSF is effective for treating lumbar intervertebral space infection, with little trauma, blood loss, or intra-operative infection spread, and faster neurological and functional recovery. This was a retrospective study with a small sample size; while the early results are satisfactory, longer follow-up is needed to confirm long-term efficacy.

Abbreviations

PEDL

percutaneous endoscopic debridement and lavage; **PPSF**: percutaneous pedicle screw fixation; **VAS**: Visual analog scale; **ODI**: Oswestry disability index; **WBC**: white blood cell count; **CRP**: C-reactive protein; **ESR**: Erythrocyte sedimentation rate; **PCT**: procalcitonin; **CT**: computed tomography; **MRI**: Magnetic resonance imaging;

Declarations

Ethics approval consent to participate

Informed consent was obtained in writing from all the individual participants included in the study. This retrospective study protocol was approved by the ethics committee of the Medical Faculty at the Guangzhou University of Traditional Chinese Medicine, Guangzhou, China.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are not publicly available due to feasibility but are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing financial interests.

Funding

No Funding.

Author's contributions

CJQ, LVM, LZY, CMS made substantial contributions to conception and design of the study along with analysis and interpretation of data. CJQ, WX,TSD, LY,ZXF have been involved in the drafting of the manuscript and have given final approval of the version to be published.

Acknowledgments

Not Applicable.

References

1. Helewa RM, Embil JM, Boughen CG, Cheang M, Goytan M, Zacharias JM, Trepman E: **Risk factors for infectious spondylodiscitis in patients receiving hemodialysis.** *Infect Control Hosp Epidemiol* 2008, **29**(6):567–571.
2. Kourbeti IS, Tsiodras S, Boumpas DT: **Spinal infections: evolving concepts.** *Curr Opin Rheumatol* 2008, **20**(4):471–479.
3. Chung TC, Yang SC, Chen HS, Kao YH, Tu YK, Chen WJ: **Single-stage anterior debridement and fibular allograft implantation followed by posterior instrumentation for complicated infectious spondylitis: report of 20 cases and review of the literature.** *Medicine (Baltimore)* 2014, **93**(27):e190.
4. Wang X, Zhou J, Zhang C, Liu Z: **Single-stage anterior debridement and fusion with autografting and internal fixation for pyogenic lumbar spondylodiscitis.** *Arch Orthop Trauma Surg* 2012, **132**(4):487–493.
5. Yang SC, Fu TS, Chen HS, Kao YH, Yu SW, Tu YK: **Minimally invasive endoscopic treatment for lumbar infectious spondylitis: a retrospective study in a tertiary referral center.** *BMC Musculoskelet Disord* 2014, **15**:105.

6. Yang SC, Chen WJ, Chen HS, Kao YH, Yu SW, Tu YK: **Extended indications of percutaneous endoscopic lavage and drainage for the treatment of lumbar infectious spondylitis.** *Eur Spine J* 2014, **23**(4):846–853.
7. Hsu LC, Tseng TM, Yang SC, Chen HS, Yen CY, Tu YK: **Bilateral Portal Percutaneous Endoscopic Debridement and Lavage for Lumbar Pyogenic Spondylitis.** *Orthopedics* 2015, **38**(10):e856-863.
8. Park Y, Ha JW, Lee YT, Sung NY: **The effect of a radiographic solid fusion on clinical outcomes after minimally invasive transforaminal lumbar interbody fusion.** *Spine J* 2011, **11**(3):205–212.
9. Ziu M, Dengler B, Cordell D, Bartanusz V: **Diagnosis and management of primary pyogenic spinal infections in intravenous recreational drug users.** *Neurosurg Focus* 2014, **37**(2):E3.
10. Bhagat S, Mathieson C, Jandhyala R, Johnston R: **Spondylodiscitis (disc space infection) associated with negative microbiological tests: comparison of outcome of suspected disc space infections to documented non-tuberculous pyogenic discitis.** *Br J Neurosurg* 2007, **21**(5):473–477.
11. Heyer CM, Brus LJ, Peters SA, Lemburg SP: **Efficacy of CT-guided biopsies of the spine in patients with spondylitis—an analysis of 164 procedures.** *Eur J Radiol* 2012, **81**(3):e244-249.
12. Yang SC, Fu TS, Chen LH, Chen WJ, Tu YK: **Identifying pathogens of spondylodiscitis: percutaneous endoscopy or CT-guided biopsy.** *Clin Orthop Relat Res* 2008, **466**(12):3086–3092.
13. Xu J, Zhang L, Bu R, Liu Y, Lewandrowski KU, Zhang X: **Minimally invasive debridement and drainage using intraoperative CT-Guide in multilevel spondylodiscitis: a long-term follow-up study.** *BMC Musculoskelet Disord* 2021, **22**(1):120.
14. Gillard J, Boutoille D, Varin S, Asseray N, Berthelot JM, Maugars Y: **Suspected disk space infection with negative microbiological tests-report of eight cases and comparison with documented pyogenic discitis.** *Joint Bone Spine* 2005, **72**(2):156–162.
15. Gessler F, Mutlak H, Tizi K, Senft C, Setzer M, Seifert V, Weise L: **Postoperative patient-controlled epidural analgesia in patients with spondylodiscitis and posterior spinal fusion surgery.** *J Neurosurg Spine* 2016, **24**(6):965–970.
16. Guerado E, Cervan AM: **Surgical treatment of spondylodiscitis. An update.** *Int Orthop* 2012, **36**(2):413–420.
17. D'Aliberti G, Talamonti G, Villa F, Debernardi A: **The anterior stand-alone approach (ASAA) during the acute phase of spondylodiscitis: results in 40 consecutively treated patients.** *Eur Spine J* 2012, **21** Suppl 1:S75-82.
18. Kim SH, Kang MS, Chin DK, Kim KS, Cho YE, Kuh SU: **Anterior lumbar interbody fusion for the treatment of postoperative spondylodiscitis.** *J Korean Neurosurg Soc* 2014, **56**(4):310–314.
19. Lee JS, Suh KT: **Posterior lumbar interbody fusion with an autogenous iliac crest bone graft in the treatment of pyogenic spondylodiscitis.** *J Bone Joint Surg Br* 2006, **88**(6):765–770.
20. Yee DK, Samartzis D, Wong YW, Luk KD, Cheung KM: **Infective spondylitis in Southern Chinese: a descriptive and comparative study of ninety-one cases.** *Spine (Phila Pa 1976)* 2010, **35**(6):635–641.

21. Moritani T, Kim J, Capizzano AA, Kirby P, Kademian J, Sato Y: **Pyogenic and non-pyogenic spinal infections: emphasis on diffusion-weighted imaging for the detection of abscesses and pus collections.** *Br J Radiol* 2014, **87**(1041):20140011.
22. Verdu-Lopez F, Vanaclocha-Vanaclocha V, Mayorga-Villa JD: **Minimally invasive spine surgery in spinal infections.** *J Neurosurg Sci* 2017, **61**(3):303–315.
23. Wang X, Zhou S, Bian Z, Li M, Jiang W, Hou C, Zhu L: **Unilateral percutaneous endoscopic debridement and drainage for lumbar infectious spondylitis.** *J Orthop Surg Res* 2018, **13**(1):306.
24. Yang SC, Chiu YC, Chen HS, Kao YH, Jou IM, Tu YK: **Percutaneous endoscopic debridement and drainage for the treatment of instrumented lumbar spine infection.** *J Orthop Surg (Hong Kong)* 2019, **27**(3):2309499019863356.
25. Fu TS, Chen LH, Chen WJ: **Minimally invasive percutaneous endoscopic discectomy and drainage for infectious spondylodiscitis.** *Biomed J* 2013, **36**(4):168–174.
26. Stuer C, Stoffel M, Hecker J, Ringel F, Meyer B: **A staged treatment algorithm for spinal infections.** *J Neurol Surg A Cent Eur Neurosurg* 2013, **74**(2):87–95.
27. Yang SC, Fu TS, Chen LH, Niu CC, Lai PL, Chen WJ: **Percutaneous endoscopic discectomy and drainage for infectious spondylitis.** *Int Orthop* 2007, **31**(3):367–373.
28. Duan K, Qin Y, Ye J, Zhang W, Hu X, Zhou J, Gao L, Tang Y: **Percutaneous endoscopic debridement with percutaneous pedicle screw fixation for lumbar pyogenic spondylodiscitis: a preliminary study.** *Int Orthop* 2020, **44**(3):495–502.

Figures

Figure 1

Exemplary case of a 73-year-old male was diagnosed as having L4-5 pyogenic spondylodiscitis. MRI revealed L4/5 infection with a paraspinal abscess (a,b,c,d). The insertion of a percutaneous pedicle screw guide wire is performed guidewire was inserted at the same time as the placement of the endoscopic cannulated sleeve was placed(e,f,g). On endoscopic views, debridement was performed piecemeal by manipulating the forceps to withdraw as much necrotic tissue as possible(h). T2-weighted MR images

demonstrated no compression of dural sac, and smooth signal of cerebrospinal fluid at 12 months(I,J). CT images demonstrated bony fusion on the sagittal and coronal view at 12 months(K,I) Good stability of lumbar spine was obtained after surgery with no screw loosening(M,N).