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Original Research Article

A CLINICORADIOLOGICAL STUDY OF C1-C2 JOINT ORIENTATION IN CONGENITAL ATLANTOAXIAL DISLOCATION PATIENTS

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Abstract:
Introduction: Congenital atlantoaxial dislocation (CAAD) presented at variable age, Factors that determining this variability remain obscure. The orientation of these facets disrupted in congenitally deformed joints and this may be the reason for progressive slip and then irreducibility in CAAD **Aims and objective**. The aim of the current study was to review the specific anatomical
and morphological features of the C1-C2 joint orientation and to add to
existing knowledge by documenting their anatomical variability **Materials and method:** this is a prospective as well as retrospective , observational study conducted on patients with congenital atlantoaxial dislocation irrespective of age admitted in the department of Neurosurgery at the G. R. Medical College &J.A. Group of Hospitals, Gwalior(M.P.) **Result & Conclusion:** patients of AAD concluded that bony and vascular anomalies are more common in patients with irreducible AAD as compared to reducible one, thereby making surgery more challenging. Preoperative detection of irreducible AAD must make the surgeon aware of difficulties and to be prepared for that.

Keywords: Congenital atlantoaxial dislocation , congenital spine deformity

1. INTRODUCTION

The upper cervical complex is a distinctive spinal area with a great need for mobility as well as stability. The specific anatomical morphology of the atlanto-occipital and of the atlanto-axial joints seemsto support these complex functional demands.[1] Atlantoaxial instability (AAI) is characterized by excessive movement at the junction between the atlas (C1) and axis (C2) as a result of either a bony or ligamentous abnormality. Neurologic symptoms can occur when the spinal cord or adjacent nerve roots are involved.
The stability of a joint mainly depend on the position and relationship of facets and other factors, like ligaments and capsule. C1-2 facets orientation in sagittal plane would possibly determine the anterior slip of C1 over C2 and orientation in the coronal plane would determine the telescoping of C2 into C1 (vertical slip).[2]

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Congenital atlantoaxial dislocation (CAAD) presented at variable age, Factors that determining this variability remain obscure. The orientation of these facets disrupted in congenitally deformed joints and this may be the reason for progressive slip and then irreducibility in CAAD.[3]

The spectrum of symptoms that result from both congenital and acquired lesions of the CVJ is remarkable. Many patients remain asymptomatic for long periods, and the anomalies often are discovered by chance. Others may complain of dizziness, gait disturbances, nuchal headaches and paraesthesias. Some may even present with quadriparesis.[4]

2. MATERIALS AND METHOD

Duration of study: one years

Design of study: Both retrospective and prospective study

Place of study: Tertiary care center

Inclusion Criteria: Patients with congenital atlantoaxial dislocation irrespective of age

Exclusion criteria:

Not providing consent

Traumatic atlantoaxial dislocation

Patients with chiari malformation and associated genetic syndrome

Definitions:

Congenital atlantoaxial dislocation:Atlantodental interval > 5 mm in children and > 3 mm in adults

Normal patients: Patients with normal CT cervical spine for suspected spinal trauma

Inferior C1 sagittal facetal angle: Angle between the line joining anterosuperior and posterior points of the hard palate and the line joining antero-inferior and posterioinferior points of the C1 facet in that sagittal section.

Inferior coronal C1facetal angle: Angle between the line joining the lateral and medial points along the inferior surface of the C1 facet and the line joining the edges of foramen magnum in that coronal section. 38

In the study group, following data will be collected:

- Demographic profile
- Symptoms at presentation
- Clinical examination findings
- Neurological deficits

Dynamic [flexion/neutral/extension]X-rays done in all case on the basis of x –ray patients further divided in to RAAD and IrAAD and CT scan of the craniovertebral junction (CVJ) done in all the patients with reconstruction(1 mm section in neutral position),mricraniovertibral junction done in all cases

Parasagittal sections passing through facets of occiput-C1-C2 in neutral position will be studied. Inferior C1 sagittal facetal angle and inferior c1 coronal facet angle measured in all cases. Atlantodental interval will be recorded in all patients and data analyzed.

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3. OBSERVATION AND RESULTS

Table 1: Distribution of patients according to age and gender

Age group (yrs)	Male	Female	Total
1-10	2	3	5
11-20	4	1	5
21-30	4	1	5
31-40	2	1	3
41-50	2	3	5
51-60	0	2	2
Total	14	11	25

Out of 5 patients between 1 to 10 years 2 were male and 3 were female.
Out of 5 patients between 11 to 20 years 4 were male and 1 was female,
Out of 5 patients between 21 to 30 years 4 were male and 1 was female,
Out of 3 patients between 31 to 40 years 2 were male and 1 was female,
Out of 5 patients between 41 to 50 years 2 were male and 3 were female, and between 51 to 60 years both patients were female.

Table 2: Distribution of patients according to symptoms

Symptoms	No. of patients	Percentage
Motor weakness	21	84
Sensory involvement	12	48
Neck pain	14	56
Autonomic disturbance	4	16
Cranial nerve involvement	0	0
Respiratory involvement	1	4

Out of 25 patients 21 patients presented with motor weakness, 12 patients presented with sensory involvement,14 presented with neck pain,4 presented with autonomic disturbances

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(bowel and bladder involvement), no patient presented with cranial nerve involvement and 1 patient presentedwith respiratory involvement.

Table 3: Distribution of patients according to signs

Signs	No. of patients	Percentage
Head tilt	4	16
Motor weakness	25	100
Sensory involvement	18	72
Cranial nerve involvement	0	0
Autonomic disturbance	4	16
Short neck	2	8

Out of 25 patients 4 had head tilt,25 had motor weakness,18 had sensory involvement,4 had autonomicdisturbances,2 had short neck and no patient had cranial nerve involvement.

Table 4: Distribution of patients according to reducible/irreducibleAtlanto axial dislocation

	No. of patients	Percentage
Reducible	16	64
Irreducible	9	36
Total	25	100

Out of 25 patients 16 patients had reducible AAD and 9 patientshad IrAAD

Table 5: Atlanto dental interval in irreducible AAD

Age and sex	Atlanto dental interval (mm)
9 yrs/F	9
13 yrs/M	10

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13 yrs/M	10
22yrs/M	9
30 yrs/M	10
34 yrs/M	9
45 yrs/F	9
50 yrs/F	7
55 yrs/F	10

Table 6: Atlanto dental interval in reducible AAD

Age and sex	Atlanto dental interval (mm)
6 yrs/F	7
7 yrs/F	9
10 yrs/M	5
10 yrs/M	6
18 yrs/M	7
18 yrs/M	9.5
19 yrs/F	8
26 yrs/M	7
27 yrs/F	7.5
30 yrs/M	6
33 yrs/F	6
35 yrs/M	9

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45 yrs/F	6
45 yrs/M	5
50 yrs/M	6
55 yrs/F	6

Table 8: Inferior C1saggital angle in irreducible AAD

Age and sex	Inferior C1saggital angle	
	Right	**Left**
9 yrs/F	116	118
13 yrs/M	120	136
13 yrs/M	136	120
22yrs/M	120	135
30 yrs/M	140	134
34 yrs/M	144	136
45 yrs/F	138	142
50 yrs/F	142	152
55 yrs/F	160	154
Mean	135.11	136.33

Table show inferior c1 sagittal angle in irreducible AAD, angle more acute in younger age group

4. DISCUSSION

The atlas first cervical vertibra articulates with the axis at 4 synovialjoints, 2 median front and back of dens and 2 lateral between opposing articular facet. Principal stabilizing ligament of c1 transverse ligament andalar ligament.

The articular surfaces of the joints between the lateral masses are often classified as planer. Inferior articular facet of c1 is classified as planar. The inferior articular facet of C-1

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is almost circular and is slightlyconcave. It is oriented obliquely to transvers plane and faces more medially[1]. Superior articular facet of second cervical vertibra(c2) is slightlyconvex.

Atlas and axis articulation is the most mobile but the least stability of any vertebral articulation.

The A-A joints allow less flexion –extension motion than rotation.There is greater movement with extension(upto10^o) than with flexion (upto5^o).Flexion extension of the O-A joint exceeds that of the A- A joint (flexion 10^o, extension 25^o).The ratio of extension to flexion is approx 2:1 & this ratio maintains itself at both the O-A & A-A joints.Totalrotation of the entire cervical spine is upto90^o& approx. ½occurs at the A-A joint.

Rotation with accompanying lateral flexion in the cervical spine occurs below the axis due to oblique orientation of the facets & their gliding motion.

Thus, C1–2 is extremely mobile but structurally weak and is located between 2 relatively fixed points the Oc–C1 and C2–3 joints[2].

The presence of a bony anomaly in the region significantly influence the stability atlantoaxial joint has a significantinfluence on its stability. Congenitalatlantoaxial dislocation patients become symptomaticat different ages.

In IrAAD facet joint oriented craniocaudally (posteroanteriorly) in the sagittal plane compared with those in patients with RAAD and normal individuals. The younger patients with IrAAD had a more acute inferior sagittal C-1 facet angle than the older patients with IrAAD. The obliquity of joints correlated with the age of presentation in patients with IrAAD. The obliquity of joint determines slippage rate of c1 over c2vertibra in various plane.

The ligament and capsule become fibrotic at dislocated position. Sagittally obliqe joint slip more anteriorly producing compressionover cervicomedullaryjunction giving rise to symptoms.

The more acute the inferior sagittal C-1 facet angle, the earlier the presentation and stage of irreducibility. Vertical orientation of facets in coronal plane determine telescoping c2 in to c1.This explains the variable age at presentation. With the aging additional compromise due to the degenerative changes causes cervical articulation to become more rigid.

The genesis of congenital RAAD was thought to be different. The inferior sagittal C-1 facet angles in RAAD patients are slightly acute .ligament and soft tissue are probable cause of dislocation in RAAD.lax ligament due to congenital absence of transverse ligament or due to short peg like odontoid ,there may be dislocation of facet3. patients with more weak ligament present earlier.

Salunke et al studied 36 patients of congenital AAD. They concluded that congenital AAD is a dynamic process and progress with time. The acuteness of the inferior C1 sagittal facet angles determine the age of presentation and reducibility. Coronal angle is the determining feature for the telescoping of C2 within C1. Intreaoperative reduction can through a direct posterior approach can be safely achieved in patients withirreducible AAD by drilling the wedge of C1-2 facets to make the joints relatively flat. Comprehensive facetal drilling also increases the rates of fusion.5,6,7

Another study done by Yuan et al involved 24 patients of irreducibleAAD. They opined that sagittal atlantoaxial joint inclination and reductionindex can be used as important imaging indicators to determine the reversibility of irreducible AAD. They also concluded that if the RI value is > 27.9% and SSAJI value <32.5 degree, posterior approach is sufficientelse a combination of anterior and posterior approach may be required.8,9,10

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5. CONCLUSION

Patients of AAD concluded that bony and vascular anomalies are more common in patients with irreducible AAD as compared to reducible one, thereby making surgery more challenging. Preoperative detection of irreducible AAD must make the surgeon aware of difficulties and to be prepared for that.

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