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Case Report:
Short Segment Rigid Fixation for a Patient of Basilar Invagination and Assimilated C1 With Quadriparesis

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ABSTRACT

Background & Importance: Atlas assimilation is the congenital Atlas fusion with the base of the occipital bone.

Case Presentation: A patient was presented with neck pain, dysaesthesia and tingling of hands and feet and difficulty in walking for 4 years. On examinations, the patient had a short neck with rigidity in neck muscles and there were exaggerated jerks with bilateral Babinski sign. Cervical spinal x-ray indicated basilar invagination with the absence of a C1 arch and CT scan of the cervical spine showed assimilation of C1 with basilar invagination. Occipitocervical stabilization has been commonly proposed for the operational fusion. The iliac crest interposing bone graft was performed for fusion and stabilization of the occipitocervical region. The patient was treated surgically and soon after operation became painless and was able to move easily.

Conclusion: In C1 assimilation with basilar invagination, bicortical occipital screws and C2 pedicle screws with interposition bone graft can be the way to optimize the shortest segmental stabilization and fusion procedure for occipitocervical fusion.

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Highlights

- Occipitocervical fusion operational decompression is recommended in atlantoaxial instability.
- The bone graft fusion in occipitocervical area made the patient pain-free with motor control grade 4.
- Bicortical occipital screws and C2 pedicle screws with bone graft result in fast stabilization and fusion.

Plain Language Summary

Assimilation by Atlas refers is defined as the congenital fusion of the Atlas with the occipital bone as its base. Occipitocervical fusion of operational decompression has been widely suggested for the patient in the present study. The patient was treated surgically. He was pain-free soon after surgery and able to walk freely with motor control grade 4. Fusion at the Craniocervical Junction (CCJ) leads to a major problem in movement in the cervical spine. Moreover, the inclusion of any segment of the subaxial spine will result in more loss. Hence, selecting the caudal degree of fusion is a very significant issue. In C1 assimilation with basilar invagination, bicortical occipital screws and C2 pedicle screws with interposition bone graft can be the way to optimize the shortest segmental stabilization and fusion procedure for occipital-cervical fusion. Bicortical occipital screws and C2 pedicle screws with interposition bone graft may be the way that optimizes the shortest segmental stabilization and fusion procedure for occipital-cervical fusion in C1 assimilation with basilar invagination.

1. Background and Importance

Atlanto-occipital failure of segmentation between the fourth occipital sclerotome and the first cervical sclerotome bring about atlanto-occipital non-segmentation/assimilation (also termed occipitalization of the Atlas) [1]. Occipitalization has been observed in 0.08% to 3% of the general population. It involves men and women, equally [2].

Frequently, in children up to four years old, according to reports, artilaginous clefs and open synchondrosis are observed in the osseous posterior arches. Real defects in the posterior arch were diagnosed only in patients who had more than four years of age [3]. Atlanto-occipital fusion diminishes the foramen magnum dimension and causes neurological problems because of the compression in the spinal cord [4]. The slow development of the fibrosis was the source of gradual spinal-cord compression with increasing symptoms [5]. The fusion of atlanto-occipital joints can also result in restricted neck movement [6]. Basilar invagination is an abnormality at the Craniocervical Junction (CCJ) either congenital or degenerative, where the odontoid tip is inside the foramen magnum with or without neurological symptoms [7].

C-2 posterior wiring is not as solid as the screw techniques [8]. The surgical procedure for fusion in patients with CCJ instability like posterior stabilization and correction, reduction, realignment of the deformity is complex [9, 10]. Concomitant Atlantoaxial instability in radiologic findings makes, operation is performed for decompression with occipitocervical fusion [2].

Anatomically, the C2 pedicle is a dense bony structure connecting the inferior articular facet of the Atlas to the C2 vertebra, and biomechanically it ensures a more robust fixation than C2 pars and laminar screws, as reported in some studies [11]. C2 pedicle screw placement is still technically challenging due to the varying location of the foramen transversarium [12], high-riding Vertebral Artery (VA) or medially positioned VA, in terms of VA injury pars screws (not reaching the pedicle) or laminar screws are of low risk [13].

Vertebral artery injury occurs from 2.6% to 4.1% in transarticular screws due to abnormal vertebral artery anatomy [14]. It has been observed that C2 pedicle screws have twice the pullout strength than those of C2 pars screws after cyclical loading [15]. Occipital plate fixed in the midline region and the bicortical screw at the occiput causes more rigid fixation than a plate fixed laterally and unicortically [16].

2. Case Presentation

A 45-year-old male, farmer, was presented with neck pain, dysaesthesia and tingling in hands and feet along with the difficulty in walking for 4 years. On examinations,

Figure 1. CT scan showing basilar invagination [white arrow] and assimilated C1 [red arrow]

the patient had a short neck with rigidity in neck muscles, Romberg's sign was positive, and there were exaggerated jerks in limbs with bilateral Babinski sign. Hoffman's sign was positive on both sides. Motor power grade 3 was seen in both upper and lower limbs. The patient was able to walk with support with an unsteady gait.

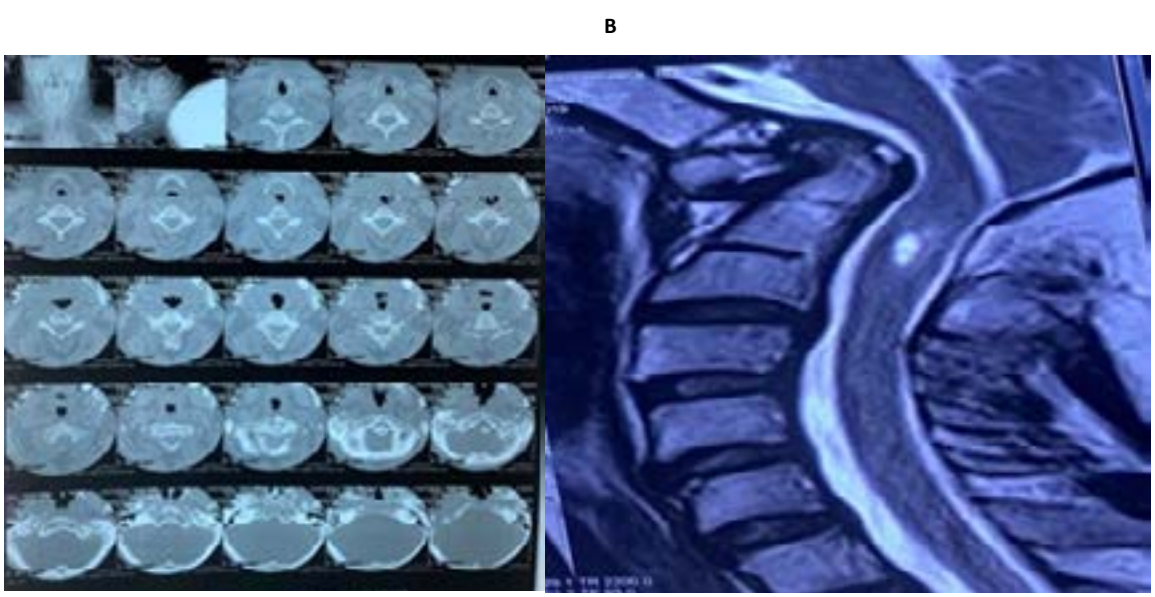
On investigation, cervical spinal x-ray revealed basilar invagination with the absence of a C1 arch. CT scan of the cervical spine (Figures 1 A and B) showed assimilated C1 with basilar invagination. Instability in a functional X-ray was noted at the craniocervical junction. MRI of the cervical spine (Figures 2 B) revealed basilar invagination with assimilated C1 and a signal change in T2 weighted image.

The patient was treated surgically. Reduction, iliac crest interposition bone graft for fusion and stabilization at occipito-cervical region was done (Figures 3 A, B, C, and D). Immediately after surgery, the patient was painfree and able to walk independently with motor power grade 4 in the limbs.

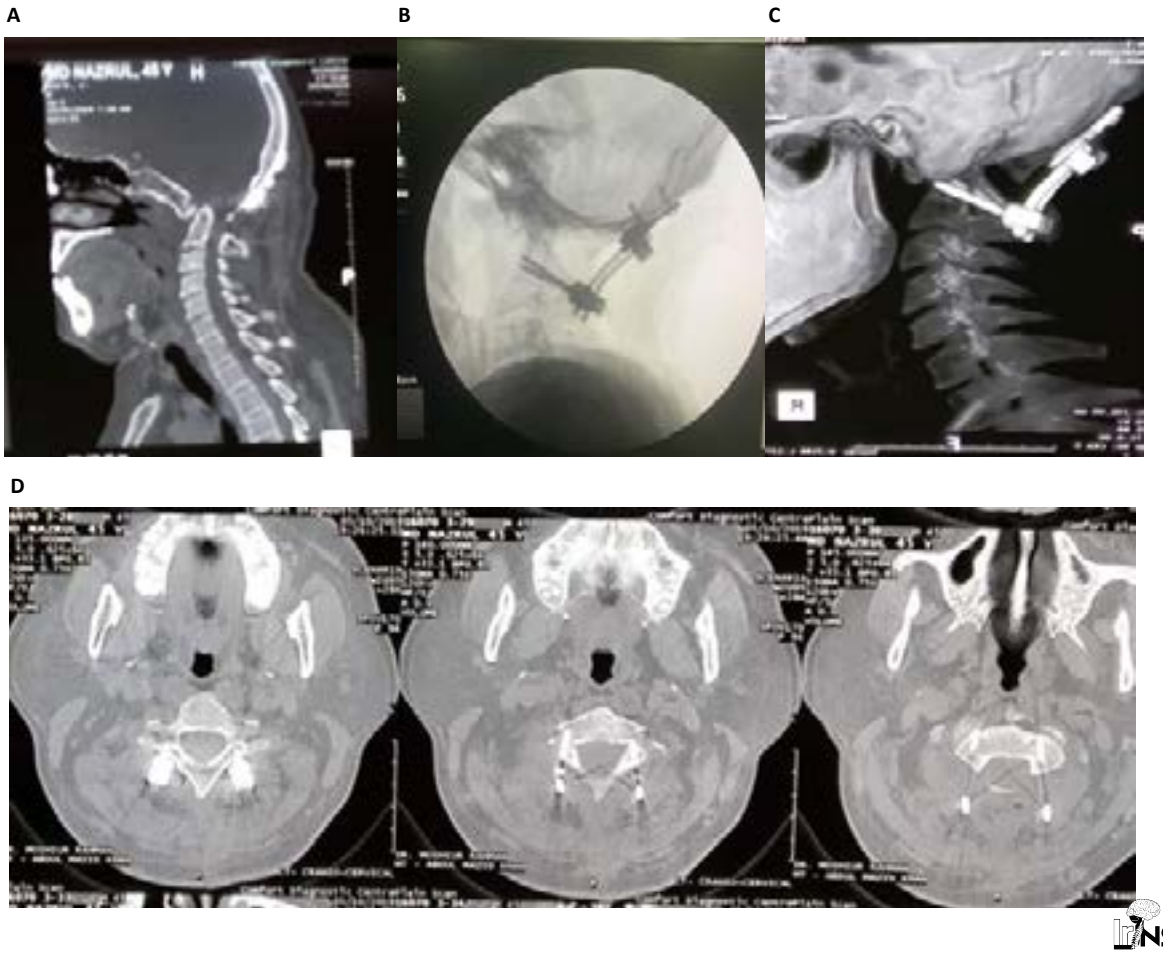
3. Discussion

Atlas assimilation is the term for congenital fusion of the Atlas with the base of the occipital bone [17]. Although atlanto-occipital assimilation (AOA) is often congenital, most of the cases do not show any symptom up to the second decade of their lives. This condition is thought to be due to the gradual increase in ligamentous laxity and the increase in the degree of instability with age [18]. Goel A. (2009) has elaborated on the manipulation of the dimensions of C1-C2, pinpointing the reduction of the basilar invagination and fixation of the atlantoaxial joint [19].

According to some authors, preoperative reduction and fixation with posterior decompression via a single-stage posterior approach should be considered first for



Figures 2. CT scan axial showing assimilated C1 [red arrow] and MRI T2 showing compression at CCJ [green arrow] with the hyper-intense lesion [white arrow]



Figures 3. CT scan showing transpedicular C2 screws [white arrows] and bicortical occipital screws [red arrows] and reduction of the odontoid tip [blue arrow]

treating patients with basilar invagination and craniocervical instability [20]. The pullout strength of occipital screws whether unicortical or bicortical is acceptable for craniocervical junction stabilization, and the strength is proportional to the thickness of the bone [21, 22].

The shape of the C2 pedicle and the course of the vertebral artery entering the C2 foramen transversarium varies, increasing the risk of damaging vertebral artery. In order to decrease the risk of arterial trauma, different techniques including intraoperative neuronavigation, thin-slice CT imaging, and CT angiography [23].

Fusion at the CCJ can bring about a major damage to motion in the cervical spine. Incorporation of each subaxial spine segment leads to extra loss of 10 degrees of movement per segment. Consequently, the caudal extent of fusion should be determined with precision [24]. The fusion rates in Atlantoaxial arthrodesis surgeries combining screw fixation and iliac crest interposition bone graft has been reported about 95%, making the operations highly prosperous [25].

4. Conclusion

A craniocervical junction is complex and assessment of the anomaly to minimize the morbidity is always crucial. Bicortical occipital screws and C2 pedicle screws with interposition bone graft may be the way that optimizes the shortest segmental stabilization and fusion procedure for occipito-cervical fusion in C1 assimilation with basilar invagination.

Ethical Considerations

Compliance with ethical guidelines

As the authors, we announce that written informed consent was received from the patients for publication of this research paper. We, hereby, declare that all experiments have been reviewed and approved by the appropriate ethics committee and have thus been carried out in accordance with the ethical standards set out in the 1964 Declaration of Helsinki. Written informed consent was taken from the patient. All procedures per-

formed in this study involving human participant were in accordance with the ethical standards of institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments.

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Authors contributions

All authors have contributed to designing, running, and writing of all sections of the study.

Conflict of interest

All authors declared no conflict of interest.

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