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# MRI Evaluation of CVJ Anomalies: Report of 7 Cases

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**Abstract:** Occipitocervical junction is an important area of the spine. This paper reports 7 cases of Craniovertebral Junction (CVJ) anomalies. The prime objective of the study was to provide a vision to the importance of MR imaging in early diagnosis of CVJ anomalies. The cases were diagnosed prospectively on 1.5 Tesla Siemens MRI machine in Department of Radiodiagnosis of our Institute. The anomalies were predominantly found in male patients. Increase in preodontoid space, spinal canal stenosis, spinal cord thinning, myelomalacic changes and basilar invagination in spinal cord were common findings in this case report. Whereas, basilar impression, Os odontoideum, C1-C2 block vertebra, single condylus tertius were less common findings. With the widespread availability of radiation free Magnetic Resonance Imaging (MRI), early and accurate diagnosis of CVJ anomalies is possible.
**Keywords:** Anomalies, Basilar invagination, Condylus tertius, Cranoivertebral, Os odontoideum, Preodontoid space.

## INTRODUCTION

The CVJ refers to the occiput, atlas, axis and their supporting ligaments enclosing the soft tissue structures of medulla, spinal cord and lower cranial nerves [1]. Various anomalies are associated with CVJ causing severe neurological deficit. This sector is relatively unexplored and it requires attention as it provides an early diagnosis of CVJ anomalies through radiation free MR imaging.

## CASE REPORT

MRI was done on 1.5 Tesla Siemens Avanto MR machine on patients referred from Orthopaedic and Neurosurgery Departments between January to July 2013. T1W, T2W sequences of cervical spine were taken. Additional FLAIR and STIR images were taken. Computed Tomography (CT) images were taken to show bony abnormalities. CVJ anomalies were found in 7 patients. All ethical statements were met with consent from the responsible committee of the Institute. The Craniometric measurements are presented in Table 1 [1-3] and in Fig. 1-4. The age range varied from 15 to 67 years in this case report. The clinical presentation and MRI findings of the patients are listed in Table 2 and Table 3 respectively.

**Table 1: Craniometric measurements**

| Eponym | Parameters | Pathology |
|---|---|---|
| Chamberlain line | Extends from hard palate to posterior margin of basiocciput | Protrusion of dens >6.3 mm above line is seen in Basilar invagination, Basilar impression and Platybasia |
| Wackenheim clivus baseline | Tangent drawn along superior surface of clivus | Odontoid process should be below this line |
| Clivus–canal angle Angle | Angle formed by Wackenheim clivus baseline and line drawn along the posterior surface of axis and odontoid process. This line should fall tangent to the posterior aspect of the tip of the odontoid process | Normal range is 150° in flexion and 180° in extension. Ventral spinal cord compression can occur when angle is <150° |
| Welcher basal angle | Intersection of nasion-tuberculum line and tuberculum-basion line | Normal range is 125°-140°; platybasia occurs when basal angle is >140° |
| Preodontoid space | Distance between anterior arch of atlas and | Atlantoaxial instability occurs when |

| | | |
|---|---|---|
| | odontoid process of axis | distance is > 3mm in adults and >5 mm in children |

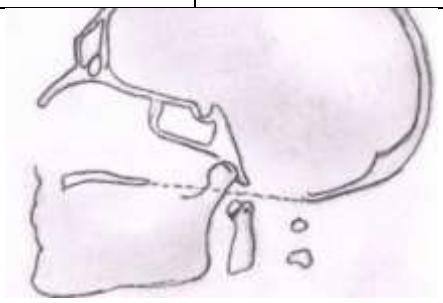


**Fig. 1: Chamberlain line**

**Fig. 2: Wackenheim clivus baseline**

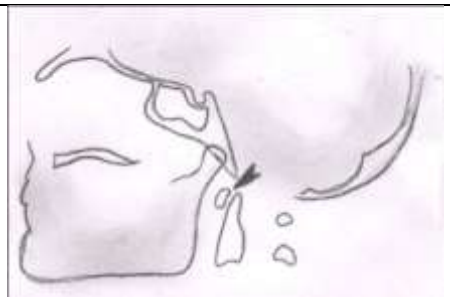


**Fig. 3: Welcher angle**

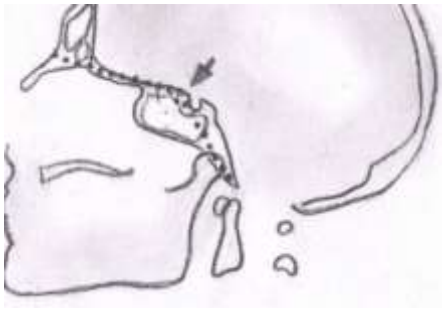


**Fig. 4: Preodontoid space**

**Table 2: Clinical findings**

| Case number | Gender | Age (years) | Complaints | Clinical findings |
|---|---|---|---|---|
| 1 | Male | 18 | Neck pain | No sensory or motor deficit |
| 2 | Male | 67 | Weakness in all four limbs | Quadriplegia (motor + sensory) with bladder involvement |
| 3 | Female | 45 | Low backache radiating to bilateral lower limbs | No sensory or motor deficit |
| 4 | Male | 15 | Weakness in all four limbs, not able to hold stools since 1 year | Quadriparesis: sensory + motor involvement |
| 5 | Male | 27 | Back pain, generalized weakness | No significant sensory or motor deficit |
| 6 | Female | 50 | Neck pain, generalized weakness | No significant sensory or motor deficit |
| 7 | Male | 35 | Weakness in all four limbs | Quadriparesis :sensory + motor involvement |

**Table 3: MRI findings**

| Abnormality | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 | Case 7 |
|---|---|---|---|---|---|---|---|
| Chamberlain line violated | √ | √ | | | | √ | √ |
| Preodontoid distance > 5 mm | | √ | √ | √ | √ | √ | √ |
| Clivus canal angle < 150 degrees | √ | √ | √ | √ | | √ | √ |
| Welcher basal angle > 140 degrees | | | | | | | |
| Os odontoideum | √ | | | | | | |
| Condylus tertius | | | √ | √ | | | |
| C1-C2Block vertebra | √ | | | | | | |
| C2-C3 Block vertebra | | | | | | √ | |
| Basilar invagination | √ | | | | | √ | √ |
| Basilar impression | | √ | | | | | |
| Atlantooccipital accimilation | | | | | | | √ |
| Atlantoaxial Instability | | √ | √ | √ | √ | √ | √ |
| Spinal canal stenosis at CVJ | √ | √ | √ | √ | √ | √ | √ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Spinal cord thinning | | √ | √ | √ | √ | √ | |
| Melomalacic changes in spinal cord | | √ | √ | | √ | √ | |

**DISCUSSION**

There was predominance of male patients in CVJ anomalies. Our case report shows that CVJ anomalies can be present in any age. This is because clinical manifestations are often delayed in CVJ anomalies [4].

Two cases showed features of Condylus Tertius (Fig.5). The basiooccput derived from fusion of occipital sclerotomes forms lower portion of clivus. Here hypochordal bow of fourth occipital sclerotome persists or proatlas fails to integrate. An ossifled remnant may be present at distal end of clivus known as condylus tertius [1]. Though in our case it was typically single but multiple supranumerary ossicles may be present [2]. This third condyle may form a joint or pseudojoint with the odontoid process or with anterior arch of first cervical vertebra leading to limitation in motion at CVJ. So, in both cases preodontoid distance was > 5 mm and Clivus canal angle < 150 degrees causing ventral spinal cord compression leading to spinal cord thinning with myelomalasic changes in one case [5].

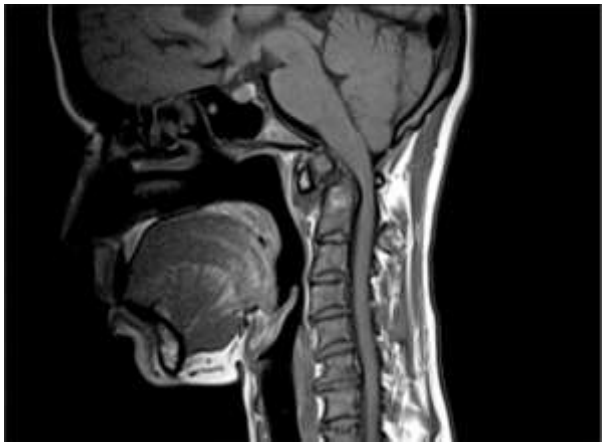


**Fig. 5: The T1W MRI images shows increase in anteroposterior diameter of preodontoid space (measuring 7 mm). There is an independent osseous structure located in distal end of clivus suggesting condylus tertius.**

Three cases showed findings of Basilar invagination which was primary developmental anomaly of abnormally high vertebral body prolapsed into skull base (Fig. 6). There is violation of Chamberlain line and clivus canal angle causing spinal canal stenosis. Out of three, one showed presence of Os Odontoideum (Fig. 7) which is an independent osseous structure seen proximal to axis body in the location of the odontoid process [1]. The gap between Os Odontoideum axis body extends above the level of superior articular facet of axis leading to cruciate ligament incompetence and atlantoaxial instability [6]. This should be differentiated from type 2 odontoid fracture by presence of corticated margins and absence of history of trauma [7]. It is also associated with C1-C2 block vertebra (Fig. 8).

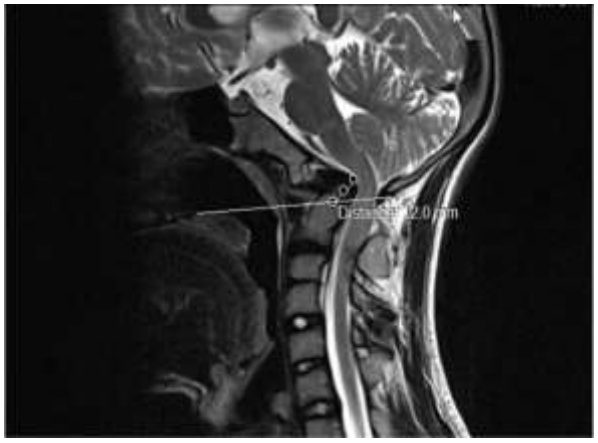


**Fig. 6: T2W image shows violation of chamberlain line in Basilar invagination. Horizontal line is chamberlain line. Vertical measurement shows dens 12 mm above chamberlain line.**

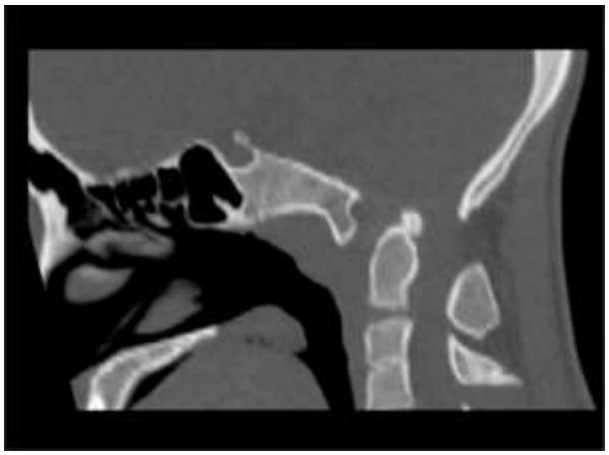
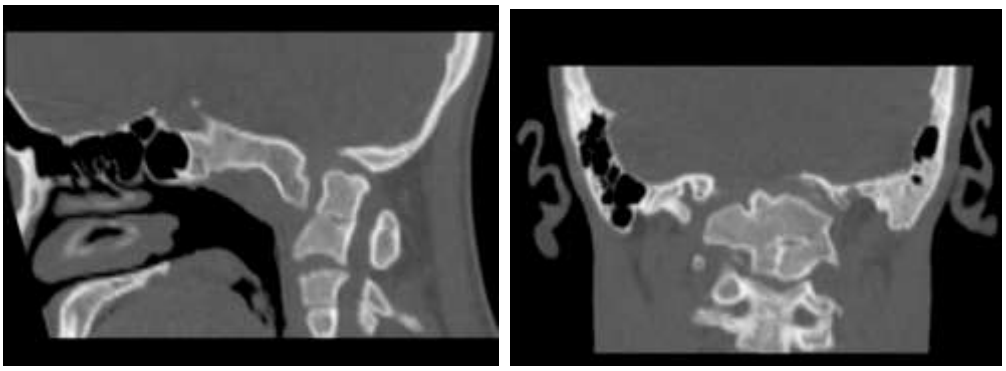


**Fig. 7: CT images shows an independent sclerosed osseous structure proximal to odontoid process suggestive of Os odontoidum**



**(a)** **(b)**

**Fig. 8 (a, b): CT images showing C1-C2 Block vertebra: complete fusion of lateral masses of C1 with C2 vertebra. There is a rudimentary C1-C2 intervertebral disc.**

Six cases showed increase in preodontoid space which was associated with atlantoaxial instability, spinal cord thinning secondary to cord compression in 5 cases. Basilar impression seen in one case was an acquired form due to softening of skull base in old age (Fig. 9). The Chamberlain line, Preodontoid distance, Clivus canal angle (Fig. 10) are abnormal in this case which was associated with chronic spinal cord compressing leading to cord thinning and myelomalasic changes in spinal cord.

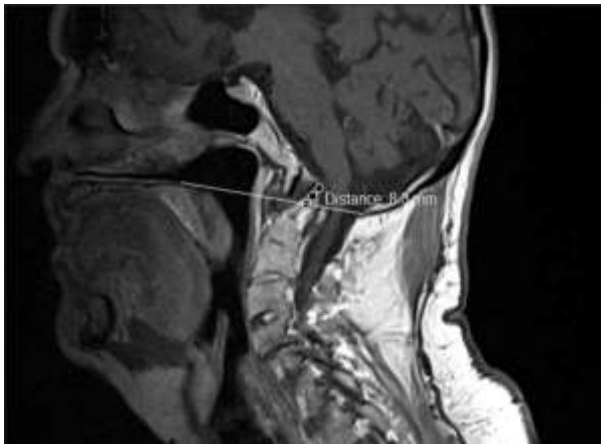
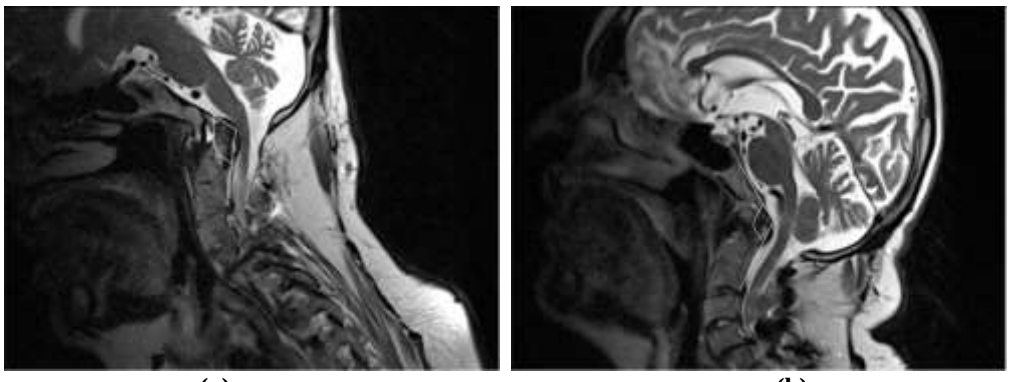


**Fig. 9: T1W MRI image shows odontoid process to be around 8.3 mm above Chamberlain line. Basilar impression is due to osteoporosis in old age**



**(a)** **(b)**

**Fig. 10 (a, b): T2W MRI images shows significant decrease in clivus canal angle in both flexion and extension measuring around 115 and 120 degrees respectively leading to spinal cord compression. The sagittal canal dimension in flexion is 14.4 mm and extension is 17.8 mm at the level of foramen magnum suggests unstable type of atlantoaxial instability. The spinal cord is thinned out measuring around 4 mm at same level.**

Atlantooccipital assimilation was seen in one case associated with basilar invagination, decrease in clivus canal angle and increase in preodontoid space.

C2-C3 block vertebra was present in one case associated with basilar invagination, decrease in clivus canal angle and atlantoaxial instability leading to myelomalasic changes in spinal cord seconadary to spinal cord compression.

## CONCLUSION

Occipitocervical junction is an important area of the spine. Anomalies were predominantly found in male patients. The CVJ anomalies such as increase in preodontoid space, spinal canal stenosis, spinal cord thinning, myelomalacic changes and basilar invagination in spinal cord were common findings. Whereas, basilar impression, os odontoideum, C1-C2 block vertebra, single condylus tertius were less common findings. So, with adequate anatomical knowledge of CVJ and availability of MR imaging early diagnosis is possible. Early management saves the patient from devastating effects of the pathology.

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## REFERENCES

1. Smoker WR; Craniovertebral junction: normal anatomy, craniometry, and congenital anomalies. Radiographics, 1994; 14(2): 255-277.
2. Benke M, Yu WD, Peden SC, O'Brien JR; Occipitocervical junction: imaging, pathology, instrumentation. Am J Orthop (Belle Mead NJ), 2011; 40(10): E205-E215.
3. Lustrin ES, Karakas SP, Ortiz AO, Cinnamon J, Castillo M, Vaheesan K *et al.*; Pediatric cervical spine: normal anatomy, variants, and trauma. Radiographics, 2003; 23(3): 539-560.
4. Kale SS, Ailawadhi P, Yerramneni VK, Chandra PS, Kumar R, Sharma BS *et al.*; Pediatric bony craniovertebral junction abnormalities: Institutional experience of 10 years. J Pediatr Neurosci., 2011; 6(1): S91-S95.
5. Menezes AH, VanGilder JC, Graf CJ, McDonnell DE; Craniocervical abnormalities: A comprehensive surgical approach. J Neurosurg., 1980; 53(4): 444-455.
6. Moeller TB, Emil R; Normal Findings in CT and MRI. 1st edition, Thieme, New York (NY), 2000: 162-167.
7. Henderson S, Henderson D; Os odontoideum with associated multidirectional atlantoaxial instability: imaging and clinical considerations. J Can Chiropr Assoc., 2006; 50 (2):111-117.