Bilateral C1-C2 Claw for Atlantoaxial Instability

Atlantoaksiyel İstabilite için C1-C2 Pence Uygulaması

ABSTRACT

OBJECTIVE: Atlantoaxial stability can be achieved by laminar hook systems via posterior approach. This technique is much more safer than using screws. We presented our experience with the C1-C2 claw procedure.

METHODS and MATERIAL: Seven patients with atlantoaxial instability were operated by using C1 and C2 hooks, rods and transverse connector at Neurosurgery Clinic of Istanbul University Cerrahpasa Medical Faculty between the years 2005 and 2008.

RESULTS: Satisfactory stabilization was achieved in all patients. Operative complication or instrumentation failure was not observed.

CONCLUSIONS: C1-C2 claw is a safe technique and adequate stabilization is achieved with the use of a transverse connector.

KEYWORDS: Atlantoaxial instability, Claw systems, Transverse connector

ÖZ


BULGULAR: Tüm hastalarda yeterli stabilizaston sağlanmıştır. Cerrahi komplikasyon veya entrümantasyon problemleri olmasıdır.

SONUÇ: Atlantoaksiyal pence uygulaması güvenli bir tekniktir ve transvers konnektör kullanımı ile yeterli stabilizasyon sağlanmaktadır

ANAHTAR SÖZCÜKLER: Atlantoaksiyal instabilite, Kanca sistemleri, Transvers bağlayıcı

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INTRODUCTION

The atlantoaxial complex, bearing the weight of the head and the atlantoaxial joint, generates most of the rotation of the head and neck (14). In normal conditions this complex is very strong in spite of its high mobility. However, atlantoaxial instability generally needs to be fixed by surgical intervention in order to create a strong but immobile structure when it occurs.

Several posterior surgical approaches have been used to achieve atlantoaxial arthrodesis, such as the Gallie technique (1939), Brooks and Jenkins technique (1978), and interlaminar clamping (1982). In 1979, Magerl and Seemann reported the results of a posterior C1-C2 transarticular screw fixation technique (TAS) (2). Although the biomechanical superiority of transarticular screws over posterior wiring has been clearly established by numerous studies, the technique has several drawbacks. In this article, we present a modification of the old technique, where C1 and C2 hooks are interconnected with a transverse connector, thereby reinforcing the stability of the construct against rotational forces. We conclude that this construct provides adequate stability for fusion if the posterior elements are intact. We present 7 patients with atlantoaxial instability operated on by this technique.

PATIENTS and METHODS

Seven consecutive patients with upper cervical instability were treated between the years of 2005 and 2008 by the atlanto-axial claw procedure at the Neurosurgery Clinic of Istanbul University Cerrahpasa Medical Faculty. Details of the cases are listed on the (Table I). All patients were evaluated preoperatively with radiographs, computed tomography (CT), and magnetic resonance imaging.

Surgical Procedure:

All patients were positioned prone, with the head and cervical spine neutral on the horse-shoe head holder and/or Halo-West, if required. Exposure of the posterior upper cervical spine and craniometrical junction (C0-C3) was then accomplished in the usual manner. The posterior elements of C1 and C2 were cleared off from all soft tissues at least 15mm to each side of the midline. The insertion sites of hooks were prepared using a periosteal elevator. The dissection was extended to the ring of C1 and below the inferior border of lamina of C2 to accommodate the hooks. The grafting sites were decorticated using a high-speed drill. After these preparations, suitable hooks were inserted carefully and rods placed over them and then compressed bilaterally. A transverse connector was placed between the C1 and C2 hooks. The grafting sites were decorticated using a high-speed drill. After these preparations, suitable hooks were inserted carefully and rods placed over them and then compressed bilaterally. A transverse connector was placed between the C1 and C2 hooks. The grafting sites were decorticated using a high-speed drill. After these preparations, suitable hooks were inserted carefully and rods placed over them and then compressed bilaterally. A transverse connector was placed between the C1 and C2 hooks. The g

Table I: Details of the cases

<table>
<thead>
<tr>
<th>Patient</th>
<th>Cause of Instability</th>
<th>Preoperative Neurological Status</th>
<th>Complication</th>
<th>Follow-Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 / F</td>
<td>Dens Hypoplasia + atlantoaxial subluxation (minor trauma)</td>
<td>Frust paresis of right upper extremity</td>
<td>-</td>
<td>9 weeks no complaint</td>
</tr>
<tr>
<td>53 / F</td>
<td>C2 metastasis of Breast Cancer</td>
<td>Intact</td>
<td>-</td>
<td>4 months no complaint</td>
</tr>
<tr>
<td>16 / F</td>
<td>Atlantoaxial subluxation + type III odontoid frx* (road accident)</td>
<td>Intact</td>
<td>-</td>
<td>37 months no complaint</td>
</tr>
<tr>
<td>16 / M</td>
<td>Atlantoaxial subluxation (road accident)</td>
<td>Intact</td>
<td>Superficial skin infection</td>
<td>28 months no complaint</td>
</tr>
<tr>
<td>53 / M</td>
<td>Atlantoaxial subluxation + rheumatoid arthritis</td>
<td>Quadriparesis Upper: 2/5 Lower:2/5</td>
<td>-</td>
<td>42 months Self mobilization with one cane</td>
</tr>
<tr>
<td>60 / F</td>
<td>Atlantoaxial subluxation + rheumatoid arthritis</td>
<td>Quadriparesis Upper: 3/5 Lower:4/5</td>
<td>Transient Chest Pain</td>
<td>Operated 26 months ago, Last follow-up 12th month: no complaint</td>
</tr>
<tr>
<td>20 / M</td>
<td>Os odontoideum + atlantoaxial subluxation (road accident)</td>
<td>GCS**: 7/15 Multiple ICH</td>
<td>-</td>
<td>1 week GCS**: 12/15</td>
</tr>
</tbody>
</table>

*frx: fracture, **GCS: Glasgow coma scale
RESULTS

Satisfactory stabilization and reduction was achieved in all patients. There were no spinal cord injuries due to hook placement under the lamina. No peroperative or early postoperative instrumentation failure was observed.

DISCUSSION

Atlantoaxial fusion was first described by Mixter and Osgood (8) in 1910 using braided sutures. Gallie revised this technique using wire and bone graft. Brooks and Jenkins further described double graft compression between the lamina of the atlas and axis with a sublaminar wire. Grob and Magerl (9) introduced the transarticular technique, a technically difficult procedure, with the added risk of inadvertent injury to the vertebral artery not inherent in wiring techniques. The technique of atlantoaxial fusion through C1 lateral mass and C2 pedicle with screws, which was first described by Goel et al. (3,4,5,7) and then subsequently popularized by Harms and Melcher (10), reduced the risk of injury to the vertebral artery. Another modification of this crossed intralaminar fixation described by Wright (15) reduced the complications yet further.

Various surgical methods have been described for the surgical treatment of atlantoaxial instability since the 1939 Gallie technique with sublaminar wires. All the methods that used wires only did not succeed in overcoming the disadvantages. These techniques do not provide sufficient immobilization of the atlantoaxial complex, thus resulting in non-union rates up to 30% even with adjunctive halo vest immobilization (6). Increasing the number of wires would mean more manipulation within the spinal canal and therefore additional risk of neural tissue damage.

Screw fixation techniques were developed after wiring techniques. Biomechanically, transarticular screws are superior to wiring techniques (13). The transarticular screw fixation technique was first described by Magerl and Seemann in 1986 and led to significant improvements in fusion rates. This technique requires reduction of C1 on C2 before screw placement. Achieving the proper placement of the screws and avoiding injury to the vertebral artery are technically demanding procedures. Additionally, proper allowance of the drill whilst accessing the insertion point on C2 can be restricted in some cases by the patient’s osseous axial anatomy, e.g., pronounced thoracic kyphosis. Approximately 20% of patients requiring atlantoaxial fusion display anatomic variations in the course of the vertebral artery and in the osseous anatomy, at least on one side, precluding screw placement(1). To maximize the stability, the transarticular screw fixation has to be combined with either a Gallie or a Brooks’s fusion. This increases the risk of neural injury caused by the passage of wires or cables into the spinal canal. Transarticular fixation with combination of wiring therefore does not attenuate the neural damage risk and, on the contrary, the additional risk of vascular damage arises. However, excellent biomechanical stabilization is acquired making halo application is inessential and perfect union rates are

Figure 1: A. Preoperative lateral X-Ray of seventh patient. Obvious atlantoaxial instability seen. Please note that there is increased posterior atlantoaxial distance and anterior displacement of atlas and tip of odontoid process. B. Postoperative lateral X-Ray of same patient. Note that reduction is achieved.

Figure 2: A. Intraoperative picture of seventh patient showing construct that is done by C1 and C2 hooks interconnected by 2 rods and one transverse connector. B. Intraoperative picture of same patient after bone allograft are placed . We don’t use drainage tube after that stage.
achieved. The technique described by Goel et al. in which atlantoaxial fusion is attained through the use of C1 lateral mass and C2 pedicle with screws reduced the rate of injury to the vertebral artery, but the risk is still being present. Another advantage of this technique is that any additional wiring is not necessary, but malposition of the pedicle screws also carries a risk of neural damage and a case has been reported.

Posterior interlaminar clamps can be used if the C1-C2 laminas are intact. Without a transverse connector, laminar clamps biomechanically provide reliable stability with flexion and extension maneuvers. However, the clamps are not as effective as in any other technique involving posterior screws with or without wires in rotational motion. Halo immobilization for at least 3 months is also recommended with Halifax interlaminar systems (11).

A study by Harms et al. introduced the biomechanical properties of a novel C1 posterior locking plate applied with his own technique, while comparing it to the conventional C1 lateral mass to C2 pars screw fixation. This study concluded that the C1 locking plate technique functioned in an equivalent manner as the existing Harms technique. The C1 plate may be a viable alternative that is technically less demanding and possessing lower surgical risk. The system encloses only the posterior bony elements of atlas and axis. The interlocking plate behaves as a transverse connector (12).

We presented seven patients treated by C1-C2 claws interconnected by a transverse connector. This technique is superior to wiring techniques mainly because there is no need for a halo-vest application. All seven patients used a cervical collar after the surgery and the strength of the construct was adequate. The transverse connector reinforces the stability of the construct against rotational forces. The possibility of vertebral artery damage is nearly zero with this technique. The major disadvantage of this technique is the need for intact posterior bony elements.

CONCLUSION

Despite of our small patient population, we conclude that the bilateral C1-C2 claw system interconnected with a transverse connector is a safe, simple and an alternative method to achieve rigid and immediate atlantoaxial stabilization which can be executed without any risk of vertebral injury.

REFERENCES