ORIGINAL ARTICLE
52

J Turk Spinal Surg 2025;36(2):52-55
DOI: 10.4274/jtss.galenos.2025.44153

MID-TERM RESULTS OF YOUNG ADULT PATIENTS WHO UNDERWENT AUTOGRAFT AND DIRECT PARS REPAIR USING U-ROD TECHNIQUE FOR LUMBAR SPONDYLOLYSIS

Abdulhalim Akar[1], Tuna Pehlivanoglu[2,3], Mehmet Aydogan[1]

[1]Memorial Şişli Hospital, Spinal Health Center, Clinic of Orthopedic Surgery and Traumatology, İstanbul, Türkiye
[2]Medicana Bahçelievler Hospital, Department of Orthopedic Surgery and Traumatology, Spine Health Center, İstanbul, Türkiye
[3]İstanbul Okan University Faculty of Medicine, Department of Orthopedic Surgery and Traumatology, İstanbul, Türkiye

ABSTRACT

Objective: This study aimed to present the clinical and radiological results of patients with spondylolysis (SL) with pars interarticularis defect who were treated with a pedicle screw and a U-shaped rod system passed under the spinous process.

Materials and Methods: A total of 26 patients with lumbar SL and pars fracture were included in the study. Their demographic characteristics were recorded. Patients with adjacent disc pathology and Grade 2, 3, 4 spondylolistheses were excluded. Clinical outcomes were evaluated with visual analog score (VAS) and Oswestry Disability Index (ODI) preoperatively and at the postoperative 3-year follow-up. Radiologically, union was evaluated with plain radiographs and computed tomography if necessary. Patients' return to their daily routine and sports were also evaluated.

Results: Of the 26 patients included in the study, 16 were male (57.1%) and 12 were female (42.8%). The mean age of the patients was 16.7±12.1 years (13-20). Patients were followed up for an average of 51.2 (36-78) months. The mean ODI score was 33.4±21.2 (24-46) and the mean VAS score was 8.1±1.2 (7-10) preoperatively, whereas the mean ODI score was 16.8±11.6 (10-21.4) and the mean VAS score was 1.4±2.3 (1-3) at the postoperative third year follow-up. Six patients who were professional athletes returned to their sports life at the eighth month. Patients' pars fractures were united. One (3.5%) patient underwent revision surgery due to delayed union. Superficial tissue infection developed on the wound site in one patient and was treated with daily dressing and oral antibiotherapy.

Conclusion: Good clinical and radiological results can be obtained in the young adult population with SL accompanied by pars fractures via polyaxial pedicle screws and U-shaped rod surgery.

Keywords: Lumbar spondylolysis, U-rod technique, pars defect, ODI, VAS

INTRODUCTION

Spondylolysis (SL) is a bone defect in the vertebral pars interarticularis with no slippage into the adjacent segment. SL is mostly seen at the L4 and L5 levels by 60%[1,2]. It is usually asymptomatic, and the majority of patients are treated with conservative therapies such as physical therapy, medical therapy, and lumbar corsets[3]. In cases where conservative treatment is unresponsive and the patient's complaints do not regress, surgical treatments stand out[4].

In surgical treatments, the most preferred method is lumbar interbody fusion surgery[5]. In fusion surgeries, both the mobile segment is sacrificed, and patients are exposed to the risk of adjacent segment disease. Therefore, direct repair of pars fractures is recommended especially for young patients[6,7].

Kimura[8] described bone grafting of the bone defect without using implants, but patients required prolonged postoperative bed rest and casting. Gillet and Petit[7] described pedicle screws and V-shaped smiley face rod, and later this surgical technique was modified and used with different names[9,10]. The authors reported that the protection of the capsuloligamentous structures is of vital importance in this surgery. In this technique, the aim is to close the defect by compression using a U-shaped bent rod that passes under the spinous process and is fixed with bilateral pedicle screws. In the literature, high satisfaction rates have been reported for this surgical technique[11-13].

In this study, we treated young adult SL patients with a u-shaped titanium rod and autograft and achieved good clinical and radiological outcomes. We aimed to share our mid-term results with the literature.

Address for Correspondence: Abdulhalim Akar, Memorial Şişli Hospital, Spinal Health Center, Clinic of Orthopedic Surgery and Traumatology, İstanbul, Türkiye
E-mail: ahalimakar@gmail.com
ORCID ID: orcid.org/0000-0002-3153-4799
Received: 03.03.2025 **Accepted:** 18.03.2025 **Epub:** 24.03.2025 **Publication Date:** 15.04.2025
Cite this article as: Akar A, Pehlivanoglu T, Aydogan M. Mid-term results of young adult patients who underwent autograft and direct pars repair using U-rod technique for lumbar spondylolysis. J Turk Spinal Surg. 2025;36(2):52-55

©Copyright 2025 The Author. Published by Galenos Publishing House on behalf of Turkish Spine Society.
This is an open access article under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 (CC BY-NC-ND) International License.

MATERIALS AND METHODS

Ethical approval for the study was obtained from Memorial Şişli Hospital Ethics Committee (approval number: 004, date: 26.12.2024). In this retrospective study, datas were obtained retrospectively from the hospital database. This retrospective study was conducted in compliance with the ethical principles outlined in the Declaration of Helsinki. All patients were thoroughly informed about the study process, and written informed consent was obtained, detailing the surgical risks and potential complications.

A total of 28 patients diagnosed with lumbar SL and operated with the U-rod technique in our clinic between January 2018 and January 2022 were included in the study. The age, gender, and pars defect level of the patients were recorded. Demographic information of the patients was obtained from the hospital database. Patients were followed up for at least 3 years.

The inclusion criteria included being diagnosed with SL without spondylolisthesis, having persistent low back pain unresponsive to conservative treatment, having no weakness or loss of sensation in the lower extremities, having accessible data, and having regular follow-up visits. Patients with Grade 2, 3, 4 spondylolisthesis, radicular complaints and adjacent segment disc degeneration were excluded.

Patients were clinically evaluated according to their Oswestry Disability Index (ODI) and visual analog scale (VAS) scores in the preoperative period, early postoperative period, and postoperative third year follow-up. The time the patients returned to daily life and sports was recorded.

Radiological Evaluation

Spondylolisthesis was evaluated with anterior-posterior, lateral, flexion-extension dynamic radiographs in the preoperative period. Adjacent segment disc degeneration was assessed with preoperative lumbar MR imaging. Pars union was assessed with CT and radiographs taken in the postoperative period.

Statistical Analysis

Mean, standard deviation, median, minimum and maximum values were reported for numerical variables while frequency (n) and percentages (%) were given for categorical ones. Normality assumption was tested via Kolmogorov-Smirnov test. Student t-test was applied to compare 2 independent groups, and Wilcoxon test was performed to assess the dependent pre-op and post-op measures. Spearman correlation coefficients were provided to evaluate the relationship between preop-postop measures and other parameters in dataset. SPSS 21.0 IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp. was used for all analyses. Statistical significance was taken as $p \leq 0.05$ in all analyses.

Surgical Procedure

Surgical procedure performed in the study by Gillet and Petit[7] was performed. Patients were placed in the prone position and total intravenous anesthesia was administered. The L5 vertebra was marked with scopy and exposed with a midline insertion. Attention was paid to preserve the capsuloligamentous structures. Bilateral L5 pedicle screws were sent. Then the pars defect was debrided. Using the same incision, spongiosis autologous bone graft was taken from the iliac bone and the debrided fracture line was grafted. A 6 mm titanium rod was bent in the U-shape and passed under the L5 vertebral spinous process and fixed to the pedicle screws (Figure 1). The fractured pars defect was gently compressed over the rod. Hemovac drains were used in all patients and the layers were closed anatomically.

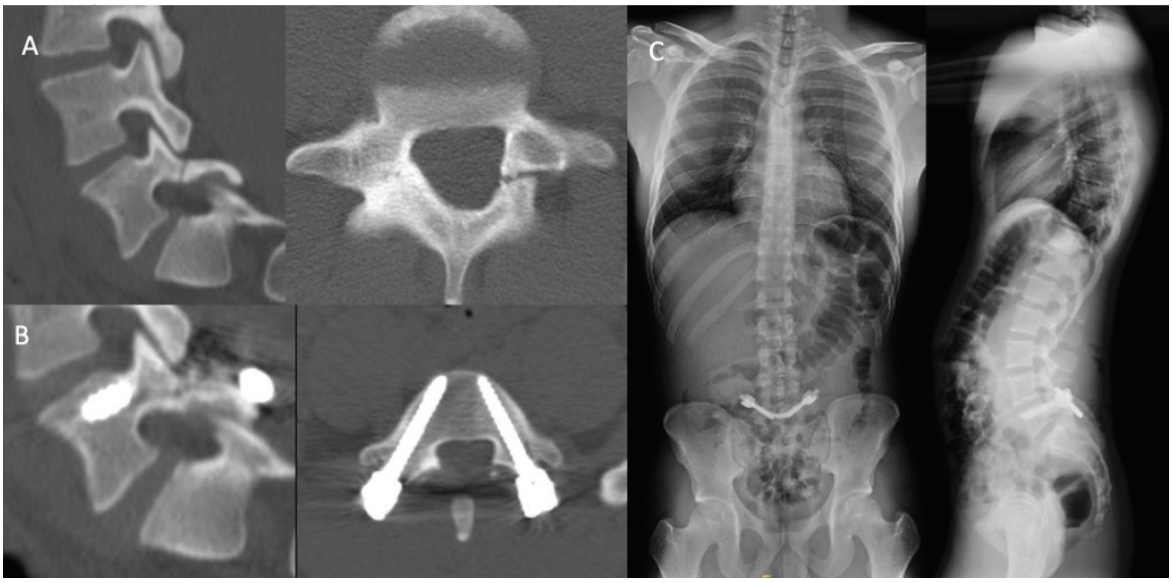

Figure 1. (A) Preoperative CT image of pars defect in one of the patients (B) CT image of complete fusion (C) postoperative radiographs
CT: Computed tomography

RESULTS

Of the 28 patients included in the study, 16 (57.1%) were female and 12 (42.8%) were male. The mean age of the patients was 16.7±12.1 years (range between 13-20). Patients were followed up for 51.2 months (range between 36-78). All patients had L5 pars fracture. The mean preoperative ODI score was 33.4±21.2 (24-46) and the mean VAS score was 8.1±1.2 (7-10). The mean ODI score was 16.8±11.6 (10-21.4) ($p<0.001$) and the mean VAS score was 1.4±2.3 (1-3) ($p<0.001$) at the postoperative third-year follow-up. Patients were able to perform their daily activities in the early postoperative period. At the first-year follow-up, all patients had no restriction in their lives and reached their pre-fracture sports activity levels. Six patients who were professional athletes returned to their sports life at the eighth month. In 28 patients, the pars fracture completely united, while one (3.5%) patient underwent revision surgery at the fourth month due to delayed union. In revision surgery, the fracture was debrided and grafted again with a graft taken from the iliac crest. Union was completed at the fifth month following revision surgery. Wound healing was delayed in one (3.5%) patient. The patient was treated with daily dressing and oral antibiotherapy.

DISCUSSION

In this retrospective study reports the mid-term results of autograft and U-shaped bent rod system applied in the treatment of young adult patients diagnosed with SL. Direct pars repair was performed with bone grafts taken from the patients' iliac bones and in this way, satisfactory clinical and radiology results were obtained.

In previous studies in the literature, similar results were obtained with the V-rod system in young patients with L5 SL[14]. In a systematic review conducted in 2011, 18 studies in which lumbar SL was directly repaired in young athletes were analyzed. It was reported that most of the patients had L5 vertebral fractures and that the average time to return to sports after surgery was 5-12 months[15]. In our study, young adult patients with pars defects at the L5 level were included in the study. Six patients who were professional athletes were allowed to return to sports at the end of the eighth month. Similar to the literature, we obtained good clinical and radiological results in our study.

In a previous study, 10-year results of patients treated with the U-rod technique were reported and a statistically significant decrease in ODI scores was observed[6]. In another study, patients who underwent scoliosis surgery and had a pars fracture were included in the study. In these patients, instead of including the fractured segment in the fusion, direct repair with V-rod was performed and good clinical results were achieved[16]. In this study, when the preoperative and postoperative third year postoperative ODI results were analyzed, a significant decrease was observed.

When the VAS scores of the patients were compared with their preoperative VAS scores, a statistically significant decrease was observed in the VAS score at the postoperative 3rd year follow-up. In the study conducted by Chen et al.[17] in 2013, 21 patients were operated with the V-rod system and a significant decrease was observed in the VAS score. In similar studies, a decrease was reported in the VAS scores of patients[6,16]. It was observed that the change in the VAS score in our study was consistent with the literature.

Although union was observed in all the 28 patients, revision surgery was performed in one patient due to delayed union. Superficial tissue infection in one patient was treated with daily dressing and oral antibiotics. There was no predisposing factor in the patient with delayed union. Despite these complications, this study demonstrated that good results can be achieved with the U-rod technique combined with autografting in the treatment of pars fractures without spondylolisthesis in the young adult population.

Study Limitations

This study had some limitations. In particular, the small number of cases and the single-center design were the most important limitations. In addition, the relatively short follow-up period and lack of evaluation of cost-effectiveness were other limitations.

CONCLUSION

Good results can be achieved with autologous bone graft from the iliac bone and the U-rod technique in young adult patients with pars defects and without spondylolisthesis. This technique can enable early return to sports, especially in young athletes.

Ethics

Ethics Committee Approval: The study was approved by the Memorial Şişli Hospital Ethics Committee (approval number: 004, date: 26.12.2024).

Informed Consent: All patients written informed consent was obtained.

Footnotes

Authorship Contributions

Surgical and Medical Practices: A.A., T.P., M.A., Concept: M.A., Design: M.A., Data Collection or Processing: T.P., Analysis or Interpretation: T.P., Literature Search: A.A., Writing: A.A.

Conflict of Interest: One author of this article, Tuna Pehlivanoğlu, is a member of the editorial board of the The Journal of Turkish Spinal Surgery. However, he did not take part in any stage of the editorial decision of the manuscript. The other authors declared no conflict of interest.

Financial Disclosure: The authors declared that this study received no financial support.

REFERENCES

1. Sakai T, Sairyo K, Takao S, Nishitani H, Yasui N. Incidence of lumbar spondylolysis in the general population in Japan based on multidetector computed tomography scans from two thousand subjects. Spine (Phila Pa 1976). 2009;34:2346-50.
2. STEWART TD. [The age incidence of neural-arch defects in Alaskan natives, considered from the standpoint of etiology]. J Bone Joint Surg Am. 1953;35-A:937-50.
3. McNeely ML, Torrance G, Magee DJ. A systematic review of physiotherapy for spondylolysis and spondylolisthesis. Man Ther. 2003;8:80-91.
4. Omidi-Kashani F, Ebrahimzadeh MH, Salari S. Lumbar spondylolysis and spondylolytic spondylolisthesis: who should be have surgery? An algorithmic approach. Asian Spine J. 2014;8:856-63.
5. Noorian S, Sorensen K, Cho W. A systematic review of clinical outcomes in surgical treatment of adult isthmic spondylolisthesis. Spine J. 2018;18:1441-54.
6. Linhares D, Cacho Rodrigues P, Ribeiro da Silva M, Matos R, Veludo V, Pinto R, et al. Minimum of 10-year follow-up of V-rod technique in lumbar spondylolysis. Eur Spine J. 2019;28:1743-49.
7. Gillet P, Petit M. Direct repair of spondylolysis without spondylolisthesis, using a rod-screw construct and bone grafting of the pars defect. Spine (Phila Pa 1976). 1999;24:1252-6.
8. Kimura M. [My method of filing the lesion with spongy bone in spondylolysis and spondylolistesis]. Seikei Geka. 1968;19:285-96.
9. Ulibarri JA, Anderson PA, Escarcega T, Mann D, Noonan KJ. Biomechanical and clinical evaluation of a novel technique for surgical repair of spondylolysis in adolescents. Spine (Phila Pa 1976). 2006;31:2067-72.
10. Voisin MR, Witiw CD, Deorajh R, Guha D, Oremakinde A, Wang S, et al. Multilevel spondylolysis repair using the "smiley face" technique with 3-dimensional intraoperative spinal navigation. World Neurosurg. 2018;109:e609-14.
11. Altaf F, Osei NA, Garrido E, Al-Mukhtar M, Natali C, Sivaraman A, et al. Repair of spondylolysis using compression with a modular link and screws. J Bone Joint Surg Br. 2011;93:73-7. Erratum in: J Bone Joint Surg Br. 2011;93:566.
12. Pu X, Yang S, Cao H, Jing X, Yin J. [Effectiveness of U-shape titanium screw-rod fixation system with bone autografting for lumbar spondylolysis of young adults]. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi. 2014;28:354-7.
13. Dong QY, Yang XF, Wu HL, Shi Y, Yu LM, Huang YC, Yu BS. Comparison of the smiley face rod method versus intervertebral fusion for the treatment of L5 spondylolysis in adults. Front Med (Lausanne). 2024;11:1499773.
14. Chen MR, Moore TA, Cooperman DR, Lee MJ. Anatomic variability of 120 L5 spondylolytic defects. Global Spine J. 2013;3:243-8.
15. Drazin D, Shirzadi A, Jeswani S, Ching H, Rosner J, Rasouli A, et al. Direct surgical repair of spondylolysis in athletes: indications, techniques, and outcomes. Neurosurg Focus. 2011;31:E9.
16. Koptan WM, ElMiligui YH, ElSharkawi MM. Direct repair of spondylolysis presenting after correction of adolescent idiopathic scoliosis. Spine J. 2011;11:133-8.
17. Chen XS, Zhou SY, Jia LS, Gu XM, Fang L, Zhu W. A universal pedicle screw and V-rod system for lumbar isthmic spondylolysis: a retrospective analysis of 21 cases. PLoS One. 2013;8:e63713.