Orthopaedics & Traumatology: Surgery & Research xxx (2016) xxx–xxx

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Original article

Anterior cervical interbody fusion using polyetheretherketone cage filled with synthetic bone graft in acute cervical spine injury

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ARTICLE INFO

Article history:
Received 5 November 2015
Accepted 14 September 2016

Keywords:
Cervical Spine
Trauma
Polyetheretherketone
Bone fusion
Anterior cervical
Discectomy and fusion

ABSTRACT

Purpose: The aim of this study was to assess the interbody fusion rate for patients treated by anterior cervical interbody fusion (ACIF) using polyetheretherketone (PEEK) cages filled with synthetic bone graft in acute cervical spine injury.
Materials and methods: Twenty-nine patients (mean age: 49 years) with monosegmental instability due to cervical spine injury were followed. We assessed the rate of and time to interbody fusion at 1-year follow-up. In case of secondary displacement, we analysed its causes and surgical management.
Results: The rate of fusion was 86.2%. The mean time to fusion was 7.2 months. Interbody fusion was observed at 3 months in 4 patients, at 6 months in 14 and at 1 year in 7. Four patients had secondary displacement within 3 months.
Conclusion: ACIF with a PEEK cage filled with synthetic bone graft seems to be an alternative to iliac crest bone graft with no morbidity related to the harvest site.

1. Introduction

Acute spine injuries are frequent with an incidence of 19.4 cases per million inhabitants in France. It is estimated that there are more than 900 new cases per year [1]. In Europe, cervical spine injuries represent 45% of spinal cord injuries [2]. The most common causes are road accidents, falls and sports injuries. Subaxial cervical spine injuries affect mostly young patients. In contrast, elderly people have more upper cervical spine injuries [3]. Subaxial spinal injuries may cause mechanical instability with bone fractures or disco-ligamentous disruption and can lead to nerve root injury or spinal cord compression [4,5]. The goal of treatment of unstable lesions is restoration of a normal spinal canal and decompression of the spinal cord [6]. In case of a fracture with dislocation or translation, reduction is recommended first [7]. Treatment is based on external immobilisation, anterior surgery with fusion [8] or posterior arthrodesis [9].

Introduced at the end of the fifties by Cloward, Smith and Robinson [10,11], anterior cervical interbody fusion (ACIF) using a tricortical bone graft harvested from the iliac crest is often performed with a high rate of interbody fusion [8,12,13] in injuries. However, this method leads to harvest-site morbidity such as unsightly scars, infections, haematomas, prolonged pain, nerve injury, higher intraoperative blood loss, and fracture and could impair recovery [14,15]. Fusion with a cage filled with synthetic bone is the most used technique in cervical spondylosis [16–19]. In these cases, polyetheretherketone (PEEK) cages are the most common choice [17,19,20]. In acute cervical spine injuries, interbody fusion with cages has rarely been reported [15,21,22]. In these rare reports, cages are filled with autologous bone graft. To our knowledge, no study has reported the use of PEEK cages filled by synthetic bone graft.

The aim of this study was to assess the interbody fusion rate for patients with acute cervical spine injury treated by ACIF using PEEK cages filled with synthetic bone graft.

2. Materials and methods

2.1. Materials

Thirty-four patients suffering from acute cervical spine injury with monosegmental instability were enrolled retrospectively between January 2009 and April 2014 in our study. Mean age at presentation was 52 years (range: 19–88 years) with a sex-ratio of 1:0.26. We analysed the patients' preoperative neurological status, the type of fracture and the integrity of the disco-ligamentous soft tissue complex on cervical CT scan or/and MRI according to the Subaxial injury classification (SLIC) (Table 1) [4]. This

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http://dx.doi.org/10.1016/j.otsr.2016.09.004
1877-0568/

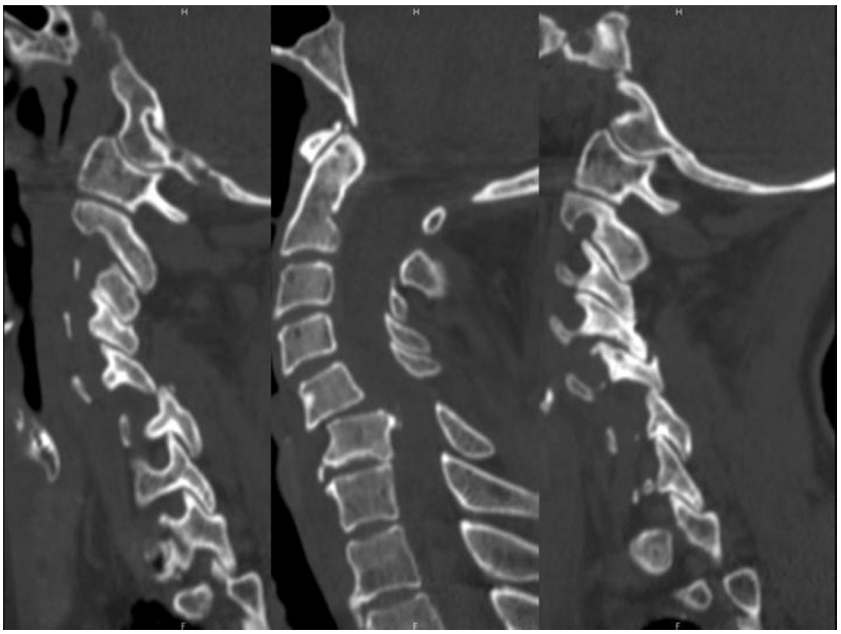

Fig. 1. CT scan (sagittal view) showing a right unilateral translation of C5-C6 with antelisthesis of C5 over C6 (case 2).

Table 1
Sub-axial cervical spine injury classification system (SLIC).

Morphology	
No abnormality	0
Compression	1
Burst	+1 = 2
Distraction (e.g., facet perch, hyperextension)	3
Rotation/translation (e.g., facet dislocation, unstable teardrop or advanced staged flexion compression injury)	4
Disco-ligamentous complex	
Intact	0
Indeterminate (e.g., isolated interspinous widening, MRI signal change only)	1
Disrupted (e.g., widening of disc space, facet perch or dislocation)	2
Neurological status	
Intact	0
Root injury	1
Complete cord injury	2
Incomplete cord injury	3
Continuous cord compression in setting of neurological deficit	+1

According to Vaccaro et al., 2000.

Fig. 2. PolyEtherEtherKetone cage filled with synthetic bone graft (LDR medical MC+®).

classification has been validated and is recommended (level I of evidence) for management of cervical spine injury [5]. The SLIC system separates fractures according to their morphology in compression, distraction, rotation or translation. We added disc herniation and isolated facet fracture, which were not described specifically in this classification. The mean SLIC score was 5.5 (range: 2–10). A score greater or equal to 5 is considered as severe and surgical treatment is recommended in these cases [4]. The mean neurological score was 1.4 (range: 0–4). Twenty-six patients had a neurological deficit and eight had no deficit. The mean Disco-ligamentous complex (DLC) score was 1.8 (range: 0–2). The mean morphology score was 2.3 (range: 0–4). Fifteen patients had a translation injury (eight biarticular and seven uniarticular) (Fig. 1); eight had an isolated facet fracture; eight had a distraction; four had a disc herniation and one had a vertebral body compression injury. C5-C6 level was the most frequently involved level ($n = 10$), then C6-C7 ($n = 9$), C3-C4 ($n = 5$), C4-C5 ($n = 5$), C7-T1 ($n = 4$) and C2-C3 ($n = 1$). In cases of dislocation, closed reduction was performed first under radioscopic control by pulling gently on the cervical spine with a slight extension. All patients included were treated by an ACIF using a modular PEEK cage filled with synthetic bone graft composed exclusively of hydroxyapatite (LDR medical MC+®) (Fig. 2) combined with an anchoring clip placed into the lower vertebrae for almost of them (Fig. 3). We added an anterior locking plate to strengthen stabilization for all patients. Patients did not have postoperative immobilisation by cervical collar. Patients requiring an open reduction were excluded and had a posterior osteosynthesis. Cases with fracture or deformation of the vertebral body were also excluded because of technical constraints (insufficient height of the cage). The mean duration of surgery was 83 min (range: 60–143 min). Concerning the height of PEEK cages, we used 4.5 mm for one patient, 5 mm for seven, 6 mm for 15, 7 mm for 10 and 7.5 mm for the last one. The mean hospital stay was 10 days (range: 4–46 days). Twenty-two patients

Please cite this article in press as: Hattou L, et al. Anterior cervical interbody fusion using polyetheretherketone cage filled with synthetic bone graft in acute cervical spine injury. Orthop Traumatol Surg Res (2016), http://dx.doi.org/10.1016/j.otsr.2016.09.004