A chronic flexion-distraction injury with a “fistulous wither” on the split spinous process of the L1 vertebra—a case report of a modified transpedicle wedge osteotomy

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Introduction

Flexion-distraction injuries (FDIs) are caused by high-energy force and momentum on the spine. In general, the posterior column and the posterior wall of the affected vertebra have failed in distraction, and the anterior column has failed in compression based on Denis’ three column theory [1]. Hoshikawa et al. has proposed a motion axis of FDIs, which is defined as a transitional line from the anterior compression to the posterior splitting failure [2]. In terms of biomechanics, the integrity of the posterior tension band of the affected vertebrae has failed in FDIs. As a result of this loss of integrity of the posterior element, kyphotic deformity easily develops and remains unless proper treatment has been optioned in FDIs.

Fresh FDIs with minimal displacement are usually treated with an extension brace or body cast, and they have a good prognosis. Meanwhile, treatment of chronic FDIs is complicated. Backache and/or gibbus, which is caused by rigid kyphosis even after bone fusion at the affected segment, is a major residual symptom in chronic FDIs. Nonoperative treatment can rarely cure rigid kyphotic deformity. Malcom et al. stated that persistent back pain in the lumbar spine and the buttocks is usually related to a compensatory hyperlordosis below the kyphotic segment [3]. Although the degree to which kyphosis should be corrected operatively is still controversial, surgical intervention is indicated for some cases with backache and/or ill cosmesis caused by rigid kyphotic deformity in chronic FDIs. LeGay et al. have proposed that a deformity of

greater than 17° in kyphosis of FDIs shows a clinically poor result and an instability in vivo [4]. For surgical treatment of a rigid kyphotic deformity of chronic FDIs, access to the damaged vertebra, releasing the scar tissue, correction of the kyphosis and a stable support in the anterior and middle columns are crucial. In the anterior approach, a wide surgical field of the affected segment is obtained, but it is associated with significant pulmonary and incisional morbidity. Conversely, the posterior approach provides more limited access with less morbidity, and it also enables surgeons to directly observe the neural tissue after resection of the damaged posterior elements in FDIs.

A supraspinous bursitis is described as “fistulous withers” in horses [5]. It is a mechanical inflammation caused by a poorly fitting tack on horse withers. It begins as a painless encapsulated accumulation of serum associated with the supraspinous bursa. To my best knowledge in English and Japanese literature, there is no report of a symptomatic bursitis on the lumbar spinous process in humans. The supraspinous and the interspinous ligaments are less resilient to stress than the interval disc and the capsular ligament. Thus, there is a possibility that a condition similar to “fistulous withers” in horses develops in humans, when a local post-traumatic kyphosis of chronic FDIs remains in the human thoracolumbar spine.

The purpose of the current article is a case report of chronic FDIs in the L1 vertebra. The patient had developed a rigid kyphosis associated with a bursitis on the distracted spinous process. He underwent radical excision of the affected soft tissue, partial resection of the fractured spinous process, a modified transpedicle wedge osteotomy in a fractured line, and augmented with pedicle screws and titanium interbody cages. An excellent prognosis has been obtained in the current case.

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Case report

A 59-year-old man, a retired worker, presented chronic pain in his lower back. There was no history of definitive trauma, but he mentioned that he had experienced a mild motor vehicle crash while wearing a three-point seat belt 6 months earlier and the swelling in his back had been deteriorating for 3 months. The pain was dull in character, and confined to the thoracolumbar spine. He also described that standing, walking, and especially lying in a supine position aggravated the pain.

Physical examination revealed that he was poorly nourished. His body mass index was 19.7 (body height, 173 cm; body weight, 59 kg). A visible thoracolumbar gibbus was present. A subcutaneous fluctuation, which seemed to be the size of a large egg, was palpable at the tip of the deformity (Fig. 1a). Tenderness was also present at the affected spinous process. Five milliliter of bloody serum was aspirated from the fluctuation (Fig. 1b). Bacterial culture of the fluid was negative. A lateral plain X-ray demonstrated a kyphosis of 35° at T12/L1 (Fig. 2a). No instability of the fracture site was found in flexion and extension X-rays. MRI was not performed because he had a stainless steel clip in his cranium. Reconstructed CATs in the sagittal plane demonstrated a fracture line through the spinous process, the pedicle, and the upper vertebral body in L1. A lesion containing gas was

Fig. 1 A visible thoracolumbar gibbus and a subcutaneous fluctuation at the tip of the deformity (a). A 5.0 ml of bloody serum was aspirated from the fluctuation (b)

Fig. 2 A lateral plain radiogram showing a kyphosis of 35° at T12/L1 (a). Reconstructed CATs demonstrating a fracture line through the spinous process, the pedicle, and the upper vertebral body in the L1 vertebra. A lesion containing gas at the T12/L1 intervertebral disc and the upper vertebral body of the L1 vertebra (b)

also seen at the T12/L1 intervertebral disc and the upper vertebral body of the L1 vertebra, whereas no bony protrusion was present in the spinal canal at the affected level (Fig. 2b). These investigations suggested a diagnosis of a chronic FDI with a bursitis or hematoma on the split spinous process in L1. In spite of a thoracolumbar brace, NSAIDs, and repeated aspiration, no recovery from the symptoms were observed. Corrective surgery for the gibbus and resection of the bursa or hematoma was indicated 6 weeks after his initial visit.

At operation, a posterior approach was chosen. The patient was positioned prone on a Hall-Relton spine frame.

Thereafter, a midline incision was made, a subcutaneous fibrous cystic lesion, which was connected with the split L1 spinous process, was demarcated and radically excised. It was elliptical in shape and approximately 40×50 mm in size. Pathological diagnosis was a bursitis (Fig. 3a, b). The supraspinous process on the spinous ligament in L1 was completely torn. Secondly, the T11 to L2 laminae was exposed subperiosteally. A fracture line of the L1 spinous process was identified. No instability or bleeding was identified. The cephalad portion of the split spinous process and the lamina was resected. Then, the facet joints of T12/L1 were bilaterally removed. Discectomy of T12/L1 and osteotomy of the posterior wall of L1 was then performed. The bilateral L1 pedicles were also subtracted from their base. Anterior soft tissue was released as much as possible with a great care. Resected local bone and two titanium spacers (8° angled, 7 mm in height, 25 mm in length) were placed at the T12/L1 space. Pedicle screws were bilaterally inserted in T11, T12, and L2. Correction was done via compression of the pedicle screws and rods assembly using two titanium spacers as a fulcrum. Postoperatively, the patient was placed in a soft

thoracolumbar brace for 3 months. At 1.5-year follow-up, he reported no backache. Recurrence of the bursitis at the spinous process in L1 was not observed. Plain radiograms and reconstructed CAT demonstrated a solid boney fusion with a minimal kyphosis of 5° at T12/L1 (Fig. 4a–d).

Discussion

In FDI, neurological deficits are rarely observed as the spinal canal diameter at the affected segment is being elongated in the antero-posterior direction, and backache and/or gibbus, which is caused by a local kyphotic deformity, is a dominant residual symptom in chronic cases. As backache and/or gibbus is usually minimal to mild in chronic FDI, they do not disturb daily or work activities in the long-term prognosis. Thus, nonoperative treatment should be considered prior to surgical intervention. Conversely, when backache and/or gibbus, which prevents patients from normal daily life, sports, and employment, is persisting, operative treatment should be optioned. Kostuik et al. proposed that a significant kyphosis of more than 30° was an indicator of surgical intervention for post-traumatic kyphosis [6]. Our surgical criteria for post-traumatic kyphosis without neurological deficits in the thoracolumbar spine are defined as following (1) association with persistent back and/or leg pain; (2) progression of 20° or more; (3) less than 50 % of anterior vertebral height [7].

Releasing and removing of the scar tissue, reducing kyphotic deformity, and anterior to middle column support is critical for operative procedures of chronic FDI. It is still controversial whether anterior or posterior approach should be chosen for the surgery of chronic FDI. An advantage of posterior approach is that surgeons can correct the kyphosis of the affected segment under direct observation of the spinal cord after resection of the damaged lamina, the pedicle, and the vertebral body. In terms of this merit, a posterior approach is optioned in the current case. Huang et al. have reported a case of chronic Chance injury with a kyphotic deformity of 38°. They have performed a transforaminal interbody fusion of T11/12, at which a dynamic motion is still preserved, and the result is excellent [8]. Relative to the case of Huang et al. in the current case, as the dynamic motion is not present at the affected segment at all, correction of the rigid kyphosis was supposed to be difficult by interbody fusion maneuver alone at T12/L1. Thereby, transpedicle wedge osteotomy was added along a transpedicle fracture line in the L1 vertebra. Opening and closing wedge osteotomy is a standard procedure for correction of post-traumatic kyphosis in the thoracolumbar region. Pedicle subtraction osteotomy is also a useful technique, and provides a 30° to 40° corrective angle. One of the severe complications of the extensive correction of rigid kyphosis by posterior wedge osteotomy however is a

Fig. 3 A subcutaneous fibrous cystic lesion connected with the split L1 spinous (a). Pathological diagnosis was bursitis. H&E; magnification; ×40 (b)

Fig. 4 Plain radiograms demonstrating a solid boney fusion with a minimal kyphosis of 5° at T12/L1 (**a** and **b**). Reconstructed CATs showing an intense bone bridging (**c** and **d**)

neurological deterioration. Wang et al. have pointed out potential reasons for the neural damage: (1) shortening and/or compression of the spinal cord; (2) translation at the osteotomy site; and (3) compression of the neural tissue by the residual lamina or pedicle [9]. Kawahara et al. have reported that no paraparesis was found in experimental canines in which shortening of the dural sac and the spinal cord was limited within 10 mm [10]. To prevent extreme shortening of the neural tissue, we have used interbody spacers by maintaining the intervertebral height at T12/L1. Furthermore, we partially resected the lamina of the adjacent vertebra to prevent an impingement of the neural tissue. As a result, a corrective angle of 30° is obtained at T12/L1 with no neurological deterioration in the current case.

Barrstrap's disease is a well-documented inflammatory condition of interspinous bursa in the lumbar spine. The incident of Barrstrap's disease is 8.2 % of 539 patients in cross-sectional retrospective review with MRI [11]. On the contrary, to my knowledge, there is no report of symptomatic bursitis on the thoracolumbar spinous process of humans in English and Japanese literature. In 1925, a supraspinous bursitis of horses was initially described as "fistulous withers" [5]. This pathogenesis

is attributed to a mechanical inflammation caused by a poorly fitting tack on horse withers. Bursae, localized around articular cavities, exist in over 150 diverse regions, and adhere to tendon sheath and muscle overlying bony prominence, but existence of the supraspinous bursa in the normal spine was not definitively described in the human body [12]. Tanemura et al. has mentioned that subcutaneous bursitis often results from repetitive local trauma, gout, and septic change of its inside [13]. In the current report, the patient had a very poor amount of subcutaneous fat tissue (BMI, 19.7). Thereby, it is assumed that repeated friction stress concentrated directly on the split spinous process at the top of the L1 vertebra and the painful bursitis developed subcutaneously.

Conflict of interest The manuscript submitted does not contain information about medical devices or drugs. No benefit in any form has been or will be received from a commercial party related directly or indirectly to the subject of this manuscript.

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