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# Vertebral split fractures: Technical feasibility of percutaneous vertebroplasty

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ABSTRACT

*Objective:* The treatment of vertebral split fractures remains controversial, consisting of either corset or internal fixation. The aim of this study was to evaluate the technical feasibility of CT- and fluoroscopy-guided percutaneous vertebroplasty in the treatment of vertebral split fractures.
*Materials and methods:* Institutional review board approval and informed consent were obtained for this study. Sixty-two consecutive adult patients who had post-traumatic vertebral split fractures (A2 according to the AO classification) without neurological symptoms were prospectively treated by percutaneous vertebroplasty. All these procedures were performed by an interventional radiologist under computed tomography (CT) and fluoroscopy guidance by using only local anaesthesia. Postoperative outcome was assessed using the visual analogue scale (VAS) and Oswestry disability index (ODI) scores.
*Results:* Vertebroplasty was performed on thoracic and lumbar vertebrae, creating a cement bridge between the displaced fragment and the rest of the vertebral body. Seven discal cement leakages (11%) were observed, without occurrence of adjacent vertebral compression fractures. The mean VAS measurements ± standard deviation (SD) significantly decreased from 7.9 ± 1.5 preoperatively to 3.3 ± 2.1 at 1 day, 2.2 ± 2.0 at 1 month, and 1.8 ± 1.4 at 6 months ($P < 0.001$). The mean ODI scores ± SD had also a significant improvement: 62.3 ± 17.2 preoperatively and 15.1 ± 6.0 at the 6-month follow-up ($P < 0.001$).
*Conclusion:* This study suggests that type A2 vertebral fractures could be successfully treated by CT- and fluoroscopy-guided percutaneous vertebroplasty.



## 1. Introduction

Indications of percutaneous vertebroplasty have been gradually broadened, including severe vertebral compression fractures, post-traumatic burst fractures, malignant vertebral fractures with epidural involvement, or osteolytic lesions of C2 [1–5]. Such extremes can be reached notably thanks to an excellent image guidance. Gangi et al. [6] showed first in vertebroplasty procedures that the combination of computed tomography (CT) and fluoroscopy could facilitate needle placement and reduce complications.

Vertebral split fractures which are classified A2 (according to the AO classification) have the potential to end with a non-union due to the impacted disc material within the vertebral body [7]. The treatment of vertebral split fractures remains controversial, consisting of either corset or internal fixation [8,9]. The surgical treatment of these fractures has the advantage over the conservative management to prevent secondary displacement. However, the surgical option may lead to complications due to extensive exposure and screw malposition [10].

An alternative treatment could be percutaneous vertebroplasty. The purpose of our study was to evaluate the feasibility of this technique in the treatment of split fractures.

## 2. Materials and methods

### 2.1. Patients

This study was approved by the Institutional Review Board of our institution. Patients were enrolled after giving written informed consent.

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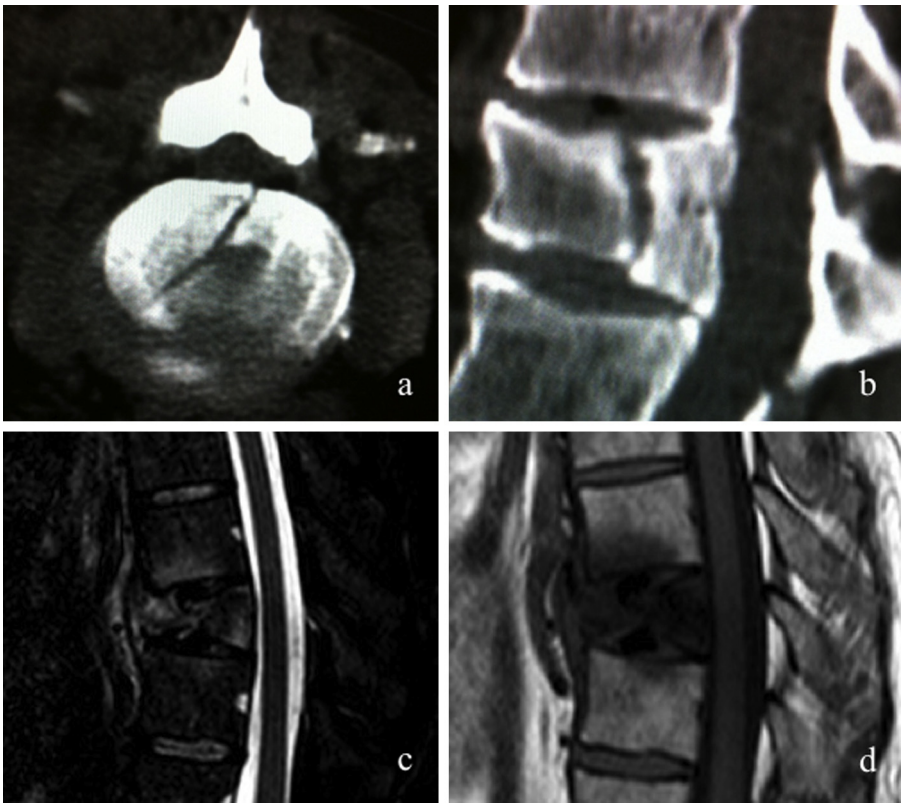


**Fig. 1.** (a) Axial CT scan: a lateralized sagittal split fracture (A 2.1 according to the AO classification). (b) Sagittal CT scan: a coronal split fracture (A 2.2). (c and d) STIR and T1-weighted MR sagittal images showed a coronal split fracture, with oedema of fractured vertebral body and adjacent vertebral endplates. Neither spinal cord compression nor involvement of posterior elements were observed.

From January 2004 to October 2010, we performed a single-centre prospective study of 62 consecutive adult patients referred by the trauma department of our institution for non-neurological post-traumatic vertebral split fractures.

There were 34 men and 28 women. The mean age was 65 years (range, 28–88 years). The mechanisms of injury were a road traffic accident for 41 patients, a fall from window or balcony for 9, a skiing accident for 6, a fall from horseback for 5, and a water-skiing accident for 1.

On the basis of CT imaging, these fractures were classified A2 according to the AO classification [7], with a sagittal split (A 2.1) in 23 cases and a frontal split (A 2.2) in 39 cases within their vertebral body (Fig. 1).

A magnetic resonance (MR) imaging including T1-weighted and Short-Tau-Inversion-Recovery (STIR) sagittal sequences and T2-weighted axial sequence was systematically made to exclude spinal cord compression and type B fractures (i.e., without involvement of posterior elements).

The visual analogue scale (VAS) for the severity of back pain and the Oswestry disability index (ODI) [11] for functional disability were measured preoperatively.

### 2.2. Technique of percutaneous vertebroplasty

In all patients, the decision to apply the technique of percutaneous vertebroplasty was made during interdisciplinary meetings by mutual agreement by interventional radiologists and orthopaedic surgeons who mainly took account of the degree of displacement between vertebral fragments, their retropulsion, and the collapse of posterior wall.

All procedures were performed by a senior interventional radiologist.

Procedures were performed under aseptic conditions in an interventional CT suite using CT (GE Lightview 8-row MDCT scanner; GE Healthcare, Milwaukee, WI, USA) and lateral fluoroscopy (GE Stenescop C-arm) guidance. Patients were placed in a prone position on the CT table with a support optionally placed under abdomen to decrease lumbar lordosis and simplify the access to the vertebral body.

We first performed a CT acquisition centred around the fractured vertebra with millimetric multiplanar reconstructions which were analyzed on a GE ADW 4.2 workstation to plan the approach. This planning consists in:

- analyzing the anatomy of the vertebra,
- determining the best approach – transpedicular, inter-costo-vertebral or latero-vertebral – so that the direction of needles can transfix at best the plane of the sagittal (A2.1) or coronal (A2.2) fracture line to be fixed by cementoplasty. The choice of the route depended thus on the level and the type of fracture to be treated. An imaginary line of the needle trajectory passing through the vertebral body was drawn on the axial CT images for guidance. A skin entry point was determined, and the distance was measured from the midline.

A radiopaque marker was put on the skin prior to the insertion of the material (Fig. 2). Using a 22-gauge needle, a local anaesthesia (lidocaïne 1% [Xylocaïne; Astra, Sodertalge, Sweden]) was administered in subcutaneous tissues. Three minutes later, a 20-gauge 20-cm Chiba needle (Cook Medical, Bloomington, IN, USA) was inserted to bone contact under fluoroscopy guidance according to the angle previously determined. An axial CT acquisition (SmartStep system) confirmed the correct positioning of the tip of the Chiba needle (Fig. 3). A local anaesthesia of the periosteum was