

World Journal of *Clinical Cases*

World J Clin Cases 2021 June 16; 9(17): 4116-4459



Contents

Thrice Monthly Volume 9 Number 17 June 16, 2021

EDITORIAL

- 4116 Is it time to put traditional cold therapy in rehabilitation of soft-tissue injuries out to pasture?
Wang ZR, Ni GX

MINIREVIEWS

- 4123 Health-related quality of life after gastric cancer treatment in Brazil: Narrative review and reflections
Pinheiro RN, Mucci S, Zanatto RM, Picanço Junior OM, Oliveira AF, Lopes Filho GJ
- 4133 Nonalcoholic fatty liver disease and COVID-19: An epidemic that begets pandemic
Ahmed M, Ahmed MH

ORIGINAL ARTICLE

Retrospective Study

- 4143 Why MUC16 mutations lead to a better prognosis: A study based on The Cancer Genome Atlas gastric cancer cohort
Huang YJ, Cao ZF, Wang J, Yang J, Wei YJ, Tang YC, Cheng YX, Zhou J, Zhang ZX
- 4159 Design and development of a new type of phimosis dilatation retractor for children
Yue YW, Chen YW, Deng LP, Zhu HL, Feng JH
- 4166 Primary needle-knife fistulotomy for preventing post-endoscopic retrograde cholangiopancreatography pancreatitis: Importance of the endoscopist's expertise level
Han SY, Baek DH, Kim DU, Park CJ, Park YJ, Lee MW, Song GA

Observational Study

- 4178 Patients with functional bowel disorder have disaccharidase deficiency: A single-center study from Russia
Dbar S, Akhmadullina O, Sabelnikova E, Belostotskiy N, Parfenov A, Bykova S, Bakharev S, Baulo E, Babanova A, Indeykina L, Kuzmina T, Kosacheva T, Spasenov A, Makarova A
- 4188 Self-perceived burden and influencing factors in patients with cervical cancer administered with radiotherapy
Luo T, Xie RZ, Huang YX, Gong XH, Qin HY, Wu YX

SYSTEMATIC REVIEWS

- 4199 COVID-19 in gastroenterology and hepatology: Lessons learned and questions to be answered
Liu S, Tang MM, Du J, Gong ZC, Sun SS

META-ANALYSIS

- 4210 Efficacy of topical *vs* intravenous tranexamic acid in reducing blood loss and promoting wound healing in bone surgery: A systematic review and meta-analysis

Xu JW, Qiang H, Li TL, Wang Y, Wei XX, Li F

CASE REPORT

- 4221 *Ex vivo* liver resection followed by autotransplantation in radical resection of gastric cancer liver metastases: A case report

Wang H, Zhang CC, Ou YJ, Zhang LD

- 4230 Bone marrow inhibition induced by azathioprine in a patient without mutation in the thiopurine S-methyltransferase pathogenic site: A case report

Zhou XS, Lu YY, Gao YF, Shao W, Yao J

- 4238 Eosinophilic gastroenteritis with abdominal pain and ascites: A case report

Tian XQ, Chen X, Chen SL

- 4244 Tunica vaginalis testis metastasis as the first clinical manifestation of pancreatic adenocarcinoma: A case report

Zhang YR, Ma DK, Gao BS, An W, Guo KM

- 4253 “AFGP” bundles for an extremely preterm infant who underwent difficult removal of a peripherally inserted central catheter: A case report

Chen Q, Hu YL, Su SY, Huang X, Li YX

- 4262 Dynamic magnetic resonance imaging features of cavernous hemangioma in the manubrium: A case report

Lin TT, Hsu HH, Lee SC, Peng YJ, Ko KH

- 4268 Diagnosis and treatment of pediatric anaplastic lymphoma kinase-positive large B-cell lymphoma: A case report

Zhang M, Jin L, Duan YL, Yang J, Huang S, Jin M, Zhu GH, Gao C, Liu Y, Zhang N, Zhou CJ, Gao ZF, Zheng QL, Chen D, Zhang YH

- 4279 Stevens-Johnson syndrome and concurrent hand foot syndrome during treatment with capecitabine: A case report

Ahn HR, Lee SK, Youn HJ, Yun SK, Lee IJ

- 4285 Rosai-Dorfman disease with lung involvement in a 10-year-old patient: A case report

Wu GJ, Li BB, Zhu RL, Yang CJ, Chen WY

- 4294 Acute myocardial infarction in twin pregnancy after assisted reproduction: A case report

Dai NN, Zhou R, Zhuo YL, Sun L, Xiao MY, Wu SJ, Yu HX, Li QY

- 4303 Complete recovery of herpes zoster radiculopathy based on electrodiagnostic study: A case report

Kim HS, Jung JW, Jung YJ, Ro YS, Park SB, Lee KH

- 4310** Acute liver failure with thrombotic microangiopathy due to sodium valproate toxicity: A case report
Mei X, Wu HC, Ruan M, Cai LR
- 4318** Lateral epicondyle osteotomy approach for coronal shear fractures of the distal humerus: Report of three cases and review of the literature
Li J, Martin VT, Su ZW, Li DT, Zhai QY, Yu B
- 4327** Pancreatic neuroendocrine carcinoma in a pregnant woman: A case report and review of the literature
Gao LP, Kong GX, Wang X, Ma HM, Ding FF, Li TD
- 4336** Primary primitive neuroectodermal tumor in the pericardium—a focus on imaging findings: A case report
Xu SM, Bai J, Cai JH
- 4342** Minimally invasive surgery for glycogen storage disease combined with inflammatory bowel disease: A case report
Wan J, Zhang ZC, Yang MQ, Sun XM, Yin L, Chen CQ
- 4348** Coronary sinus endocarditis in a hemodialysis patient: A case report and review of literature
Hwang HJ, Kang SW
- 4357** *Clostridium perfringens* bloodstream infection secondary to acute pancreatitis: A case report
Li M, Li N
- 4365** Kidney re-transplantation after living donor graft nephrectomy due to *de novo* chromophobe renal cell carcinoma: A case report
Wang H, Song WL, Cai WJ, Feng G, Fu YX
- 4373** Pelvic lipomatosis with cystitis glandularis managed with cyclooxygenase-2 inhibitor: A case report
Mo LC, Piao SZ, Zheng HH, Hong T, Feng Q, Ke M
- 4381** Prone position combined with high-flow nasal oxygen could benefit spontaneously breathing, severe COVID-19 patients: A case report
Xu DW, Li GL, Zhang JH, He F
- 4388** Primary intratracheal schwannoma misdiagnosed as severe asthma in an adolescent: A case report
Huang HR, Li PQ, Wan YX
- 4395** Prenatal diagnosis of cor triatriatum sinister associated with early pericardial effusion: A case report
Cánovas E, Cazorla E, Alonzo MC, Jara R, Álvarez L, Beric D
- 4400** Pulmonary alveolar proteinosis complicated with tuberculosis: A case report
Bai H, Meng ZR, Ying BW, Chen XR
- 4408** Surgical treatment of four segment lumbar spondylolysis: A case report
Li DM, Peng BG

- 4415** Efficacy of artificial liver support system in severe immune-associated hepatitis caused by camrelizumab: A case report and review of the literature
Tan YW, Chen L, Zhou XB
- 4423** Anti-Yo antibody-positive paraneoplastic cerebellar degeneration in a patient with possible cholangiocarcinoma: A case report and review of the literature
Lou Y, Xu SH, Zhang SR, Shu QF, Liu XL
- 4433** Intraneural ganglion cyst of the lumbosacral plexus mimicking L5 radiculopathy: A case report
Lee JG, Peo H, Cho JH, Kim DH
- 4441** Effectiveness of patient education focusing on circadian pain rhythms: A case report and review of literature
Tanaka Y, Sato G, Imai R, Osumi M, Shigetoh H, Fujii R, Morioka S
- 4453** Schwannoma mimicking pancreatic carcinoma: A case report
Kimura K, Adachi E, Toyohara A, Omori S, Ezaki K, Ihara R, Higashi T, Ohgaki K, Ito S, Maehara SI, Nakamura T, Fushimi F, Maehara Y

ABOUT COVER

Editorial Board Member of *World Journal of Clinical Cases*, Pietro Scicchitano, MD, Professor, Research Scientist, Department of Emergency and Organ Transplantation, School of Medicine, University of Bari, Bari 70124, Italy. piero.sc@hotmail.it

AIMS AND SCOPE

The primary aim of *World Journal of Clinical Cases* (WJCC, *World J Clin Cases*) is to provide scholars and readers from various fields of clinical medicine with a platform to publish high-quality clinical research articles and communicate their research findings online.

WJCC mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

INDEXING/ABSTRACTING

The WJCC is now indexed in Science Citation Index Expanded (also known as SciSearch®), Journal Citation Reports/Science Edition, Scopus, PubMed, and PubMed Central. The 2020 Edition of Journal Citation Reports® cites the 2019 impact factor (IF) for WJCC as 1.013; IF without journal self cites: 0.991; Ranking: 120 among 165 journals in medicine, general and internal; and Quartile category: Q3. The WJCC's CiteScore for 2019 is 0.3 and Scopus CiteScore rank 2019: General Medicine is 394/529.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: Jia-Hui Li; Production Department Director: Yu-Jie Ma; Editorial Office Director: Jin-Li Wang.

NAME OF JOURNAL

World Journal of Clinical Cases

ISSN

ISSN 2307-8960 (online)

LAUNCH DATE

April 16, 2013

FREQUENCY

Thrice Monthly

EDITORS-IN-CHIEF

Dennis A Bloomfield, Sandro Vento, Bao-Gan Peng

EDITORIAL BOARD MEMBERS

<https://www.wjnet.com/2307-8960/editorialboard.htm>

PUBLICATION DATE

June 16, 2021

COPYRIGHT

© 2021 Baishideng Publishing Group Inc

INSTRUCTIONS TO AUTHORS

<https://www.wjnet.com/bpg/gerinfo/204>

GUIDELINES FOR ETHICS DOCUMENTS

<https://www.wjnet.com/bpg/GerInfo/287>

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH

<https://www.wjnet.com/bpg/gerinfo/240>

PUBLICATION ETHICS

<https://www.wjnet.com/bpg/GerInfo/288>

PUBLICATION MISCONDUCT

<https://www.wjnet.com/bpg/gerinfo/208>

ARTICLE PROCESSING CHARGE

<https://www.wjnet.com/bpg/gerinfo/242>

STEPS FOR SUBMITTING MANUSCRIPTS

<https://www.wjnet.com/bpg/GerInfo/239>

ONLINE SUBMISSION

<https://www.f6publishing.com>



Surgical treatment of four segment lumbar spondylolysis: A case report

Duan-Ming Li, Bao-Gan Peng

ORCID number: Duan-Ming Li 0000-0002-9753-1355; Bao-Gan Peng 0000-0003-1667-4125.

Author contributions: Li D and Peng B wrote the manuscript, collected data for review, and treated patients; All authors read and approved the final version of the manuscript.

Informed consent statement: Written informed consent was obtained from the patient.

Conflict-of-interest statement: The authors declare that they have no current financial arrangement or affiliation with any organization that may have a direct influence on their work.

CARE Checklist (2016) statement: The authors have read the CARE Checklist (2016), and the manuscript was prepared and revised according to the CARE Checklist (2016).

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially,

Duan-Ming Li, Bao-Gan Peng, Department of Orthopedics, The Third Medical Center of People's Liberation Army General Hospital, Beijing 100039, China

Corresponding author: Bao-Gan Peng, MD, PhD, Professor, Surgeon, Department of Orthopedics, The Third Medical Center of People's Liberation Army General Hospital, No. 69 Yongding Road, Beijing 100039, China. pengbaogan76611@163.com

Abstract

BACKGROUND

Four-level lumbar spondylolysis is extremely rare. So far, only 1 case has been reported in the literature.

CASE SUMMARY

A 19-year-old man presented with severe back pain unresponsive to conservative therapies for 2 years. Lumbar radiographs and two-dimensional computed tomography scan showed four segment lumbar spondylolysis on both sides of L2-L5. Lumbar magnetic resonance imaging showed normal signal in all lumbar discs. Because daily activities were severely limited, surgery was recommended for the case. The patient underwent four-level bilateral isthmic repair at L2-L5. During surgery, L2-L5 isthmi were curetted bilaterally, freshened, and then grafted with autologous iliac bone that was bridged and compressed with a pedicular screw connected to a sub-laminar hook by a short rod. The symptoms of back pain almost disappeared. He has been followed-up for 96 mo, and his symptoms have never recurred. Fusion was found in all repaired isthmi 14 mo after surgery according to evaluation of lumbar radiography and computed tomography scan.

CONCLUSION

We report here 1 case of four-level lumbar spondylolysis that was treated successfully with direct isthmic repair.

Key Words: Lumbar spondylolysis; Isthmic repair; Pedicle screw-hook system; Case report

©The Author(s) 2021. Published by Baishideng Publishing Group Inc. All rights reserved.

Core Tip: Four-level lumbar spondylolysis is extremely rare. So far, only 1 case has

and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

Manuscript source: Unsolicited manuscript

Specialty type: Orthopedics

Country/Territory of origin: China

Peer-review report's scientific quality classification

Grade A (Excellent): 0

Grade B (Very good): B

Grade C (Good): 0

Grade D (Fair): 0

Grade E (Poor): 0

Received: February 2, 2021

Peer-review started: February 2, 2021

First decision: March 25, 2021

Revised: March 27, 2021

Accepted: April 7, 2021

Article in press: April 7, 2021

Published online: June 16, 2021

P-Reviewer: Cawley DT

S-Editor: Zhang H

L-Editor: Filipodia

P-Editor: Wang LL



reported in the literature. In the present study, we report 1 case of four-level lumbar spondylolysis that was treated successfully with direct isthmic repair.

Citation: Li DM, Peng BG. Surgical treatment of four segment lumbar spondylolysis: A case report. *World J Clin Cases* 2021; 9(17): 4408-4414

URL: <https://www.wjgnet.com/2307-8960/full/v9/i17/4408.htm>

DOI: <https://dx.doi.org/10.12998/wjcc.v9.i17.4408>

INTRODUCTION

Four-level lumbar spondylolysis is extremely rare[1-3]. So far, only 1 case has been reported in the literature[4]. We report here 1 case of four-level lumbar spondylolysis that was treated successfully with direct isthmic repair.

CASE PRESENTATION

Chief complaints

A 19-year-old man presented with low back pain without radicular pain in both lower extremities for 2 years.

History of present illness

His back pain worsened from stretching and standing for a long time. He had no history of trauma. He rated himself as 7 on a 10-point visual analogue scale. Conservative treatment, such as rest, lumbosacral brace immobilization, oral non-steroidal anti-inflammatory drugs, and physical therapy, did not relieve his back pain, which seriously affected his daily activities.

History of past illness

He had no relevant traumatic history.

Physical examination

Physical examination revealed a reduced range of motion in the lumbar spine, especially with limited lumbar extension. Tenderness was noted over and beside L2-L5 spinous processes. Bilateral straight leg raising test was negative. The sensory, motor, and tendon reflexes of both lower limbs were normal.

Imaging examinations

Lumbar dynamic radiographs showed no instability (Figure 1), two-dimensional computed tomography (CT) scan showed lumbar spondylolysis at bilateral L2-L5 levels (Figure 2), and lumbar magnetic resonance imaging showed no signs of lumbar disc degeneration (Figure 3). Because daily activities were severely limited, surgery was recommended for the case.

FINAL DIAGNOSIS

Four segment lumbar spondylolysis.

TREATMENT

This case underwent a surgery of direct isthmic repair in eight lytic defects at bilateral L2-L5 levels. Under general anesthesia, the conventional posterior midline approach was used to expose L2-L5 spinous processes, lamina, and facet joints. Firstly, under the guidance of fluoroscopy, a 6.0 mm × 45 mm pedicle screw was implanted into the vertebral body. Secondly, the involved lysis area was scraped and freshened, and

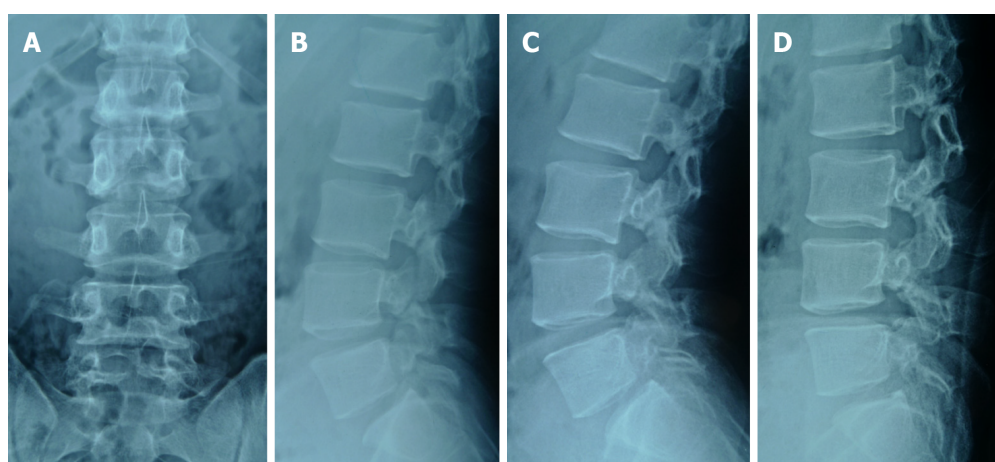


Figure 1 Lumbar radiographs. A: Anteroposterior radiograph; B: Lateral radiograph showed L2-L5 spondylolysis; C: Lateral radiograph of lumbar extension position; D: Lateral radiograph of lumbar flexion position. Note that lumbar dynamic radiographs showed no instability.

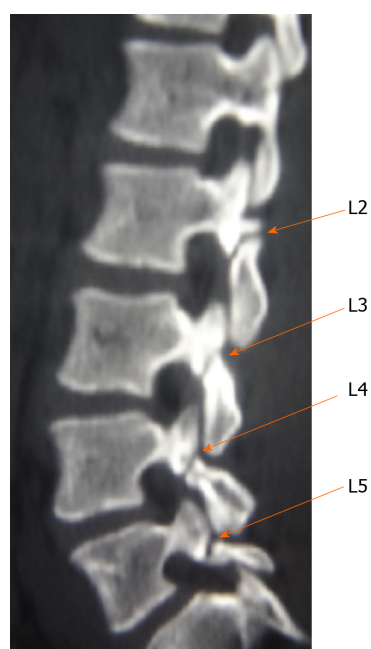


Figure 2 Two-dimensional computed tomography scan shows lumbar spondylolysis at bilateral L2-L5 levels.

autologous iliac bone grafting was performed. Finally, the sub-laminar hook was placed and connected through a short rod under compression with corresponding pedicle screw. Subsequently, the remaining repair of seven lytes was completed in the same manner. Total operation time was 3.5 h, and blood loss was 350 mL. The neurological function of the patient remained intact after operation. A lumbosacral-brace was used for 3 mo.

OUTCOME AND FOLLOW-UP

After the operation, the patient's back pain disappeared, and he returned to work 3 mo later. During the 8-year follow-up, he had no complaints of low back pain. The dynamic plain films showed that movement was retained (Figure 4). Bone healing was found in all eight lytic defects (Figure 5). After the donor site of iliac crest was filled with allogeneic bone, osteogenesis was formed (Figure 6).



Figure 3 Magnetic resonance imaging showed no signs of lumbar disc degeneration.

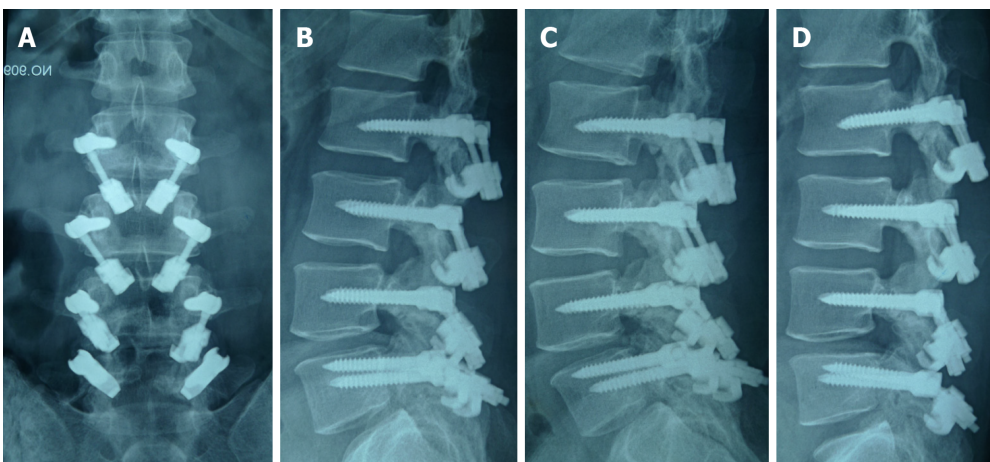


Figure 4 Lumbar dynamic radiographs after operation showed that lumbar movement was retained. A: Anteroposterior radiograph; B: Lateral radiograph; C: Lateral radiograph of lumbar extension position; D: Lateral radiograph of lumbar flexion position. Note that lumbar dynamic radiographs show that movement was retained.

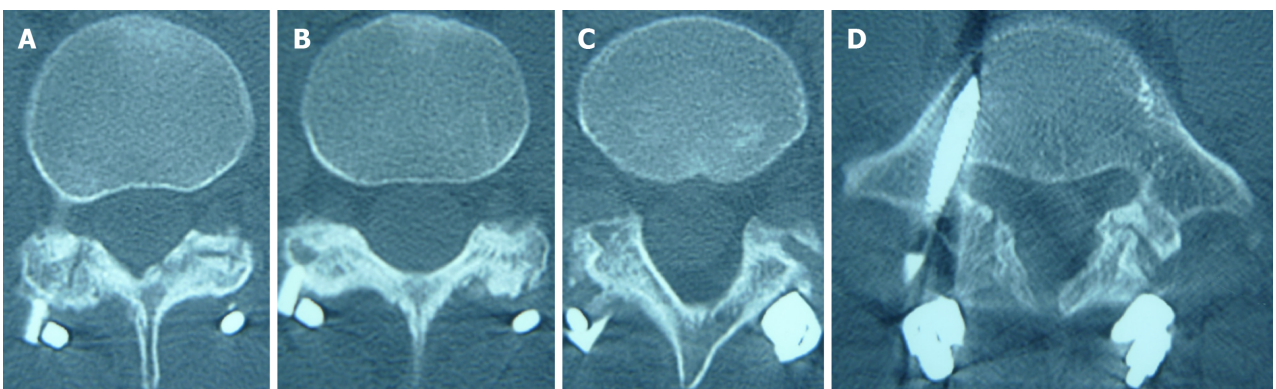


Figure 5 Computed tomography scan showed bone healing in all eight lytic defects at L2-L5. A: L2; B: L3; C: L4; D: L5.

DISCUSSION

Lumbar spondylolysis is a common cause of low back pain in adolescents. It occurs in about 6% of the population and is reported to be more common in men. It usually occurs in L5, accounting for more than 80% of patients with lumbar spondylolysis. Multi-segmental spondylolysis is rare[1]. According to Ravichandran[2], multilevel lumbar spondylolysis only accounts for 1.48% of patients with spondylolysis. The

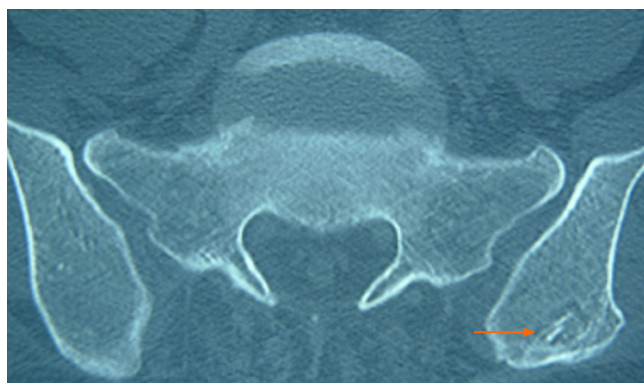


Figure 6 Donor site of iliac crest was filled with allogeneic bone, which resulted in osteogenesis (arrow).

incidence rate of three level lumbar spondylolysis is very low, less than 0.1% of lumbar spondylolysis[3]. To our knowledge, only 1 case of four segment lumbar spondylolysis has been reported in the literature[4]. The possible causes of lumbar spondylolysis include dysplasia, excessive exercise, fatigue fracture, *etc.* The cause of multilevel lumbar spondylolysis is not clear. Ogawa *et al*[5] considered that the causes of multi-segmental lumbar spondylolysis are the same as single segmental lumbar spondylolysis. Ravichandran[2] believed that fatigue fracture is the main cause of multi-segmental lumbar spondylolysis. According to Wiltse[6], genetic factors may also play a role.

Treatment for multi-segmental lumbar spondylolysis is still controversial[5,7]. If lumbar spondylolysis occurs in adolescents, conservative treatment is usually the first choice[8]. Clinical observation found that new onset spondylolysis may be cured by restricting lumbar spine movement with a brace[2,5,9,10]. A retrospective study showed that a union rate of conservative treatment in adolescents was 76%[11]. However, about 90% of end-stage L5 spondylolysis patients are first diagnosed in adulthood. In addition, about 40% of cases had no sports history or low back pain experience in their growth period[12]. If patients with lumbar spondylolysis have low back pain, conservative treatment is ineffective, or imaging shows spondylolisthesis, surgical treatment is required[5]. Studies have observed that lumbar spondylolysis is often accompanied by degeneration of adjacent upper and lower discs[13]. Lumbar spondylolysis increases disc stresses at the affected as well as adjacent levels, which may lead to disc degeneration. However, increase in stresses and angular displacement are higher at the adjacent caudal level than at the cranial level, which may explain why isthmic lysis often causes adjacent caudal disc degeneration. Buck's technique can restore the increased disc stress to normal level[14]. Therefore, this technique may be beneficial from a biomechanical point of view. It has been speculated that multi-segment lumbar spondylolysis is more vulnerable to disc degeneration. Some studies have reported that patients with multi-segmental lumbar spondylolysis have poor effect of conservative treatment and are prone to disc degeneration and pseudarthrosis[2,10,15]. Therefore, surgical treatment is recommended for patients with multi-segmental lumbar spondylolysis[16].

For the surgical treatment of lumbar spondylolysis, several techniques have been reported in the literature[2,5,17,18], and these can be divided into two categories: The first is lumbar fusion, including interbody fusion and postero-lateral arthrodesis; the second is direct isthmic repair, bone grafting, fusion, and fixation. Several surgical techniques using various internal fixation devices for direct repair of the pars defect were reported in the literature, including Buck's operation, Morscher's hook-screw system, Scotting's wiring technique, segmental pedicle screw-hook fixation, and Gillet's rod-screw construction[14,19,20].

How to choose the surgical method to treat lumbar spondylolysis is mainly based on whether there is the degeneration of the disc in the pathological segment[19]. If the lumbar disc in the pathological segment is normal, it usually indicates that the back pain is originated from the isthmus region, and the chosen surgical method should be direct isthmus repair. If the disc of the pathological segment is degenerative or protruded or has already had lumbar spondylolisthesis, the lumbar interbody fusion operation should be selected. According to the different conditions of the lumbar intervertebral discs, combination lumbar fusion and isthmus direct repair to treat multi-segmental lumbar spondylolysis should be performed[21]. Preoperative radiog-

raphy and two dimensional CT reconstruction of the lumbar spine confirmed that the patient had L2-L5 bilateral isthmic lyses, without lumbar spondylolisthesis. Lumbar magnetic resonance imaging showed that all lumbar intervertebral disc signals were normal, so this patient underwent four segments of isthmic direct repair and bone grafting and pedicle screw and laminar hook fixation. Autogenous iliac crest bone graft can improve the fusion rate of bone grafting. At the same time, allogeneic bone is filled in the iliac crest to avoid postoperative pain in the donor site[22]. Two points should be paid attention to during the operation: Exposure of entry point and placement of pedicle screw should avoid damage to corresponding facet joint capsule; when placing screw-laminar hook system, mutual interference between the upper level hook and the lower level screw head should be avoided. At the 96 mo follow-up, the visual analogue scale score of low back pain was 1. Dynamic radiographs showed that the lumbar motion was normal. CT scan of the lumbar spine showed that all eight isthmic bone graft areas were fused.

Our clinical results suggest that active surgical treatment should be considered in young patients with multilevel lumbar spondylolysis. According to the different conditions of the upper and lower discs of each damaged segment, the operation methods should be direct isthmic repair or combination direct isthmic repair and lumbar fusion. The incidence rate of multi-segmental lumbar spondylolysis is low in young people. More cases and longer follow-up time are needed to evaluate the curative effect.

CONCLUSION

We report here 1 case of four-level lumbar spondylolysis that was treated successfully with direct isthmic repair and pedicle screw-hook system fixation.

REFERENCES

- 1 **Fredrickson BE**, Baker D, McHolick WJ, Yuan HA, Lubicky JP. The natural history of spondylolysis and spondylolisthesis. *J Bone Joint Surg Am* 1984; **66**: 699-707 [PMID: [6373773](#)]
- 2 **Ravichandran G**. Multiple lumbar spondylolyses. *Spine (Phila Pa 1976)* 1980; **5**: 552-557 [PMID: [7466463](#) DOI: [10.1097/00007632-198011000-00011](#)]
- 3 **Darnis A**, Launay O, Perrin G, Barrey C. Surgical management of multilevel lumbar spondylolysis: a case report and review of the literature. *Orthop Traumatol Surg Res* 2014; **100**: 347-351 [PMID: [24657151](#) DOI: [10.1016/j.otsr.2013.12.021](#)]
- 4 **Gu SX**, Ma Y, Chen X, Cai XJ, Cui X, Bao D, Huang FS, Luo ZP, Li DW, Luo XB, Li LT, Re : He B, Yan L, Guo H, *et al.* The difference in superior adjacent segment pathology after lumbar posterolateral fusion by using 2 different pedicle screw insertion techniques in 9-year minimum follow-up. *Spine (Phila Pa 1976)* 2014; **39**: 1093-8. *Spine (Phila Pa 1976)* 2014; **39**: E1493 [PMID: [25387145](#) DOI: [10.1097/BRS.0000000000000618](#)]
- 5 **Ogawa H**, Nishimoto H, Hosoe H, Suzuki N, Kanamori Y, Shimizu K. Clinical outcome after segmental wire fixation and bone grafting for repair of the defects in multiple level lumbar spondylolysis. *J Spinal Disord Tech* 2007; **20**: 521-525 [PMID: [17912129](#) DOI: [10.1097/BSD.0b013e3180335c1f](#)]
- 6 **Wiltse LL**. Etiology of spondylolisthesis. *Clin Orthop* 1957; **10**: 48-60 [PMID: [13561552](#)]
- 7 **Song D**, Chen Z, Song D. Surgical treatment of double-level isthmic spondylolisthesis. *J Neurosurg Spine* 2014; **20**: 396-399 [PMID: [24484307](#) DOI: [10.3171/2013.12.SPINE13521](#)]
- 8 **Sairoyo K**, Sakai T, Yasui N, Dezawa A. Conservative treatment for pediatric lumbar spondylolysis to achieve bone healing using a hard brace: what type and how long? *J Neurosurg Spine* 2012; **16**: 610-614 [PMID: [22519929](#) DOI: [10.3171/2012.2.SPINE10914](#)]
- 9 **Park KH**, Ha JW, Kim HS, Moon ES, Moon SH, Lee HM, Kim HJ, Kim JY. Multiple levels of lumbar spondylolysis - a case report -. *Asian Spine J* 2009; **3**: 35-38 [PMID: [20404945](#) DOI: [10.4184/asj.2009.3.1.35](#)]
- 10 **Eingorn D**, Pizzutillo PD. Pars interarticularis fusion of multiple levels of lumbar spondylolysis. A case report. *Spine (Phila Pa 1976)* 1985; **10**: 250-252 [PMID: [3992343](#) DOI: [10.1097/00007632-198504000-00010](#)]
- 11 **Tatsumura M**, Gamada H, Okuwaki S, Eto F, Nagashima K, Iwabuchi S, Ogawa T, Mammoto T, Hirano A, Yamazaki M. Union evaluation of lumbar spondylolysis using MRI and CT in adolescents treated conservatively. *J Orthop Sci* 2021 [PMID: [33597077](#) DOI: [10.1016/j.jos.2021.01.002](#)]
- 12 **Sakai T**, Goda Y, Tezuka F, Abe M, Yamashita K, Takata Y, Higashino K, Nagamachi A, Sairoyo K. Clinical features of patients with pars defects identified in adulthood. *Eur J Orthop Surg Traumatol* 2016; **26**: 259-262 [PMID: [26662560](#) DOI: [10.1007/s00590-015-1727-x](#)]
- 13 **Sairoyo K**, Goel VK, Faizan A, Vadapalli S, Biyani S, Ebraheim N. Buck's direct repair of lumbar

- spondylolysis restores disc stresses at the involved and adjacent levels. *Clin Biomech (Bristol, Avon)* 2006; **21**: 1020-1026 [PMID: 16959387 DOI: 10.1016/j.clinbiomech.2006.06.011]
- 14 **Buck JE.** Direct repair of the defect in spondylolisthesis. Preliminary report. *J Bone Joint Surg Br* 1970; **52**: 432-437 [PMID: 4916960]
- 15 **Chang JH,** Lee CH, Wu SS, Lin LC. Management of multiple level spondylolysis of the lumbar spine in young males: a report of six cases. *J Formos Med Assoc* 2001; **100**: 497-502 [PMID: 11579618]
- 16 **Hersh DS,** Kim YH, Razi A. Multi-level spondylolysis. *Bull NYU Hosp Jt Dis* 2011; **69**: 339-343 [PMID: 22196393]
- 17 **Liu X,** Wang L, Yuan S, Tian Y, Zheng Y, Li J. Multiple-level lumbar spondylolysis and spondylolisthesis. *J Neurosurg Spine* 2015; **22**: 283-287 [PMID: 25525958 DOI: 10.3171/2014.10.SPINE14415]
- 18 **Al-Sebai MW,** Al-Khawashki H. Spondylolysis and multiple-level spondylolysis. *Eur Spine J* 1999; **8**: 75-77 [PMID: 10190858 DOI: 10.1007/s005860050130]
- 19 **Arai T,** Sairyo K, Shibuya I, Kato K, Dezawa A. Multilevel direct repair surgery for three-level lumbar spondylolysis. *Case Rep Orthop* 2013; **2013**: 472968 [PMID: 23607020 DOI: 10.1155/2013/472968]
- 20 **Chung CH,** Chiu HM, Wang SJ, Hsu SY, Wei YS. Direct repair of multiple levels lumbar spondylolysis by pedicle screw laminar hook and bone grafting: clinical, CT, and MRI-assessed study. *J Spinal Disord Tech* 2007; **20**: 399-402 [PMID: 17607107 DOI: 10.1097/01.bsd.0000211253.67576.90]
- 21 **Dai LY.** Disc degeneration in patients with lumbar spondylolysis. *J Spinal Disord* 2000; **13**: 478-486 [PMID: 11132978 DOI: 10.1097/00002517-200012000-00003]
- 22 **Delawi D,** Dhert WJ, Castelein RM, Verbout AJ, Oner FC. The incidence of donor site pain after bone graft harvesting from the posterior iliac crest may be overestimated: a study on spine fracture patients. *Spine (Phila Pa 1976)* 2007; **32**: 1865-1868 [PMID: 17762294 DOI: 10.1097/BRS.0b013e318107674e]



Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA

Telephone: +1-925-3991568

E-mail: bpgoffice@wjgnet.com

Help Desk: <https://www.f6publishing.com/helpdesk>

<https://www.wjgnet.com>

