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Outcome Of Traumatic Cervical Spine Facet Subluxation Using Pre-Filled Cervical Cage And Anterior Cervical Plating

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ABSTRACT

Backgrounds: This study assesses the efficacy of anterior cervical decompression and fusion utilizing a pre-filled cage, coupled with anterior cervical plating for traumatic facet joint subluxation. Key considerations include neurological outcomes, post-operative cervical spine stability, and immediate rehabilitation.

Patient & Methods: This study was conducted at Erbil Teaching Hospital and PAKY Hospital from July 2014 to March 2021. It included a total of 128 individuals diagnosed with cervical facet dislocations. Every patient had comprehensive clinical and imaging assessments. The ASIA impairment scale was used to first evaluate neurological deficits. Every participant received cervical traction. An extensive set of pre-and post-operative data was gathered, which included X-rays and MRI scans. Individuals with facet dislocations from C3 to C7 had decompression and fusion procedures employing an anterior approach, which included the use of a pre-filled cervical cage and a titanium plate system.

Results: The study sample comprised 110 males (85%) and 18 females (15%), aged between 18 and 60 years. Complete spinal cord injuries were observed in 14 cases (10.9%), while 114 cases (89%) exhibited partial cord injuries. The most common causes of trauma were falls from heights and motorcycle accidents. Post-surgical assessments indicated significant improvements in clinical and radiographic outcomes. The use of a pre-filled cervical cage facilitated early rehabilitation: 34.46% of patients improved by one ASIA grade, 42.94% by two grades, and 22.6% transitioned from wheelchair dependence. The only noted post-operative complication was transient dysphagia.

Conclusion: Anterior cervical decompression and fusion employing a pre-filled cage and anterior plating with a titanium system have demonstrated high effectiveness, yielding excellent neurological improvements and successful fusion rates, as confirmed by radiological assessments.

Key Words: Cervical spine fracture, Facet dislocation, Spinal cord injury, Spinal trauma

Introduction

Cloward, Robinson, and Smith pioneered the primary technique for the anterior approach to cervical spine decompression in the 1950s (1). This method involved a longitudinal incision along the anterior border of the sternocleidomastoid muscle to facilitate soft tissue dissection (2). Following the removal of compressive structures and discectomy, an autogenous graft was used for fusion (3). Significant advancements in anterior cervical surgery have been associated with the development of cervical spine instrumentation (4, 5). These innovations have progressively evolved over the past several decades. In 1960, Bailey and Badgley expanded the use of Anterior Cervical Discectomy and Fusion (ACDF) to treat neoplastic conditions and pathological instability (6, 7) .

In 1970, Declos and Tapies introduced the development of anterior cervical plating. For the first time, these plates were used to stabilize cervical injuries resulting from trauma (8, 9). Subsequent research by Caspar led to the creation of a trapezoidal anterior stabilization system, which significantly enhanced fusion rates following trauma (10).

Theoretically, the integration of a plate provides immediate stabilization, mitigates the risk of graft expulsion, and reduces the need for external cervical stabilization during the surgical procedure. Additionally, the use of anterior cervical plates contributes to the restoration of the cervical spine's sagittal alignment and helps prevent cage collapse and expulsion (11-14). The purpose of this study is to examine the outcomes related to neurological status, fusion rates, symptomatic adjacent-segment pathology, and post-surgical complications.

Patients and Methods

This study was conducted at Erbil Teaching Hospital and PAKY Hospital from July 2014 to March 2021. A total of 128 patients with facet dislocations were enrolled. Each case underwent a detailed examination of clinical and imaging outcomes. Initially, the level and severity of neurological impairment were assessed using the ASIA impairment scale (15). Cervical traction treatment was administered to all patients. Comprehensive records, including X-rays and MRI scans, were maintained for pre- and post-treatment analysis.

Patients presenting with facet dislocation from C3 to C7 underwent decompression and fusion procedures via an anterior approach, employing a pre-filled cervical spine cage and a titanium plate system. Follow-up evaluations, ranging from 3 to 18 months post-procedure, included both clinical assessments and imaging studies.

Procedure

The patient was anesthetized with general anesthesia and positioned supine with tongue traction maintained. A sandbag was placed beneath the cervical area, and both upper extremities were positioned away from the surgical site for shoulder protection. Adhering to strict aseptic protocols, a transverse incision approximately 4 cm in length was made on the left side of the neck, following the natural skin contour. The platysma was incised at the same location and separated from the surrounding muscles through blunt dissection. The subcutaneous muscle layer was then divided along the plane between the sternocleidomastoid and strap muscles. The surgical team accessed and dissected the prevertebral fascia, identifying two parallel longus colli muscles. An image intensifier confirmed the disc space location before the disc was extracted and vertebral reduction was achieved through gentle manipulation, measuring the intervertebral distance.

A pre-filled cervical cage was placed in the prepared operative field and secured with a titanium plate and screws. The wound closure was completed with the placement of a drainage tube, and the tongue traction was subsequently removed.

Research ethics

The study received approval from the research ethics committee of the College of Medicine at the respective medical university. Written informed consent was obtained from each patient before they participated in the study.

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS, version 27). Frequencies and percentages were calculated to summarize the findings.

Results

The mean age of the participants was 43.23±11.687 years, ranging from 18 to 60 years. The study included 128 patients, predominantly male 110 (85%) with females constituting 18 (14%). Complete spinal cord injuries were present in 14 (10.9%) patients, whereas 114 (89%) exhibited partial spinal cord injuries (Table 1).

Table 1. Sociodemographic character of patients

Sociodemographic variable		Frequency	Percent
Age		43.23±11.687	
Sex	Male	110	85
	Female	18	14
spinal cord injuries	Complete	11	11
	partial	114	89

Surgical interventions were performed at various cervical levels: C3-4 in 8 patients, C4-5 in 34 patients, C5-6 in 80 patients, and C6-7 in 6 patients (Figure 1).

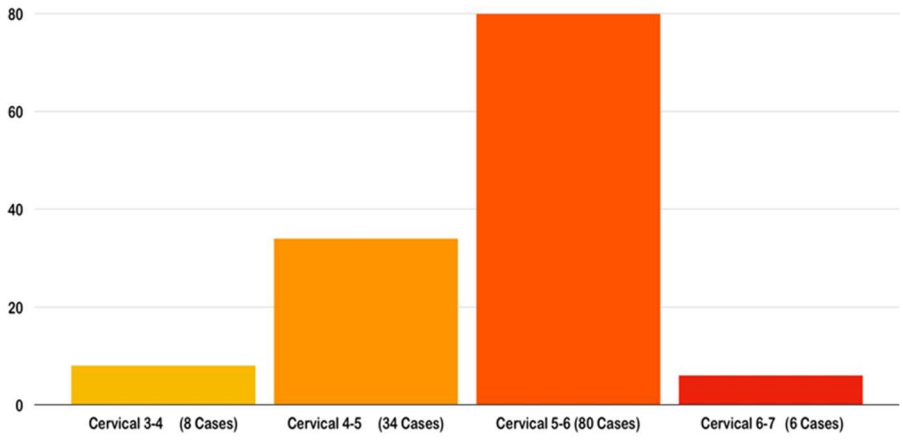

Figure 1. Levels and numbers of cervical facet joint dislocation cases

The degree of neurological deficit was assessed both pre- and post-operation using the ASIA scale. The ASIA scores for injury of the spinal cord divide the extent of the neurological status/functional status into 5 degrees (Table 2).

Table 2. The ASIA scores for injury of spinal cord

ASIA Scores	Before operation	Last Follow-up				
		A	B	C	D	E
A	14	14	--	--	--	
B	26	--	--	8	18	
C	56	--	--	2	12	42
D	24	--	--	--	4	20
E	8	--	--	--	--	8

The most common causes of spinal cord trauma were falls from heights (n=66) and motor vehicle accidents involving motorcycles (n=48). Other causes included direct trauma to the back (n=10) and heavy objects falling on individuals (n=4) (Figure 2). Post-surgical outcomes indicated significant improvements in clinical and radiographic evaluations. The use of a pre-filled cervical cage contributed to expedited rehabilitation. Enhancements in neurological function were noted as follows: a one-grade improvement in 34.46% of patients, a two-grade improvement in 42.94%, and 22.6% of patients previously using a wheelchair showed improvement. The only complication observed was transient dysphagia.

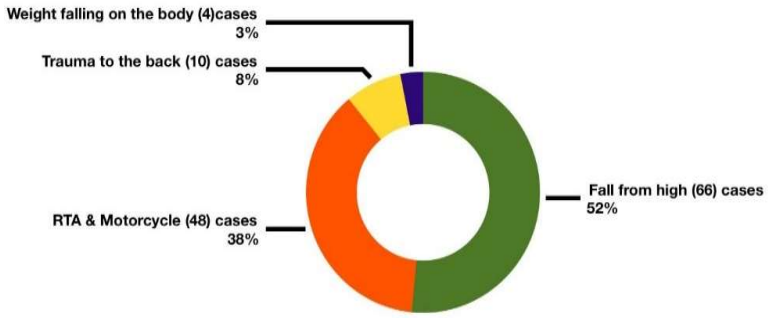

Figure 2. Most frequent Modalities of cervical facet joint dislocation and spinal cord injury.

(1) (2)

Figure 3. 1 &2 Showing fracture dislocation at C5 on C6 before and after operation

Discussion

Cervical spinal injuries predominantly affect young adult males and represent a critical health issue. The primary objective of surgical intervention is to restore and preserve neurological function and ensure spinal stability via the application of a pre-filled cervical cage. Road traffic accidents and falls from elevated surfaces were identified as the leading causes of these injuries, with the latter affecting 66 patients and the former 48 patients (16).

The rationale for adopting the screw plate system revolves around the potential for patients with such implants to experience shortened hospital stays and an expedited return to their socio-economic activities, as opposed to patients undergoing cervical fusion procedures without these plates (17).

The strategic placement of screws, their lengths, and the dimensions of the cage are imperative. The employed methodology includes the use of cortical screws, and no spinal cord injuries were reported in this analysis, despite the inherent risks associated with the use of bi-cortical screws (18, 19). The outcomes included proficient restoration of spinal alignment and effective immobilization during the follow-up period. Risks associated with cervical spine screw-plate fixation include complications from anterior discectomy, impairment of the vagus nerve branches, dysphagia, radicular or myelopathic injuries, cerebrospinal fluid leakage, anterior or posterior displacement of the grafted bone, fractures of screws and plates, postoperative hemorrhage, tracheoesophageal injuries, vascular trauma, and infections. The most common neurological issue following anterior cervical discectomy and fusion (ACDF) is recurrent laryngeal

nerve damage, with reported incidence rates ranging from 0.2% to 11% (20, 21). Flynn reported a 0.05% incidence of spinal cord injuries post-ACDF, which was not observed in the present study. Autologous bone grafts have been used in anterior cervical procedures for over five decades, with a noted risk of spinal cord injury during graft insertion. The dimensions of the graft should be smaller than the vertebral body. Approximately 22% of patients experience postoperative pain at the iliac crest donor site, with additional potential complications including infection, bleeding, pelvic bone fractures, and nerve damage at the donor site, though none were observed in this study. However, the present study did not observe any such complications. The prevalence of nerve root palsy has been approximated to be 0.17% (22).

Anterior cervical decompression has been associated with radicular pain incidence ranging from 2% to 15%, often related to adjacent-segment disease (23). Hilibrand et al. conducted a long-term study of 374 individuals undergoing 409 cervical instrumentations via anterior procedures, finding a steady annual incidence of 2.9% for symptoms related to adjacent-segment disease (24).

Ishihara et al. documented an increase in symptomatic adjacent segment disease from 7% to 15% in a cohort followed for more than two years (25). In the present study, 50% of participants (5 out of 10) monitored over 24 months developed persistent radiculopathy, attributed to nerve root damage. Vascular injuries, including potential carotid artery damage and vertebral artery injury due to extensive lateral dissection or retraction, are risks of anterior cervical procedures, with incidences reported between 0.3% and 0.5% (26-28).

Coe and Vaccaro reviewed literature indicating that the prevalence of screw and plate loosening ranges from 0% to 15.4%, screw fractures at 13.3%, plate fractures from 0% to 6.7%, plate and graft dislodgements from 0% to 21.4%, and implant misalignments from 0% to 12.5% (29).

The occurrence of infections following cervical spine fusion is notably low, with rates ranging from 0% to 4.5% (1). Fusion rates for single-level implants have been reported between 90% and 100%, and between 70% and 95% for multi-level procedures (30, 31).

Cheng et al. documented a 100% fusion rate in a group of seventeen patients (32), whereas Johnson et al. reported a fusion rate of approximately 93% in a cohort of 87 patients, with a 27% incidence of incomplete fusion (33).

A fusion rate of 112 (87.5%) was observed, with insufficient follow-up preventing the determination of fusion rates in 16 patients. In contrast to other studies reporting complication rates between 2-3% and 17%, our study encountered minimal complications, with only one patient experiencing temporary dysphagia (34).

Conclusion

The strategy of anterior decompression, fusion using a pre-filled cervical cage, and fixation with a cervical titanium plate has been highly effective, resulting in superior neurological outcomes and high fusion rates.

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Conflict of interest: The authors declare no conflict of interest regarding the publication of this study.

Data availability: The corresponding author can provide the study's data upon reasonable request.

Consent for publications: The authors reviewed and gave their approval to the published version of the study.

Ethics approval and consent to participate: The Helsinki Declaration was followed in the conduct of this investigation. The Local Ethics Committee approved the study and participants provided informed permission.

Authors' contributions: The Authors contributed to this study work equally.

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