Injury, Int. J. Care Injured 45 (2014) 792–798

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Additional anterior plating enhances fusion in anteroposteriorly stabilized thoracolumbar fractures

Klaus John Schnake [a,*], Stavros I. Stavridis [a,1], Sebastian Krampe [b,2], Frank Kandziora [a,3]

[a] Center for Spinal Surgery and Neurotraumatology, BG Unfallklinik Frankfurt am Main, Friedberger Landstraße 430, D-60389 Frankfurt am Main, Germany
[b] Center for Dialysis, Königin Elisabeth Herzberge Krankenhaus, Berlin, Herzbergstraße 79, D-10365 Berlin, Germany

ARTICLE INFO

Article history:
Accepted 11 November 2013

Keywords:
Thoracolumbar fractures
Combined anteroposterior stabilization
Spinal fusion
CT-scan
Corpectomy cage

ABSTRACT

Introduction: To prospectively evaluate the potential radiological and clinical effect of the additional application of an anterior plate in anteroposteriorly stabilized thoracolumbar fractures.
Patients and methods: 75 consecutive patients with unstable thoracolumbar fractures underwent posterior (internal fixator) and anterior stabilization (corpectomy cage with local autologous bone grafting). 40 (53.3%) patients received an additional anterior plate (Group A), while 35 (46.6%) (Group B) did not. Plain X-rays and CT-scans were obtained pre- and postoperatively, after 12 months and at the last follow-up (mean 32 months, range 22–72). Loss of reduction, cage subsidence to adjacent vertebrae, fusion rates and clinical results were evaluated.
Results: 66 (87%) patients (36 Group A; 30 Group B) were available for follow-up. Patients in both groups were comparable regarding age, gender, comorbidities, localization and classification of fracture. Average loss of reduction was 2.4° in Group A, and 3.1° in Group B (not significant). Cage subsidence did not differ significantly between both groups, too. However, after 12 months the rate of continuous osseous bridging between endplates was significantly higher in Group A (63% vs. 25%) ($p < 0.05$). After 32 months this difference was even higher (81% vs. 33%) ($p < 0.001$). The bony fusion mass was located beneath or around the anterior plate in 94% of patients. There was no significant difference in clinical outcome.
Conclusions: Additional anterior plating in anteroposteriorly stabilized thoracolumbar fractures leads to significant faster fusion but does neither influence reduction loss nor cage subsidence. The anterior plate serves as a pathway for bone growth and increases biomechanical stability, resulting in a higher fusion rate.

Introduction

Modern operative treatment of thoracolumbar spinal fractures aims to ensure adequate primary stability in order to prevent reduction loss and facilitate fracture healing. Therefore, many authors have stated that highly unstable fractures should be stabilized with both posterior and anterior instrumentation [1–3]. To avoid morbidity of iliac crest bone grafting, corpectomy cages can be used for vertebral body replacement.

Biomechanical studies could demonstrate that additional anterior plating could further increase the instrumentation's primary stability [2,4]. The possible clinical advantage of additional anterior plating including mainly the acceleration of the bony fusion has not yet been elucidated. On the other hand, it is possible that the increased stress shielding effect could lead to the opposite result, namely the delay of the bony fusion [2,5,6].

The aim of this prospective, non-randomized study was to analyze the potential radiological and clinical implications of additional anterior plating in patients with anteroposterior instrumentation of a thoracolumbar fracture. The primary hypothesis was that patients treated with additional anterior plating would demonstrate significantly higher fusion rates, compared to patients, where a cage was solely applied. A second hypothesis was that additional anterior plating would significantly prevent loss of reduction and subsidence of the cage, which would result in an improved radiological and clinical outcome.

Patients and methods

75 consecutive patients having suffered an unstable thoracolumbar injury (from T6 to L5) of type A.3, B or C according to the Magerl AO-classification [7] were included in this prospective, non-randomized study. All patients had a burst type fracture of the

* Corresponding author. Tel.: +49 69 475 1556.
E-mail addresses: klaus.schnake@bgu-frankfurt.de, klausschnake@hotmail.com (K.J. Schnake), sstavridis@yahoo.com (S.I. Stavridis), s.krampe@keh-berlin.de (S. Krampe), frank.kandziora@bgu-frankfurt.de (F. Kandziora).
[1] Tel.: +49 69 475 2020.
[2] Tel.: +49 30 5472 3401.
[3] Tel.: +49 69 475 2020.

0020–1383/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.injury.2013.11.011

vertebral body. Patients with osteoporosis were excluded from the study.

All patients were initially treated by posterior stabilization with an internal fixator (USS Fracture, Synthes, Solothurn, Switzerland).

Following posterior instrumentation, the patients were subjected in a second session to an anterior corpectomy of the fractured vertebra and implantation of an expandable cage (VBR, Ulrich, Ulm, Germany). 40 patients (53.3%) additionally received in the same operative session an anterolaterally implanted plate. The non-angular stable "St. Georg" plate (Link, Hamburg, Germany) with monocortical screws was used in 21 cases, while 19 patients received an angular stable plate with monocortical screws (LCP, Synthes, Solothurn, Switzerland).

The decision to additionally apply the plate was based on surgeon's intraoperative subjective judgement concerning fracture stability, but was not related either to fracture type or to any other objective criteria.

Patients receiving additional plating constituted Group A, while patients treated without plating were characterized as Group B.

The patients were evaluated radiologically and clinically every 12 months postoperatively up to 72 months.

Radiological evaluation

Conventional standing anteroposterior (ap) and lateral radiographs of the operated spinal region were obtained at the follow-up visits. Additionally, a CT-scan with two-dimensional reconstruction was performed at 12 months and final follow-up (LightSpeed 8/16, General Electric, Fairfield, CT, USA; slice thickness: 2.5 mm, reconstruction: 1.5 mm). A second CT-scan was performed only in patients, in which fusion rate was initially judged as "incomplete" or "no fusion" in the first CT-scan.

At each time point conventional radiographs were evaluated by use of the Osiris® Software program and following parameters were defined: the bisegmental kyphosis angle (BKA) defined as the angle between the superior endplate of the cephalad intact vertebra and the inferior endplate of the caudal intact vertebra, as measured by the Cobb method (Fig. 1), as well as the cage subsidence, defined as the ratio of the distance between the centres of the adjacent intact superior and inferior endplates to the backside length of the cage. Since measuring the absolute length of the cage can vary, this ratio using the cage length as a constant factor, was utilized to detect even subtle subsidence (Fig. 2).

Two-dimensional reconstructions as well as transverse images of CT scans were selected to evaluate the progress of the bony fusion (Fig. 3). Images were evaluated for the existence of osseous structures, signs of osteolysis and resorption zones at three prior defined locations, namely the inside of the cage, the periphery of the cage and in cases where the additional plate had been applied, directly underneath the plate. Criteria for bony fusion were defined as follow:

- ossification inside the cage
- formation of bridging bone along the stabilized segment
- lack of osteolysis areas and resorption zones.

In cases of additional anterior plating it was evaluated, whether there was an osseous bridge formed directly underneath or along the plate's surface.

According to these and similarly to the criteria described by McAfee for interbody fusion [8] three fusion grades were differentiated (Table 1): complete fusion; incomplete fusion; apparently no fusion.

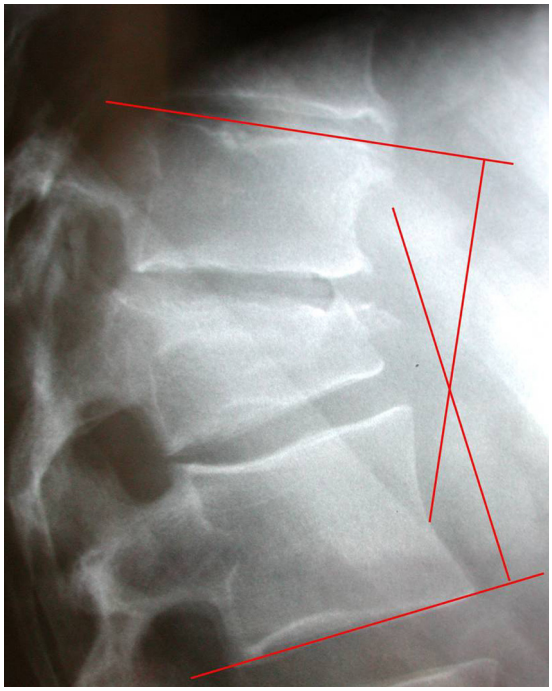

Fig. 1. Bisegmental kyphosis angle (BKA) is defined as the angle between the superior endplate of the cephalad intact vertebra and the inferior endplate of the caudal intact vertebra, as measured by the Cobb method.

Radiological evaluation was performed by two independent observers, a radiologist experienced in spinal imaging and a spinal surgeon not involved in the surgical treatment.

Clinical evaluation

The neurological status of the patients according to the Frankel/ASIA classification, as well as the patient' range of motion (ROM) of

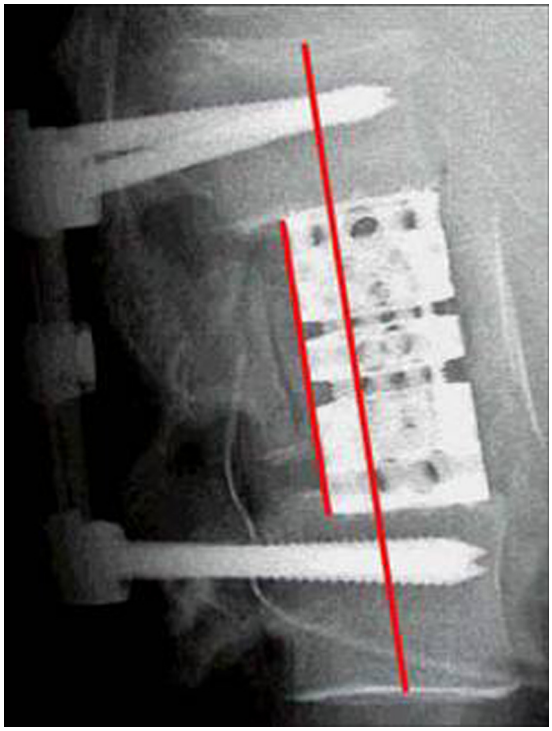

Fig. 2. Cage subsidence is defined as the ratio of the distance between the centres of the adjacent intact superior and inferior endplates to the backside length of the cage.