Case Report

Case report: Minimally invasive modification of the Goel-Harms atlantoaxial fusion utilizing percutaneous screws and intra-articular cage is feasible and results in decreased blood loss

ABSTRACT

Treatment of atlantoaxial pathology is often associated with significant morbidity and mortality. While surgical techniques for fixation are well established, approaches that minimize blood loss and muscle dissection are advantageous for expediting recovering and minimizing surgical risk. We present a 34-year-old female who presented with a Type III odontoid fracture requiring surgical fixation. She underwent a C1-2 fusion employing a novel minimally invasive modification of the Goel-Harms atlantoaxial fusion using percutaneous screws and intra-articular cage.

Keywords: C1-2 fusion, cage, cervical, Harms technique, MIS, odontoid fractures, percutaneous

INTRODUCTION

Cervical spine injury is a common pathology encountered in the clinical setting accounting for approximately 3% of patients suffering blunt trauma.[1] Of these fractures, approximately 18% present as odontoid fractures.[2] In addition, in patients over the age of 65, odontoid fractures are the most common cervical spine fracture encountered in the setting of trauma. Failure to treat odontoid fractures in the elderly has been associated with significant morbidity and mortality.[3] The posterior C1-2 fusion with rod fixation, otherwise known as the Goel-Harms fusion, has been presented as a reliable method for fixating odontoid fractures.[4] Specifically, with a Goel-Harms fusion, the primary disadvantages are significant blood loss during dissection of the cervical venous plexus which places elderly patients at increased risk of perioperative complications.[5] We present the case of a modified Goel-Harms fusion using percutaneous screws and intra-articular cages to minimize intraoperative blood loss and neck dissection. Informed consent was obtained before surgical intervention, and the surgery was performed by a board-certified neurosurgeon with subspecialty training in spinal deformity.

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CASE REPORT

A 34-year-old female with significant past medical history for anemia and morbid obesity presented after a motor vehicle crash with no neurologic deficits. She was found to have a Type III odontoid fracture with minimal anterior displacement of the dens and no angulation. She was first treated conservatively with cervical orthosis but repeat cervical X-rays 3 days after her initial injury showed increased anterior displacement of the odontoid. Due to the progression of her fracture, it was felt that posterior fixation in the form of a

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C1-2 fusion would be necessary to ensure long-term fixation and fusion. Given the patient's anemia and morbid obesity, the decision was made to perform a modification of the Goel-Harms C1-2 fusion utilizing percutaneous screws and intra-articular cages.

The patient was placed in a Mayfield head holder and flipped into the prone position. Intraoperative computed tomography (CT) scan was then performed to establish 3D stereotactic navigation. Using image guidance, two lateral incisions were planned directly over C1 and C2 bilaterally. The C2 lateral masses were exposed, and percutaneous C2 pars screws (Spine Wave, Shelton, CT) were placed as previously described [Figure 1a].[4] A distractor was placed percutaneously under fluoroscopic guidance and intra-articular cages packed with DBX (Providence Medical Technology, Pleasanton, CA) were placed in the C1-2 facet joint bilaterally [Figure 1b]. Next, percutaneous C1 lateral mass screws were placed bilaterally and connected using cut rods to C2 [Figure 1b and c]. Estimated blood loss was 25 mL at the completion of the case. The patient did well and was discharged on postoperative day 1. Follow-up cervical X-rays at 6 months postoperatively showed stable alignment without adverse hardware features [Figure 2].

DISCUSSION

We present the novel use of a modified Goel-Harms posterior C1-2 fusion that utilizes lateral incisions for percutaneous screw and intra-articular cage placement. The advantages of this technique are three-fold: (1) minimizes blood loss by persevering the cervical venous plexus, (2) minimizes midline neck dissection to reduce postoperative pain and expedite recovery, and (3) preserves posterior tension band reducing the risk of future cervical deformity.

Numerous surgical approaches have been utilized to treat injury to the atlantoaxial spine which most commonly present as odontoid fractures. Historically, the two cornerstone surgical treatments have been the use of an anterior odontoid screw or posterior C1-2 fixation and fusion. Given that the majority of patients presenting with odontoid fractures are elderly, often an anterior odontoid screw is inhibitory due to the high risk of postoperative dysphagia and aspiration risk in this patient population.[3] For this reason, posterior C1-2 fusion is often utilized as the primary surgical treatment despite this method's significant limitations.

C1-2 cervical fusion offers exceptional fusion rates that approach 100%, making it, from a biomechanical standpoint, an ideal method for the fixation of odontoid fractures.[6] Despite high fusion rates, posterior C1-2 fusions are not without their drawbacks. Using traditional methods, extensive midline soft-tissue dissection is required to expose the required bony landmarks for placement of C1-2 hardware. This has shown to prolong recovery time due to increased postoperative pain levels.[7] In addition, disruption of the cervical venous plexus can often lead to significant blood loss which is suboptimal in the large majority of elderly patients presenting with odontoid fractures.[5]

Although previously challenging, modern advances in intraoperative navigation have made percutaneous placement of cervical hardware achievable without significant increased risk of injury to the vertebral artery.[8,9] In lieu of this, biomechanically sound fusion techniques such as the Goel-Harms fusion can be modified to further reduce some of the known disadvantages. By utilizing lateral incisions, the cervical venous plexus and midline soft-tissue dissection can be avoided completely. In the instance of this single case report, this resulted in significantly less blood loss than what would typically be expected in a posterior C1-2 fusion. Further studies are necessary to further evaluate the technical advantages and disadvantages of this methodology.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients

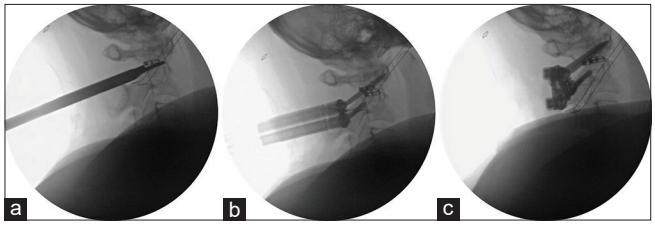

Figure 1: Intraoperative fluoroscopy demonstrating (a) placement of C2 pars screws followed by (b) placement of intra-articular cages and C2 lateral mass screws with (c) connection of the construct with rods

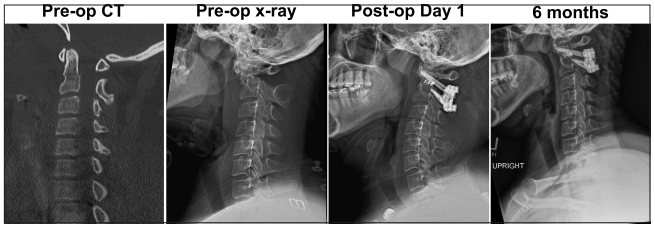

Figure 2: Preoperative computed tomography cervical spine and cervical upright X-rays with subsequent follow-up cervical X-rays

understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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