

Health-related quality of life after anterior-only fixation of lower cervical spine fractures: long-term follow-up

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Background

The management of lower cervical spine fractures at the cervicothoracic junction is challenging and the selection of suitable approach is a matter of debate. The results of anterior fixation of those injuries in the available literatures are ambiguous due to the heterogeneity of the studied groups and lacking long-term follow-up. Moreover, the assessment of patients' quality of life was not taken into consideration. Our aim was to assess the health-related quality of life and long-term follow-up of a homogenous group of patients of unstable lower cervical spine fractures managed by anterior-only fixation and iliac autograft.

Patients and methods

Data from hospital records of 13 cases of lower cervical spine fracture managed by anterior fixation and graft were examined and analyzed. All cases were operated as the Subaxial Injury Classification (SLIC) score was greater than or equal to 5. The International Standards for Neurological Classification of Spinal Cord Injury and American Spinal Injury Association (ASIA) scores were used to assess patients' neurologic status; segmental kyphosis angle for cervical kyphosis and short-Form 36-item was used for health-related quality of life assessment.

Results

Thirteen cases were included in this series with a mean age of 36.15 ± 7.82 years. C6 was fractured in 3 cases (24%), C7 in 5 cases (38%) and both C6 and C7 in 5 cases (38%). All cases have a SLIC score more than 5 with a mean of 7.0 ± 1.53 (range 5:9). The mean follow-up was 75.54 ± 22.33 months. The operative time was 90.62 ± 20.67 min. The total motor score was improved from 72 ± 33.44 preoperatively to 76.92 ± 31.80 at the final follow-up. The segmental kyphosis angle was improved from $15.62 \pm 3.25^\circ$ preoperatively to $-9.84 \pm 1.77^\circ$ directly postoperative and $-1.30 \pm 2.32^\circ$ at the final follow-up and the short-Form 36-item total score was 75.04 ± 24.26 .

Conclusion

The procedure proved to be safe and has yielded excellent results. The late patient outcome from the quality-of-life perspectives was not affected by loss of cervical lordosis, but on the contrary improved significantly in correlation with improvement of patients' motor power.

Keywords:

anterior-only fixation, lower cervical, quality of life

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Introduction

The peculiar biomechanical characteristics of the distal end of the cervical spine where it is the site of reversal of mobile cervical lordosis to rigid thoracic kyphosis render the sound fixation of fractures at this area a difficult task to reach [1]. Several techniques have been described to manage these fractures with several pros and cons for each [2–5]. Although the anterior exposure of the cervicothoracic junction poses a significant challenge to the spine surgeon because of presence of many vital structures in the operative field [6] and the bony obstacle caused by the manubrium sterni [7], yet there is an obvious enthusiasm to this approach as it causes less blood loss, provides direct access to decompress traumatic disc herniation which

occurs in 80% of cases [8] and avoids prone position in poly-traumatized patient [9].

The short follow-up period in most of the available literatures together with the heterogeneous patient groups represents a major hurdle to achieving an adequate evaluation of the results, furthermore, the assessment of the results depends on radiological parameters and complication rate without taking the health-related quality of life (HRQOL) of

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the patients into consideration although the main goal of treatment is to improve the patients' quality of life [10,11]. The selection of an evaluation instrument specific to the target patient population is of paramount importance. Short-Form 36-item (SF-36) is one of the most widely used HRQOL questionnaires [12–14].

The aim of the current retrospective study is to assess HRQOL, and long-term follow-up results of a homogenous group of patients of lower cervical spine fractures managed by anterior-only fixation and iliac autograft.

Patients and methods

After obtaining the institutional review board approval, a retrospective study, reviewing patients with lower cervical spine fractures treated by anterior-only instrumentation and iliac autograft was conducted.

For the purpose of investigating a homogenous group of patients, the following exclusion criteria were applied:

- (1) Congenital cervical deformity.
- (2) Previous cervical spine surgery.
- (3) Patients needing sternotomy for distal fixation.
- (4) Patients with spinal tumours, infections or lesions associated with ankylosing spondylitis and Diffuse idiopathic skeletal hyperostosis.

All patients had preoperative plain radiographs (AP and Lateral views), computed tomography and MRI.

The patients' neurologic status was assessed according to the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) [15] and American Spinal Injury Association (ASIA) Impairment Scale [16].

According to the Subaxial Injury Classification (SLIC) the fracture was considered unstable and operative decision was taken if the score was greater than or equal to 5 [17,18].

Preoperative cervical realignment and immobilization were maintained using cervical collar or skull traction by Gardner-Wells tongs.

An informed consent was obtained from all patients.

Surgical technique

The operation was performed via the left anterior cervical approach due to the predictable course of

the recurrent laryngeal nerve on the left side [19,20]. Patients were placed in the supine position and with the table tilted gently in anti-Trendelenburg position to decrease bleeding with a small pillow placed between the shoulder blades with the head slightly turned to the right.

The shoulders were pulled caudally to allow intraoperative x-ray.

Longitudinal incision was made along the medial border of the left sternocleidomastoid muscle and extending to the sternal notch.

The platysma was incised, and the fascial layers were dissected to the plane between the oesophagus and the trachea medially and the left carotid sheath laterally.

Packing the upper mediastinum with a towel prevents missing of a screw if it slips inadvertently during insertion.

After completion of the partial or complete corpectomy of the involved vertebra, the length of the defect was measured, and an appropriate length of tricortical iliac bone graft was harvested and impacted into the cavity followed by application of appropriately contoured anterior plate.

The wound was closed with a suction drain kept for 24 h.

Postoperatively, all patients were immobilized in a Philadelphia collar for 12 weeks.

Outcome measurement

Segmental kyphosis angle (SKA) was measured using the Cobb method between the superior endplate of the next proximal unaffected vertebra and the inferior endplate of the next distal unaffected vertebra (Fig. 1).

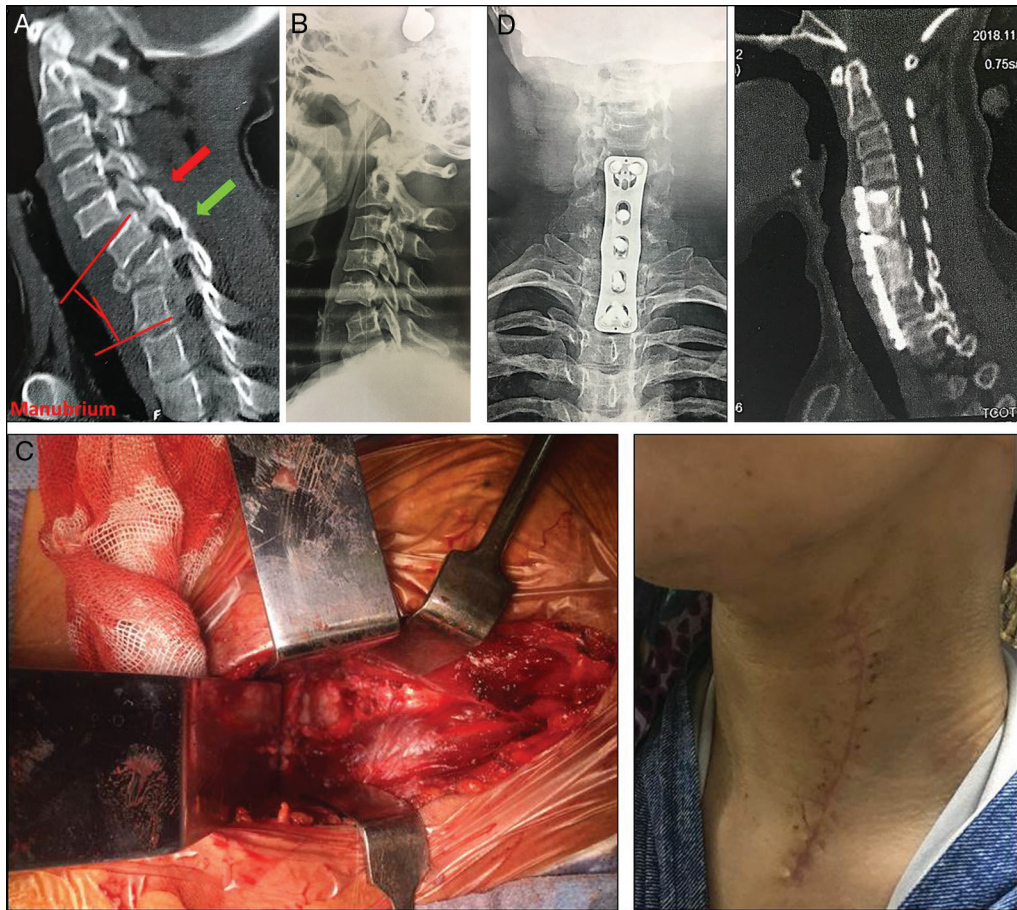
Kyphosis was indicated by a positive value and lordosis by a negative value.

Solid fusion was considered present if there is no lucency across the fusion site or around any of the screw sites and trabeculae across the fusion site at the final follow-up (Fig. 2).

Any complication related to the procedure was recorded.

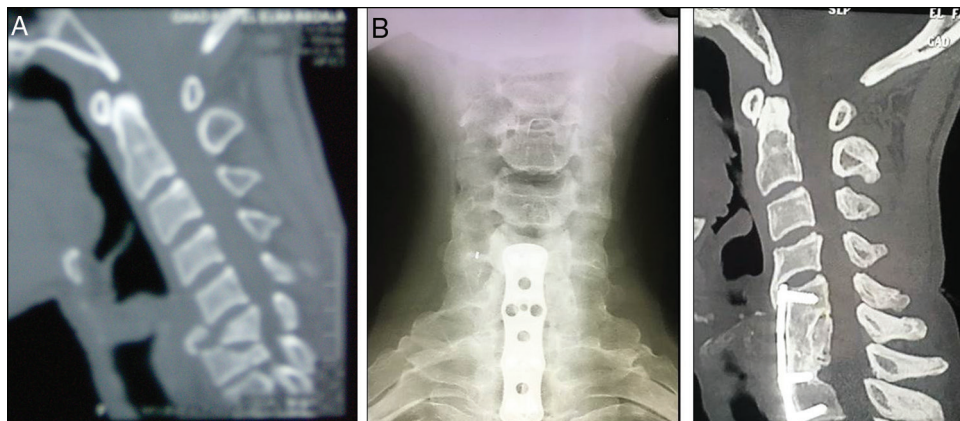
A validated version of the SF-36 questionnaire was used to assess HRQOL of the patients at final follow-up [14].

Figure 1



Twenty-five-year-old female suffered from C7 fracture due to traffic accident. She was ASIA type D with SLIC score = 7. (A) Preoperative CT, dislocated C5–6 facets (red arrow) and perched C6–7 facets (green arrow), (B) preoperative x-ray after skull traction and facet reduction, (C) intraoperative and postoperative clinical photo, (D) late postoperative AP x-ray and sagittal CT showing iliac autograft and anterior fixation from C5 to T2 with solid fusion. ASIA, American Spinal Injury Association; CT, computed tomography; SLIC, Subaxial Injury Classification.

Figure 2



45Forty-five-year-old male suffered from C6–7 fracture due to fall from a palm, ASIA type D, SLIC score = 7. (A) Preoperative sagittal CT, (B) late postoperative AP x-ray and sagittal CT showing iliac autograft and fixation from C5 to T1 with solid fusion. ASIA, American Spinal Injury Association; CT, computed tomography; SLIC, Subaxial Injury Classification.

Statistical analysis

Data was analyzed using STATA version 14.2 (Stata Statistical Software: Release 14.2 College Station, TX: Stata Corp LP). Quantitative data were represented as

mean, SD, median and range. Correlation analysis was done using Spearman's correlation test. Graphs were produced by using STATA program. P value less than 0.05 was considered significant.

Results

A total of 13 (10 men and 3 women) patients were included. The injury levels included C6 in 3 cases (24%), C7 in 5 cases (38%) and both C6 and C7 in 5 cases (38%); with a mean age of 36.15 ± 7.82 years (range 25:48). The mechanism of injury was traffic accident in 8 cases (61.5%) and fall from height in 5 cases (38.5%) (Table 1).

The mean operative time was 90.62 ± 20.67 min (range 55–125). The SLIC score was 7.0 ± 1.53 (range 5–9). The average duration of follow-up period was 75.54 ± 22.33 months (range 49–118). The total motor (ISNCSCI) score was significantly improved from 72 ± 33.44 preoperatively to 76.92 ± 31.80 at the final follow-up ($P=0.004$) and detailed ASIA score for every case is shown in Table 1. Also, the SKA was significantly improved from $15.62 \pm 3.25^\circ$ preoperatively to $-9.84 \pm 1.77^\circ$ directly postoperative ($P=0.0002$) reflecting correction of kyphosis to $25.46 \pm 4.44^\circ$. At final follow-up, the SKA was $-1.30 \pm 2.32^\circ$ with correction loss of $8.53 \pm 2.22^\circ$ ($P=0.0002$) (Fig. 3).

SF-36 total score was 75.04 ± 24.26 (range 10.4–94.3) at final follow-up (Table 2).

SF-36, short-Form 36-item; SLIC, Subaxial Injury Classification.

The correlation co-efficient between SF-36 total score and final Cobb angle was -0.13 ($P=0.67$) (weak negative and insignificant correlation) while the correlation between SF-36 total score and final motor score was 0.73 ($P=0.005$) (strong positive and significant correlation).

There were no intraoperative complications.

Hoarseness of voice was noticed in 1 case and dysphagia in 3 cases and resolved spontaneously in the 1st postoperative month.

No wound problems or postoperative neurological deterioration.

Apart from transient pain at the donor site, there were no major complications related to the iliac graft harvesting.

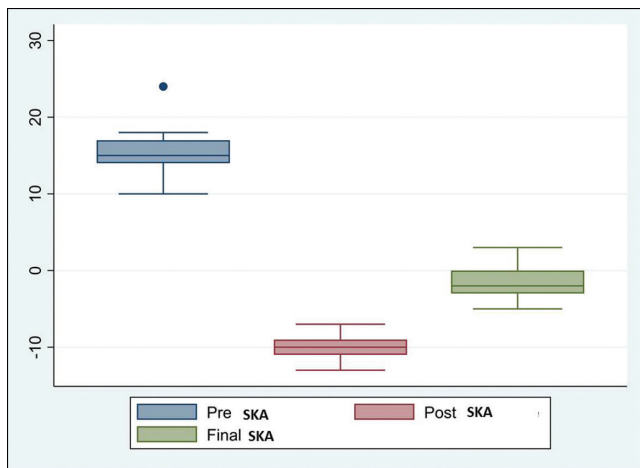
All cases achieved successful fusion and there were no implant-related complications at the final follow-up.

Table 1 Detailed demographic, radiological and clinical data of the studied cohort

No	Age	Sex	Trauma	Cervical level	Op time (min)	Follow-up (month)	Pre-cobb angle°	Post-cobb angle°	Final Cobb angle°	Correction°	Correction loss°	Pre-ASIA	Final ASIA	SLIC	Sf-36 score	Pre-Motor score	Final Motor score
1	45	M	FFH	6-7	115	118	17	-11	0	28	11	D	E	7	76.2	95	100
2	25	F	TA	7	125	102	24	-13	-3	37	10	D	E	7	79.2	92	100
3	28	M	TA	7	90	100	10	-8	-2	18	6	E	E	6	94.3	100	100
4	35	M	FFH	6	80	90	15	-9	3	24	12	A	A	8	10.4	14	17
5	35	M	TA	7	75	85	14	-8	-2	22	6	E	E	5	92.9	100	100
6	28	F	FFH	6-7	80	81	15	-10	-2	25	8	C	D	9	74	39	50
7	48	M	TA	6	85	70	18	-7	3	25	10	E	E	5	94.3	100	100
8	47	M	TA	7	118	66	13	-9	-3	22	6	D	E	5	93	94	100
9	34	M	TA	6-7	110	62	17	-12	-5	29	7	C	C	8	44.9	26	29
10	43	M	TA	7	55	56	14	-10	-2	24	8	C	D	9	86.3	41	49
11	37	M	FFH	6-7	70	50	16	-9	-1	25	8	D	E	7	77.9	93	100
12	27	F	FFH	6	85	53	14	-12	0	26	12	C	D	9	61.3	42	55
13	38	M	TA	6-7	90	49	16	-10	-3	26	7	E	E	6	90.8	100	100

ASIA, American Spinal Injury Association; F, female; FFH, fall from height; M, male; SLIC, Subaxial Injury Classification; TA, traffic accident.

Figure 3



Box plot graph showing Pre-SKA, Post-SKA and Final SKA. SKA, segmental kyphosis angle.

Table 2 Statistics of cohort's data

Variable	Mean±SD	Median (range)
Age (year)	36.15±7.82	35 (25: 48)
Op time (min)	90.62±20.67	85 (55: 125)
Follow-up(month)	75.54±22.33	70 (49: 118)
SLIC score	7.0±1.53	7 (5: 9)
Pre-Cobb angle°	15.62±3.25	15 (10: 24)
Post-Cobb angle°	-9.84±1.77	-10 (-13: -7)
Final Cobb angle°	-1.30±2.32	-2 (-5: 3)
Correction°	-25.46±4.44	-25 (-37: -18)
Correction loss°	8.53±2.22	8 (6: 12)
Pre-Motor score	72±33.44	93 (14: 100)
Final Motor score	76.92±31.80	100 (17: 100)
SF-36 total score	75.04±24.26	79.2 (10.4: 94.3)

Discussion

Our series included a homogeneous group of fractures of the lower cervical spine. The indication of surgery was SLIC score greater than or equal to 5 [18]. In comparison to the literatures suggesting that anterior fixation is biomechanically inadequate for unstable lower cervical fractures compared with posterior fixation [5,21], we found significant postoperative correction of kyphosis ($25.46 \pm 4.44^\circ$), but we noticed also a significant late loss of correction ($8.53 \pm 2.22^\circ$) which can be explained by graft resorption.

kyphosis greater than 10° constitutes an unstable segment and was defined as construct failure [22]; however, in our series there was no failure and final lordosis of ($-1.30 \pm 2.32^\circ$) was maintained.

In the light of our results, we tried to answer the question, whether the radiological outcome in the form of SKA or the clinical outcome in the form of

the total motor score has any impact on the patients' quality of life. Through the analysis of the SF-36, we found that the HRQOL was not significantly affected by the cervical kyphosis at long-term follow-up, while HRQOL significantly improved by improvement of the motor status of the patients.

This can be explained by the fact of insignificant segmental kyphosis ($<10^\circ$) and the young age group of our patients with high physical demand which is profoundly affected by motor power improvement.

The most frequent complication related to the anterior approach to the cervicothoracic junction is recurrent laryngeal nerve palsy accounting for 4.76–16.67% in the literatures [23]. We had 1 case (7.7%) which was temporary and resolved within 1 month.

However, our study has some limitations; the study was retrospective, lack of preoperative SF-36 score which can be attributed to the circumstances of acute trauma and small sample as a result of strict exclusion criteria.

Conclusion

The current study reports on a homogenous subgroup of patients with lower cervical spine fractures treated by anterior-only reconstruction with long-term follow-up and negligible complications. The resultant late kyphosis due to graft resorption had no deleterious effect on patients' HRQOL, while motor power improvement had significant positive effect.

Future study with a larger case series and preoperative quality of life assessment for the sake of sound comparison is needed.

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Author contribution

A.S.S. carried out the study conception and design, drafted the manuscript and performed the surgeries. E.S. carried out data acquisition and drafted the manuscript. H.T. designed tables and figures and drafted the manuscript.

Ethical approval and consent to participate

The study was approved by the Ethics Committee of our institution. All participants' parents gave their written informed consent to participate in the study.

Consent to publish

All participants gave their written informed consent to publish the obtained data of the current study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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