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CASE REPORT

Percutaneous Direct Repair of a Pars Defect Using Intraoperative Computed Tomography Scan

A Modification of the Buck Technique

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Study Design. Case report.
Objective. To describe a young adult with a pars defect undergoing percutaneous direct fixation using intraoperative computed tomography (CT) scan.
Summary of Background Data. Direct pars repair has been utilized since the 1960s. There are no reports in the literature describing a percutaneous technique.
Methods. Using a percutaneous technique under the guide of intraoperative CT scan, a cannulated partially threaded screw was inserted across the pars defect.
Results. Surgery was completed without complication and the patient returned to preoperative activity level 3 months post-op. Postoperative CT scan showed a well-healed L4 pars defect.
Conclusion. Percutaneous direct pars repair using intraoperative CT scan offers the advantage of minimal soft tissue dissection, thereby reducing blood loss, infection risk, and recovery time.
Key words: back pain, Buck technique, cannulated screws, compute tomography guided, direct repair, lumbar spine, pars defect, percutaneous, spondylolysis, surgical technique.
Level of Evidence: 5
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Approximately 6% of the population has lumbar spondylolysis.[1] Although often managed nonoperatively, chronic disabling back pain and neurological deficits are indications for operative management.[2] Since 1970, several authors have described direct pars repair techniques with a recent trend toward minimal invasiveness (Table 1).[3–6,8–21] For young patients without severe disc degeneration and instability, success rates of direct pars repairs range from 78% to 100%.[3–5,7]

The following report presents the case of a young adult athlete with spondylolysis who underwent percutaneous direct pars defect repair. This is the first reported case in the literature utilizing a percutaneous approach.

CASE REPORT

A 20-year-old male, college athlete, was referred to the orthopaedic spine clinic for midline low back pain. He was diagnosed with a unilateral L4 pars interarticularis defect without spondylolisthesis, which had activity consistent with a healing stress fracture on single photon emission computed tomography scan (Figures 1A, B, 2A–D). He failed nonoperative management, and it was decided to proceed with surgical repair.

The goal of surgery was to achieve a stable anatomic construct which would allow the patient to heal the defect adequately and return to his normal activities as quickly as possible. After evaluating the preoperative imaging, it appeared that a screw could be placed across the defect using the junction of the contralateral lamina and the spinous process as the starting point. This novel trajectory would allow for a screw angle amenable to percutaneous placement. A hybrid operating room (OR) equipped with the Artis Zeego (Siemens Healthcare, Erlangen, Germany) was utilized for real-time guidance and confirmation of optimal implant placement.

General anesthesia was initiated and the patient was positioned prone. Preprocedure fluoroscopy confirmed the appropriate location for incision. A stab incision was made approximately 5 cm lateral to the spinous process on the contralateral side caudal enough to allow for the projected screw trajectory across the defect. A cannulated needle was advanced to the screw starting point at the junction of the contralateral lamina and the spinous process. A guide wire was then placed through the needle across the pars defect terminating in the lateral wall of the right pedicle. A 2.7-mm drill was advanced past the defect over the guide wire, followed by a partially threaded 4 mm ×

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TABLE 1. Previously Reported Repair Techniques

ApproachOptions	
Surgical approaches	Preparation of the defect
Midline approach[12]	Debridement of the fracture site[8–10,12–16]
"Minimally invasive" midline[8,9,11,14,15]	Bone graft (allograft *vs.* autograft)[3–6,12–16]
Paraspinal approach[13,14,16]	No debridement[11]
Fixation techniques	
Direct instrumentation across the fracture	Tension constructs
Buck technique—lag screws across the fracture site (starting at the inferior edge of the ipsilateral lamina)[5]	Scott—cerclage wiring through drill holes in the transverse and spinous processes[18]
Morscher—added laminar hooks to Buck technique to increase compression across the fracture[17]	Songer—modified Scott technique to use pedicle screws to anchor the wire[19]
	Tokuhashi—pedicle screws and the wire is replaced with a connecting rod under the spinous process[20]
	Gillet—pedicle screws and laminar hooks (a tension version of Morscher technique)[21]

46 mm cannulated titanium screw and washer utilizing multiplanar fluoroscopy. The total radiation dose was 1148 mGy. Immediate postoperative radiographs confirmed optimal implant placement (Figure 1C, D). No complications were encountered throughout the procedure.

A postoperative computed tomography (CT) scan (Figure 2E, F) 3 months later confirmed improved fracture healing, well-maintained screw position, and no evidence of complications. The patient had excellent range of motion with complete resolution of pain, and was cleared to gradually return to full conditioning and athletic training.

DISCUSSION

Direct pars repair was initially described by Buck in 1970 to help eliminate the risk of adjacent segment degeneration associated with multilevel fusions.[6] In the ensuing decades, numerous technique modifications have been developed. This case is the first report in the literature that is truly percutaneous.

The percutaneous modification offers the advantage of minimal soft tissue dissection. Decreased dissection has been shown to decrease infection risk, perispinal muscle atrophy, hospital length of stay, blood loss, and recovery time in spine surgery.[22–24] Evaluating the screw trajectory and starting point on preoperative imaging—and confirming in the OR prior to incision—is critical to success. Additionally, the size and diameter of the screw should be evaluated on preoperative imaging. A 4-mm screw was chosen to maximize fixation while minimizing the risk of cortex breach, which can lead to nerve impingement.

Because the screw trajectory crosses the midline, it would be impossible to fix bilateral pars defects with the described technique. Furthermore, in unilateral pars defects, the posterior elements are inherently stable, and drilling did not carry significant risk of fracture displacement. Additionally, without dissection, there was no debridement of the fracture site. In this case, the compression by the lag screw was adequate to reduce the fracture and provide enough stability to yield osseous integration. However, it is possible that in some circumstances excessive fibrous tissue within the defect site could lead to an incomplete reduction, which could inhibit bony healing across the site. The fragment distraction and surrounding tissue present in preoperative imaging must be carefully evaluated prior to attempting a percutaneous approach.

SUMMARY

Percutaneous fixation of a unilateral pars defect refractory to conservative management successfully alleviated the

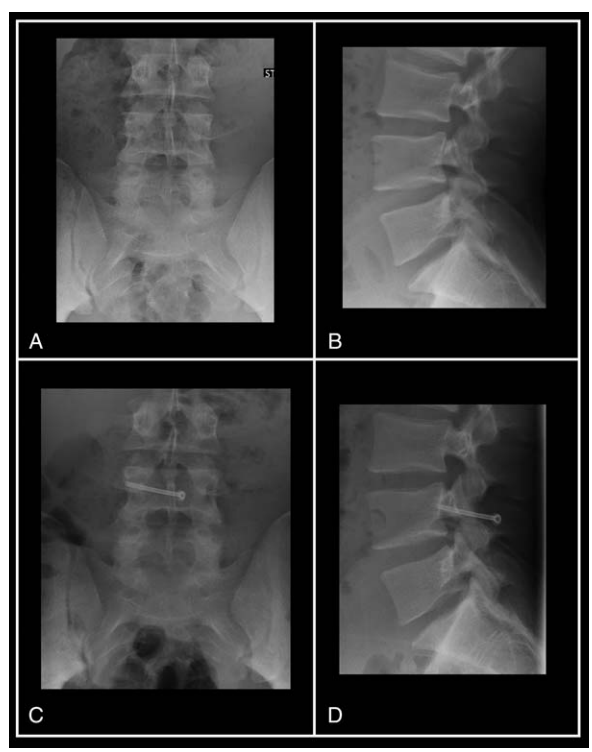

Figure 1. The preoperative anteroposterior (**A**) and lateral (**B**) radiograph of the lumbar spine. The postoperative views are shown in (**C**) and (**D**).

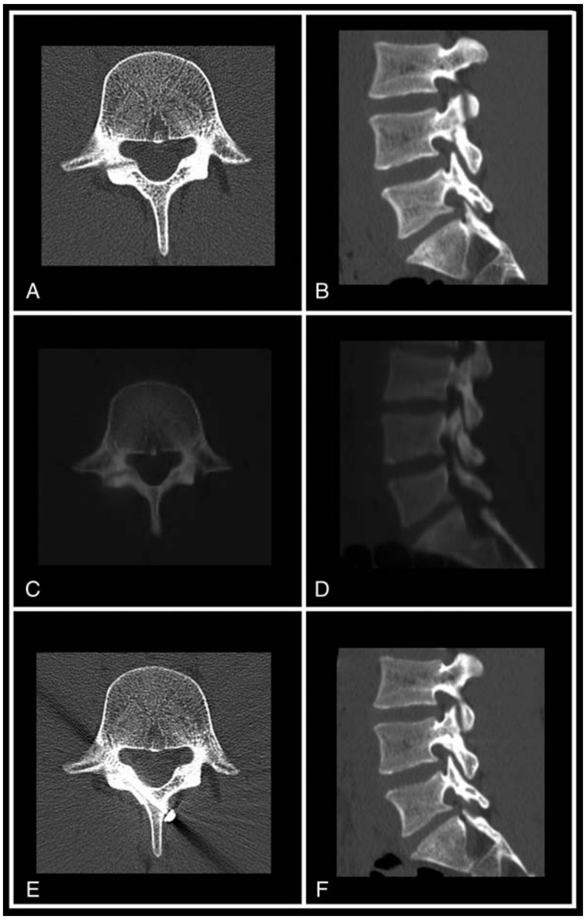

Figure 2. The axial (**A**) and sagittal (**B**) CT scan images of the pars defect with vertical orientation. Axial (**C**) and sagittal (**D**) SPECT images show the pars defect and bone regeneration activity. Three-month postoperative axial (**E**) and sagittal (**F**) CT scan images that demonstrate fracture healing and well-maintained position of the screw. CT indicates computed tomography; SPECT, single photon emission computed tomography.

patient's symptoms and provided a stable construct resulting in fracture healing. This approach has significant advantages when compared with a minimally invasive or more traditional open approaches due to the minimal soft tissue dissection. There are technical considerations that may narrow the indications for this procedure and must be evaluated prior to attempting a percutaneous repair. Long-term follow-up and repetition are needed to determine whether this technique can become a mainstay of treatment.

➢ Key Points

- ❑ Direct pars repair can be used in young adults for spondylolysis which has failed to respond to nonoperative management.
- ❑ Percutaneous CT-guided pars repair can be a safe option with minimal blood loss and soft tissue dissection.
- ❑ Proper position of the screw can be verified intraoperatively.
- ❑ The starting point on the lamina, the best possible location of the incision, as well as the size and diameter of the screw need to be evaluated on the preoperative CT scan.

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