TRAUMATIC ATLANTOAXIAL ROTATORY DISLOCATION IN THE PEDIATRIC POPULATION

LUXAÇÃO ROTACIONAL TRAUMÁTICA DE C1-C2 NA POPULAÇÃO PEDIÁTRICA

LUXACIÓN ROTATORIA TRAUMÁTICA DE C1-C2 EN POBLACIÓN PEDIÁTRICA

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ABSTRACT

Objective: The treatment of C1-C2 rotatory dislocation remains controversial and surgery is rare. Surgical treatment is indicated when the injury satisfies the instability criteria or when it cannot be reduced. The objective of this study is to analyze the principles and the adaptations necessary for treating these injuries in the pediatric population. Methods: A retrospective case series study. Three cases of patients diagnosed with traumatic C1-C2 rotatory dislocation and treated surgically in our hospital were studied. Through critical analysis of the available literature, a practical guide was proposed to establish the principles and competencies for the treatment of these injuries. Results: The operated cases were female patients between 8 and 16 years of age, with a diagnosis of traumatic atlantoaxial dislocation. Two patients required preoperative skeletal traction with halo. All patients underwent posterior instrumented arthrodesis, two with a transarticular screw technique and one with mass and C2 isthmic (Göel-Harms) screws. Conclusion:. It is essential to determine if the injury is stable and reducible. We recommend treating this type of injury keeping the criteria and competencies related to the stability, alignment, biology and function of the spine in mind. ***Level of evidence IV; Case series.***

Keywords: Rotatory; Torticollis; Atlas; Axis, Cervical Vertebra.

RESUMO

Objetivo: O tratamento da luxação rotacional de C1-C2 permanece controverso, e a cirurgia é rara. O tratamento cirúrgico é indicado quando a lesão satisfaz os critérios de instabilidade ou quando não pode ser reduzida. O objetivo deste estudo é analisar os princípios e a adequação necessários para tratar essas lesões na população pediátrica. *Métodos: Estudo retrospectivo de série de casos. Foram estudados três casos em pacientes tratados cirurgicamente em nosso hospital com diagnóstico de luxação rotacional traumática de C1-C2. Por meio de análise crítica da literatura disponível, foi proposto um guia prático para estabelecer os princípios e a adequação do tratamento dessas lesões. Resultados: Os casos submetidos à cirurgia foram pacientes do sexo feminino, entre 8 e 16 anos de idade, com diagnóstico de luxação atlantoaxial traumática. Duas pacientes precisaram de tração esquelética pré-operatória com halo. Todas as pacientes foram submetidas à artrodese instrumentada por via posterior, duas com técnica de parafuso transarticular e uma com parafusos de massa e pedículo e lâmina em C2 (técnica de Göel-Harms). Conclusões: É essencial determinar se a lesão é estável e se pode ser reduzida. Recomenda-se tratar esse tipo de lesão tendo em mente os critérios e a adequação relacionados com estabilidade, alinhamento, biologia e função da coluna vertebral.* ***Nível de evidência IV; Série de casos.***

Descritores: *Luxação; Torcicolo; Atlas; Vértebra Cervical Áxis.*

RESUMEN

Objetivo: El tratamiento de la luxación rotatoria de C1-C2 permanece controversial y la cirugía es rara. Se indica tratamiento quirúrgico cuándo la lesión cumple criterios de inestabilidad o cuándo es considerada irreductible. El objetivo de este estudio es revisar los principios y competencias necesarios para tratar esas lesiones en la población pediátrica. Métodos: Estudio retrospectivo de serie de casos. Se estudian tres casos en pacientes tratados quirúrgicamente en nuestro hospital con diagnóstico de luxación rotatoria de C1-C2 traumática. A través del análisis crítico de la literatura disponible se elabora un esquema práctico para establecer los principios y competencias para el abordaje de estas lesiones. Resultados: Los casos intervenidos fueron pacientes de sexo femenino entre 8 y 16 años, con diagnóstico de luxación atlantoaxoidea traumática. Dos pacientes requirieron tracción esquelética preoperatoria con halo. A todas las pacientes se les practicó artrodesis instrumentada por vía posterior, dos con técnica de tornillos transarticulares y una con tornillos de masa e ístmicos de C2 (Göel-Harms). Conclusiones: Resulta imprescindible determinar si la lesión es estable y reductible. Siempre abordar este tipo de lesiones teniendo presentes los criterios y competencias relacionados con la estabilidad, alineación, biología y función de la columna vertebral. ***Nivel de Evidencia IV; Serie de casos.***

Descriptores: *Luxaciones; Tortícolis; Atlas; Vértebra Cervical Axis.*

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INTRODUCTION

Traumatic atlantoaxial rotatory dislocation is a rare entity in the surgical management of the axial cervical spine in pediatric patients. Surgery is indicated when the injury is mechanically unstable or when time-related factors or joint blockage have made it irreducible.

In each institution, it is mandatory to protocolize therapeutic algorithms that contemplate non-invasive reduction and stabilization in ascending order, ranging from head/cervical sling traction, collar use, etc. to skeletal traction techniques and instrumented arthrodesis, and that can be adapted to the patient's condition and to the characteristics of the institution where the attending team conducts its activity and the experience and training of the surgeon in performing the technique.

Based on an analysis of three cases operated on at our institution, the objective of this review is to establish which principles and competencies must be considered by the surgeon undertaking the treatment of this pathology.

METHODS

A retrospective study was designed with a series of 3 cases of traumatic atlantoaxial rotatory dislocation operated on at the Hospital Provincial de Neuquén by the same surgical team, each with more than 2 years of follow-up. All the patients and parents signed the informed consent form for the study.

Case 1

Female patient, 8 years of age, (Figure 1) who came to the outpatient clinic with painless torticollis of 9 months of evolution, reporting a history of trauma in the pool at her home. A typical cock robin attitude, limited mobility, mainly for rotation, and the absence of neurological manifestations were observed.

Chronic rotatory C1C2 dislocation, Fielding type 2, with indemnity of the transverse ligament and plastic deformity of the left articular complex was diagnosed from the imaging studies.

Halo skeletal traction was performed in the first instance with the patient hospitalized for 10 days. Anatomical reduction of the joint was achieved, and stabilization was carried out by means of instrumented C1C2 arthrodesis using the transarticular screw technique (Magerl) and an autologous structural graft obtained from the iliac crest. Both an adequate occipitocervical hinge axis and proper consolidation of the arthrodesis were confirmed during follow-up.

Case 2

Female patient, 15 years of age, (Figure 2) who was admitted to the emergency service of our hospital following a traffic accident. The car was equipped with an anti-rollover mechanism and she was wearing her seat belt. The patient was admitted with mild TBI, without loss of consciousness, Glasgow 15, without neurological disorders and with the torticollis attitude with an absolute block of active or passive movement of the cervical spine.

From the imaging studies, a diagnosis of traumatic C1C2 rotatory dislocation, Fielding 4, with posterior dislocation of the left lateral mass, intra-articular fracture of the right lateral mass at the level of the C2 facet joint with avulsion fracture of the transverse ligament and indemnity of both vertebral arteries was made.

It was decided to perform skeletal traction for 1 week and, as no anatomical reduction of the components was obtained, she was admitted to the operating room and the following sequence was performed: reduction of the articular surfaces through interfacetary manipulation with osteotomy according to the technique described by Göel. This was followed by instrumented stabilization with C1 lateral mass screws (Göel Harms) and C2 isthmus screws.

Adequate clinical and radiological results were observed in long-term follow-up.

Case 3

The third case was of a 16-year-old female patient (Figure 3) who was admitted to Emergency Services following a motorcycle-automobile collision. She was polytraumatized with TBI and loss of consciousness, severe fracture of the lower jaw, fracture of the olecranon and a Fielding 1 rotatory dislocation with associated fracture of the left lateral mass and indemnity of the transverse ligament and vertebral arteries.

The patient spent 7 days in the intensive care unit of the hospital and completed a total of 20 days in a hospital room for lower jaw surgeries and osteosynthesis of the olecranon. Three months of rigid orthosis treatment were indicated, but in the 2-month follow-up assessment progressive and painless torticollis was reported. Surgical resolution by transarticular instrumentation was performed, with adequate clinical and radiological results.

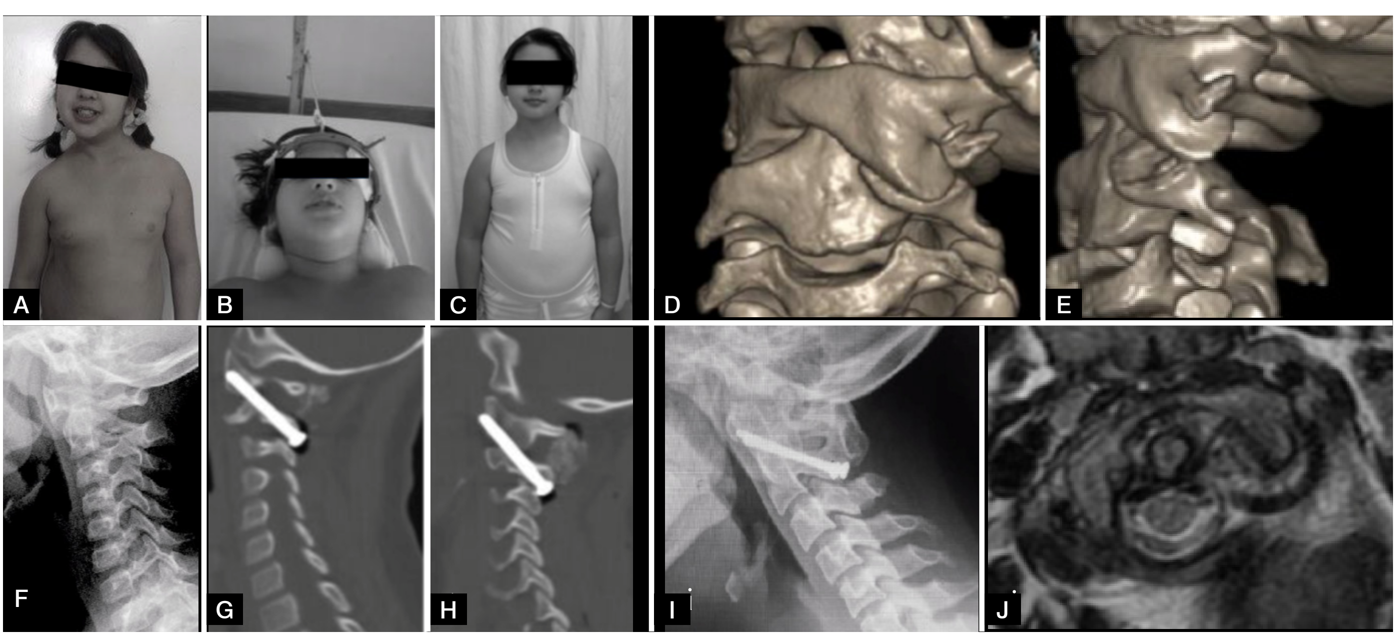

Figure 1. A: Cock robin attitude, B: Skeletal traction, C: Postsurgical clinical result, D: Tomographic reconstruction with facet joint deformity, E: Tomographic reconstruction with post traction reduction, F: Cervical spine X-ray with ADI 3 mm, G: Transarticular screw left isthmus, H: Transarticular screw right isthmus, I: Consolidated arthrodesis, J: MRI with indemnity of the transverse ligament.

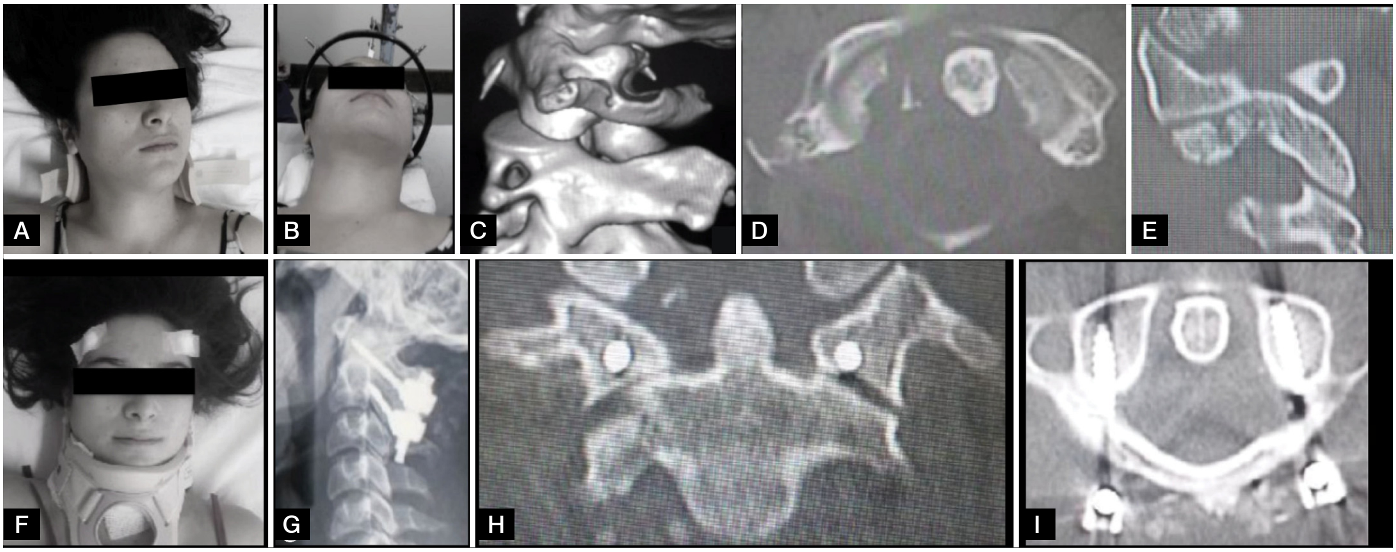

Figure 2. A: Clinical attitude, B: Skeletal traction, C: 3D tomographic reconstruction, D: Avulsion of the transverse ligament, E: Intraarticular fracture, F: Postsurgical clinical result, G: Postsurgical radiological result, H: Mass screw positioning, I: Axial rotation reduction.

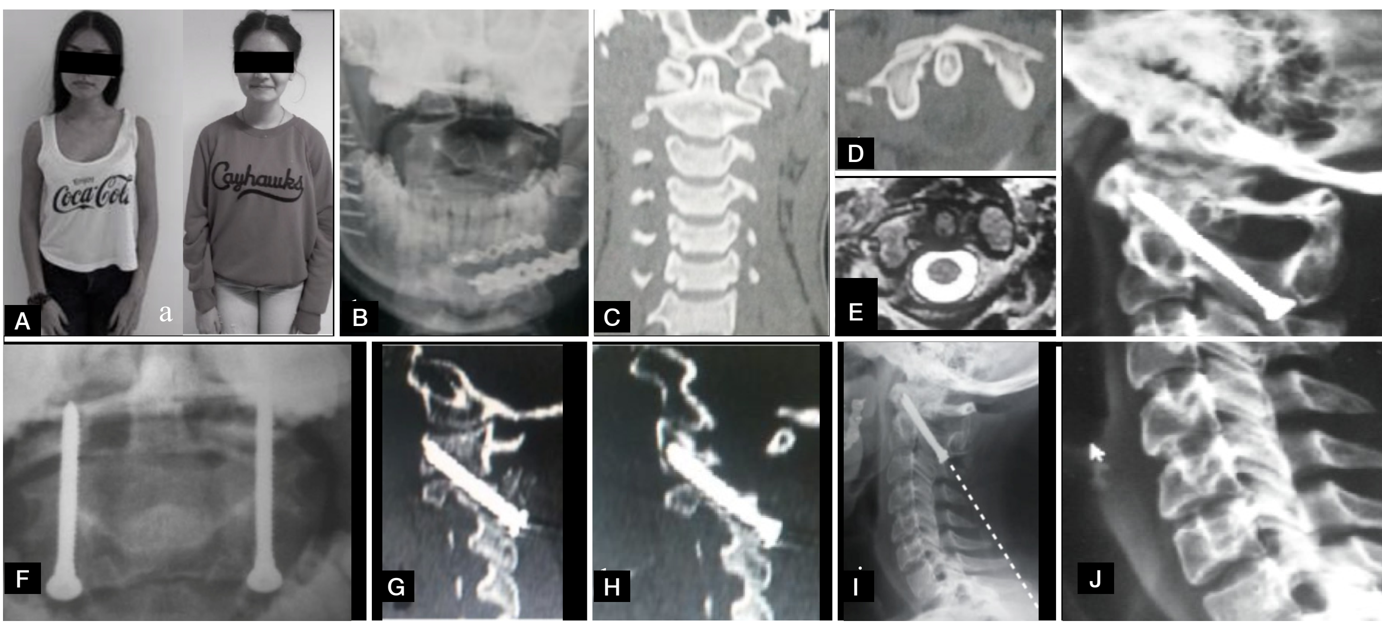

Figure 3. A: Pre- and postsurgical clinical photos, B: Transoral X-ray with enlarged left LADI, C: Coronal CT, D: Axial CT with rotation of the atlas, E: MRI with indemnity of the transverse lig., F: Transoral X-ray with Magerl-type instrumentation, G and H: Parasagittal CT cuts to see positioning of the screws, I: Dotted line marks the trajectory that must be kept in mind for the surgical field, J: Late postsurgical results.

DISCUSSION

Treating this type of injury is a challenge for the surgeon due to its low prevalence, the anatomy of the axial region of the cervical spine and the potential complications, associated mainly with injury of the vertebral artery.

The objective of this review is to recognize which principles and skills must be considered in the therapeutic approach. For this purpose, the main concepts that I consider important will be presented as questions that we pose to our team in the preoperative planning stage and the goal of accessing the current state of knowledge and important technical details in a useful and practical way will be pursued.

Stability: How do I define the need for intervention?

Most of the authors consulted agree that there are two variables that define the need to intervene in an atlantoaxial rotatory dislocation: instability and reducibility. As for the definition of instability, there are different classification schemes, (Figure 4) among which stand out that proposed by Fielding and Hawkings,[1] which contemplates the direction and quantification of the rotation of the atlas and predicts the impact of the ligament injury; that of Ishii, which measures inclination and interfacetary deformity; and that of Pang, which takes the time of the injury into account. In summary, it is necessary to consider that the instability of the injury increases the more time passes and the greater the displacement, angulation and facetary deformity that accompany the injury.

Different alternatives for reduction have been described, ranging from treatment with a collar and muscle relaxants to non-invasive sling traction to more invasive techniques such as skeletal traction or successive distraction with halo. On the other hand, direct reduction maneuvers with transoral manipulation and indirect manipulation with axial head traction and rotation have also been described. In accordance with the concept proposed by Göel[2], we consider an injury to be irreducible when some of these techniques have been implemented over the course of three weeks and reducibility has not been achieved.

What is the best stabilization method?

The atlantoaxial joint is the most moveable joint in the body, specialized particularly in head rotation. Thus, the selected instrumentation method must above all contemplate restricting this type of movement. There is consensus in the literature[3] that using screws to achieve segmental anchoring in the anterior and posterior spine of each vertebra is superior to hook or wire techniques.

On the other hand, Gallie-Brooks type[4] wiring techniques require prolonged rigid immobilization with a halo vest, and changes in the axis of the pediatric cervical spine have also been described after using these techniques.

In our institution, we use both screw techniques[5] as the first line choice before trying to use any hook or wire technique in the posterior spine. We prefer, in the first instance, to attempt transarticular instrumentation because it is less expensive, takes less time and causes less bleeding, which is beneficial from a biological perspective.

Alignment: What tools do we have available to restore the axis?

Anatomical reduction of the atlantoaxial joint is a prerequisite for its stabilization.[6] I have identified two stages in which alignment can be achieved: the preoperative stage, which consists of interventions ranging from the use of orthosis and muscle relaxants to the implementation of specific maneuvers or skeletal traction; and the intraoperative phase, which involves the positioning of the patient, intraoperative maneuvers and techniques for atlantoaxial manipulation, and possibly release maneuvers.

In our service, we use preoperative skeletal traction with halo (Figure 5) as a reduction action in acute posttraumatic injuries that meet mechanical instability criteria and in those that we consider irreducible.[7] In accordance with J. M. Vital's traction scheme, we use between 4 and 6 kg, but for never longer than 10 days, even though some authors advocate the need to attempt reduction over a period of up to three weeks. There are also transoral reduction maneuvers, but our team has no experience using them.

Once anesthetized, we position the patient (Figure 6) on the surgical table with a halo. We adapted a support system for this, considering that problems could arise during the procedure that require it to be aborted, making it necessary to complete the final treatment with a halo vest. This system may be adapted if intraoperative traction is required, an option which has not been necessary to date.

Once the patient is positioned, we observe the clinical alignment in the sagittal profile and the frontal and axial planes. We acquire an FTV image in which a clear profile of the cervical spine is visible.[8]

Regarding the intraoperative technical details that we consider when performing manipulation and C1C2 joint reduction maneuvers, we contemplate the following steps in sequential order: a. control of the C1 posterior arch, b. ascending compression of the C2 spinous process, c. interfacetary manipulation (Göel technique),[2,9] d. joystick, and e. cantilever. (Figure 7)

Function: How can we preserve the greatest number of mobile segments?

As regards this point, our team seeks to perform actions designed to protect structures that we consider vital to the stability of the axial cervical spine.

The first of these is to perform an osteotomy of the spinal apophysis, with the objective of preserving the muscle insertions of the main extensions of the cervical spine. We have to try to direct

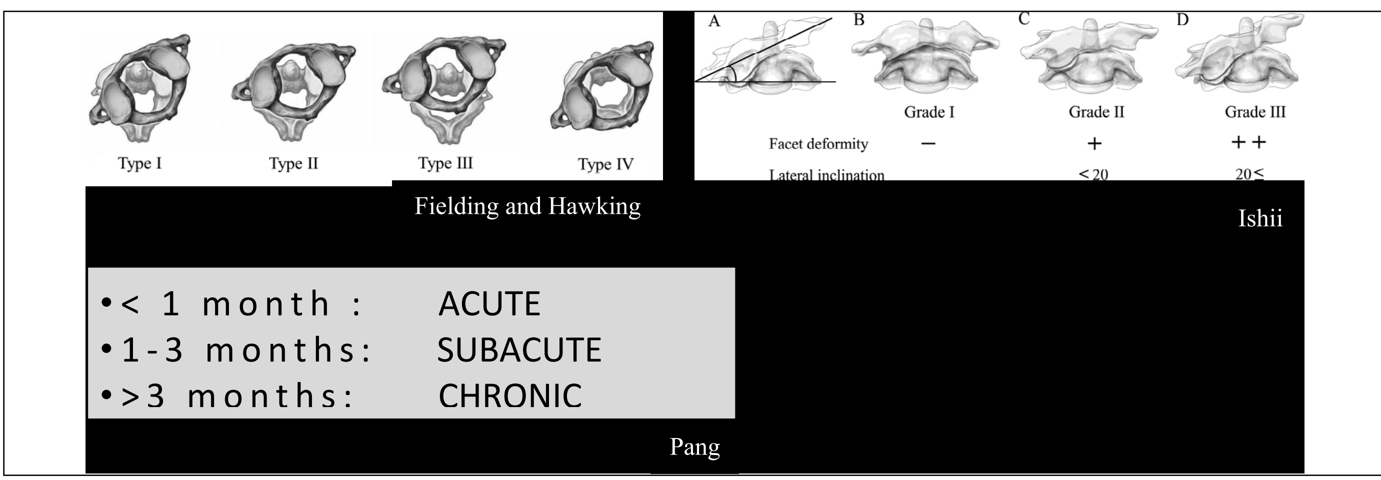

Figure 4. Classification systems.

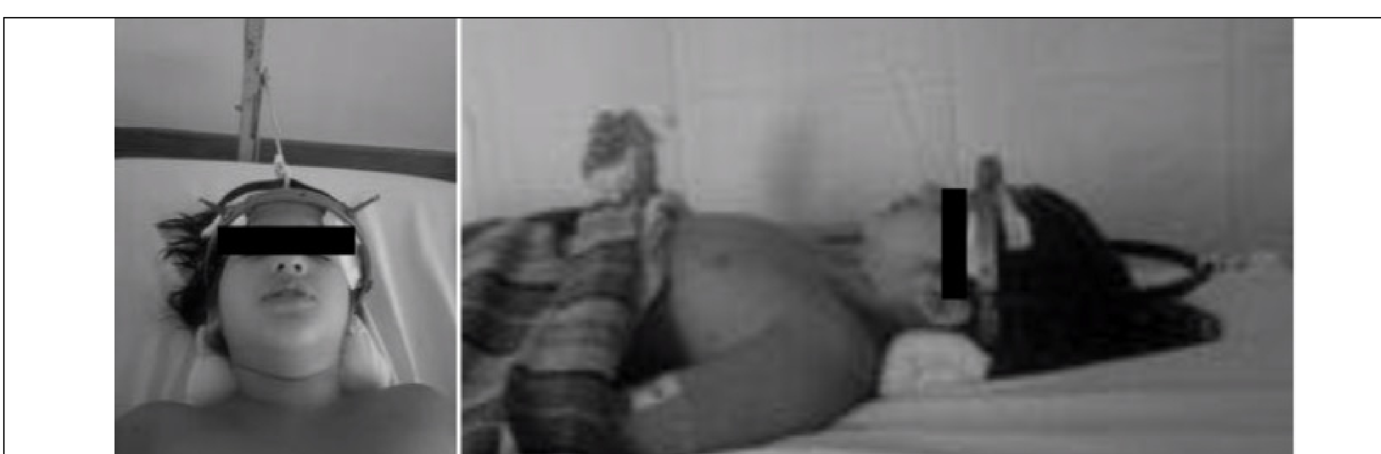

Figure 5. Skeletal traction with halo.

Figure 6. Halo support.

the saw in the oblique descending direction to facilitate the osteotomy technique and not to further damage the spinous apophysis.

We always try to avoid extending our arthrodesis to the occipital bone because of the comorbidity that it causes, and we are extremely careful in the dissection to avoid damaging the C2C3 joint capsule.

Biology: How to protect neurological and vascular structures?

With regard to protection of the neurological structures, care in the dissection of the C2 nerve, located posteriorly to the atlantoaxial joint, is emphasized. On certain occasions we consider resecting it, especially when working in the field of interfacetary manipulation. Our team always attempts to preserve it and we try not to use electrocauterization in the surrounding areas or we prevent the positioning of the shank of the mass screw from dropping into a very inferior location.

The main vital structure that must be considered in the work area is the vertebral artery. It must be studied in preoperative planning to determine whether it has been damaged or there are anatomical variants that could interfere with the instrumentation.[7]

There must be a scaled protocol at the institutional level that includes the mechanism of action that each surgeon must follow when confronted with a vertebral artery injury from hemostatic packing to endovascular intervention by the hemodynamic service.

CONCLUSION

The key to defining whether these types of injuries require surgical treatment is to determine if they are unstable or irreducible. Preferably, the use of instrumentation techniques with screws should be considered and the positioning and the reduction technique must be planned, always keeping in mind the possibility of injury to the vertebral artery.

All authors declare no potential conflict of interest related to this article.

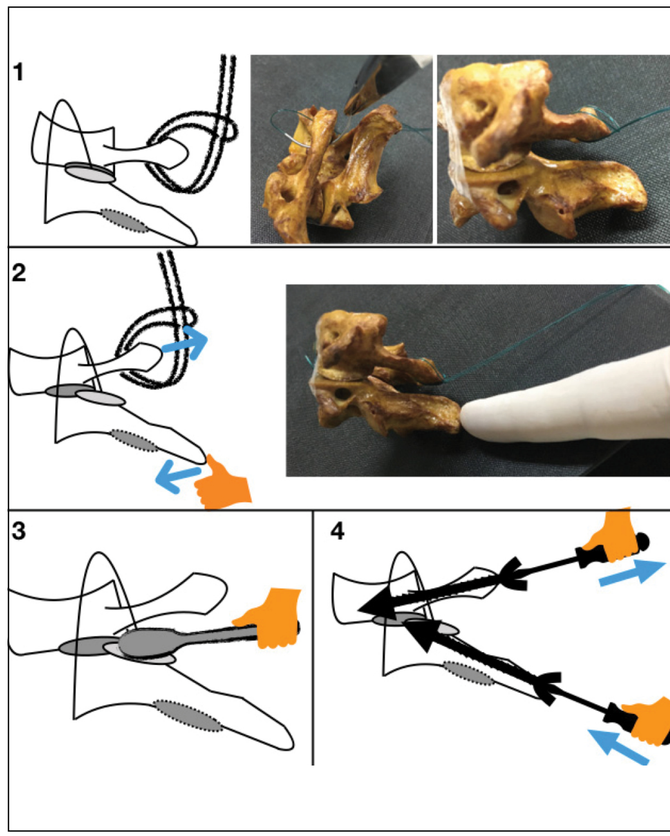

Figure 7. Technical details for reduction: 1. Control of the posterior arch of C1, 2. Ascending compression of the spinous process of C2, 3. Interfacetary manipulation, 4. Joystick.

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