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Comparison of the AOSpine subaxial cervical spine injury classification system and the Allen classification

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Abstract

The AOSpine group has launched a new subaxial cervical spine injury system (AOSCIS) based on morphology. The objective of this study was to use the AOSCIS and compare it to the widely used Allen classification (AC) based on mechanics for subaxial cervical spine injury. Twenty-two consecutive patients with subaxial cervical spine injury who received posterior cervical fixation in our hospital were included in this study. Medical records were evaluated retrospectively. The evaluated factors were as follows: preoperative ASIA impaired scale (AIS), AOSCIS, AC, and diffuse idiopathic skeletal hyperostosis (DISH). There was AIS A in nine patients, AIS C in four patients, AIS D in four patients, and AIS E in five patients. Two patients with AOSCIS B2 were classified as AC DF1. Two AOSCIS F3 patients were classified as AC CE1. Eighteen AOSCIS C patients were classified into multiple categories: five as AC DF2, three as DF3, one as CF4, one as CF5, four as DE2, three as CE3 + DE1, and one as CE3 + VC2. All of the AOSCIS A0 (F) or B patients were classified as AC stage 1, and all of the AOSCIS C patients were classified as AC stage 2 and higher ($P < 0.05$). All of six patients with DISH were classified as AOSCIS C and CE3, DE2, or DF3. AOSCIS and AC are correlated. Conducting an evaluation using both systems helps us to better comprehend subaxial cervical spine injuries.

Keywords Subaxial cervical spine · Trauma · Injury · Classification

Introduction

The Spine Trauma Study Group proposed a system (known as the SLIC) based on three main categories: injury morphology, discoligamentous complex integrity, and neurologic status [1]. Each injury category was assigned a score, and treatment options were suggested based upon these values. In this system, morphology of subaxial cervical spine trauma was divided into three main categories in reference to the association of the vertebral bodies with each other: compression, distraction, and translation/rotation [1]. However, there has been a poor agreement on the morphologic injury characteristics of the SLIC system [2]. Therefore, a new morphological classification for subaxial spinal injury with a high agreement may be needed.

In order to fill this need, the AOSpine group has launched a new subaxial cervical spine injury system (AOSCIS) based on morphology. The main three compartments of morphology in AOSCIS were modified to Type A: compression injury, Type B: tension band injuries, and Type C: translational injury in any axis. AOSCIS also has additional evaluations for facet joint complex. The interobserver and intraobserver reliabilities for this system were substantial (0.64 and 0.75, respectively) [3]. However, the classical Allen classification (AC) based on mechanics for subaxial cervical spine injury may still be a standard, and this system may be familiar to many surgeons [4]. If correlations between AOSCIS and AC are discovered, it will help us to understand AOSCIS and subaxial cervical spine injuries. Therefore, the objective of this study was to use AOSCIS and compare it to the AC.

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Materials and methods

Twenty-two consecutive patients with subaxial cervical spine injury who received posterior cervical fixation in our hospital were included in this study. Medical records were evaluated retrospectively. The ethics committee's approval was given for this study at our institution, and a written informed consent for participation, use of personal data, and follow-up was signed by all of the patients. The evaluated factors were as follows: preoperative ASIA impaired scale (AIS), AOSCIS, AC, and diffuse idiopathic skeletal hyperostosis (DISH). In the statistical analysis, Fisher's exact test was performed using SPSS (SPSS, Chicago, IL, USA) for the relationship of AOSCIS and AC stages. A P value of < 0.05 was considered to indicate significance.

Results

The average age was 61.4 years old. There were 21 male patients and 1 female patient. There was AIS A in nine patients, AIS C in four patients, AIS D in four patients, and AIS E in five patients. The fracture pattern of patients was classified using both systems. Two patients with AOSCIS B2 were classified as AC DF1. Two AOSCIS F3 (A0) patients were classified as AC CE1. Eighteen AOSCIS C patients were classified into multiple categories: five as AC DF2, three as DF3, one as CF4, one as CF5, four as DE2, three as CE3 + DE1, and one as CE3 + VC2 (Table 1). All AOSCIS A0 (F3) or B patients were classified as AC stage 1, and all of the AOSCIS C patients were classified as AC stage 2 and higher (Table 2, $P < 0.05$). All six patients with DISH were classified as AOSCIS C and CE3, DE2, or DF3.

Table 1 Comparison of AOSCIS and the Allen classification

Allen	AOSCIS	Cases	DISH
CE1	A0 (F3)	2	0
DE1 + CE3	C	3	3
DE2	C	4	2
VC2 + CE3	C	1	0
DF1	B2	2	0
DF2	C	5	0
DF3	C	3	1
CF4	C	1	0
CF5	C	1	0

AOSCIS AOSpine group subaxial cervical spine injury system, *DISH* diffuse idiopathic skeletal hyperostosis

Table 2 The relationship of AOSCIS C and other types with AC stage 1 or stage 2 and higher

		AOSCIS	
		A or B	C
Allen stage	1	4	0
	2 and higher	0	15

AOSCIS AOSpine group subaxial cervical spine injury system

*A P value of < 0.05 was considered to indicate significance

Discussion

Silva et al. reported in regard to AOSCIS. They found that Type B injuries were rarely diagnosed, and only mild (Type A0) and extremely severe (Type C) injuries had a high rate of interobserver agreement [5]. While severe cases might be corrected because all cases received surgery in the present study, Type A or B was rarely diagnosed, similar to what was reported in Silva's study. However, it was found that two categories were especially similar between AC and rare AOSCIS Type A or B. One of them was CE1, unilateral vertebral arch fracture and AOSCIS F3, floating lateral mass (Fig. 1). The other was DF1, flexion sprain injury with facet subluxation and divergence of spinous processes and AOSCIS B2, complete disruption or separation of the posterior capsuloligamentous or bony structures (Fig. 2). Moreover, these two categories were all of Type A or B as diagnosed in the present study, and their severity is relatively high.

While severe cases might be corrected in the present study because all cases received surgery, many subaxial cervical spine injuries tended to be classified as AOSCIS C. Moreover, all of the AOSCIS C injuries were classified as AC stage 2 and higher in the present study. Meanwhile, all AOSCIS Type A or B injuries were classified as Allen stage 1. This correlation had a significant difference ($P < 0.05$, Table 2). Therefore, the severity of the injury is likely correlated between AOSCIS and AC, and AOSCIS C indicates severe injury.

All six patients with DISH were classified as AOSCIS C and CE3, DE2, or DF3. Patients with DISH may have three-column injury because of the stiffness of their spinal columns. Bransford et al. have reported about 33 patients with DISH and cervical spine injury. These patients had severe injuries, with a high average of SLIC score (7.2 ± 1.4), and all patients received cervical fixation just as in the present study [6]. DISH patients may be increasing in the aging population, and there should be awareness to prevent cervical injury.

The limitations of this preliminary study were the retrospective cross-sectional study design and the small

Fig. 1 **a** CE1, unilateral vertebral arch fracture, **b** AOSCIS F3, floating lateral mass, **c** CT images of floating lateral mass
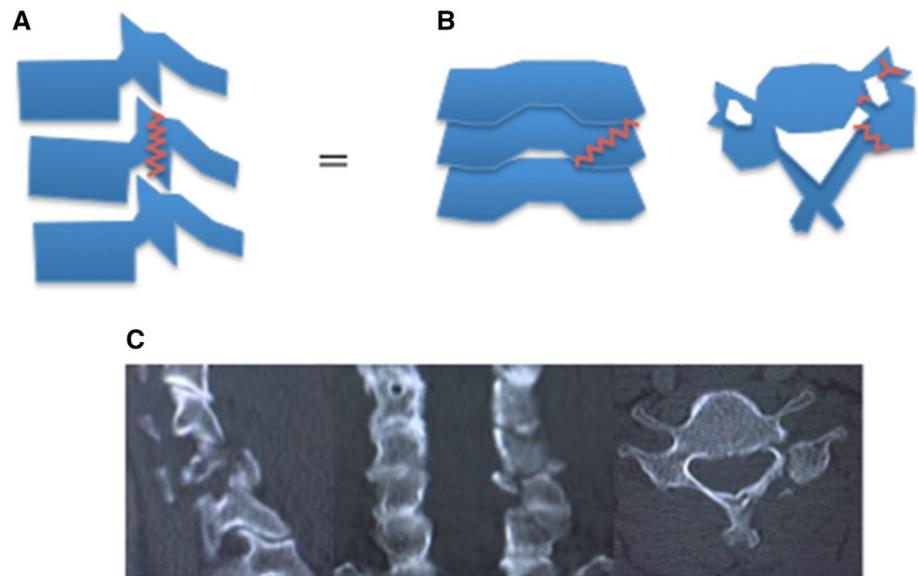
Fig. 2 **a** DF1, flexion sprain injury with facet subluxation and divergence of spinous processes, **b** AOSCIS B2, complete disruption or separation of the posterior capsuloligamentous or bony capsuloligamentous structures, **c** an X-ray photograph of facet subluxation
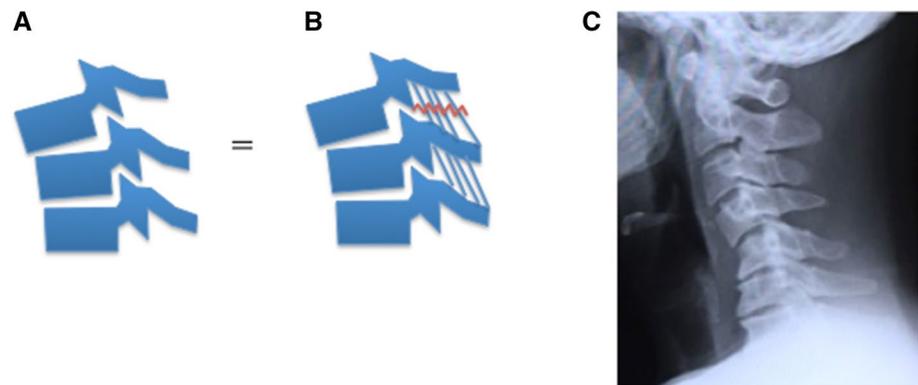
sample size. Thus, the data were not robust enough to draw definite conclusions. Further prospective studies with larger numbers of patients will be needed to draw definite conclusions.

Conclusions

AOSCIS and AC are likely correlated. Conducting an evaluation using both systems helps us to better comprehend subaxial cervical spine injuries.

Compliance with ethical standards

Conflict of interest The authors declare that there are no conflicts of interest.

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