

Direct Intraoperative Reduction of Basilar Invagination Associated with Atlantoaxial Subluxation – Technical Note

Redução intraoperatória direta da invaginação basilar associada a subluxação atlantoaxial – nota técnica

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Abstract

Keywords

- ▶ basilar invagination
- ▶ atlantoaxial subluxation
- ▶ technical note
- ▶ intraoperative reduction

Resumo

Palavras-chave

- ▶ invaginação basilar
- ▶ subluxação atlantoaxial
- ▶ nota técnica
- ▶ redução intraoperatória

In the present article, we describe a technique of direct intraoperative reduction of congenital atlantoaxial subluxation associated with severe basilar invagination and atlas assimilation. It consists of a wide dissection of the craniovertebral junction, exposing the region between the superior facet of C2 and the occiput (described as a “pseudoarticulation” by some authors). After exposure, a self-rotating small dissector or Kobe is used bilaterally, pushing C2 anteriorly and inferiorly, with reduction of the dislocation, followed by craniovertebral fixation. The technique is safe and eliminates the need for an anterior approach to the odontoid reduction, as well as the need to dissect the C1–2 joint.

Neste artigo, descrevemos a técnica de redução intraoperatória direta de subluxação atlantoaxial congênita associada a invaginação basilar grave e assimilação do atlas. Ela consiste em ampla dissecação da junção craniovertebral, expondo a região entre a face superior da C2 e o osso occipital (descrita como uma “pseudoarticulação” por alguns autores). Após exposição, um descolador pequeno ou Kobe é usado bilateralmente com rotação própria, deslocando C2 anterior e inferiormente, com redução da luxação, seguido de fixação craniovertebral. A técnica é segura e elimina a necessidade de uma abordagem anterior para a ressecção do odontóide, além de evitar a dissecação da junta C1–C2.

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Introduction

Basilar invagination (BI) is a primary developmental anomaly in which the spine is elevated and protruding relative to the base of the skull.¹ It is one of the most common congenital craniocervical malformations.²⁻⁶ It is defined when the apex of the odontoid process is at least 2.5 mm above the Chamberlain, although other thresholds were proposed, such as 5 mm.²⁻⁷

When symptomatic, BI may present with many clinical syndromes, isolated or combined, such as: cervical pain, cranial nerve syndromes, superficial and deep sensory syndromes, cerebellar symptoms, intracranial syndrome and hydrocephalus, bulbar symptoms, vertebrobasilar insufficiency, among others.⁸⁻¹²

The first publication on the surgical treatment of BI was made by Ebenius¹³ in 1934. Throughout the years, occipitocervical fixation techniques with external orthoses were initially proposed, followed by the use of autologous bone grafts (such as the fibular strut), and cables and wires for fixation and fusion²⁻⁶. More recently, screws, rods and plates have been employed with immediate stabilization and high fusion rates.¹⁴⁻²¹ However, until recently, anterior craniocervical compression required combined approaches, with anterior odontoidectomy due to anterior brainstem compression.

Goel²² revolutionized the treatment of BI with associated atlantoaxial dislocation²⁻⁶ using C1-2 fixation with an intra-articular spacer, when both anterior and posterior compressions were solved with craniocervical junction realignment.²²

In the present article, we present a direct intraoperative craniocervical realignment technique, with reduction of the anterior compression without the need of placing intra-articular cages and without preoperative cranial traction, as an alternative to treat this challenging malformation.

Case and Technical Description

We report the case of a 41-year-old male patient, with no comorbidities, who complained of decreasing muscle strength in his four limbs, cervical pain and paresthesia in the upper

limbs, which had progressed over the previous 4 years. The patient had no speech difficulties or swallowing disorders. He was able to walk without assistance, but with some difficulty.

A computed tomography (CT) scan revealed a clear BI with atlantoaxial dislocation. C1 was assimilated with the occipital condyles. The tip of the odontoid was 17.3 mm above the Chamberlain line. In addition, the patient had atlas assimilation (fused to the occipital condyles). Atlantoaxial subluxation was clearly evident. A magnetic resonance imaging (MRI) scan showed anterior brainstem compression by the tip of the odontoid, as well as C3-4 compression (►Fig. 1).

With the patient in prone position and with rigid fixation of the skull, with a neutral craniocervical alignment, the occipitocervical region was exposed, as well as the subaxial cervical spine. An occipital plate was fixed with screws at the occipital squama, as well as C2 laminar screws, C3 and C4 lateral masses screws. Decompression of the foramen magnum was performed to avoid further compression of the neural tissue during the realignment procedure; a C3-4 laminectomy was also performed. A Cobb instrument inserted between the “pseudointerjoint” formed between the superior pars of C2 and the occipital squama was rotated, pushing the axis anteriorly and inferiorly, reducing the subluxation and descending the tip of the odontoid (as shown in ►Fig. 2).

After reduction, in the new space formed between the axis and the occiput, a tricortical iliac graft was placed, and the occipitocervical stem was fixed, maintaining the reduction.

In ►Figs. 3 and 4 we present the radiological result. The clivus canal angle increased from 105.6° preoperatively to 123.1° after surgery. The tip of the dens above the Chamberlain line descended significantly. The patient was discharged at postoperative day 3 with tremendous improvement in his symptoms.

Discussion

The treatment of patients with congenital craniocervical junction malformation consists mainly of restoring the craniocervical alignment, fixing the instabilities when present, and decompressing the neural structures.²⁻⁶ Recently, modern

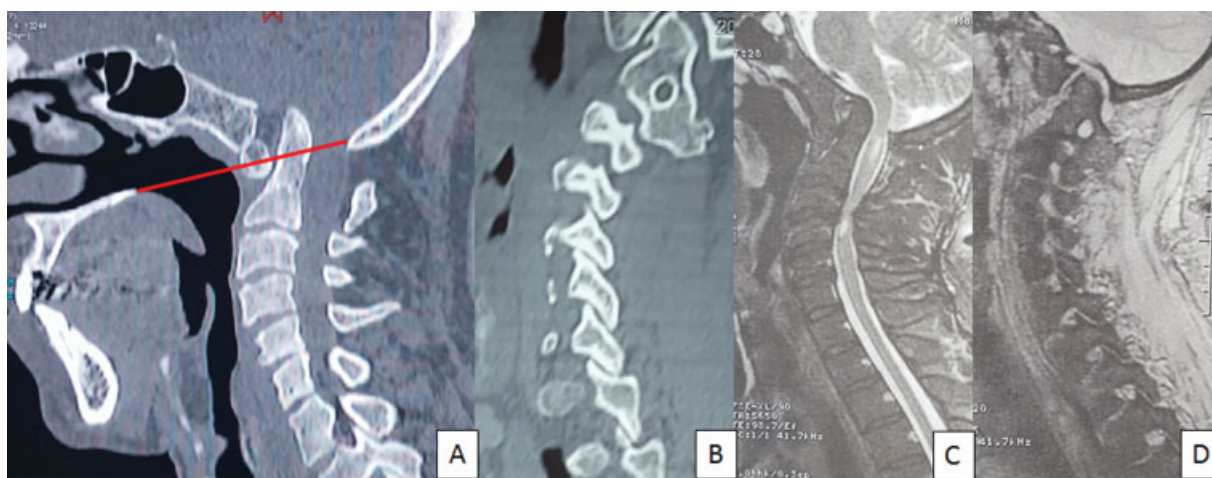


Fig. 1 (A) Sagittal CT scan showing the tip of the dens above the Chamberlain line (17.3 mm). (B) Sagittal CT scan with C1-2 facet joint subluxation. (C) Sagittal MRI showing anterior brainstem compression by the tip of the odontoid, as well as C3-4 cervical compression. (D) Sagittal MRI showing atlas assimilation and the C1-2 facet joint subluxation.

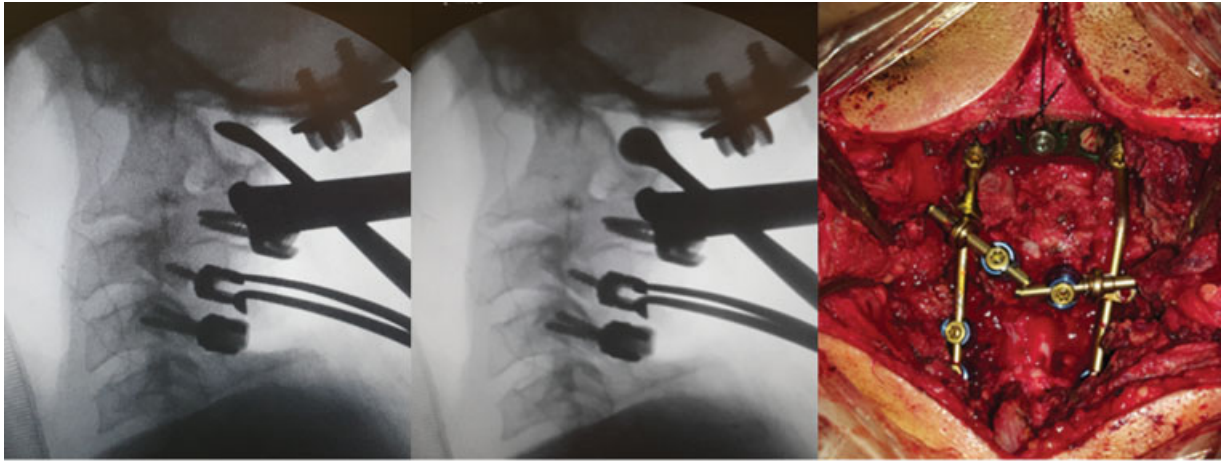


Fig. 2 (A) The Cobb instrument was inserted between the superior pars of C2 and the occipital squama. (B) We rotated the Cobb, dislocating C2 anteriorly and inferiorly. After that, we inserted in this new space a tricortical iliac crest graft and fixed the rods. (C) Intraoperative view of the construction.

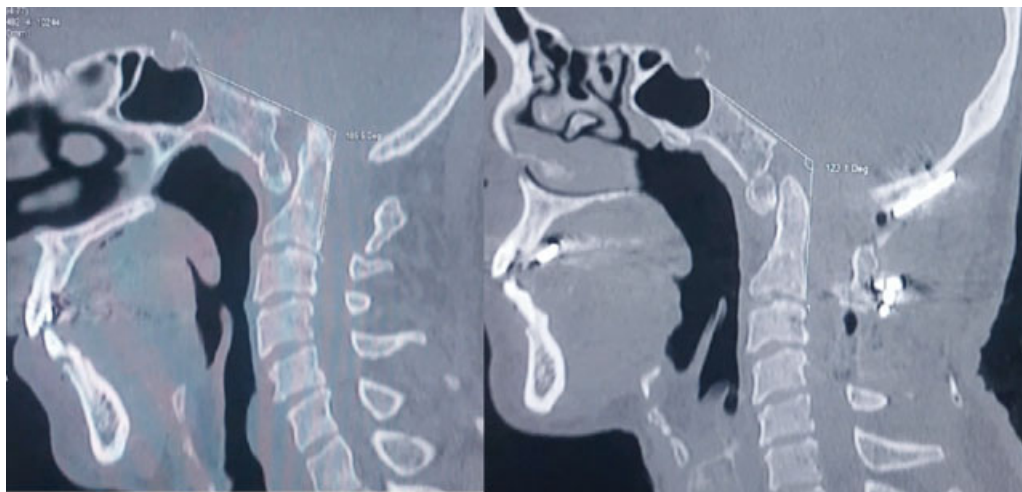


Fig. 3 Sagittal CT scan – preoperative (A), the clivus canal angel was 105.3° versus 123.1°, seen at (B).



Fig. 4 Sagittal CT scan – preoperatively (A); (B) postoperatively with the dens displaced downward and the posterior fossa decompression; (C) sagittal CT scan with the tricortical bone inserted between the space created between C2 and the occipital squama (arrow).

techniques of occipitocervical fixation enabled the treatment of these challenging diseases with an exclusive posterior approach, eliminating the need of an anterior approach (such as the transoral or endonasal endoscopies for resection of the odontoid),²³⁻²⁶

In the presence of atlantoaxial instability, realignment can be achieved with preoperative cranial traction, in which a prolonged decubitus is necessary, and there are risks of immobilization to the patient, as well as tremendous discomfort.²⁻⁶ Distraction of the C1-C2 joints with the placement of intra-articular spacers, which enables the realignment and eliminates the need of anterior surgery, is advocated, but it requires tremendous surgical skills and management of the vertebral artery, which usually has anomalies in these patients.²⁷ Other posterior techniques of craniocervical realignment, such as the one proposed by Chandra et al,²⁸ which consists of– distraction, compression, extension and reduction (DCER), are also effective, but they require a greater learning curve.

In this setting, our proposed technical note provides a relative safe and easy way to restore craniocervical realignment in BI associated with atlantoaxial subluxation. This maneuver may be incorporated into the arsenal of surgeons who handle these complex malformations.

Conflicts of interest

The authors have no conflicts of interest to disclose.

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