Case Report

Bilateral pure facet joint dislocation in thoracolumbar junction (T11–T12) without facet fracture using a 3D digital printing model for surgical planning: A case report

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ABSTRACT

Background: Thoracolumbar junction pure bilateral facet joint dislocation without facet fracture is an extremely rare injury. A current review of thoracolumbar junction pure bilateral facet joint dislocation reported less than 15 cases in which the surgeon had a difficulty with the dissection of surgical planning using only 2D radiographic film and the axial or coronal view in computerized tomography. Bilateral pure facet joint dislocation in the thoracolumbar junction without facet fracture is difficult to understand the morphology of bone injuries.

Case presentation: A 25-year-old Thai gentleman presented with paraplegia and loss of sensation in the lower extremity (ASIA A) following a fall from a high lorry. Radiographic film and computed tomography scan revealed pure facet dislocation T11–T12 without facet fracture. The patient's thoracolumbar junction of the spine is presented to describe the three-dimensional (3D) printing technique for surgical preoperative planning. After the patient underwent open reduction, decompression and instrumentation with posterolateral fusion, the patient's thoracolumbar junction was described in the three-dimensional (3D) printing again for follow-up and in order to help the surgeon understand about the morphology and alignment after surgery.

Conclusion: Pure facet dislocation is rarely seen at the thoracolumbar junction; it is a very unstable injury. In this case, we performed an early investigation using a 3D digital printing model in order to help with orthopedic surgical planning, emergency early open reduction and instrumentation with fusion. Neurological status was recovered. The 3D digital printing model should be a standard investigation in rare cases of orthopedic surgical planning.

Introduction

Three-dimensional (3D) printing is the most important aspect of 3D technology in medicine and orthopedics for preoperative planning [1]. 3D printers are becoming necessary in medical applications, including surgical planning, the creation of implants and prostheses, and medical education. In the spine field, 3D printing is commonplace worldwide and essential for complex treatments [2]. We report on a case of thoracolumbar junction injury which presented with ASIA A in order to describe the three-dimensional (3D) printing technique for surgical preoperative planning.
A 25-year-old gentleman presented with ASIA Impairment Scale (AIS) grade [3] in ASIA B and paraplegia following a fall from a high lorry. Radiographs and computed tomography scan revealed pure facet dislocation T11–T12 without facet fracture. The patient also had sustained a mild head injury. Computed tomography scans of the brain and cervical spine were unremarkable. The patient's ASIA B progressed to ASIA A. He was referred from a private hospital to our institution.

The patient's thoracolumbar junction of the spine was investigated with 2D radiographs preoperatively using X-ray film and the coronal view in magnetic resonance imaging (MRI) (Fig. 1). To describe the three-dimensional (3D) printing technique, we used Materialise’s software for surgical preoperative planning (Fig. 2). Under general anaesthesia in the prone position the patient underwent open reduction, decompression and instrumentation. The thoracic spine was exposed through the standard posterior midline approach from T10 to L2. Intraoperatively we found the inferior facet of T11 anterior to the superior articular facet of T12, with no evidence of facet fracture (Fig. 3). Pedicle screws were placed bilaterally from T10 to L2 and scripted T12 level. The superior articular process of T12 was partially resected using a high-speed carbide cutting burr. Reduction was achieved. Laminectomy at T12 level was done and the screws were connected using interconnecting rods at both sides. Crosslink was applied and then posterolateral fusion with local bone graft was carried out.

Post-operatively radiographs were satisfactory. The patient received rehabilitation program and training transfer with wheelchair without caregiver. Patients’ thoracolumbar junction was assessed using three-dimensional (3D) printing and analysis by Materialise’s software (Mimic) (Fig. 4) to allow the surgeon to understand the morphology and alignment after surgery. The patient improved significantly neurological status at 3-month follow-up.

Discussion

The thoracolumbar spine is a common site of fracture after trauma and depending on the mechanism of injury different radiographic patterns can develop. Thoracolumbar junction of T11/T12 pure bilateral facet joint dislocation without facet fracture is a very rare injury. Review of the literature of thoracolumbar junction pure bilateral facet joint dislocation revealed that less than 15 cases have been reported [4–6]. Thoracolumbar junction injury without facet fracture is uncommon and difficult to understand the morphology of injury. Consequently, 3D digital printing model could be an important adjunct for pre-operative and post-operative surgical planning and management [7].

In 2018, R.M. Narendra et al. [6], reported a rare case of bilateral pure facet joint dislocation of upper lumbar spine (L1–L2) without facet fracture that was treated with open instrumented reduction along with left-sided transforaminal removal of damaged disc and inter body fusion that demonstrated recovery of neurological status at 6-month follow-up.

Three-D printed models to plan for operations involving rare or abnormal anatomy are being used in orthopedics surgery. Other published orthopedic applications include planning for the correction of spine trauma. The desire to be more precise and reliable whilst operating on the spine has led to an interest in this technology which has claimed to achieve these goals. 3D printing has been used pre-operatively for surgical planning and for resident or patient education. It has also found its way to the operation theatre
where it is used to fabricate customized surgical tools or patient-specific implants. Several authors have highlighted significant benefits when 3D printing is used for specific indications in spine surgery [8].

In conclusion, the authors report a case of pure facet dislocation (a very unstable injury), which is rarely seen at thoracolumbar junction. 3D digital printing model help orthopedic surgical planning and surgical treatment with instrumented fusion which led to recovery of neurological status (ASIA B) after 3 months. This approach of 3D digital printing model can assist surgeons in the management of these difficult cases.

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**Fig. 2.** Materialise’s software for surgical pre-operative planning.

**Fig. 3.** Inferior facet of T11 anterior to superior articular facet of T12 (green circle). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Fig. 4. Initial post-operative surgery showing reduction and alignment well maintained with three-dimensional (3D) printing.
Ethical statement

The patient provided written informed consent, permitting us to publish the case details and any accompanying images. The Nakornping Hospital Institutional Review Board provided its approval to publish the case details. The patient had the opportunity to refuse. The patient's personal information remains confidential. There was no cost or harm to the patient as a result of the study.

Declaration of competing interest

No potential conflict of interest relevant to this article was reported.

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