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Case Report

Rod Fracture Causing Relief of Back Pain That Developed After Adult Lumbar Degenerative Flat-Back Correction Surgery: A Case Report

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A 73-year-old woman underwent deformity correction surgery (anterior lumbar interbody fusion of L2-L3-L4-L5-S1, pedicle subtraction osteotomy at L4, and posterior screw fixation from T10 to the pelvis) due to lumbar degenerative flat-back. Following the operation, the patient experienced pain in her back and buttocks, for which she regularly took medications. She reported frequently feeling a heavy and stretched sensation of pain after the operation in those areas, which made her regret undergoing the operation. However, at 33 months postoperatively, she reported that one day, while getting up from a chair, she felt a crack in her back, which was followed by an improvement in her back and buttock pain; thereafter, she stopped taking pain medications. Follow-up radiography revealed a bilateral rod fracture at the L4–5 level on the right side and at the L3–4 level on the left side. The overall pelvic parameters, except pelvic incidence, slightly changed after the rod fracture. Therefore, the broken rod was replaced and another rod was added to the broken rod area; however, the changed pelvic parameters were not corrected further during the reoperation. Following the reoperation, the patient showed improvements and she no longer required pain medication.

Keywords: Lumbar, Osteotomy, Pelvic, Pain, Radiography

INTRODUCTION

A rod fracture (RF) can significantly affect patients, leading to, amongst others, pain, loss of deformity correction, and the need for revision surgery.[1] Additionally, it may be a risk factor for pseudarthrosis if occurring soon after the operation. The largest study to date, which examined symptomatic RF, reported a lower incidence (6.8%) of symptomatic RF in an adult population of spinal deformity when treated with long (>5 levels) posterior instrumented fusion, and a higher incidence (15.8%) of the symptomatic RF in a subset of patients who underwent osteotomy.[2] Nearly two-thirds of the patients (63.6%) with RF underwent revision and had lower scores in the Oswestry Disability Index (ODI) and in the 22-item Scoliosis Research Society questionnaire scores than did those who did not undergo revision surgery.[3] In this study, we document and analyze the reasons for a rare case of a patient who reported an immediate improvement in her persistent pain in both her buttocks and leg as a result of adult lumbar degenerative flat-back surgery following the RF.

CASE REPORT

Institutional Review Board approval was obtained before initiating the study. A 73-year-old woman reported an improvement in pain in her back and buttocks following a "cracking" sound in her back. The patient described to have had back and buttock pain for several years as a result of her lumbar degenerative flat-back (Fig. 1A), for which she underwent deformity correction surgery (anterior lumbar interbody fusion of L2-L3-

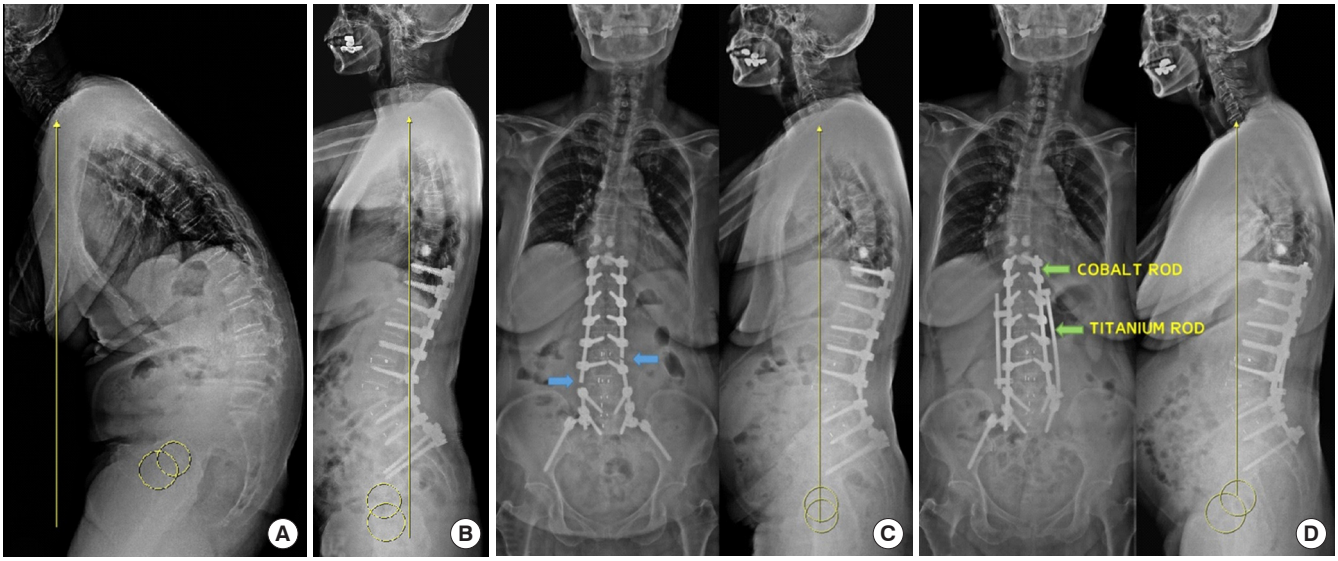

Fig. 1. (A) Preoperative whole spine X-ray showing a positive sagittal imbalance. (B) Postoperative (ALIF L2-3-4-5-S1, pedicle subtraction osteotomy at L4, and posterior screw fixation from T10 to pelvis) whole spine X-ray showing the correction of the preoperative sagittal imbalance. (C) Bilateral rod fracture (arrow) at the L4–5 level on the right side and at the L3–4 level on the left side. (D) Change of the previous titanium rod to the current cobalt rod, with the addition of a titanium rod beside the cobalt rod.

Table 1. Changes in spinopelvic parameters relative to the operation stage

Parameter	Preoperative	POD #7	POD #1 yr	Rod fracture	After reoperative
SVA (mm)	-254	-10	0	40	40
PI (°)	56	56	56	56	56
SS (°)	-5	48	47	40	36
PT (°)	61	8	9	16	20
LL (°)	26	-65	-63	-50	-50
TL (°)	18	-1	-1	5	5
TK (°)	30	34	36	40	40
PI-LL mismatch (°)	30	-9	-7	6	6
LL-TK (°)	-4	31	27	10	10
TPA (°)	71	1	5	16	16

POD, postoperative day; SVA, sagittal vertical axis; PI, pelvic incidence; SS, sacral slop; PT, pelvic tilt; LL, lumbar lordosis; TL, thoracolumbar lordosis; TK, thoracic kyphosis; TPA, T1-pelvic angle.

L4-L5-S1, pedicle subtraction osteotomy [PSO] at L4, and posterior screw fixation from T10 to pelvis) 33 months ago (Fig. 1B). Her pelvic parameters described in Table 1, were measured before deformity correction, 7 days postoperatively, and 1 year postoperatively, following RF and reoperation. Following the operation, the patient experienced back and buttock pain for which she regularly took medications. She described the pain that frequently felt heavy and stretched in her back and buttock, and also felt like being bulled her back posteriorly, which made her regret getting operated. Because of her severe pain, the patient has taken several steroid injection therapies at another hospital and pain medications (Ultracet tablet [tramadol hydrochloride 37.5 mg/acetaminophen 325 mg] and Targin tablet [oxycodone hydrochloride 5 mg/naloxone hydrochloride 2.5 mg]) ever since. Additionally, follow-up plain radiography did not reveal any complications. Considering that the postoperative pelvic parameters and sagittal balance were in the reference range, reoperation was not considered. However, 33 months after the operation (postoperative day #978), the patient noted an improvement in her back and buttock pain following a "cracking" sound in her back while getting up from a chair. However, this did not lead to any aggravation of the deformity and resulted in reduced back discomfort, for which pain medications were not required any longer. The following month, the patient visited the outpatient clinic and a follow-up plain radiography revealed a bilateral RF at the L4–5 level on the right side and at the L3–4 level on the left side (Fig. 1C), without a periscrew halo. We found the interbody bony formation between the intervertebral bodies at the L2-L3-L4-L5-S1 level with computed tomography which checked 33 months after operation (Fig. 2). We compared the postoperative 1-month spinopelvic parameters to postoperative 33-month spinopelvic parameters, and the results is as follows; S1 upper endplate – L5 upper endplate: 17.5° to 13.5° ($\triangle = 4°$), S1 upper endplate – L4 upper endplate: 50° to

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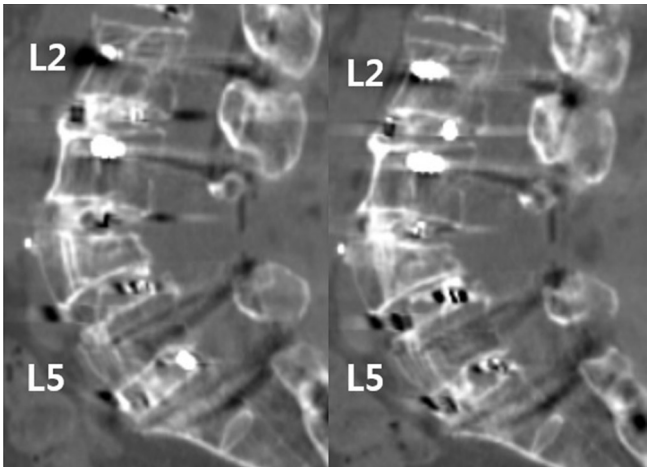

Fig. 2. Bony bridge between intervertebral bodies at the L2-3-4-5-S1 level through a computed tomography scan.

44° (△ = 6°), S1 upper endplate – L3 upper endplate: 58° to 46° (△ = 12°), S1 upper endplate – L1 upper endplate: 65° to 50° (△ = 15°). These results showed that the significant changes occurred at L3–4 level (6°), and this level is the L3–4 RF site on the right side.

Although we attempted to remove both the iliac bolt screws, as they could be cause of the buttocks pain, we could remove only the left iliac bolt screws as the right iliac bolt screw was too strongly attached to the iliac bone. Considering that the patient's symptoms improved as a result of the worsening of her pelvic parameters, we did not consider further correction (Fig. 1D). Although the patient's overall pelvic parameters slightly changed except pelvic incidence (Table 1) following the RF, her symptoms improved; therefore, she did not require pain medication any longer. The patient's positive outcome was maintained for 12 months following her reoperation.

DISCUSSION

Smith et al.[2] described pain as the primary symptom of symptomatic RF in 29 patients (97%), whereas 1 patient (3%) reported a progressive worsening of the positive sagittal malalignment. Additionally, postoperative loss of deformity correction occurred in 5 other patients. According to several studies, linear regression between pelvic parameters and normal sagittal plane alignment is helpful in preoperative planning to achieve optimal postoperative sagittal balance. On the basis of these correlations, various mathematical formulae have been developed to improve the accuracy of the prediction of sagittal balance after deformity correction.[4-8] However, Lafage et al.[9] suggested that ideal spinopelvic alignment values, corresponding to patient-reported outcomes, increased with age, briefly, older patients have greater baseline deformities. Therefore, they proposed that the patient's age must be considered in the evaluation and operative treatment of adult spinal deformities. In fact, they determined in their study that, for a given ODI value, older patients were more likely to have an element of sagittal malalignment, based on the classic spinopelvic parameters. Therefore, we conclude that rigorous alignment values should not be applied to older patients, as a modest increase in the anterior shift and pelvic retroversion may happen naturally.

Table 2. Comparison of our patient's spinopelvic parameters with Lafage's age-adjusted parameters

Parameter	Lafage's	POD #7	POD #1 yr	Rod fracture	After re-operative
SVA (mm)	53.4–55.6	-10	0	40	40
PT (°)	24.9–25.5	8	9	16	20
PI-LL mismatch (°)	7.5–13.4	-11	-7	6	6
LL-TK (°)	5.9–6.1	37	29	10	10
TPA (°)	22.5–22.8	1	5	16	16

POD, postoperative day; SVA, sagittal vertical axis; PT, pelvic tilt; PI, pelvic incidence; LL, lumbar lordosis; TK, thoracic kyphosis; TPA, T1-pelvic angle.

A comparison of our patient's pelvic parameters after deformity correction with the age-adjusted pelvic parameters identified by Lafage et al.[9] revealed overcorrection (Table 2). Indeed, the patient's pelvic parameters following the RF were instead better aligned with the aforementioned age-adjusted pelvic parameters. Therefore, we suggested that, initially, the deformity was overcorrected with the surgery; however, the much correction to age was modified after the RF and was associated with symptom improvement.

Considering that one article reported an overcorrection of lumbar lordosis (LL) as an effective treatment modality to maintain optimal sagittal alignment in patients with degenerative lumbar kyphosis, it should be considered in preoperative planning for patients with adult spinal deformity and sagittal imbalance.[10] The primary goal of the surgical correction described in this study was to achieve an ideal LL, with a theoretical value calculated according to the Korean version of Legaye's formula (sacral slope [SS] = 0.80+0.74 pelvic incidence, lower LL = 5.20 +0.87 SS, maximal LL = 17.41+0.96 SS), as reported by Lee et al.[10-12] In our case study, according to this formula, the highest and lowest LL in the patient were -57.97° and -41.94°, respectively. Therefore, in the first operation performed on our patient,

the LL was highly overcorrected.

RFs are known to occur frequently in the PSO site in adults with spinal deformities.[1] In our case, we assumed that an anterior force, which resulted from the much correction to age, acted on the rod, resulting in an RF at the PSO site.

We believed that pain after the first operation was caused by an excessive correction of the patient's deformity or by pelvic inflammation due to irritation of iliac bolt screws, which was, however, less believable because the pain was improved immediately following the "cracking" sound in the patient's back. We, therefore, considered the change in the pelvic parameters following the RF to be more likely the cause of symptom improvement. Therefore, we changed the previous titanium rod to a cobalt rod, and added the titanium rod beside the cobalt rod to prevent further RF.

The authors did not find any known mechanism or cause for the loss of pain due to changes in balance parameters after RF.

CONCLUSION

Older patients are likely to have substantially more severe baseline deformities than the rest of the population. In correcting spinal sagittal deformities, quantitative targets should be achieved for ideal sagittal alignment. In addition, surgeons should consider age-adjustment of the sagittal spinopelvic alignment, considering that rigorous alignment values may represent an overcorrection for older patients and should not be applied to them.

CONFLICT OF INTEREST

The authors have nothing to disclose.

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