

Hesham ElSaghir · Heinrich Böhm

## Anterior versus posterior plating in cervical corpectomy

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**Abstract** This is a prospective study comparing anterior and posterior plating in cervical corpectomy. Each group comprised 30 patients who were candidates for corpectomy. In the first group, anterior plating was done using Orosco-type titanium plates. In the second group, lateral mass plating was done. In all cases, titanium cages were used to replace the removed vertebral body or bodies. The mean follow-up was 12.68 months (SD 3.85 months). Pseudarthrosis was not encountered in either group. Posterior plating was better than anterior plating in terms of the stability of the construct and problems related to the hardware. Screw breakage was encountered in seven patients with anterior plating (23.33%). This complication was not seen in the group with posterior plating. The difference between the groups was statistically significant (chi-square = 7.92,  $p = 0.004$ ). Screw loosening was encountered in 2 patients in the group with anterior plating and in only 1 patient in the group with posterior plating. The difference between the incidence of screw loosening in both groups was not statistically significant (chi-square = 0.35,  $p = 0.5$ ). Sinking-in of the cage was encountered in 7 cases with anterior plating and in only 3 cases with posterior plating. However, the difference between the groups was not statistically significant (chi-square = 1.92,  $p = 0.16$ ).

### Introduction

The spinal surgeon is frequently confronted with conditions in the cervical spine in which corpectomy forms part of the solution. The surgeon has to deal with the gap left after corpectomy. The cervical spine can be reconstructed using autografts, allografts, and bone cement [8, 10, 20].

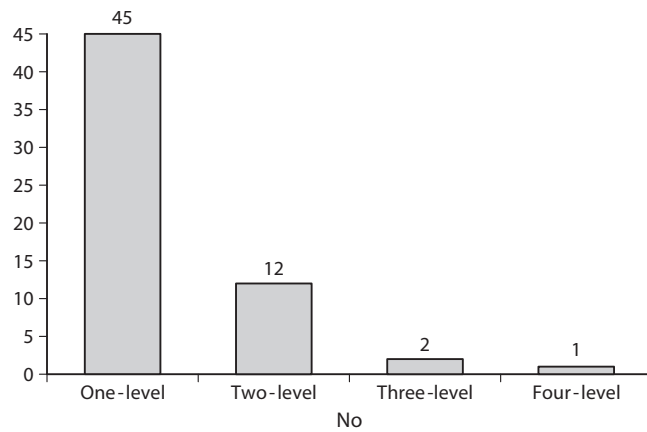
H. ElSaghir (✉) · H. Böhm  
Department of Orthopaedics, Spinal Surgery and Paraplegia,  
Zentralklinik Bad Berka, Robert Koch Allee 9,  
99437 Bad Berka, Germany  
e-mail: gf@Zentralklinik-bad-berka.de,  
Tel.: +49-36458-51401, Fax: +49-36458-53517

There is an increasing interest in the use of cages made of titanium [6, 8]. The availability of the cages in different sizes facilitates bridging of large gaps. The cage, acting as a stable shell or a vessel, can be filled with cancellous bone. Thus, apart from cervical tumours and infections, the removed vertebral body can be used for filling the cage. In this way, one can avoid the potential donor site morbidity associated with autogenous iliac grafts [14].

Internal fixation by means of anterior plating has been reported to increase the incidence of fusion and to decrease the need for a rigid orthosis or posterior cervical fixation [5]. However, a brief review of the literature reflects a substantial rate of complications associated with the use of anterior hardware, some of which are very serious [16, 19]. Since Böhler [5] introduced anterior cervical plating in 1967, there have been several attempts to modify and introduce fixation systems capable of fulfilling the aim of their use while at the same time minimising the failure rate and potential complications related to their use. Most of these studies, however, dealt with the properties of the hardware, the locking principle and the significance of single or bicortical fixation [7, 9]. The aim of the present study was to compare the results of anterior plating with those of posterior plating in cervical corpectomies reconstructed using cages.

### Patients and methods

This study consisted of 60 patients presenting with cervical problems requiring corpectomy. All of them were treated at our institution. Thirty-three patients were men and 27, women. The age of the patients at the time of the operation ranged between 19 and 73 years (mean 53.36 years, SD 12.38 years). The conditions for which corpectomy was indicated included cervical spondylosis in 47 patients (78.33%), traumatic disorders in 10 patients (16.67%), spondylitis and spondylodiscitis in 2 patients (3.33%), and rheumatoid disease in the remaining patient (1.67%). Patients with cervical tumours were excluded. The number of corpectomies was one in 45 patients (75%), two in 12 patients (20%), and three in 2 patients (3.33%) and four in the remaining patient (1.67%) (Fig. 1). In one-level corpectomy the level involved was the 4th cervical body in 2 patients, the 5th in 18 patients, the 6th in 22 patients and the 7th in 3 patients. In double-level corpectomy the removed cer-



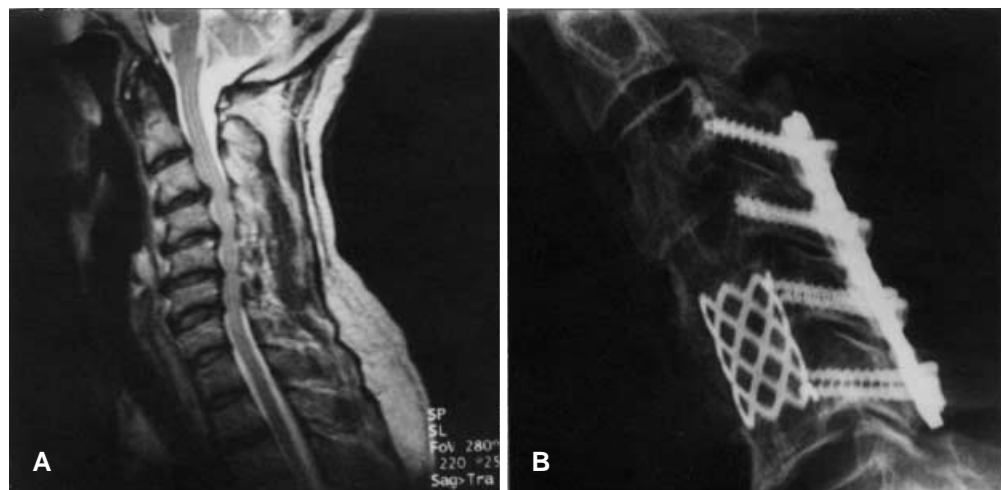
**Fig. 1** Graphical representation of the number of corpectomies

vical bodies were the 4th and 5th in 3 patients and the 5th and 6th in 9 patients. In three-level corpectomy, the level was the 4th, 5th and 6th cervical bodies in 2 patients. In the remaining patient the 3rd, 4th, 5th and 6th vertebral bodies were removed. Of those patients with cervical spondylosis, 4 had previously undergone cervical surgery. Associated discectomies and intersomatic fusion were performed in 8 patients.

The indication for corpectomy was based upon the clinical findings and the preoperative imaging diagnosis. The anterior approach did not differ from that described by Robinson and Smith [18]. A right-sided approach was undertaken in 57 patients. A left-sided approach was undertaken in only 3 patients because a left-sided approach had been used previously. The gap left after the corpectomy was bridged with a titanium cage of the appropriate size. In 54 patients (90%), the cage was filled by cancellous bone taken from the removed vertebral body or bodies. In the remaining 6 patients (10%), iliac bone graft was used. The latter was resorted to in cases with spondylodiscitis and those with inadequate bone stock.

In 30 patients anterior plating was done using Orosco-type titanium plates. Of those, 25 patients underwent one-level corpectomy and the remaining 5 underwent two-level corpectomy. In the other 30 patients, posterior fusion and lateral mass fixation using plates was done. In all patients a cervical collar was worn for a period of 6 weeks. A radiological check up of the cervical spine was done in the immediate postoperative period, and 6 weeks, 3 months, 6 months and 1 year after the operation. Unless the clinico-radiological findings necessitated further examination, a regular follow-up was done at 1-year intervals. The minimum follow-up was 6

**Fig. 2** **A** Preoperative magnetic resonance imaging showing cervical spondylosis with multiple level stenosis. **B** Postoperative lateral radiograph of the same patient 1 year after corpectomy of the 5th cervical vertebra and intersomatic fusion at the C3/4 disc level



months and the longest was 36 months, with a mean follow-up of 12.68 months (SD 3.85 months).

Statistical analysis was done using Student's *t*-test and chi-square. For all analyses, the significant criterion was  $p < 0.05$ .

## Results

### Bone healing after corpectomy

It is very difficult to establish that solid fusion has occurred when a cage is present. It was sometimes possible to trace bone bridging anterior to the cage (Fig. 2). In the absence of clinical symptoms suggestive of instability and the presence of a radiologically stable construct, the cervical collar was taken off. No signs of pseudarthrosis were detected intraoperatively in 3 patients who had repeat anterior surgery because of problems related to the hardware.

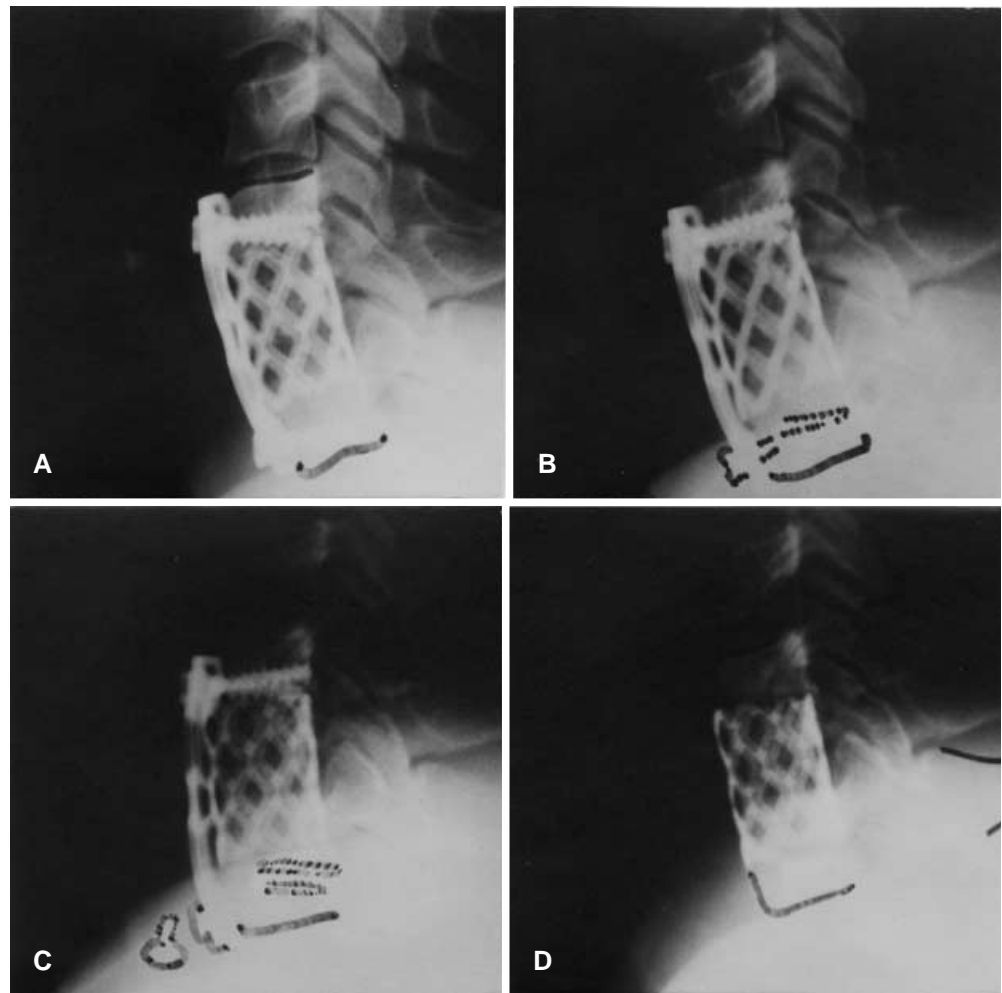
### Technical faults

Of those who underwent anterior plating, the position of the cage was correct in all of them. No faults were detected regarding the length, location or direction of the screws. Of those who underwent posterior plating, the location of the lateral mass screws in the 7th cervical vertebra was considered not optimum in 2 cases (6.67%), and the anterior border of the upper end of the cage was 2–3 mm anterior to the anterior wall of the upper neighbouring vertebral body in 2 cases (6.67%).

### Screw breakage

In the anterior plating group, screw breakage was detected in 1 patient 6 months after the operation. The number of cases with screw breakage reached 7 by the 1-year follow-up (23.33%). After a mean follow-up of 12.68 months (SD 3.85), no new cases demonstrated such a problem (Fig. 3). The number of corpectomies in those patients was two in 2 patients and one in 5 patients.

**Fig. 3** **A** Postoperative lateral radiograph after single-level anterior corpectomy of the 6th cervical vertebra and anterior plating. **B** Lateral radiograph 6 months after the operation showing sinking-in of the cage and breakage of the caudal screws. **C** Lateral radiograph of the same patient 1 year after surgery showing migration of the broken screws. **D** Lateral radiograph after removal of the plate and screws. Complete fusion was evident intraoperatively



In the posterior plating group, screw breakage was not encountered.

The difference in the incidence of screw breakage between the groups was statistically significant (chi-square = 7.92,  $p = 0.004$ ).

#### Screw loosening

In the group with anterior plating, loosening of the screws was encountered in 1 patient 3 months after the operation (3.33%). After 6-months' follow-up the number of cases with screw loosening increased to 2 (6.67%). No additional loosening was observed at later follow-ups.

In the group with posterior plating, incomplete backing out of a screw on one side was encountered in 1 patient (3.33%) 3 months after the operation. No additional loosening was observed at further follow-up.

The difference in the incidence of screw loosening between the groups at the 6-month follow-up was not statistically significant (chi-square = 0.35,  $p = 0.5$ ).

#### Sinking-in of the cage

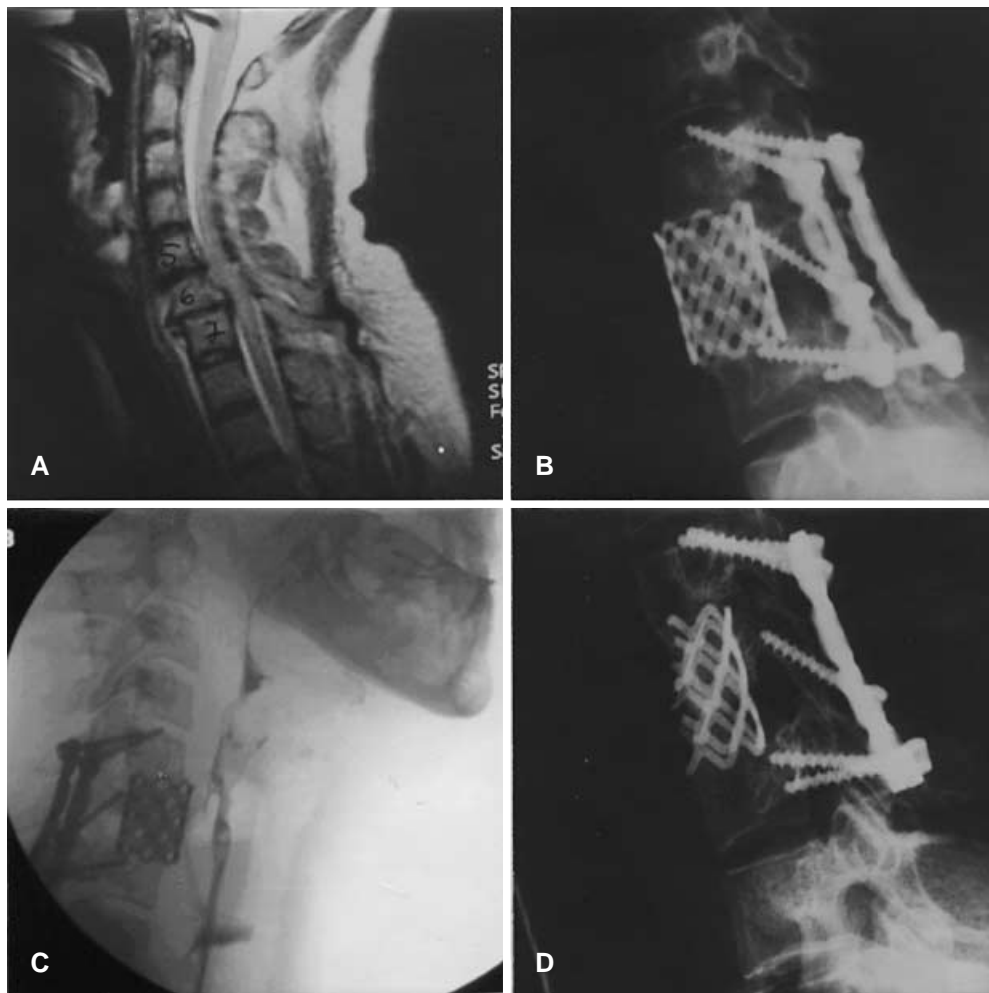
In the group with anterior plating, sinking-in of the cage was observed in 7 cases (23.33%). This was associated with screw breakage and kyphosis in 3 of them. In the group with posterior plating, sinking of the cage was observed in 3 (10%) and was not associated with significant kyphosis (less than  $5^\circ$ ). The difference between the two groups was, however, not statistically significant (chi-square = 1.92,  $p = 0.16$ ).

Of those in whom sinking-in of the cage occurred, the number of the corpectomies was two in 3 cases and one in the remaining 7 cases.

#### Extraction of the implants

In the group with anterior plating, extraction of the plate and screw was indicated in three patients (10%) because of screw breakage and/or loosening. Those patients had difficulty in deglutition. Their preoperative oesophagodiagraph did not show abnormalities in the oesophagus. In the group with posterior plating, revision anterior surgery was necessary in 1 patient presenting with a deep

**Fig. 4** **A** Preoperative magnetic resonance imaging of a case with traumatic subluxation at the C6/7 level with epidural haematoma. **B** Post-operative lateral radiograph during the immediate post-operative period. **C** Oesophagoradiograph showing the presence of an oesophago-spinal fistula. **D** Lateral radiograph 6 months after removal of the anterior part of the cage



cervical infection. The oesophagoradiograph and the oesophagoscopy showed the presence of oesophageal fistula. The site of the fistula was related to the anteriorly protruding margin of the upper end of the cage. In spite of the spondylodesis, the cage was relatively loose. Resection of the anterior wall of the cage was done and a vascularized pectoralis muscle flap was used for closing the fistula. The postoperative course of this patient was smooth at the 9-month follow-up after the revision (Fig. 4). Backing out of a screw was not a sufficient indication for revision surgery of the posterior hardware.

#### Neurological deterioration after surgery

None of our patients developed recurrent laryngeal nerve palsy. Three patients with multiple-level corpectomies developed motor paralysis of the 5th root on one side. In 2 of them, the neurological deficits developed in the first 3 days after surgery. In the remaining patient, the deficit occurred 10 days after surgery. The postoperative imaging diagnosis (plane radiograms and magnetic resonance imaging of the cervical spine) showed a clear spinal and wide root canals. One of them had completely recovered

neurologically by the 3-month follow-up examination, while the remaining 2 had a partial recovery.

#### Problems with swallowing

In the group with anterior plating, difficulty in swallowing was encountered in 10 patients during the postoperative period. Eight of them manifested complete regression of the symptoms by the 3-months follow-up. By the 1-year follow-up, the number of patients having difficulty with swallowing was 3.

In the group with posterior plating, difficulty in swallowing was a complaint during the immediate postoperative period in 9 patients, with complete regression of the symptoms by the 3-month follow-up in 7. By the 1-year follow-up only the patient with an oesophageal fistula was still complaining of improper deglutition.

#### Wound infection

In the group with anterior plating, no infection was encountered during the postoperative period. In the group

with posterior plating, infection occurred in two cases. One of them had a superficial posterior wound infection which was controlled by wound debridement and administration of the proper antibiotic. The other one developed a deep anterior infection secondary to an oesophageal fistula.

## Discussion

A controversy exists regarding the role of anterior cervical plates in non-traumatic disorders of the cervical spine. Proponents of this method find anterior plating advantageous in limiting graft migration and collapse, in improving the fusion rate, particularly for multilevel fusion, and in eliminating the need for a rigid external support. In the present study, problems related to the use of anterior plates were encountered in 23.33% of the cases. To avoid possible irritation of the oesophagus, prophylactic removal of the plate and screws was done in 3. Paramore et al. [17] reported a rate of plate failure in 28.5%; however, only 10% required treatment. Eleraky et al. [9] reported a failure rate of 21.4% using Caspar bicortical non-locking plates and found a lower rate of failure in cases stabilised by anterior locking plates. Intersomatic transdiscal fusion, however, was associated with the lowest rate of anterior hardware problems [2, 7]. In the current study the problems related to the use of anterior plating were higher in double-level corpectomy than in single-level corpectomy. Thus, from the biomechanical point of view, long anterior fusions are more liable to anterior plate failure than short fusions.

In the current study, posterior plating was an efficient method of providing multisegmental stabilisation. No neurological or vascular complications were attributed to the insertion of the screws. Backing out of a screw on one side did not adversely affect bone healing but necessitated prolonged wearing of the neck collar. Posterior plating was associated with a lower rate of sinking-in of the cage. The sagittal profile was better maintained with posterior plating than with anterior plating.

Anterior column reconstruction after corpectomy is a necessary step to restore the axial height and the sagittal plane contour. Bone is considered the best material for bridging the gap and achieving permanent stability through fusion [12]. Bernard and Whitecloud [4] used autologous fibula in 21 patients and obtained a 100% fusion rate. Kadoya et al. [11] found dislodgement of the graft to be a significant problem. Abe et al. [1], Kojima et al. [13] and Barnerji et al. [3] used autogenous anterior iliac bone to perform long fusion. The anterior iliac crest becomes less useful as the length increases because of its curvature. This is an additional risk explaining dislodgement of the graft in some cases. Other authors preferred the use of allografts with their potential hazards and reported a high fusion rate [10, 15]. In the current study, titanium cages were used for anterior reconstruction of the gap left after corpectomy. In 56 cases (90%), the cancellous bone taken from the removed vertebral bodies was used to fill the

cage. In this way the need for distant autogenous grafts was avoided. Neither dislodgement nor fracture of the cage was encountered. Sinking-in of the cage is, however, a problem equivalent to graft resorption seen with the use of grafts. This complication was associated with metal failure in 7 cases involving anterior plating. It is not known which problem is secondary to the other, sinking-in of the cage or breakage and loosening of the screws. Several factors are suggested as explanations for sinking-in of the cage and metal failure. Excision of too much subchondral bone or softening of the bone in the healing process potentiate sinking-in of the cage. Once sinking-in of the cage is established, the anterior plate will lose its function as a compressive device, and the necks of the screws will be put under mechanical stress at their interface with the holes in the plate. This could be the mechanism explaining screw loosening and breakage.

## Conclusions

1. Posterior plating is preferable to anterior plating, particularly for multilevel corpectomy.
2. Titanium cages filled with the bone taken from the excised vertebra(e) is an accepted form of anterior reconstruction quite comparable to the use of fibular and iliac grafts. The cages may even be advantageous in avoiding the donor-site problems associated with autogenous grafts.

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