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Research Article

Angular Stable Plating of the Cervical Spine Comparing Cages and Bone Grafts

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Abstract

Background: The aim was to examine treatment strategies after injury of the lower cervical spine (C3-T1). The hypothesis was that ventral spondylodesis using cages and non-angular stable plates are before locked plates and tricortical bone graft.

Methods: This study was retrospective, case-controlled. During 01/2017 and 12/2019 all patients, with lower cervical spine fractures and instabilities of C3 to T1 were examined clinically and radiographically, for bony consolidation and stability after 3 and 12 months. Two groups were examined. In group, A stabilization was performed by angular stable plating and cage and in group B angular stable with additional bone graft interposition was performed. As for stability criteria, bony union and alignment of the spine were evaluated. Loss of stability, revision rate, and dysphagia were recorded.

Results: We included 77 patients stabilized by angular stable plates. Group A obtained 41 and group B 36. In group A, 30% were healed after 3 months, while none of the patients in group B were healed. In group B a healing rate of 66% was achieved after 12 months. After 3 and 12 months, patients of group A showed a significantly higher healing rate than in group B. All patients in group A showed good alignment, while in group B differences in the joint width occurred in 21%. Dysphagia occurred more often in group B than in Group A.

Conclusion: Faster healing and better alignment of cervical spine instabilities and fractures can be achieved by implantation of cages after angular stable plating. The risk for dysphagia can be also reduced by the implantation of cages.

Keywords: ACDF; Bone graft; Cage; Cervical spine; Surgery

Introduction

Regarding the location of cervical spine fractures, 55% are located at the level of C5/6 and C6/7 and there is a common agreement that surgical stabilization using the anterior approach is favored [1]. Surgical treatment of the segments C3-T1 using the anterior approach has been introduced in 1952 [2] and since then the technique has changed over the years, so now there are many plating systems, angular stable or non-angular stable plates, available on the market. In a biomechanical study by Zdeblik, et al. [3], it was possible to show that load-sharing is needed for a faster union of the segmental fusion. In a clinical study, it was possible to show, that angular stable plating in the cervical spine leads to a bridging of the stabilized segments and bone grafts showed significantly higher failure rates [4]. There are different preferences by surgeons regarding the use of cages or bone grafts and it is to state that autografts are the most common procedure for intervertebral interposition [5,6]. Avoiding co-morbidities when using cages instead of bone grafts from the iliac crest, is an argument to use cages [7,8]. In an animal study, it was shown, that cage interposition is before autologous bone graft regarding the preservation of disc height [9].

By using cages it is possible to reduce operation time and donor site morbidities as pain or infections. Arguments for autologous bone grafts are the lower costs and no risk for allergic reactions. The rationale of this retrospective investigation was to examine the time until bony healing, alignment, and rate of

secondary operations. Secondarily we wanted to examine the rate of dysphagia. We hypothesized that non-unions or secondary dislocations can be decreased by restoration of disc height using PEEK cages.

Methods

This study was planned retrospectively and case-controlled. During a time range between 01/2017 until 01/2019 all patients with fractures or traumatic instabilities of the lower cervical spine between the segment C3 and T1 and operative stabilization were included. The included patients were divided into two groups. Group A was treated by anterior angular stable plating and cage and group B by angular stable plating and bone graft (Figure 1a-b). For anterior stabilization, the patients were put in a supine position and the head was positioned in a radiolucent head frame. The skin incision was controlled under intraoperative x-ray. After a cross-section of the soft tissue, the cervical spine was exposed and a Caspar distractor was placed. After distracting the region of interest the discectomy and/or corpectomy was done and the clearance of the spinal canal was performed. The cage size was measured and the cage was filled with ß-TCP or cancellous bone graft and implanted. After loosening of the distractor the plate size was measured and the plate was implanted. All implantation processes were performed under x-ray control. We recorded the rate of postoperative complications such as dysphagia, perforations of the esophagus regarding the duration of dysphagia postoperatively after 1 month, 3 months, 6 months, or permanently and the rate of reoperation because of secondary dislocation. The radiological examination was performed after 3 and 12 months after injury with the CT-scan (Lightspeed, GE, USA) to evaluate alignment and fusion. As healing or stability criteria we recorded visible bony fusion in the anterior or posterior spine, changes in alignment or spine angulation, and loosening of the implants. Measurements were performed using the angle measurement tool of the digital x-ray system (ImpaxEE R20 VII, Agfa, Germany). As statistical tool percentages were chosen. As a statistical test, we performed a Students t-test for combined groups using the SPSS 19.0 (IBM, Ehningen, Germany).

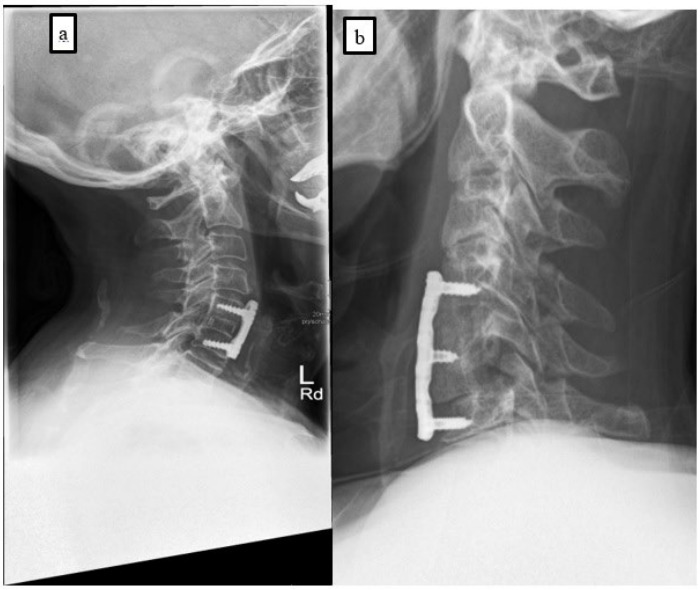

Figure 1a-b: Angular stable plate and cage, angular stable plate and bone graft.

Results

Seventy-seven (n=77) patients with a mean age of 47 years and a gender ratio of 4:1 (m:f) were included. Forty-one patients were administered to group A and 36 patients were administered to group B (Figure 2).

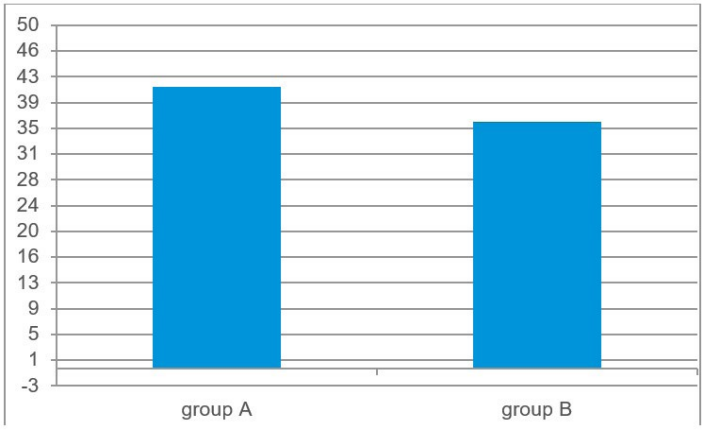

Figure 2: Group deviation of a cage (A) versus bone graft (B).

Time until healing

After 3 months patients of group A showed significantly faster healing with signs of cage integration in 30%, while no patient in group B showed integration of bone graft during the first 3 months. After 12 months 99% of patients in group A showed bony integration of the cages and no loss in alignment or angulation of the cervical spine (Figure 3), while only 66% of patients in group B fulfilled the healing criteria after 12 months.

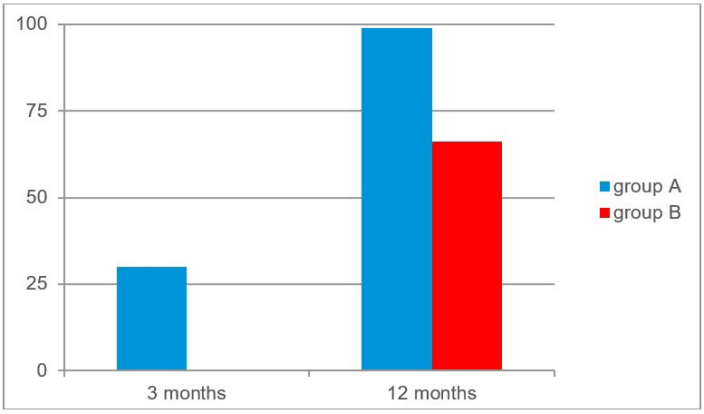

Figure 3: Percentage of full-filled healing criteria after 3 and 12 months.

Alignment

All patients treated with cages showed a good alignment of the facet joints and no differences in facet joint width, while patients treated with bone grafts showed differences in the joint width in 21% of the cases. The joint width differences were rated from 34% up to 245% in this 21% of patients. In one patient with an angular stable plate, tri-cortical bone graft and persistent luxation between C7/T1 implant failure were observed. This patient had to be revised using a ventral-dorsal approach with open reduction and fixation from C5-T3.

Dysphagia

Dysphagia was observed more often in group B postoperatively than in group A ($p<0.05$) (Figure 4). Perforations of the esophagus or deep wound infections were not observed.

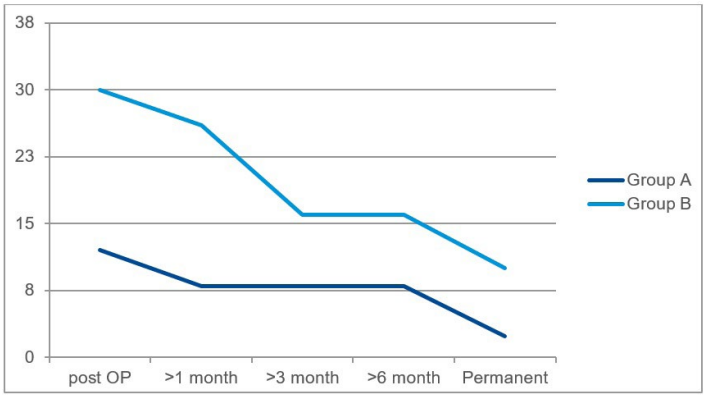

Figure 4: Rate of postoperative dysphagia more than double in-group B than group A ($n=77$, $p<0.05$).

Discussion

When using cages and angle stable plates for stabilization of the cervical spine, healing was achieved in over 80%, while only in 66% healing was achieved when using bone graft and angle stable plating. According to the publication of Zdeblik [3] and Saphier [4], this can be explained by the better positioning of cages compared to bone graft and the mechanism of load sharing by locked plates. When using a locked plate the load runs through the plate and not through the central column of the vertebrae. Therefore, bone grafts do not achieve the compression impulse which is needed for the integration of the bone.

Regarding the correctness of graft or cage implantation, it must be said, that a high percentage of the patients treated by bone grafts shows an inadequate difference of the corresponding facet joints which can lead to delayed healing or insufficient stability. The pubmed search did not give any information on why this happens in cervical fusion using bone grafts. In our opinion, it is easier to achieve a correct alignment intra-operatively using cages.

The rate of permanent dysphagia is rather small. In a prospective study about dysphagia and anterior cervical discectomy and fusion (ACDF) a rate of more than 80% of dysphagia after 1 week and about 60% after 1 month was observed. Also, a penetration rate was seen in 36% of the cases [10]. This seems to

be quite high and cannot be found in the present study. A reason for dysphagia can be the implant itself which leads to bulk, but no differences were found between the implants like was shown in a study by Skeppholm et al. [11] and Jang et al [12]. Another reason for the higher rate of dysphagia in group B might be that the soft tissue retractor might not have been loosened and therefore a high tension affected the soft tissue with resulting in more postoperative swelling, which is the cause for the higher rate of dysphagia in group B. The initial damage to the soft tissue also might be the cause for the higher rate of permanent dysfunction of the swallowing act.

As limitations of the study, we have to declare that different plates and cages were used but it was shown by Razack et al [13], that the reduction of the facet joints is a crucial point to achieve stability. In a small sample series of König and Spetzger [6], it was possible to show that there is no biomechanical difference between distractable titanium cages and peek-cages. A study of Niu et al. [14], in 53 patients, comparing titanium vs. peek cages in the cervical spine, did not show significant differences in clinical outcome. Therefore we recommend that both cages can be placed in one group and no subgroups have to be formed.

Conclusions

The fixation of cervical instabilities using angle stable plates and a bone graft is not useful because of slower healing. To achieve a faster healing of fractures or instabilities and better alignment of the facet joints at the lower cervical spine it is sensible to use angular stable plates and cages. Regarding dysphagia, it seems to make sense to perform stabilization with a dorsal approach.

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