

Cervical lordosis after subaxial spinal trauma surgery: relationship with neck pain and stiffness

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SUMMARY: Cervical lordosis after subaxial spinal trauma surgery: relationship with neck pain and stiffness

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Background. The objective of this retrospective study is to evaluate how neck pain is influenced by post-operative cervical alignment in patients operated for cervical spinal trauma.

Patients and methods. From January 2013 to June 2017, at our department we operated 34 patients with cervical spinal trauma, 22 males and 12 females. Age, sex, level and type of fractures, surgical approach, fixation levels (cervical or cervico-dorsal), preoperative and postoperative CT scan, cervical (C2-C7) Cobb angle (lordotic $> +10^\circ$, straight $0 \pm 10^\circ$, kyphotic $< 0^\circ$) at X-rays on sitting position 3 months after surgery, postoperative self-reported neck

stiffness scale, preoperative and follow-up ASIA score, pre and postoperative VAS value were evaluated for each patient. Statistical analysis was performed according to the Mann-Whitney and T-test.

Results. In this series, 22 patients were operated by anterior approach, 7 patients by posterior approach and 5 by combined approach. Postoperative chronic cervical pain was not correlated with cervical sagittal alignment after surgery, fracture type, surgical approach, fixation level and postoperative ASIA score but is correlated with the presence of neck stiffness ($P=0,001$). Patients treated with posterior approach ($P=0,022$) and fracture type C ($P=0,026$) had higher significantly neck stiffness compared to patients who underwent anterior approach for type B fractures.

Conclusions. The presence of abnormal cervical lordosis after surgery for cervical spinal trauma does not correlate with neck pain. Patients treated with posterior fixation had higher neck stiffness and related chronic pain.

KEY WORDS: Cervical spine trauma - Cervical lordosis - Neck pain - Neck stiffness - Anterior cervical approach - Posterior cervical fixation.

Introduction

The reported annual incidence rates of spine trauma are 64 cases per 100000/inhabitant/year with an increasing tendency (1).

In case of spinal cord compression or instability, surgery represents the treatment of choice to grant a neurological improvement and a rigid fixation (2). Decompression of spinal cord, realignment and stabilization of the cervical spine are the gold standard of treatment (3-5). Besides the target of surgery is the restoration of the physiological cervical lordosis. In this regard, some authors reported that cervical

sagittal imbalance is associated with chronic neck pain and decreased health-related quality of life (6).

The objective of this study is to evaluate the relationship between postoperative cervical lordosis with chronic cervical pain and neck stiffness in patients operated for cervical spine injury.

Patients and methods

From January 2013 to June 2017, at our department we operated 34 patients with SCI, 22 males and 12 females. Age, sex, level and type of fractures, surgical approach, fixation levels (cervical or cervico-dorsal), preoperative and postoperative CT scan or MRI, X-rays on sitting position 3 months after surgery, postoperative self-reported neck stiffness scale, preoperative and follow-up ASIA score, pre and

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postoperative VAS value were evaluated for each patient. All patients with neurological deficit were operated within 12-72 hours from the trauma and were submitted to corticosteroid therapy according to the recommendation of the NASCIS-2. The specific surgical procedure, such as anterior or posterior approach, was chosen by the type of fracture according to AOSpine principles (3). Surgery was carried out with conventional intra-operative fluoroscopy without neuronavigator (7, 8). A cervical post-operative CT scan was performed within 72 hours after surgery to study the correct device positioning and to exclude residual spinal cord compression.

The cervical spine alignment after surgery was calculated by the Cobb angle in lateral X-rays on sitting position. The C2-C7 Cobb angles were measured by drawing a line parallel to the inferior end plate of C2 and a second line parallel to the upper end plate of C7; perpendicular lines were then drawn at right angles to each of the previous two lines according to Cobb technique (Figure 1). The Cobb angle was summarized as lordotic $> +10^\circ$, straight from 0 to $+10^\circ$, kyphotic $< 0^\circ$ (6). Pain was recorded by VAS scale (0-4 value low, 5-10 value high), stiffness by the self-reported neck stiffness scale (absent, medium, severe). All patients underwent a rehabilitation program as soon as possible. Follow-up clinical and radiological evaluations were performed 3-12 months (mean follow-up period: 6 months) after surgery. Statistical analysis was performed by means of Mann-Whitney and T-test. Re-

sults were considered significant for p values < 0.05 (two sided). Data analysis was performed using STATA/IC 13.1 statistical package (StataCorp LP, Texas, USA).

Results

A total of 34 patients (22 males and 12 female) with mean age of 54,74 Y.O. (range 21–87 Y.O.) operated for subaxial cervical spinal trauma were analyzed and included in this study (details of each patients are summarized in Table 1). The levels of injury were C3-C4 (1 patient), C4-C5 (4 patients), C5-C6 (8 patients) and C6-C7 (15 patients). According to AO-spine classification, 21 patients out of 34 had type B fractures and 13 ones had type C. In this series, 22 patients out of 34 were operated by anterior approach, 7 patients by posterior approach and 5 by combined approach. The cervical fixation was performed in 20 patients out of 34 and cervicothoracic in 14 cases. Postoperative chronic neck pain was not correlated with postoperative cervical curvature in lordosis, straight or kyphosis ($P=0,575$), fracture type ($P=0,434$), surgical approach ($P=0,399$), fixation level ($P=0,161$) and postoperative ASIA score ($P=0,330$) but it was statistically correlated with the presence of neck stiffness ($P=0,001$) (Table 2). Patients treated with posterior approach ($P=0,022$) and fracture type C ($P=0,026$) had higher postoperative statistical significant neck stiffness grade compared to patients who underwent anterior approach for B type fractures (Table 3). At admission 19 patients out of 34 were ASIA grade E, 7 patients grade D, 3 patients grade C, 3 patients grade B, 2 patients grade A. At follow-up, the ASIA score improved one level in 11 patients out of 34.

Discussion

Cervical spine presents high mobility in the vertebral column and cervical lordosis is its physiological condition. There are some radiological parameters widely used in spinal reconstruction surgery to study the cervical lordosis as C2-C7 Cobb angles, T1 slope, C2-C7 sagittal vertex axis (SVA) (9). In



Figure 1 - Cervical lordosis was defined as Cobb's angle between C2 lower endplate and C7 upper endplate.

TABLE 1 - C2-C7 ANGLE: LORDOTIC $>+10^{\circ}$, STRAIGHT $0/+10^{\circ}$, KYPHOTIC $<0^{\circ}$.

Patient n°	Fracture type	Preoperative sagittal alignment	Postoperative sagittal alignment	VAS score
1	B	NEUTRAL	LORDOTIC	0-4
2	C	NEUTRAL	NEUTRAL	5-10
3	B	LORDOTIC	NEUTRAL	0-4
4	B	LORDOTIC	LORDOTIC	0-4
5	B	NEUTRAL	LORDOTIC	0-4
6	B	KYPHOTIC	NEUTRAL	0-4
7	B	KYPHOTIC	NEUTRAL	0-4
8	C	NEUTRAL	NEUTRAL	5-10
9	C	NEUTRAL	NEUTRAL	0-4
10	C	NEUTRAL	NEUTRAL	0-4
11	B	LORDOTIC	LORDOTIC	5-10
12	B	NEUTRAL	NEUTRAL	0-4
13	B	NEUTRAL	KYPHOTIC	0-4
14	B	LORDOTIC	LORDOTIC	5-10
15	B	LORDOTIC	LORDOTIC	5-10
16	B	NEUTRAL	LORDOTIC	0-4
17	B	LORDOTIC	LORDOTIC	0-4
18	B	NEUTRAL	LORDOTIC	5-10
19	B	NEUTRAL	LORDOTIC	0-4
20	C	LORDOTIC	LORDOTIC	0-4
21	C	NEUTRAL	LORDOTIC	0-4
22	B	NEUTRAL	NEUTRAL	0-4
23	B	NEUTRAL	NEUTRAL	0-4
24	C	NEUTRAL	NEUTRAL	0-4
25	B	NEUTRAL	LORDOTIC	0-4
26	C	NEUTRAL	LORDOTIC	0-4
27	C	NEUTRAL	NEUTRAL	0-4
28	B	KYPHOTIC	NEUTRAL	0-4
29	C	NEUTRAL	LORDOTIC	0-4
30	C	KYPHOTIC	NEUTRAL	5-10
31	B	NEUTRAL	NEUTRAL	0-4
32	C	NEUTRAL	NEUTRAL	5-10
33	C	NEUTRAL	LORDOTIC	0-4
34	B	LORDOTIC	LORDOTIC	0-4

TABLE 2 - CORRELATION BETWEEN POST-OPERATIVE VAS AND PATIENTS' PRE- AND POST-OPERATIVE CHARACTERISTICS.

Characteristic	No. or mean (min-max)			
	Total (n=34)	Post-operative VAS 0-4 (n=26)	Post-operative VAS 5-10 (n=8)	Univariate analysis P value
Age (years)	54.74 (21-87)	52.04 (21-87)	63.50 (38-80)	0.166
Gender (Male/Female)	22/12	17/9	5/3	0.881
Fracture type				
B	21	17	4	0.434
C	13	9	4	
Pre-operative MRI spinal cord contusion				
Yes	19	14	5	0.666
No	15	12	3	
Surgical approach				
Anterior	22	18	4	0.399
Posterior	7	4	3	
Anterior+Posterior	5	4	1	
Fixation level				
Cervical	20	17	3	0.161
Cervicothoracic	14	9	5	
Post-operative cervical curvature				
Lordosis	13	10	3	0.575
Straight	18	13	5	
Kyphosis	3	3	0	
Post-operative Self-Reported Neck Stiffness				
No				0.000
Medium	13	13	0	
Severe	13	11	2	
	8	2	6	
Postoperative ASIA				
A	2	2	0	0.330
B	3	1	2	
C	3	2	1	
D	7	5	2	
E	19	16	3	

case of cervical spine trauma, the goal of surgery is decompression, realignment and stabilization of the vertebral column to restore its physiological lordosis (9). In this regard, some authors reported that cervical sagittal imbalance is associated with chronic neck pain and decreased health-related quality of life (6).

In our study, postoperative chronic neck pain was not correlated with cervical lordosis, fracture type, surgical approach, fixation level and postoper-

ative ASIA score but it was statistically correlated with neck stiffness more relevant in patients operated by the posterior approach or with type C fractures. In posterior vertebral approach, many levels are fixed by means of screws and rods and type C fractures frequently need 360° stabilization; in both situation, high levels of rigidity are present and high risks of spinal infections may occur especially in emergency surgery (10-12). In the study of Serkan et

TABLE 3 - CORRELATION BETWEEN POST-OPERATIVE SELF-REPORTED NECK STIFFNESS (NO VS. SEVERE) AND PATIENTS' PRE- AND POST-OPERATIVE CHARACTERISTICS.

Characteristic	Total (n=21)	No. or mean (min-max)		
		No Post-operative Self-Reported Neck Stiffness (n=13)	Severe Post-operative Self-Reported Neck Stiffness (n=8)	Univariate analysis P value
Age (years)	56.86 (21-87)	56.00 (21-87)	58.25 (38-80)	0.799
Gender (Male/Female)	13/8	9/4	4/4	0.378
Fracture type				
B	14	11	3	0.026
C	7	2	5	
Pre-operative MRI spinal cord contusion				
Yes	13	7	6	0.332
No	8	6	2	
Surgical approach				
Anterior	13	11	2	0.022
Posterior	5	1	4	
Anterior+Posterior	3	1	2	
Fixation level				
Cervical	12	8	4	0.604
Cervicothoracic	9	5	4	
Postoperative cervical curvature				
Lordosis	9	6	3	0.620
Straight	11	6	5	
Kyphosis	1	1	0	
Post-operative VAS				
0-4	15	13	2	0.000
5-10	6	0	6	
Postoperative ASIA				
A	2	1	1	0.123
B	3	0	3	
C	3	2	1	
D	5	3	2	
E	8	7	1	

al. neck pain was correlated with muscle stiffness of the upper trapezius, elevator scapulae and sternocleidomastoid (13). The muscle stiffness causes some changes in the gamma motor activity of the muscles creating a vicious circle with stiffness and pain (14). Many authors documented that physiological cervical lordosis may influence outcome in patients operated for cervical spondylotic myelopathy and is a potential risk factor for Modic changes (15-17) but other ones disagree (6, 18, 19). In the study of Hi-

royasu et al. the radiographic cervical sagittal alignment was not significantly correlated with preoperative or postoperative axial neck pain (20). According to many authors, our data confirm that postoperative cervical curvature was not correlated with cervical neck pain (21-23). Furthermore, a large correction of the lordosis in kyphotic patients may cause a C5 nerve palsy (24).

Limitations of this study included:

- Small sample size

- Retrospective nature of the study
- Cervical pain and stiffness in some patients may be related to other traumatic lesions such as traumatic head injury (25-27)
- Other radiological parameters which are involved in cervical sagittal balance were not investigated (for example T1 slope, and C2 or C7 sagittal vertical axis [SVA])

Conclusions

The grade of cervical postoperative lordosis in patients operated for spine cervical trauma does not influence the outcome in terms of chronic pain. Pain is influenced by type of approach, type of fracture and neck rigidity. Further studies are needed to investigate the relationship between the sagittal alignment of the postoperative cervical spine and clinical outcome.

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Compliance with ethical standards

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Conflict of interest

None.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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