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Commentary Open Access

Surgical Management of Irreducible Atlantoaxial Dislocation

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Commentary

The classification and treatment of atlantoaxial dislocations (AAD) remains controversial. Despite existing debate among the literature, it is generally accepted that the treatment of symptomatic AAD should be surgical reduction and fixation. More recently, there has also been acknowledgement among treating surgeons that there are substantial differences between irreducible and reducible AAD, with significant differences between the two groups in terms of the severity of clinical presentation and ideal management [1]. Presently, however, there is little agreement on how best to manage IAAD. Specifically, the importance of anatomical reduction and the method of obtaining proper alignment surgically varies based on the treating surgeon and institution. The purpose of this commentary is to briefly discuss current options for the surgical management of IAAD.

The first goal in the treatment of IAAD is defining the irreducibility. Traditional methods include the use of dynamic imaging. Awake traction imaging has also been described by some authors. We prefer the technique described by Wang et al., which involved in-line traction with complete muscle curarization, or relaxation of the muscles surrounding the dislocation which allows the spine to straighten and the odontoid to distract from the foramen magnum (Figure 1) [1,2]. Traction is applied with gradually increasing weight for approximately ten minutes, and radiographic evaluations are made [2].

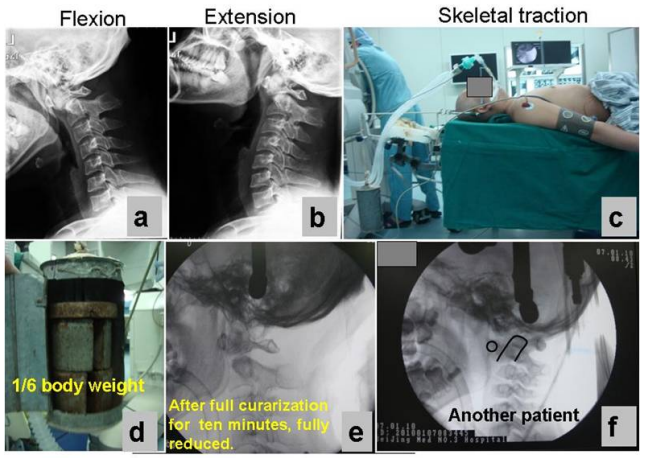

Figure 1: Skeletal traction test. Reprinted with permission from Dr. Chao Wang and Dr. Shenglin Wang.

Factors that have been considered over time in order to develop treatment algorithms include reducibility, cause of pathology, compression mechanics, and any presence of abnormal growths in the affected area [3,4]. Specifically, Menezes reported different treatment algorithms for ventral and dorsal decompressions with additional posterior fixation in the presence of instability following decompression [4]. Traditionally, IAAD has been treated with an initial anterior transoral decompression using an odontoidectomy followed by a posterior fusion [3-5]. Although this approach has been shown to avert future respiratory failure and worsening of neurological symptoms and reduce mortality, [6] there are clear and inherent risks associated with this approach, such as vertebral artery injury, kyphosis and swan neck deformity, degenerative disk disease, and subaxial subluxation, and high complication rates have been reported [7-9]. Transoral odontoidectomy is a high risk procedure that can lead to post-operative CSF leakage, meningitis, and death [10]. Additionally, posterior surgeries are difficult to perform on patients with C1 posterior arch deformities and congenital small pedicles [11]. Goel et al., have reported the successful employment of a direct posterior reduction without decompression in the case of fixed IAAD with os odontoideum or odontoid fracture [12]. In cases of locked atlantoaxial facet joints, Goel et al., directly resected the C-2 ganglion, opened up, manipulated, and distracted the atlantoaxial facet joints and then performed lateral mass fixation in order to achieve surgical realignment [13]. The same procedure has been performed in other instances of atlantoaxial dislocation and basilar invagination [13,14]. Goel et al., did, however, notice the restriction of range of neck motion as well as inflammation and numbness in some patients and concluded that there is a need for techniques that will avoid such complications [13,14]. Lateral mass fixation is associated with vertebral artery injury; Salunke et al., have outlined ways to attempt to prevent such injury, including identifying any anomalous course of the vertebral artery, avoiding monopolar cautery during dissection near the facets, and dissecting the normal C1-2 joint before widening the space around the anomalous vessel [15]. Other surgical techniques that have the potential to repair atlantoaxial dislocation in a more direct method with less complications are needed.

In 2005, a transoral atlantoaxial reduction plate, or TARP, was first used to repair basilar invagination with irreducible atlantoaxial dislocation [11]. The use of a TARP allows the relocation of the odontoid to be performed in one step without the need for a posterior operation [11]. Such a procedure could reduce complications that occur in a two-step method [11]. In May 2014, Xia et al., reported the results of the use of a TARP on 21 patients with basilar invagination [11]. 20 of the 21 patients achieved satisfactory results with varying relief of symptoms through an average follow up of twelve and a half months [11]. Limitations of this study by Xia et al., include its short follow-up period. Additional studies should be conducted to expand the length of follow-up to monitor the maintenance of relief of symptoms in the long-term. Furthermore, studies could be conducted in which patients who undergo TARP surgeries are compared directly

with patients who undergo an anterior transoral decompression and posterior fusion.

Another option for treatment is the performance of a transoral completely ligamentous release followed by posterior fixation (Figure 2). This technique was popularized by Wang et al. After traction, occipitalization of C1 is performed, in which the caudal half of the anterior ring of the atlas, joint capsules, and bilateral C1-C2 lateral joint cartilage are removed [2]. IAAD is considered reducible when it is possible to move the dens upward with a curette so that it reaches the C1 anterior arch [2]. Posterior reduction and fixation are then performed as they would be after traction for a reducible AAD [2]. According to Wang et al., other cases of IAAD involve patients with bony dislocation; in these instances, transoral odontoidectomy is necessary [2].

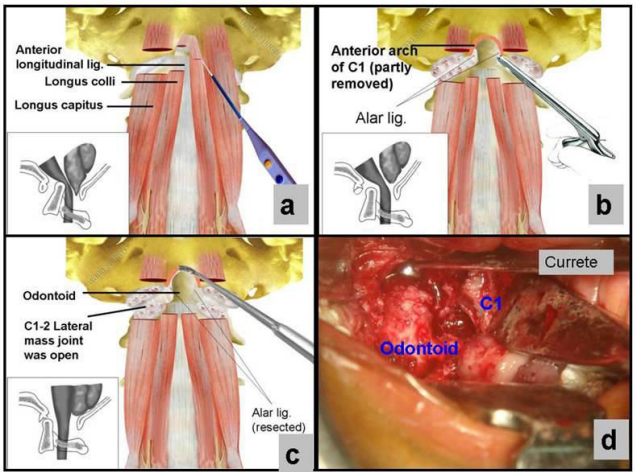

Figure 2: Transoral atlantoaxial joint release. Reprinted with permission from Dr. Chao Wang and Dr. Shenglin Wang.

An alternative to transoral odontoidectomy with subsequent posterior fusion is to replace the odontoidectomy with an endoscopic transcervical anterior release. Less invasive endoscopic transnasal and transcervical oidontoidectomies have been shown to be superior in some ways over the transoral technique [16] (Figure 3). However, Dasenbrock et al., reported in 2012 that out of fifteen patients who underwent endoscopic transcervical odontoidectomy, six experienced complications, including three accounts of CSF leak during surgery [17]. In May 2014, Hong et al., described benefits of an endoscopic transcervical anterior release prior to posterior fusion compared to a transoral approach, including less blood loss during surgery, less pain after surgery, and a short recovery time [16]. After performing the surgery, they reported relief of symptoms and no complications for 24 months [16]. Limitations of this study by Hong et al., include its lack of potential to successfully treat patients who are barrel-chested, obese, or have severe kyphosis [16]. Hong et al., did not directly compare patients who underwent endoscopic transcervical anterior release to patients who underwent endocopic transceverical odontoidectomy or transoral odointoidectomy. Furthermore, Hong et al., only performed this surgery on a single patient. A clinical trial with more patients is necessary.

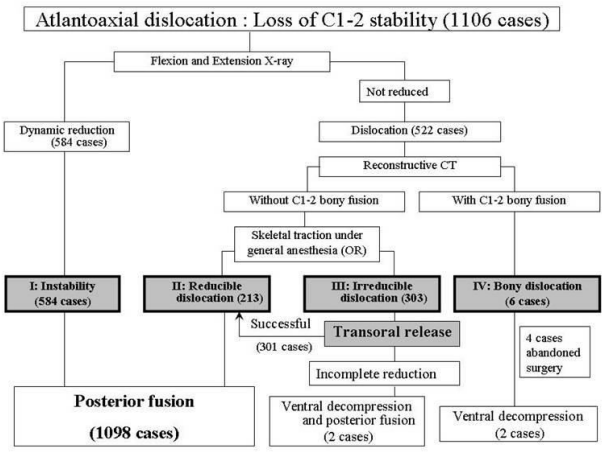

Figure 3: Surgical strategy for 1106 cases. Reprinted with permission from Dr. Chao Wang and Dr. Shenglin Wang.

Posterior treatments of IAAD include screw fixations such as C1 lateral mass screw-to-C2 pedicle screw fixation, C1 lateral mass screw-to-C2 laminar screw fixation, and C1-C2 transarticular screw fixation combined with an anterior oral transoral decompression [18]. O'Brien et al., reported the use of an open posterior reduction technique in which a rod is inserted into the C1 lateral mass and C2 translaminar screw heads [19]. Locking screws and rod holders are secured, and a distractor is used to move C2 forward and reduce C1-C2 subluxation [19]. Finally, locking screws are tightened [19].

Atlantoaxial dislocation can be treated with anterior transoral decompression or odontoidectomy and posterior fusion. However, the procedure is not suitable for all patients, and complications have been reported. There is a need for randomized clinical trials directly comparing the outcomes of anterior transoral odontoidectomy and posterior fusion with those of the TARP method. In addition, clinical trials should also be conducted that directly compare the results of an endoscopic transcervical anterior release to those of an endoscopic odontoidectomy.

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