

TRAUMATIC SPONDYLOLISTHESIS OF THE AXIS: EPIDEMIOLOGY, MANAGEMENT AND OUTCOME

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ABSTRACT

Objective: To evaluate cases of traumatic spondylolisthesis of the axis and describe them in relation to epidemiology, classification, neurological deficit, healing time and treatment method. **Method:** A retrospective analysis of the medical records of patients treated between 2002 and 2010 at IOT-FMUSP. **Inclusion criteria:** pars interarticularis fracture of C2. **Results:** 68% were male patients, with a mean age of 39.1 years. We used the classification by Effendi, modified by Levine-Edwards. Type I fractures were observed in five patients (31.2%) and type II in eight patients (50%). Only three patients (18%) had type IIa fracture. There were no cases of type III. **Mechanism:** Eight car accidents and four falls. Other mechanisms: being run over,

and diving accidents. Treatment with halo traction was used in eleven patients, using minerva cast and halo-cast. Healing time: 3.6 months. Follow-up time: 9.6 months. **Discussion:** In general, hangman fracture has a good prognosis, which is confirmed by our results. There was no need for surgery in any of the cases. The incidence of neurological deficit is low. No patient had unstable fracture (type III). **Conclusion:** This paper suggests that traumatic spondylolisthesis of the axis continues to be an injury that is successfully treated by conservative treatment in most cases. **Level of Evidence -IV, Case series.**

Keywords: Axis. Spondylolisthesis. Spine. Immobilization.

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INTRODUCTION

Traumatic spondylolisthesis of the axis is considered one of the most frequent forms of high cervical spine injury. Although it is popularly described as “hangman fracture”,¹ in allusion to the cervical damage caused by hangings,² in modern times this type of lesion occurs mainly as a result of car accidents.^{3,4} The term “hangman fracture”, already used to describe different sites of fractures of the posterior elements of C2, is, by definition, the fracture of the “pars interarticularis” (or isthmus) of C2.⁴ However, some reports mistakenly cite the pedicle as being the fractured structure.³

Traumatic spondylolisthesis of the axis is a frequently stable injury, which does not usually entail neurological deficits.⁵

The treatment of this fracture is predominantly conservative according to the literature.^{6,7} In the past there were authors who defended the recommendation of internal fixation for the majority of cases.^{8,9} Nowadays surgical indications are precise and are generally related to the presence of neurological lesions (confirmed by physical examination) and to facetary luxation (evaluated by complementary radiographic exams).

The classification of current use of this type of fracture was

defined by Effendi et al.¹⁰ and, afterwards, modified by Levine and Edwards¹¹, who included the trauma mechanism in the classification (inferred through well-defined radiographic parameters). The classification can be applied regardless of the fracture etiology and is divided into the following types:

- Type I: Fracture without deviation (less than 3 mm); the trauma mechanism is axial compression and extension;
- Type II: Deviated fracture, with predominant translation over the angulation; the trauma mechanism is extension followed by rebound flexion;
- Type IIa: fracture with greater angulation and minimum translation; the trauma mechanism is flexion-distraction; and
- Type III: presents translation and accentuated angulation, with luxation of one or two C2-C3 articular facets.

The present study aims to retrospectively evaluate cases of traumatic spondylolisthesis of the axis treated in our clinic and describes them in relation to the lesion epidemiology, fracture classification, presence of neurological deficit before and after treatment, use of the cranial halo, mean fracture consolidation time and definitive treatment employed.

All the authors declare that there is no potential conflict of interest referring to this article.

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MATERIAL AND METHOD

The medical records of sixteen patients treated between 2002 and 2010 at the Institute of Orthopedics and Traumatology of Hospital das Clínicas of the School of Medicine of Universidade de São Paulo (IOT-HCFMUSP) were analyzed retrospectively. The criterion of inclusion was convenience, while the presence of fracture of the pars interarticularis of C2 was sufficient criterion for inclusion. There were no exclusion criteria.

The patients had the following variables analyzed: sex, date of injury, age of patient upon occurrence of injury, trauma mechanism, fracture classification, presence of neurological deficit before and after treatment, use of halo, treatment employed, fracture healing time, complications and outpatient follow-up time.

The trauma mechanism and the fracture classification were analyzed through plain radiographs of the cervical spine in the front, lateral and transoral views, using the classification of Levine-Edwards. Other radiological examinations such as Magnetic Resonance and Computed Tomography of the cervical spine were not considered for this study.

The presence of neurological deficit was evaluated through descriptions in the chart of the neurological physical examination before treatment, after treatment and upon each outpatient return visit. Information was obtained from the chart, indicating whether the halo was used (according to standard use adopted by IOT-FMUSP). There was a description of the final treatment (conservative or surgical) employed in each patient based on descriptions from the medical records.

The fracture healing time was expressed in months and consolidation was evaluated by the formation of bone callus at the fracture focus identified through plain radiographies (front and lateral views of the cervical spine) in all the patients. The data obtained through the medical records were stratified and analyzed in conjunction in order to verify possible significant correlations between or among the different variables.

RESULTS

The review of the medical records of 16 patients treated at the Institute of Orthopedics and Traumatology of Hospital das Clínicas of the School of Medicine of Universidade de São Paulo (IOT-HCFMUSP), in the period from 2002 to 2010, indicated the presence of eleven male and five female patients. The patients were between 19 and 84 years of age, hence the average age of the sample was 39.1.

Type I fracture was observed in five patients (31.2%). Type II was identified in eight patients (50%) and only three patients (18%) presented type IIa fracture. No type III fractures were identified. (Figures 1 and 2)

As regards the trauma mechanism, it was observed that eight injuries resulted from car accidents and four from falls, whereas the latter were found in patients aged over 50 years. Other trauma mechanisms observed were a result of being run over and of diving accidents. All the patients were admitted with cervical pain and were initially immobilized with a rigid cervical collar.

During follow-up, the patients were evaluated through radiographs of the cervical spine, in lateral view, with observation and seriated comparison of the bone callus at the fracture focus. In the cases



Figure 1. Type 1 fracture.



Figure 2. Type 2 fracture.

where consolidation remained uncertain, computed tomography and/or flexion-extension stress radiographs were used.

No other fractures were observed in the patients studied. Only one of the patients, with a type IIa fracture, exhibited initial neurological deficit. However, the deficit improved completely and spontaneously during evolution.

The choice of the form of treatment did not comply with the pre-established protocol. Of the sixteen patients studied, eleven were immobilized with a halo for three weeks and weekly radiological control, in order to obtain fracture reduction. The patients with IIa fracture did not receive a halo. Another two did not receive a halo

as they presented fracture without deviation (type I). (Figure 3) The Minerva cast was the form of treatment used on ten patients, the cervical collar on three and the halo cast on two. (Figures 4 and 5)

The mean fracture healing time was 3.6 months. None of the patients underwent surgery. The existence of pseudarthrosis, neurological deficit or persistent cervicgia at the end of the treatment was not observed in any of the cases analyzed.

The mean follow-up time was 9.6 months. However, it is worth mentioning that in most cases, there was loss of follow-up due to abandonment by the patient within the twelve months after fracture consolidation.

None of the patients presented complications resulting from the treatment. (Table 1)



Figure 3. Cranial halo.

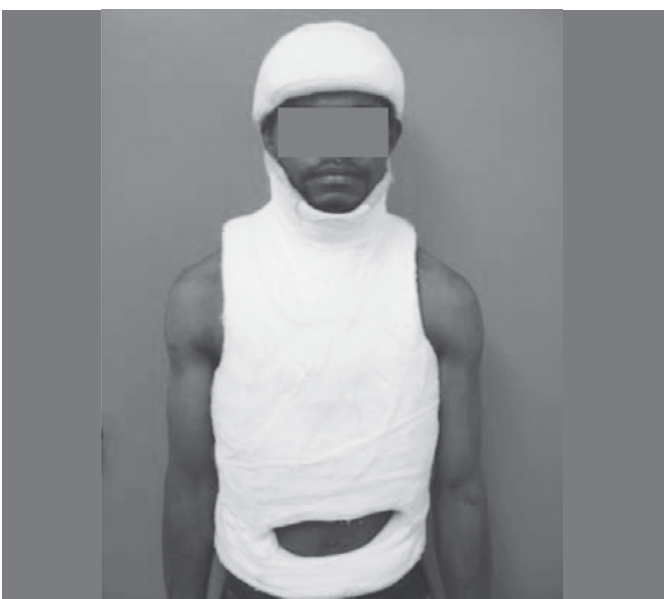


Figure 4. Minerva cast.



Figure 5. Halo cast.

DISCUSSION

Traumatic spondylolisthesis of the axis, considered one of the most common forms of injury of the high cervical spine, is frequently addressed in an ambiguous manner with regard to its definition.

Some studies address fractures of the laminae, facets, body and/or pedicles as traumatic spondylolisthesis of the axis.¹ However, more recent studies restrict the term to fractures of the C2 isthmus. This, in turn, was the approach adopted by the professionals involved in the present survey.

Most authors affirm that the hangman fracture presents good prognosis.^{12,13} Our results corroborated this statistic. There was no need for surgical approach in any of the cases, and no progression of neurological deficit was observed. It is assumed that the absence of neurological lesion is a consequence of the decompression of the cervical canal resulting from this type of fracture.^{14,15}

Thus, the incidence of neurological deficit is low, according to similar studies. Among the analyzed cases, only one presented initial deficit, with total recovery in the follow-up period.

The classification proposed by Effendi for this type of fracture suggests that subtype IIa requires differentiated treatment. However, although it is a fracture that is effectively different from type II, we did not observe relevant differences in the patients' evolution, when we weighted the form of treatment and the healing time. This observation can also be verified in other studies.¹⁶

Considering the extremely low incidence of pseudarthrosis in traumatic spondylolisthesis of the axis, it is necessary to consider the possibility of offering a more comfortable form of treatment to the patient. At our Institute, the most common treatment used was the Minerva cast. However, a less rigid form of immobilization can be an equally safe and more comfortable option, in some cases.^{14,16,17} The fact that considerable importance is attached to the patient's comfort is particularly relevant if we consider that, in the conservative treatment, immobilization will be used for a minimum period of 12 weeks.

Table 1. Summary of patients.

| Patient | Sex | Age | Mechanism | Classification | Halo | Conservative treatment | Consolidation | Follow-up |
|---------|-----|-------------|---------------------|----------------|------|------------------------|---------------|-------------|
| 1 | F | 84 | fall | 2 | Yes | Philadelphia | 4 | 4 |
| 2 | M | 21 | car accident | 2 | Yes | Minerva | 5 | 11 |
| 3 | M | 23 | car accident | 2 | Yes | Minerva | 3 | 30 |
| 4 | M | 35 | run over victim | 2 ^a | No | Minerva | 3 | 3 |
| 5 | M | 42 | car accident | 2 | Yes | Minerva | 4 | 4 |
| 6 | F | 25 | car accident | 2 | Yes | Minerva | 3 | 3 |
| 7 | F | 19 | car accident | 2 | Yes | Minerva | 4 | 6 |
| 8 | F | 27 | motorcycle accident | 1 | Yes | halo cast | 5 | 12 |
| 9 | M | 35 | car accident | 2a | No | Philadelphia | 3 | 6 |
| 10 | F | 79 | fall | 2 | Yes | halo cast | 5 | 6 |
| 11 | M | 58 | fall | 1 | Yes | Minerva | 3 | 3 |
| 12 | M | 35 | car accident | 1 | No | Philadelphia | 3 | 3 |
| 13 | M | 20 | run over victim | 2 | Yes | Minerva | 3 | 15 |
| 14 | M | 49 | diving | 1 | No | Minerva | 4 | 10 |
| 15 | M | 47 | fall | 1 | Yes | Minerva | 3 | 36 |
| 16 | M | 27 | run over victim | 2 | Yes | halo cast | 3 | 3 |
| Mean | | 39.12 years | | | | | 3.62 months | 9.68 months |

Satisfactory end results were observed in 100% of the patients. None of the patients analyzed presented unstable fracture, i.e., type III, confirming the rarity of this type of injury.¹⁸ Unstable fractures and those that require surgical intervention are not defined consensually in the literature that addresses the topic. One of the approaches defines instability when there is more than 6mm of translation or more than 2mm of mobility in the dynamic radiographs.^{4,19} Another approach considers translation of 3.5mm or angulation of 11 degrees as in the rest of the cervical spine.^{11,18}

CONCLUSION

This study suggests that traumatic spondylolisthesis of the axis continues to be an injury that is treated satisfactorily in a conservative manner in most cases, since it involves good evolution among patients and a low incidence of neurological deficit and complications. A study of longer duration with a higher number of patients would be more appropriate to obtain definitive conclusions.

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