C2 Translaminar Screw Fixation (Wright`s Technique) 
Applicability in Atlantoaxial Instability

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A instabilidade atlantoaxial possui múltiplas causas e muitas vezes requer tratamento cirúrgico. Várias técnicas estão disponíveis para realização da fixação atlantoaxial, todas elas com diferentes vantagens e desvantagens. Em 2004, Wright descreveu a técnica de fixação translaminar de C2, que oferece uma fixação rígida, porém sem a dificuldade técnica da colocação de parafusos na pars de C2 e com eliminação do risco de lesão da artéria vertebral. O objetivo deste estudo é revisar a técnica de fixação translaminar de C2, enfatizando detalhes técnicos, risco e benefícios em comparação com as outras técnicas de fixação atlantoaxial.

Palavras-chave: Coluna Vertebral; Articulação Atlantoaxial; Áxis; Fusão Vertebral: instrumentação.

ABSTRACT

Atlantoaxial instability often requires surgical treatment. Several techniques are available to perform atlantoaxial stabilization, and all of these have their different advantages and disadvantages. In 2004, Wright described the C2 translaminar screw fixation, which offers rigid fixation but without the technical demands of C2 pars placement and eliminates the risk of vertebral artery injury. The aim of this study is to review the C2 translaminar screw fixation technique, emphasizing operative details, risks and benefits comparing with the others atlantoaxial fixation techniques.

Key words: Cervical Vertebrae; Atlantoaxial Joint; Axis; Spinal Fusion: instrumentation.
INTRODUCTION

Atlantoaxial instability may be caused by traumatic, inflammatory, congenital, neoplastic, or degenerative disorders, and often requires surgical treatment. Several techniques are available to perform atlantoaxial stabilization, and all of these have their different advantages and disadvantages. Former techniques include wiring of posterior elements of the axis and atlas, such as the Gallie fusion and the Brooks-Jenkins fusion. These techniques allow safe fixation but require rigid external immobilization and have been associated with high fusion failure rates.

In the past two decades procedures for rigid screw fixation of C1-C2 were developed. These include posterior transarticular screw fixation (Margel’s technique) and fixation using C1 lateral mass screws and C2 pedicle screws (Harms/Goel’s technique). These procedures offer higher fusion rates and obviate the need of rigid immobilization but are technically demanding and entail increased risk of injury to the vertebral artery.

In 2004, Wright described the C2 translaminar screw fixation, which involves the insertion of bilateral screws into the laminae of C2 in a crossing fashion that are then connected to C1 lateral mass screws. This technique also offers rigid fixation but without the technical demands of C2 pars placement and eliminates the risk of vertebral artery injury.

The aim of this study is to review the C2 translaminar screw fixation technique, emphasizing operative details, risks and benefits comparing with the others atlantoaxial fixation techniques.

TECHNIQUE DESCRIPTION

The first description of C2 translaminar screw fixation (also known as intralaminar or crossing, bilateral C2 laminar screws) was published by Wright in 2004. In this article the author illustrates the technique of C2 translaminar screw fixation and report the initial experience in treating 10 patients with atlantoaxial instability caused by trauma, neoplasm, pseudarthrosis, and degenerative disease.

With the patient in prone position, the neck is maintained in the neutral position using the Mayfield head holder. Final positioning is performed using fluoroscopy to verify alignment of the atlantoaxial complex. Exposure of the posterior craniocervical junction and upper cervical spine is then performed in the usual manner, using subperiosteal dissection.

C1 posterior arch is exposed to the lateral aspect to visualize the bilateral lateral masses. The spinous process, laminae, and medial lateral masses of C2 are then exposed. The spinous processes, laminae, and lateral masses of the subaxial spine are exposed as needed. Where indicated, a braided cable was passed around the posterior arch of the atlas to aid in reduction.

C1 lateral mass screws are placed using Harms (or Goel) technique. The dorsal root ganglion of C2 is exposed and retracted inferiorly. This allows visualization of the junction of the C1 posterior arch and the midpoint of the inferoposterior part of the C1 lateral mass. This is the entry point for the screw and it is marked with a high-speed drill to prevent slippage. The pilot hole is drilled in a straight trajectory in an anteroposterior direction and parallel to the plane of the posterior arch of C1 in the sagittal direction, with the tip of the drill directed toward the anterior arch of C1. The hole is tapped, and an appropriate 3.5 × 22 mm polyaxial screw is inserted biconically into the lateral mass of C1. Bicortical screw is desirable, and caution with the internal carotid arteries in needed.

For fixation of C2, a high-speed drill was used to open a small cortical window at the junction of the C2 spinous process and lamina on one side, close to the rostral margin of the C2 lamina. With a hand drill, the contralateral lamina was carefully drilled to a depth of 30 mm, with the drill visually aligned along the angle of the exposed contralateral laminar surface. The angle of entry and direction of the drilling should match the slope of the lamina, usually angulating more dorsal than ventral to reduce the risk of canal entry and dural perforation. A small ball-probe was used to palpate the length of the hole to verify that no cortical breakthroughs into the spinal canal had occurred. A 4.0 30 mm polyaxial screw was then carefully inserted along the same trajectory.

In the final position, the screw head remained at the junction of the spinous process and lamina on one side with the length of the screw within the lamina of the other side. A small cortical window was then made at the junction of the spinous process and lamina of C2 on the other side, close to the caudal aspect of the lamina. With use of the same technique as above, a 4.0 30 mm screw was then placed into the other lamina, with the screw head remaining on the ipsilateral side of the spinous process.

In the sequence, rods are cut to size and inserted, connecting each C1 lateral mass screw to the ipsilaterally projecting screw head of the C2 laminar screws, thus fixing each C1 lateral mass to the contralateral C2 lamina. As the head of the screws are misaligned, polaxial screws are needed in this technique. For constructs incorporating the subaxial spine, C3 lateral
mass screws are connected to the ipsilaterally projecting screw head of the C2 laminar screws, fixing each C3 lateral mass to the contralateral C2 lamina. Arthrodesis is achieved putting bone graft into the C1-C2 joint.

**CASE ILLUSTRATION**

A 66-year-old man suffered a fall after syncope, followed by head trauma. He developed intense neck pain and inability to move the head. At physical examination, he did not exhibit neurological deficits (ASIA E). A computed tomography (CT) of cervical spine was performed (Fig. 1) and demonstrated axis fracture. Dorsal fusion of C1-C2 was accomplished according to the translaminar technique. The intraoperative image (Fig. 2), and postoperative CT scans (Fig. 3) and radiographs (Fig. 4) are demonstrated.

![Figure 1. Preoperative CT scan showing C2 complex fracture.](image)

![Figure 2. Intraoperative picture of posterior cervical approach after C1 lateral mass and C2 translaminar screws placement.](image)

![Figure 3. Position of the C2 translaminar screws at postoperative CT scan.](image)

![Figure 4. Postoperative x-ray showing C1-C2 stabilization.](image)

In the early postoperative course, x-rays and computed tomography images are indicated in order to confirm the position of the hardware.

**DISCUSSION**

Since the use of C2 translaminar screws was first reported, many studies have documented the anatomic, biomechanical, and clinical attributes of this technique.

Cassinelli et al. published in 2006 an anatomic study evaluating the applicability of C2 laminar screw placement in 420 C2 vertebrae of adult specimens. They noted that specimens had a laminar thickness 4.0 mm in 92.6% of cases and 3.5 mm in 96.7% of cases. The mean laminar thickness for all specimens was 5.77 ± 1.31 mm, with men having significantly thicker laminae than women. This study also showed that the avera-
A comparison of surgical morbidity and accuracy of translaminar versus pedicle screw fixation of C2 was published by Parker et al. The authors retrospectively reviewed the records of 167 consecutive patients who undergoing posterior cervical fusion with either pedicle or translaminar screw fixation of C2. In total, 152 C2-translaminar screws and 161 C2-pedicle screws were placed. In total, 11 (7%) pedicle screws breached the pedicle (0 requiring acute revision) versus only 2 (1.3%) translaminar screws that breached the C2 lamina (1 requiring acute revision). For subaxial constructs, screw pullout or pseudarthrosis was required in 4 (6.1%) patients with translaminar screws versus 0 (0%) patients with pedicle screws. For axial constructs, no cases of C2 translaminar or pedicle screws required reoperation or screw pullout or pseudarthrosis.

In the last year, we performed 5 surgical procedures using translaminar screws in C2. There were 3 cases of C2 complex fractures, one clival tumor requiring stabilization and one case of rheumatoid arthritis with C1-C2 instability. In four cases, fusion was limited to C1-C2, and in one case it was extended to the occiput: surgical procedure appeared to be safer and less demanding than other rigid techniques. The construct was a little demanding when the occiput was included, since connection to the rods may be somewhat difficult.

**CONCLUSION**

C1-C2 fusion techniques has been evolving, each technique having its inherent vantages and disadvantages. The technique described by Wright using C1 lateral mass screws and C2 translaminar screws is an excellent option, and seems to be simpler, safer and similar to the other screw techniques from the biomechanical point of view.

**REFERENCES**


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