Case Report

Odontoid remodeling with occipital condyle stabilization in patients with metastatic C2 involvement

ABSTRACT

The occipitocervical junction (OCJ) is a complex anatomical region crucial for protecting the lower brain stem, upper spinal cord, and lower cranial nerves. Instability in this area can lead to severe outcomes such as chronic pain, neurological deficits, or death. Various surgical techniques have been developed for OCJ stabilization, particularly using occipital condyle screws, which have shown promise in providing stability and preserving neck rotation. This article presents two cases of OCJ instability caused by metastatic involvement of the C2 vertebra, managed successfully with occipital condyle screw fixation. The first case involved a 22-year-old female with Ewing sarcoma metastasis, and the second case involved a 62-year-old male with multiple myeloma. Both patients exhibited significant improvements in neurological function and cervical stability postoperatively, with observable den remodeling. Our findings suggest that occipital condyle screw fixation is not only feasible but also effective in managing OCJ instability due to metastatic disease. Detailed preoperative evaluation and the use of advanced intraoperative imaging technologies, such as the O-arm and neuronavigation, are essential for maximizing safety and ensuring optimal outcomes. This study underscores the potential of occipital condyle screw fixation as a primary surgical method for stabilizing the OCJ in appropriate cases.

Keywords: Condyle, odontoid, posterior, screw, stabilization

INTRODUCTION

The occipitocervical junction (OCJ) consists of the occiput, the atlas, and the axis. The instability of this complex anatomical site influences cervical alignment and leads to chronic pain, neurologic deficit, or death. Because this site protects the lower brain stem, upper spinal cord, and lower cranial nerves. Due to multiple axes of movement and limited available bone surface for fusion, many surgical approaches have been developed to achieve fixation at this site.[1,2] OCJ fusion is indicated for cases of craniocervical instability and some of the reasons that lead to instability are fracture, trauma, congenital deformity, rheumatic diseases, ligamentous laxity, tumor, and degeneration. Due to its close neighborhood and protection of vital organs, deformity, pain, cranial nerve dysfunction, progressive myelopathy, paralysis, respiratory dysfunction, or even sudden death can be seen after instability.

Correction and stabilization should be done carefully, and anatomical parameters should be determined exactly before the operation. While mostly occipital condyle stabilization is considered a rescue method in operations in this critical region, it has recently been used as the main stabilization location in some cases.[1,3] The use of rigid internal fixation is well characterized by this region's stability problems. Methods of fixation include plates and screws, rods and screws, and

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wire-based techniques. Modernization in spinal implant systems advances in intraoperative imaging technology, and integration of navigation have made it possible to instrument hard-to-reach areas that were considered unsuitable for implant anchoring. The condylar emissary vein foramen, the foramen magnum, and the superior articular facet of the atlas are identified as important cranial, medial, and caudal anatomical landmarks for identifying the entry point of the occipital condyle screw.[4]

Apart from its anatomical structure and the difficulty brought by its close neighborhood with vital organs, metastatic involvement also complicates the surgery. In this article, we wanted to report the results of occipital condyle stabilization in two cases with dense involvement due to Ewing's sarcoma and multiple myeloma and who developed secondary deformity/cord compression.

CASE REPORT

A 22-year-old female patient applied to our outpatient clinic with the complaint of severe neck pain. The patient had a history of surgery due to Ewing ca in the left thigh in 2012 and chemotherapy during follow-up. Then, the patient, who was found to have metastases in the lungs, was given radiotherapy treatment for that area. The patient, who was found to have bone metastases in positron emission tomography-computed tomography (CT) taken in 2020, was treated with radiotherapy to the sacrum and lumbar region in an external center. The patient was admitted to our clinic because of the detection of a lesion consistent with a metastatic mass that caused C_2 destruction and instability in the occipitocervical (OC) region in the last cervical magnetic resonance imaging (MRI). In her neurological examination, it was determined that the patient could not sit, stayed in the supine position, and could not move her neck, but no accompanying significant neurodeficiency was detected. In addition, the patient's reflexes were moderately increased in bilateral lower extremities. Condylar screw, C_1 mass screws, and C_{4-5} pedicle screws were placed in the prone position with the help of O-arm and neuronavigation. Tumor tissue up to lateral mass level at C_2 level was excised and sent to the laboratory for pathological examination. In the postoperative period, it was observed that the neck movements of the patient were relieved, and he was able to keep his head upright. In addition, in the early postoperative cervical CT, it was determined that dens remodeling started to occur and there was an improvement in cervical deformity [Figures 1 and 2].

A 62-year-old male patient applied to our outpatient clinic with the complaint of severe neck pain. The patient has neck pain for 1 year and complaints of numbness, pain, and inability to walk in the left hand and left foot for the past 1.5 months. It was observed that the patient, who was found to have spastic quadriparesis in the neurological examination, was able to walk with support. It was observed that the patient, who was found to have spastic quadriparesis in the neurological examination, was able to walk with support. In all spinal MRI and CT scans of the patient, infiltrative bone marrow signal changes, characterized by diffuse heterogeneous contrast enhancement after intravenous contrast material injection, were noted at the C_{1-4} level, which causes narrowing in the spinal canal together with the expansile characteristic destructing the vertebrae significantly and extending posteriorly together with the soft-tissue component. In addition, height loss was observed in the T_4, T_9, and T_{11} vertebral bodies, and the spinal axis secondary to this was disrupted. After the patient was placed in the prone position, the head was fixed with a CD and C_{2-4} total laminectomy was performed, the tumor tissue was partially resected and bilateral condyle screws and $C_{5,6}$ lateral mass screws were sent and scope control was performed. Thus, occiput-C_6 stabilization was performed. It was observed that the deformity improved and dens remodeling developed

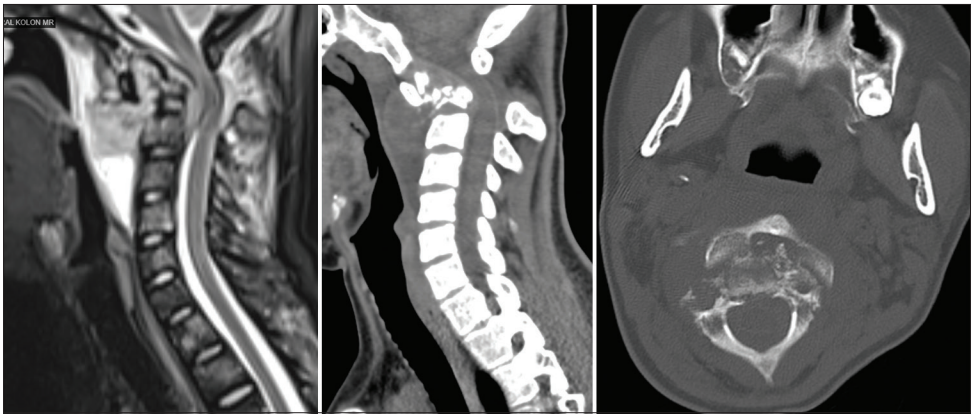


Figure 1: A 22-year-old female patient who had a lesion consistent with a metastatic mass that caused C2 destruction and instability in the occipitocervical region

in the postoperative period [Figures 3 and 4]. The patient was mobilized without support and a visible improvement was achieved in the neurological picture. After the patient's pathology was compatible with the involvement of multiple myeloma, the necessary follow-up and treatment were arranged by consulting the oncology clinic.

DISCUSSION

We discuss two novel cases of successful OC fusion with OC screws following posterior decompression and lower cervical stabilization for two patients with metastatic odontoid involvement, cervical deformity, and OCJ instability.

However, because of the technical challenges posed by the unique anatomy of this region spine surgeons have sought innovative techniques. Management of patients with OC instability can be challenging. The feasibility of OC fixation is largely determined by the bony spatial boundary and vertebral artery (VA) component.[5] It is possible to successfully treat and mechanically stabilize patients with OCJ anomalies secondary to any cause with this method. First described in 2008 by Uribe *et al*.,[6] occipital condyle screws have shown promise as an alternative surgical method to traditional techniques. After that, multiple studies have documented the feasibility of OC screw placement for OCJ stabilization. In addition, many morphometric studies have been conducted on the OCs to better understand optimal screw length and trajectory.[4,5] Furthermore, patients commonly present with significant neurologic deficits that may not be reversed even with optimal clinical management. However, the clinical results of OC screws, especially in cases with instability secondary to metastasis, data on postoperative follow-up are insufficient.

Our goal in instrumentation is to provide improved fusion rates and immediate stability, plus shorter rehabilitation times. Thus, potential complications are avoided. OC fusion is performed in cases of trauma, rheumatoid arthritis, congenital deformities, tumors, and degenerative disease. Results related to OC fusion secondary to Chiari malformation have been reported in the literature. Tong *et al*.[7] reduced this deformity by applying power on the CC complex-C2 pedicle screw, and none of the patients had implant failure with successful fusion. In the literature, there is no data on the condyle screw applied in oncological patients, and there is no data on clinical follow-up. It was noteworthy that both of our cases had metastatic involvement, improvement in their neurologic status after the operation, and good fusion rates by detecting dense remodeling. In addition, one of the important problems of patients after fusion surgery using the occipital plate, which is the classical surgical method that has been used for a long time in this region, is neck rotation movement. With this surgical method, the rotational movement of the patients is relatively preserved and indirectly contributes to the quality of life.

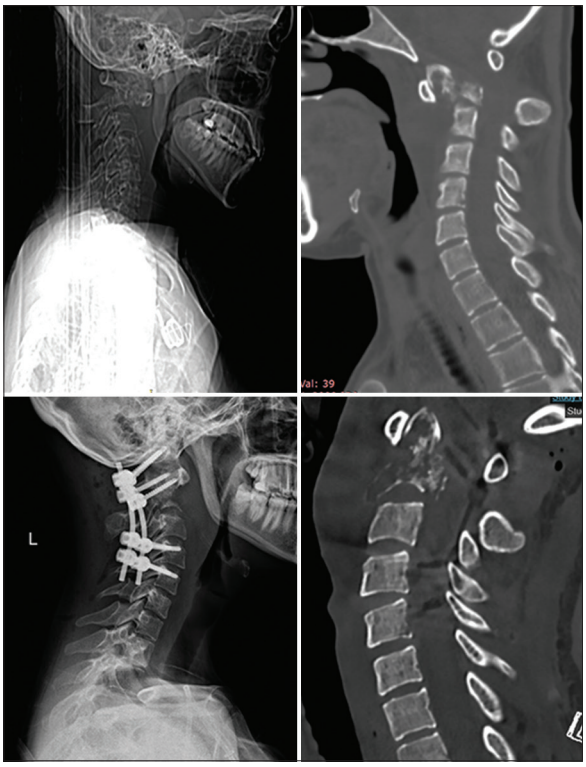


Figure 2: In the early postoperative cervical computed tomography, it was determined that dens remodeling started to occur and there was improvement in cervical deformity

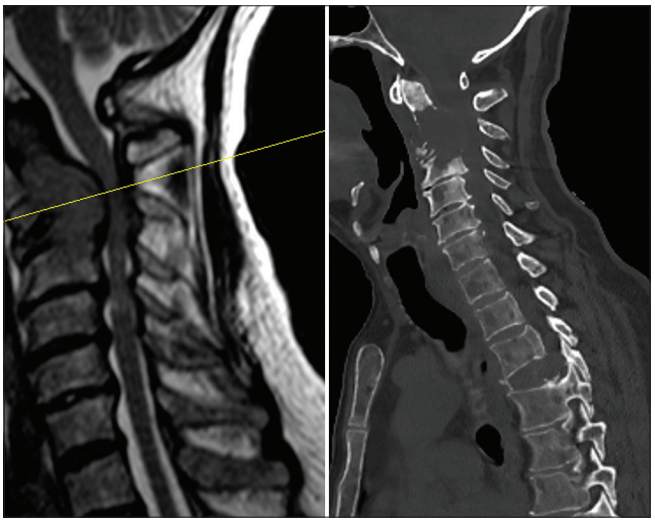


Figure 3: In the spinal magnetic resonance imaging and computed tomography scans of the patient, infiltrative bone marrow signal changes were noted at the C1-4 level. These changes are characterized by diffuse, heterogeneous contrast enhancement after injection of IV contrast

OC screw fixation can be dangerous in cases of a persistent first intersegmental artery where the VA courses abnormally

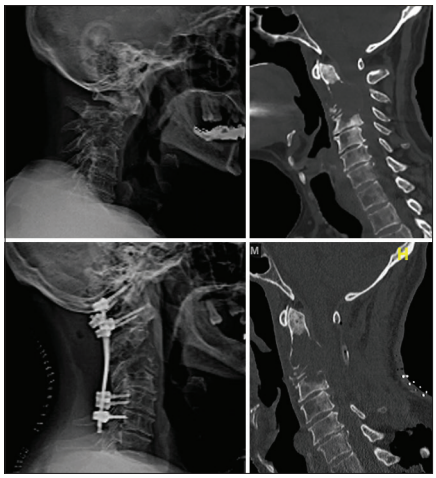


Figure 4: Occiput-C6 stabilization was performed. It was observed that the deformity improved, and dens remodeling developed in the postoperative period

below the C1 posterior arch. Based on this knowledge, a detailed preoperative investigation of the VA course should be undertaken before the screw fixation technique.[8] The use of real-time intraoperative navigation with an O-arm allows for screw size selection based on the patient's anatomy and the achievable angles. In addition to preoperative detailed evaluation in our own cases, we are trying to achieve maximal safety with the use of O-arm and neuronavigation. In addition to safe screw delivery, we also provide a decrease in screw malposition rates by performing peroperative control shots thanks to the O-arm.

As a result, condyle screwing can be chosen not only as a salvage method but also as the first preferred surgical method in stabilizing this critical and vital area in appropriate cases. It should not be forgotten that a detailed surgical anatomical evaluation is required before the operation.

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 understand that their names and initial s 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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