TREATMENT OF ODONTOID FRACTURES

PEDRO AUGUSTO PONTIN, RENAM URT MANSUR BUMLAI, OLAVO BIRAGHI LETAIF, MARCELO LOQUETTE DAMASCENO, ALEXANDRE FOGAÇA CRISTANTE, RAPHAEL MARTUS MARCON, ALEXANDRE SADAO IUTAKA, REGINALDO PERILO OLIVEIRA, TARCÍSIO ELOY PESSOA DE BARROS FILHO

ABSTRACT

Objective: This article describes a clinical and radiologic retrospective analysis of odontoid fractures in 20 patients accompanied by the IOT-HCFMUSP, from 2004 to 2010. Methods: These fractures were stratified according to their classification (AO/Anderson and D'Alonzo), epidemiologic profile, type of treatment, time to consolidation of the fracture, and complications. Results: It was observed that there was a higher number of odontoid fractures in males (4:1), between the third and fourth decades of life (60%), and that the main causes of the trauma were falling from heights (60%) and car accidents (25%). Also, 15% of the cases presented neurological deficits. The most prevalent type of odontoid fracture was Type II (55%) followed by Type III (40%). The most prevalent type of treatment used for Type II and III fractures was surgical (73%) and non-surgical (87.5%), respectively. Consolidation of the fracture took place within 16 weeks in 87.5% of surgically treated cases, and in 54.5% of those treated non-surgically. No cases of pseudoarthrosis were found. Conclusion: The surgical treatment of Type II odontoid fractures showed satisfactory results in relation to time to consolidation of the fracture and low incidence of complications, as did the non-surgical treatment used for the Type III fractures. Level of Evidence: Level IV, case series.

Keywords: Spinal fractures. Odontoid process/surgery. Odontoid process/therapy. Axis.

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INTRODUCTION

Fractures of the dens of the axis are of considerable relevance in our midst on account of the increasing prevalence of high energy trauma and as regards the difficulties and challenges associated with the treatment of this pathology. Car accidents, in particular, have been contributing toward the growth in the number of cases of odontoid fractures in recent years. These high energy traumas are associated with polytrauma, including upper cervical trauma. Among other trauma mechanisms associated with these fractures we can cite: firearm wounds, falls from great heights, falls from own height in older patients and sports or recreational traumatisms.[1,2]

The diagnosis of odontoid fracture is not always easily recognizable. This difficulty can be attributed to different causes: poor technical quality of the images obtained in the initial patient appointment, lack of experience of the orthopedic generalist or neurosurgeon in the investigation of the problem, absence of painful or neurological symptoms on the patient's part, difficulty in obtaining the assessment by a spinal specialist, shortage of qualified professionals, absence of adequate computed tomography in most services, patients presenting multiple trauma with lowering of consciousness and other systemic complications.[3,4]

The delay in odontoid fracture detection and in the establishment of its treatment can lead to countless complications, including: pseudarthrosis, delay in consolidation, chronic cervicalgia or cervicobrachialgia, neurological deficit, vicious consolidation and loss of cervical mobility.[5] These complications are sometimes much more difficult to treat than the initial fracture itself.[6,7]

Several treatments are proposed in the approach to this pathology.[8-10] The non-surgical treatments include: Minerva cast, halo cast, prolonged cranial traction with cranial halo or similar device, orthoses and cervical collars.[11,12] With regard to surgical treatment, there are various options: odontoid screw, cervical arthrodesis, with special emphasis on the C1-C2 arthrodeses by different techniques.[13-16]

This study is aimed at drawing the epidemiologic profile of patients with odontoid fractures treated at IOT-HCFMUSP during the period from 2004 to 2010 and identifying possible changes in this profile, in our environment.[1]It is also intended to compare and analyze data obtained from the medical records, such as classification of fractures, use or non-use of cranial halo, treatment employed (surgical or non-surgical) and fracture consolidation time, and to identify the main complications during its clinical evolution that could be associated with the way in which the cases are handled, evidencing a relationship with the initial characteristics of the fracture.

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

Orthopedics and Traumatology Institute of Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo.

Study conducted at LIM 41 – Musculoskeletal System Medical Investigation laboratory of the Department of Orthopedics and Traumatology of Faculdade de Medicina da Universidade de São Paulo.
Mailing address: Instituto de Ortopedia e Traumatologia do HC/FMUSP. Rua Ovídio Pires de Campos, 333, 8º andar.Cerqueira César, CEP 05403-010. São Paulo – SP, Brazil. Email: papontin@gmail.com

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CASUISTRY AND METHODS

The medical records of 20 patients seen and treated at IOT-HCFMUSP with diagnosis of odontoid fracture in the last 5 years were evaluated retrospectively.

These 20 patients had their fractures classified by the AO/Anderson and D´Alonzo methods.[17] (Figure 1)

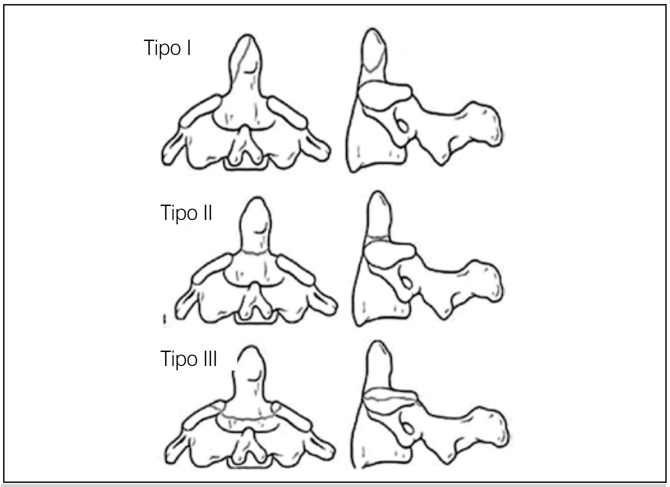

Figure 1. *Illustration of the Classification of Anderson and D'Alonzo.*[17]

The AO/Anderson-D´Alonzo classification was chosen due to its widespread use, with considerable scientific reproducibility, high degree of inter-observer concordance and good correlation between severity with clinical prognosis and conduct. In this classification Type I corresponds to avulsion fractures of the fractures-avulsions of the odontoid apex; Type II to fractures of the odontoid neck (Figures 2, 3 and 4); and Type III to fractures of the odontoid base that extend to the body.

The patients were analyzed according to: age bracket; sex; trauma mechanism; fracture classification; initial approach to lesion, including use or non-use of cranial halo; surgical or non-surgical definitive treatment (Figure 5); surgical route employed; fracture consolidation time; and the main complications (neurological deficit, pseudarthrosis, infection, vicious consolidation) during its clinical evolution.

In this study, the odontoid fracture was considered consolidated when the lateral view control X-ray showed good alignment of the bone fragments and absence of signs of distraction or excessive angulation between or among them.[18,19]

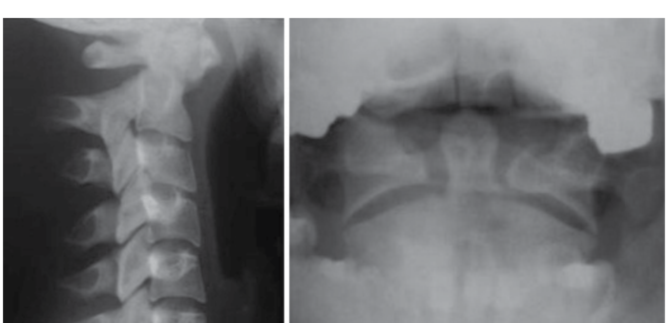

Figure 2. *Lateral and trans-oral x-ray of the neck in a patient with Type II odontoid fracture*.

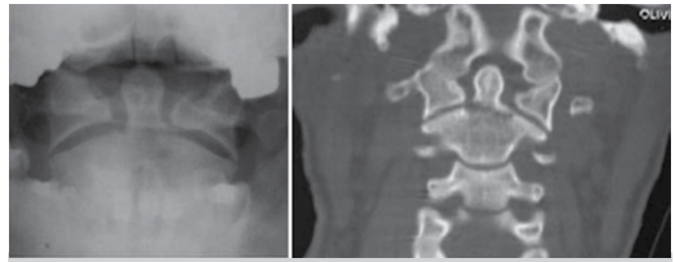

Figura 3. *Computed tomography with sagittal and coronal images of Type II odontoid fracture.*

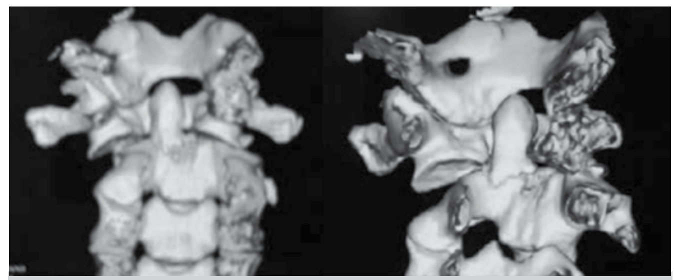

Figura 4. *Computed tomography with 3D reconstruction evidencing Type II odontoid fracture*.

Figura 5. *Lateral and Trans-oral X-ray of the neck after fixation with traction screw, by anterior approach.*

RESULTS

The study group was made up of 20 patients, with 16 (80%) male and four (20%) female patients, and the following distribution by age bracket represented in Table 1.

Table 1. *Stratification by age.*

Age	Number of patients (total 20)	%
< 10 years	1	5.0
11 – 30 years	5	25.0
31 – 40 years	7	35.0
41 – 60 years	5	25.0
> 60 years	2	10.0

The fracture classification presented the distribution shown in Table 2.

Table 2. *Classification of fractures.*

Odontoid Fractures	Number of patients (total 20)	%
Anderson and D'Alonzo type 2	11	55.0
Anderson and D'Alonzo type 3	8	40.0
Salter-Harris type 2	1	5.0

The most prevalent trauma mechanisms evidenced in decreasing order and their respective percentage are contained in Table 3.

Table 3. *Trauma Mechanism.*

Trauma Mechanism	Number of patients (total 20)	%
Fall from height	12	60
Car accident	5	25
Runover victims	3	15
Direct trauma	1	5

During the initial evaluation, following the ATLS and ASIA protocols,[20] 85% of the patients (17 cases/20 patients) did not exhibit neurological deficit upon physical examination. The remaining 15% (3 cases/20 patients), exhibited some sensory or motor alteration in the physical examination. The combined data on fracture type and presence of deficit were expressed in Table 4.

Table 4. *Neurological deficit in the initial physical exam by type of fracture.*

Fracture type	With deficit (% by fracture type)	Without deficit (% by fracture type)
Anderson and D'Alonzo type 2	2 (18%)	9 (82%)
Anderson and D'Alonzo type 3	1 (12.5%)	7 (87.5%)
Salter-Harris type 2	0	1(100%)

After the initial treatment, the decision was made to continue with the cervical collar in 12 patients (60%) and to fit the cranial halo in the remaining eight (40%). The combined data on the fracture type and use of cranial halo are described in Table 5.

Table 5. *Use of Cranial Halo in ER by fracture type.*

Fracture type	Cranial Halo (% by fracture type)	Cervical Collar (% by fracture type)
Anderson and D'Alonzo type 2	4 (36%)	7 (64%)
Anderson and D'Alonzo type 3	3 (37.5%)	5 (62.5%)
Salter-Harris type 2	1 (100%)	0

During the hospitalization period of these patients, the Spinal Group of IOT-HCFMUSP opted between surgical and non-surgical treatment according to the data contained in Table 6.

Table 6. *Treatment performed by fracture type.*

Fracture type	Non-surgical treatment (% by fracture type)	Surgical treatment (% by fracture type)
Anderson and D'Alonzo type 2	3 (27%)	8 (73%)
Anderson and D'Alonzo type 3	7 (87.5%)	1 (12.5%)
Salter-Harris type 2	1 (100%)	0

The option for the surgical approach employed discriminated by fracture type is contained in Table 7.

Table 7. *Surgical approach used by fracture type.*

Fracture type	Patients submitted anterior approach (% of total patients operated)	Patients submitted Posterior approach (% of total patients operated)
Anderson and D'Alonzo type 2	4 (44.5%)	4 (44.5%)
Anderson and D'Alonzo type 3	1 (11%)	0

The following results were obtained in relation to the consolidation time in combination with the fracture type, as shown in Table 8. The consolidation of the patient classified as Salter-Harris type 2 occurred in the period of approximately 12 weeks.

Table 8. *Consolidation time by fracture type (classification of Anderson and D'Alonzo)[17].*

Consolidation time	Type 2 (% by fracture type)	Type 3 (% by fracture type)
8 – 12 weeks	7 (70%)	2 (25%)
12 – 16 weeks	1 (10%)	2 (25%)
16 – 20 weeks	2 (20%)	2 (25%)
under consolidation	0	2 (25%)

The data on the consolidation time discriminated by treatment type can be found in Table 9.

Table 9. *Consolidation time by treatment type.*

Consolidation time	Surgical treatment (% by treatment type)	Non-surgical treatment (% by treatment type)
8 – 12 weeks	3 (37.5%)	0
12 – 16 weeks	4 (50%)	6 (54.5%)
16 – 20 weeks	1 (12.5%)	3 (27.3%)
under consolidation	0	2 (18.2)

The patients without neurological deficit (17 cases/20 patients - 85%), maintained the same pattern over the course of evolution. Among the three cases (15%) of patients with some initial neurological alteration, according to the Frankel scale[18], two patients presented complete recovery (Frankel E) after the final treatment was established and the other achieved partial improvement and continued with slight motor deficit (Frankel D). No patients were found with pseudarthrosis.

There were 2 cases of postoperative infection, in which successive surgical cleansing procedures and intravenous antibiotic therapy were sufficient for complete resolution of the situation, without implication in the consolidation or need for removal of the synthesis material. In one of the cases treated conservatively, classified as Anderson and D'Alonzo Type 2,[17] four weeks after the start of treatment it proved necessary to perform open reduction and surgical fixation (data included in patients operated through posterior approach), due to loss of fracture reduction during outpatient follow-up.

DISCUSSION

The epidemiological findings described previously corroborate the data of international literature. In the survey most of the patients were young adult males (4:1), with predominance of

patients from the 3rd to 5th decade of life (85% of the cases) and more rarely at the extremes of age.
The most prevalent trauma mechanism was fall from height. We also observed that higher-energy traumas predominated in the younger patients, while falling from own height was essentially the cause in the elderly. Car accidents represented the second most frequent cause, followed by run-overs.
According to the Classification of Anderson and D'Alonzo,[17] Type 2 (11 patients - 55% of the total), represented more than half the cases followed by Type 3 (eight patients - 40% of the total). There was one patient (5% of the total) with immature skeleton that suffered a fracture classified as Salter-Harris type 2. No Type 1 fractures, which usually have low frequency of occurrence, and that might not have been found due to the number of cases of this study, were found in this study.
Only a small percentage of patients were found with some neurological deficit (18% Type 2 and 12.5% Type 3) and all of them achieved some degree of improvement. In Type 2, both patients with neurological deficit achieved complete improvement and resumed their pre-injury activities, and in Type 3 the patient with Frankel E neurological deficit evolved with partial improvement to Frankel D. The low occurrence of this complication is expected in odontoid fractures.[6,19]
In Anderson and D'Alonzo Type 2 lesions, stabilization treatment with cranial halo was used in four of the 11 patients (36%). Surgical treatment was performed on eight patients (72% of the patients classified as Type 2), using anterior approach in four patients and posterior approach in the other four. The fact that half of the cases were operated by the anterior approach shows a greater current tendency to use the odontoid screw (traction screw). The extensive use of surgical treatment in this type of fracture can be explained by the instability intrinsic to odontoid neck fractures and by the greater incidence of complications of this type of fracture when treated conservatively in comparison to the other types.
In Type 3 lesions, use of the halo occurred in three of the eight patients with such lesion (37%), a reason very close to that evidenced in the patients with type 2 lesion, which to some extent was not expected, as this type of fracture generally presents minimum or no deviation[6,11]. The treatment of choice was, preponderantly, conservative established in seven of the eight cases (87.5%), through the use of the Philadelphia collar (one case) or Minerva-type plaster collar (six cases) during a 12-week period. There was one case submitted to surgical treatment by the anterior approach, whereas in Type 3 this conduct can be considered an exception. The consolidation time was longer than in the type 2 cases, since in four cases (50%) it occurred after 12 weeks.
As regards the consolidation time, it can be observed that the Type 2 fractures consolidated earlier (70% in up to 12 weeks) than the Type 3 fractures (only 25% in the same period). This significant difference may result from the greater use of surgical treatment in Type 2 cases, which suggests that this type of treatment shortens fracture consolidation time. Despite the risks inherent to the odontoid fracture, no cases of non-union were observed.
It is worth emphasizing that two patients with fractures classified as Anderson and D'Alonzo type 3 continued in outpatient follow-up, still without evidence of consolidation, and were at seven weeks and 12 weeks, respectively, post-injury.
The patient with Salter-Harris type 2 lesion was submitted to cranial halo use as initial treatment, which was replaced by immobilization with halo plaster cast after fracture reduction. This remained for the recommended period of 12 weeks, and the patient is evolving with complete consolidation of the fracture, not having presented neurological deficit.
This study is included in the continuous analysis periodically conducted by the Spinal Group of IOT-HCFMUSP of the medical care provided to its patients. Technical and implant material advances within spinal pathologies are fast and the constant review of the conducts employed and their consequences are of crucial importance for the preparation of protocols for better patient care.

CONCLUSION

The data analysis of this survey suggests that the surgical treatment of odontoid fractures is safe and presents reliable results as concerns neurological deficits, shortened consolidation time (particularly in cases of Type 2 fractures) and the optimal consolidation rate (no cases of pseudarthrosis were found).
The use of non-surgical treatment methods also proved efficient, but should be reserved for those cases that present contraindications to surgical treatment and preferentially in non-Type 2 cases.

REFERENCES

1. Barros Filho TEP, Oliveira RP, Silva JS, Kajitani ET. Fraturas do processo odontóide. Rev Bras Ortop. 1990;25:271-4.
2. Barros Filho TEP, Oliveira RP, Rodrigues NR, Greve JMA. Fraturas do processo odontóide em criança. Rev Bras Ortop. 1991;26:411-2.
3. NB Chutkan, AG King, MB Harris. Odontoid fractures: evaluation and management. J Am Acad Orthop Surg. 1997;5:199–204.
4. Dickson H, Engel S, Blum P, Jones RF. Odontoid fractures, systemic disease and conservative care. Aust N Z Surg. 1984;54:243-7.
5. Julien TD, Frankel B, Traynelis VC, Ryken TC. Evidence-based analysis of odontoid fracture management. Neurosurg Focus. 2000;15:e1.
6. Apuzzo ML, Heiden JS, Weiss MH, Ackerson TT, Harvey JP, Kurze T. Acute fractures of the odontoid process: an analysis of 45 cases. J Neurosurg. 1978;48:85-91.
7. Greene KA, Dickman CA, Marciano FF, Drabier JB, Hadley MN, Sonntag VK. Acute axis fractures. Analysis of management and outcome in 340 consecutive cases. Spine (Phila Pa 1976). 1997;22:1843-52.
8. Fujii E, Kobayashi K, Hirabayashi K. Treatment in fractures of odontoid process. Spine (Phila Pa 1976). 1988;13:604-9.
9. Kwon BK, Vaccaro AR, Grauer JR, Fisher CG, Dvorak MF. Subaxial cervical spine trauma. J Am Acad Orthop Surg. 2006;14:78-89.
10. An HS. Internal fixation of the cervical spine. Current indications and techniques. J Am Acad Orthop Surg. 1995; 3:194-206.
11. Wang GJ, Mabie KN, Whitehill R, Stamp WG. The nonsurgical management of odontoid fractures in adults. Spine (Phila Pa 1976). 1984;9:229-30.
12. Bono CM, The Halo Fixator. J Am Acad Orthop Surg. 2007;15:728-37.
13. Harms J, Melcher RP. Posterior C1-C2 fusion with polyaxial screw and rod fixation. Spine (Phila Pa 1976). 2001;26:2467-71.
14. Coyne TJ, Fehlings MG, Wallace MC, Bernstein M, Tator CH. C1-C2 posterior cervical fusion: long term evaluation of results and efficacy. Neurosurgery. 1995;37:688-93.
15. Agrillo A, Russo N, Marrota N, Delfine R. Treatment of remote type II axis fractures in the elderly: feasibility of anterior odontoid screw fixation. Neurosurgery. 2008;63:1145-50.
16. Aebi M, Etter C, Coscia M. Fractures of the odontoid process: treatment with anterior screw fixation. Spine (Phila Pa 1976). 1989;14:1065-70.
17. Anderson LD, D' Alonzo RT. Fractures of the odontoid process of the axis. J Bone Joint Surg Am. 1974;56:1663-74.
18. Frankel HL, Hancock DO, Hyslop G, Melzak J, Michaelis LS, Ungar GH. The value of postural reduction in the initial management of closed injury of the spine with paraplegia and tetraplegia. Paraplegia. 1969;7:179-92.
19. Clark CR, White AA. Fractures of the dens. A multicenter study. J Bone Joint Surg Am. 1985;67:1340-48.
20. ASIA. Standards for neurological classification of spinal injury. Chicago: American Spinal Injury Association; 1996.