

# U-ROD AND SCREW CONSTRUCT COMBINED WITH ILIAC BONE GRAFTING FOR DIRECT REPAIR OF TEENAGER MID-LUMBAR SPONDYLOLYSIS

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**Background:** Spondylolysis is a bony defect of the pars interarticularis that most commonly occurs in the lower lumbar spine. However, the condition is rare in the mid-lumbar region. Here, we report on a new technique that involves the use of a U-rod and pedicle screw with iliac bone grafting for the direct intrasegmental repair of mid-lumbar spondylolysis in a teenager.

**Case Report:** A 17-year-old male presented with complaints of mild low back pain after physical exercise, and the pain had aggravated in the last 3 months. Magnetic resonance imaging did not show compression of the intracanal neural tissue, and the lumbar discs did not demonstrate any obvious degeneration. He was diagnosed with L3 spondylolysis and lumbar sacralization. U-rod and screw construct with iliac bone grafting were used to directly repair the spondylolysis in L3. The low back pain totally disappeared 3 months after the surgery. A computerized tomography scan revealed the normal structure of L3 2 years post-surgically, and the internal fixation was removed 3 years later.

**Conclusions:** This novel technique involving the use of a U-rod and pedicle screw associated with iliac bone grafting for the direct repair of mid-lumbar spondylolysis in the teenager yielded a satisfactory outcome, which was confirmed by favorable clinical and radiographic outcomes after 3 years.

**Key words:** Mid-lumber spondylolysis, U-rod, direct repair

## BACKGROUND

Spondylolysis is a bony defect of the pars interarticularis that most commonly occurs in the lower lumbar spine (1). This problem does not occur frequently in the mid-lumbar region. Although the condition is often asymptomatic, it may at times be the cause of low back pain. The surgical management of symptomatic spondylolysis has been well discussed in the literature; however, the outcome is not always satisfactory (2).

Even though many surgical methods have been

reported to manage spondylolysis, the 2 kinds of techniques that are predominantly used are posterior segmental fusion to stabilize the defect by eliminating the segment movement, and the direct intrasegmental repair of the pars defect without segmental fusion (3).

Here, we report on a new technique that involves the use of a U-rod and pedicle screw associated with iliac bone grafting for the direct intrasegmental repair of mid-lumbar spondylolysis without spondylolisthesis in a teenager, which produced a satisfactory outcome.

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**Technical Note**

**Case**

A 17-year-old male presented with complaints of mild low back pain after physical exercise for 1 year, which had worsened in the past 3 months. X-ray was taken and lumbar sacralization was found, which indicated spondylolysis at L3. However, there was no sign of spondylolisthesis of the spine (Fig. 1A-1D). Computed tomography (CT) was performed, and lumbar spondylolysis at L3 was identified (Fig. 1E-1G). Magnetic resonance imaging (MRI) suggested no obvious compression of the intracanal neural tissue or lumbar disc degeneration (Fig. 1H). Despite

3 months of conservative treatment that involved adequate rest, his symptoms were not relieved. The patient and his parents reconsulted the doctor for a second opinion regarding the treatment regimen. Since conservative treatment was not effective in alleviating the pain, the doctor felt that surgical intervention was required. Hence, the patient was admitted to the hospital.

The patient complained of back pain without leg pain in the ward. The pain was exacerbated with motion of the lumbar flexion during sports activities. The ability to indulge in sports activities was obviously affected by the back pain, which was 6/10 on the visual analog scale, without obvious sciatic pain. Tenderness was noted in

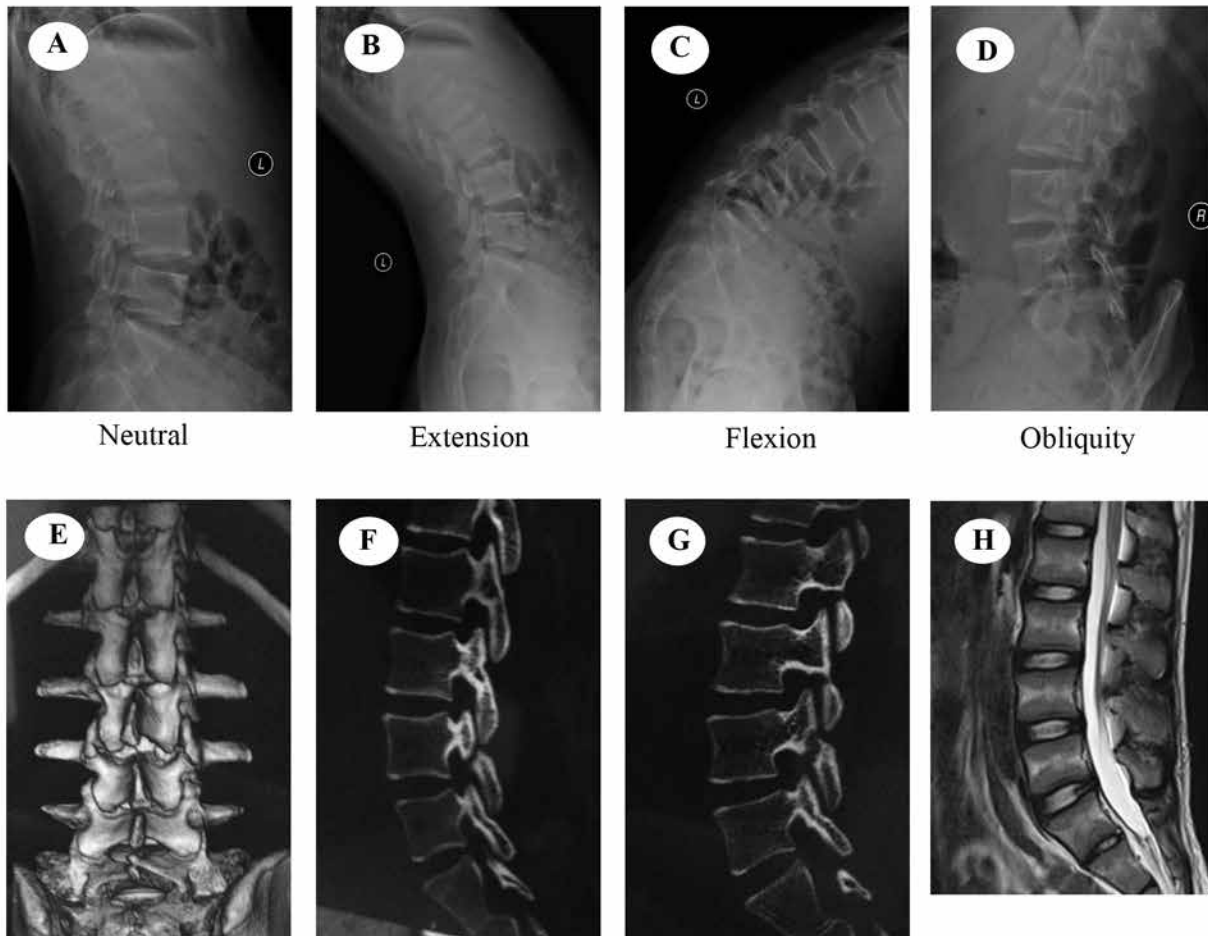


Fig. 1. The imaging for the patient at the first presentation. Neutral lateral is not standard (A). The spondylolysis can be noted at the L3 vertebral level (B, D). No instability with the dynamic motion can be observed (B, C). CT scans were taken and the lumbar spondylolysis at L3 was further identified (E). Right sagittal and left sagittal indicate spondylolysis (F, G). MRI indicated no compression of the intracanal neural tissue and lumbar disc degeneration (H).

the spinous process at the level of L3. The straight leg raising test and femoral nerve stretching sign were negative bilaterally. In addition, manual muscle testing, the sensation of the legs, and the deep tendon reflex were all intact.

### Surgery

Motion preservation surgery appeared to be suitable for this kind of patient. Therefore, we selected this treatment modality. Every spine surgeon is familiar with the pedicle screw fixation system; hence, this approach was chosen for the patient. The pedicle screws were inserted bilaterally (N2, Tianjin Zheng Tian, China). The U-rod was inserted beneath the spinous process at the level of L3 to stabilize the pars defects. Iliac bones were grafted at the pars defects bilaterally, and the stability of the spinous process was checked after the fixation (Fig. 2A-2E).

### Outcomes

The patient began to stand and walk on the second day after the surgery with the protection of the soft trunk brace. There was no obvious low back pain except slight pain attributed to the wound. Within 3 months after the surgery, he was concentrating on trunk muscle exercises. CT scan indicated that the union process had begun 3 months after the operation (Fig. 3A,2B). Six months after the surgery, light exercise, such as jogging, was allowed. The patient resumed his normal exercise 1 year later, and a CT scan signified the union of the pars (Fig. 3C,2D) and the normal structure of L3. MRI showed that the lumbar disc had no obvious degeneration 2 years later (Fig. 3E and 2F). Though the patient had no symptoms of the lower back 3 years later, he hoped to have the internal fixation removed from his body. There still was no sign of spondylolisthesis of the spine (Fig. 4A-4D). After the internal fixation removal

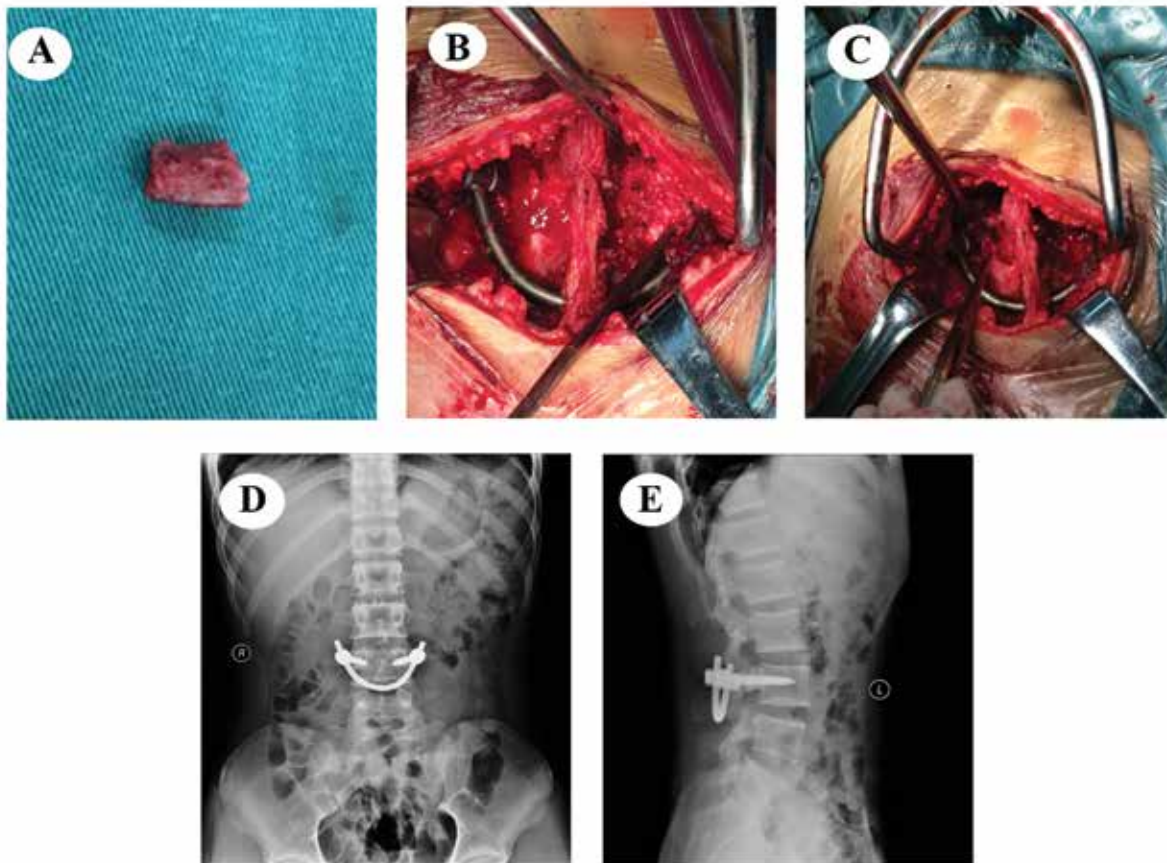


Fig. 2. Operation process. U-rod inserted beneath the spinous process at the level of L3, and the iliac bones grafted at the bilateral pars (A, B, and C). Plain radiographs including anterior-posterior and lateral after the operation (D, E).

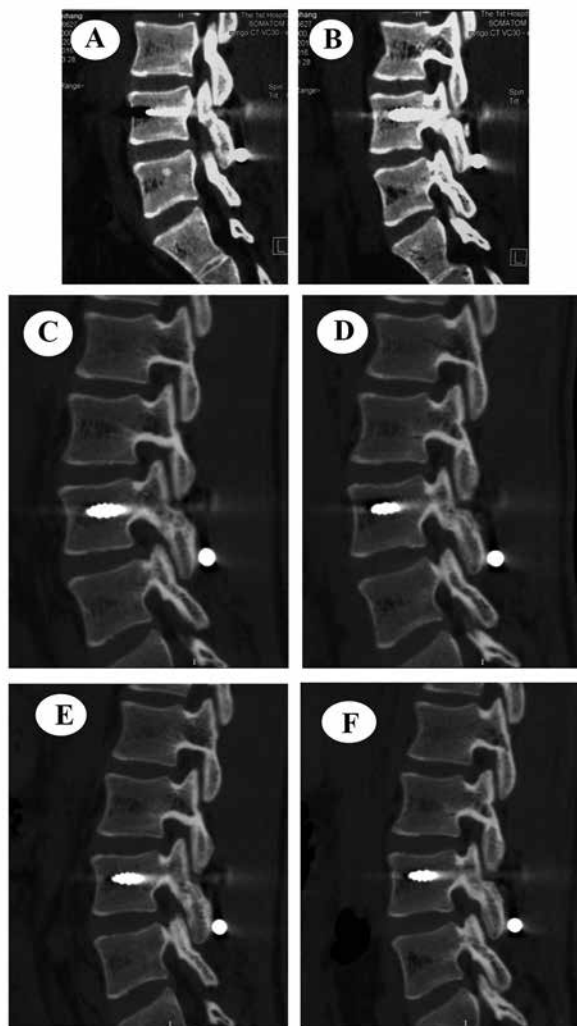


Fig. 3. Bone union process of the pars. CT scan indicates that the bone union process began to appear at the bilateral pars 3 months after the operation (A, B). Bone union is exceptionally good after 1 year of operation (C, D). A perfect bone union can be observed at the bilateral pars 2 years after the operation (E, F).

surgery, a CT scan revealed the normal structure of L3 (Fig. 4E-4G), and MRI indicated no obvious degeneration of the lumbar discs (Fig. 4H-4J).

## DISCUSSION

The treatment of spondylolysis includes conservative pain management and a surgical approach. The most common therapies for spondylolysis are conservative in nature and consist of bracing, activity restriction, and therapeutic exercises. However, although conservative

treatment is often effective for patients in the early stages of the disease, for those in the advanced stages, the broken end of the spondylolysis develops sclerosing bone and fibrous junctions that are not conducive for bony healing (4-5). In the present case, the patient was an adolescent who had lumbar spondylolysis without spondylolisthesis and his symptoms had persisted for over a year. We treated him surgically since conservative treatment, including bracing and activity restriction, did not provide any relief.

Surgery was necessary to reconstruct the defects in the pars and stabilize them in this patient. To stabilize the posterior arch of the L3 vertebra, eliminate the segment movement, and reduce the symptoms, 2 options were considered. The first one involves L3-4 fusion using the transforaminal lumbar interbody fusion or the posterior lumbar interbody fusion technique. The second one comprises the direct intrasegmental repair of the pars defects without segmental fusion. In this case, we chose the latter option. Since the patient was an adolescent, motion preservation surgery was the best choice to avoid adjacent degenerative disk disease. This patient exhibited spondylolysis; however, instability was not obvious in the dynamic flexion or the extension radiographs. Besides, there was no apparent degeneration of the lumbar discs. So, we concluded that there was no need to conduct fusion surgery from these points. Based on the biomechanical standpoint, it has been reported that the disc stress at L5-S1 is approximately 2 times higher in the L5 spondylotic spine than in the normal spine (6). From this observation, we can also infer that the disc stress at L3-4 is significantly higher in the L3 spondylotic spine when compared with the normal spine. The degeneration of the disc would be accelerated if spondylolysis is not repaired. Repairing the spondylolysis normalizes the disc stress, thereby preventing disc degeneration at L3-4, and it is unlikely to exhibit further slippage from the vertebral body as a result of having a bony connection with the posterior arch.

Several surgical methods for the direct repair of spondylolysis have been reported in the literature, such as Buck's screwing (7), Scott's wiring (8), and pedicle screw-hook-rod method (9-11). Every method has advantages and drawbacks. Buck's screwing is used to directly fix the lumbar isthmus; nonetheless, the operation is very difficult to perform, especially in patients with small pars interarticularis, such as the Asians, as it lessens the bone surface available for grafting. Biomechanically, it

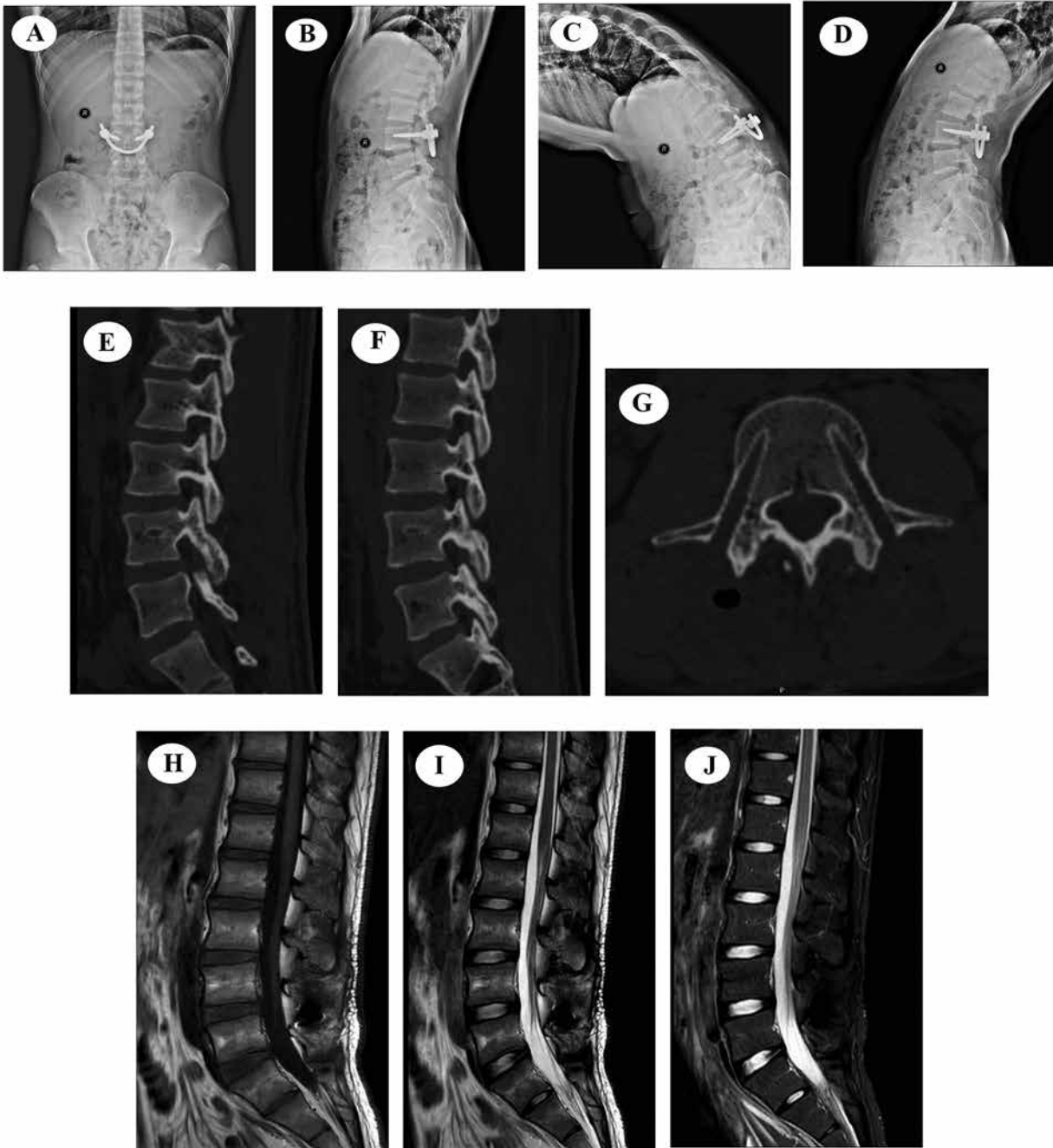


Fig. 4. The imaging for the patient 3 years after the operation. No instability with dynamic motion can be seen in the plain radiographs (A, B, C, and D). No obvious change can be seen at the bilateral pars after the internal fixation was removed (E, F, and G). MRI still indicates no obvious lumbar disc degeneration (H, I, and J).

has been reported that the wiring technique does not provide appropriate stability to the pars defects (12). The pedicle screw-hook-rod method is efficient in terms

of post-surgical stability, but finding the tool is difficult for many primary hospitals, including large-scale establishments. Thus, in this case, the new technique of

using the U-rod and pedicle screw associated with iliac bone grafting for spondylolysis was adopted. With the spinous process serving as the fulcrum, the pressure on both sides of the pars interarticularis is more symmetrical and does not occupy the area of the bone grafting, which makes the grafting highly sufficient and safe. Patients with lamina dysplasia or pars interarticularis hyperplasia could also be treated with this method. In addition, all spine surgeons are familiar with the pedicle screw fixation system. The technique is simple and is easy to apply and disseminate even in primary hospitals.

## CONCLUSION

We have thus successfully employed a novel tech-

nique involving the use of a U-rod and pedicle screw associated with iliac bone grafting for the direct repair of mid-lumbar spondylolysis in a teenager without spondylolisthesis. Satisfactory outcomes were obtained, which were confirmed clinically and radiographically 3 years later.

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