Developmental Anomalies of Vertebral Column: A Comparative Osteological Study between Coastal Odisha and Western Odisha Population.

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Abstract

Aim: To Study And Compare Different Types Of Vertebral Anomalies Between Two Socioeconomically And Culturally Different Populations Of Odisha.

Background: Vertebral Anomalies Are Multifactorial In Origin. Factors Responsible For Development Of Vertebral Abnormalities Are Alcohol, Retinoic Acid And Oral Contraceptive Pills. The Teratogenic Effect Of These Factors On Vertebral Development Has Been Studied By Many Authors. Deficiency Of Folic Acid Is One Of The Leading Causes Of Neural Tube Defect. There Are Genes Controlling The Development Of Vertebral And Failure Of Expression Of These Genes Lead To Vertebral Anomalies. Our Study Is An Attempt To Compare The Incidence Of Vertebral Anomalies Between Two Socioeconomically And Culturally Different Population And Find Out Possible Factors Responsible For The Difference.

Methods: We Collected All The Vertebrae Preserved In The Anatomy Department Of S.C.B. Medical College, Cuttack And V.S.S. Institute Of Medical Science And Research (Vimsar, Burla). Cuttack Is Situated In Coastal Odisha And Burla Belongs To Western Odisha. The Natives Of Western Odisha Constitute High Proportion Of Tribals Who Are Socioeconomically And Culturally Backward To Coastal Odisha Population. We Excluded Vertebrae With Incomplete Ossification And Vertebrae Showing Gross Pathological Changes. We Studied The Congenital Defects Like Block Vertebrae, Sacralisation And Spina Bifida. We Compared The Incidence Of Both The Samples And Made A Statistical Analysis To Know Whether The Difference Is Statistically Significant.

Result: The Incidence Of Congenital Vertebral Defects Was High In The Vertebræ Of Western Odisha Population. The Difference Was Statistically Significant (P Value-0.05).

Conclusion: Regular Consumption Of Country Liquor Which Is A Usual Practice Among Tribal Women Could Be A Cause Of High Incidence Of Block Vertebrae And Sacralisation. Dietary Deficiency Of Folic Acid Might Be Responsible For High Incidence Of Spina Bifida. To Rule Out Some Genetic Association A Genetic Study Of This Population Will Be Helpful.

Keywords: Vertebral Anomalies, Block Vertebrae, Sacralisation, Spina Bifida.

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I. Introduction

The Vertebral Column Develops From The Sclerotomes Of The Somites. The Caudal And Cranial Halves Of Adjacent Sclerotomes Fuse To Form Each Vertebra. The Process Of Formation And Rearrangement Of Segmental Sclerotome Is Complicated. So It Is Possible To Have Anomalies Like Unsegmented Vertebrae Due To Defective Segmentation Of Somites Or Spina Bifida Due To Defective Fusion Of Vertebral Arches. Sacralisation Of 5th Lumbar Vertebra Also Occurs Due To Non Segmentation Of Sclerotome. Alcohol, Retinoic Acid, Oral Contraceptive Pills Are Some Important Teratogens Which Are Responsible For Vertebral Abnormalities¹. Studies Show That 50% Of Fetal Alcohol Syndrome Patients Present With Congenital Fusion Of Cervical Vertebrae On Radiographs Of The Neck². Folic Acid Deficiency Leads To Severe Form Of Vertebral Arch Defect Like Spina Bifida. S.C.B. Medical College, Cuttack Is Situated In Coastal Odisha Where Literacy Rate And Socioeconomic Condition Of Local Inhabitants Is Higher Than Western Odisha, Where Vimsar, Burla Is Situated. The Natives Of Western Odisha Constitute Higher Proportion Of Tribals Who Are Habitual Drinkers Of Country Liquor And Their Access To Health Care Facility Is Also Poor. We Therefore Undertook This Study To Search For Incidence Of These Congenital Defects In The Dried Vertebrae Prepared

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And Collected In Anatomy Departments Of S.C.B. Medical College, Cuttack And V.S.S. Institute Of Medical Science And Research (Vimsar), Burla. Our Study Is An Endeavor To Find Out Whether The Cultural And Socioeconomic Difference Between The Two Communities Affects The Development Of Vertebral Column.

The Etiology Of Vertebral Synostosis May Be Congenital Or Acquired. The Congenital Vertebral Synostosis Is Due To Partial Or Complete Non Segmentation Of Vertebrae At The Time Of Organogenesis. But Acquired Fusion Of Vertebrae Is Usually Secondary To Diseases Like Juvenile Rheumatoid Arthritis, Tuberculosis, Ankylosing Spondilitis Or Diffuse Idiopathic Skeletal Hyperostosis. So It Is Important For Our Study To Differentiate The Congenital From Acquired Block Vertebrae. Congenital Block Vertebrae Are Characterized By Absence Of Intervertebral Disc, Maintenance Of Vertebral Body Height And Smooth Intervertebral Foramen Whereas Acquired Fusion Is Evidenced By Appearance Of Degenerative Changes In Them. We Therefore Took Enough Care To Include Only The Congenitally Fused Vertebrae After Careful Examination Of The Differentiating Features.

II. Materials And Method

We Collected All The Vertebrae Preserved In The Anatomy Department Of S.C.B. Medical College, Cuttack And Vimsar, Burla (Table 1). We Excluded All Damaged Vertebrae, Fused Vertebrae Showing Gross Degenerative Changes And Abnormal Calcification From Our Study (Fig. 1). Vertebrae With Incomplete Ossification Were Also Excluded To Avoid Confusion With Congenital Defects Like Spina Bifida (Fig. 1). After Segregating The Vertebrae Region Wise, We Examined Them To Find Out Congenital Anomalies Related To Defects In Segmentation Or Fusion. Segmentation Defects Include Block Vertebrae And Sacralisation, Whereas Defects In Fusion Include Spina Bifida. In Block Vertebra We Measured The Height Of Individual Vertebra And Total Height Of Fused Vertebra To Differentiate Acquired From Congenital Block Vertebrae. We Calculated The Percentage Of Vertebrae Affected By Different Types Of Anomalies From Each College Separately And Made A Comparative Statistical Analysis To Find Out If There Is Any Significant Difference Between The Two Study Samples. Comparison Was Done By Using Chi Square Test. P Value <0.05 Was Considered Statistically Significant. The Statistical Calculation For 2 Proportion Z- Test Was Done Using The Statistical Package Spss.

<table>
<thead>
<tr>
<th>Table 1 (Study Sample)</th>
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<tr>
<td>S.C.B. Medical College, Cuttack</td>
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<tr>
<td>V.S.S. Medical College</td>
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Observation

On Gross Examination Of Individual Vertebra, In Both The Study Samples We Observed Two Or More Vertebrae Fused Together To Form A Block Vertebra. All The Block Vertebra From Lower Thoracic And Lumbar Region Showed Abnormal Ossification Of Ligaments Like Anterior Longitudinal Ligament, Posterior Longitudinal Ligament, Ligamentum Flavum Or Capsular Ligament Of Facet Joints Leading To Obliteration Of Joint Spaces And Fusion Of The Vertebrae. All The Cervical Block Vertebra And Some Of The Upper Thoracic Block Vertebra Showed Complete Fusion Of Anterior And/Or Posterior Segment Without Any Degenerative Changes Or Associated Abnormal Calcification. We Counted Their Number Region Wise In Each Group For Comparison. The Incidence Of Congenital Cervical Block Vertebrae Was More In The Sample Collected From Western Odisha Population. Thoracic Block Vertebra Incidence Was More In Coastal Odisha Sample (Table 2). Fig. 2 (A) -2(D) Are Different Congenital Abnormalities Observed In The Samples Collected From S.C.B. Medical College, Cuttack. Fig.3(A)- 3(E) Are From Vimsar, Burla.

Sacralisation Of 5th Lumbar Which Also Occurs Congenitally Due To Non Segmentation Of Sclerotome Was Found More Frequently In Western Odisha Population (Table 2).

<table>
<thead>
<tr>
<th>Table 2</th>
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<tr>
<td>Unsegmented Cervical Vertebrae</td>
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<tr>
<td>S.C.B. Medical College</td>
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<tr>
<td>V.S.S. Medical College</td>
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Incidence Of Spina Bifida Was Also More In Vertebral Sample Of Western Odisha Population (Table 2)
Developmental Anomalies Of Vertebral Column: A Comparative Osteological Study Between Coastal

Fig. 1: Examples of fused vertebrae due to ossification of ligaments and open spine due to incomplete ossification excluded from study.

Fig. 2(a): Congenital cervical block vertebrae.
Fig. 2(b): Congenital thoracic block vertebrae.

Fig. 2(c): Sacralisation of 5th lumbar vertebrae.
Fig. 2(d): Spina bifida with open sacral canal.

Fig. 3(a): Congenital cervical block vertebrae showing failure of segmentation of sclerotomes.
Fig. 3(b): Thoracic block vertebra.
Fig. 3(c): Sacralisation of 5th lumbar.
Developmental Anomalies Of Vertebral Column: A Comparative Osteological Study Between Coastal

Statistical Analysis

<table>
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<tr>
<th></th>
<th>Unsegmented Block Vertebrae</th>
<th>Cervical Block Vertebrae</th>
<th>Thoracic Block Vertebrae</th>
<th>Sacralisation of 5th Lumbar</th>
<th>Lumbar Spina Bifida</th>
<th>Sacral Spina Bifida</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.C.B. Medical College</td>
<td>0.3%</td>
<td>0.1493%</td>
<td>1.8%</td>
<td>0.0%</td>
<td>1.8%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Vimsar, Burla</td>
<td>1.3%</td>
<td>0.1%</td>
<td>13.3%</td>
<td>0.8%</td>
<td>26.7%</td>
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The Above Table Shows The Percentage Of Anomaly In Each Of The Categories. A Statistical Test Was Done To Conclude Whether The Difference In Anomaly Is Statistically Significant To Conclude That The 2 Samples Are Different.
Null Hypothesis H0: There Is No Difference In The Sample From The 2 Colleges.
Alternative Hypothesis: There Is Difference In The 2 Samples From 2 Colleges.
Significance Level: 0.05
The No Of Anomalies And Normal Cases In Both The Medical Colleges Were Fed Into The System. 2 Proportion Z- Test Was Done And The Significance Was Found To Be 0.05. Thus The Null Hypothesis Was Rejected And Alternative Hypothesis Was Accepted. As Per The Alternative Hypothesis It Can Be Concluded That The 2 Samples Are Statistically Different.

III. Discussion


The Tribal Women Of Western Odisha Are Habitual Drinkers Of Country Liquor Whereas In Other Parts Of Odisha Female Alcoholism Is Very Rare. Therefore Female Alcoholism Could Be A Factor For The High Incidence Congenital Block Vertebrae And Sacralisation Of Lumbar Vertebrae In Western Odisha Population.

Out Of All The Vertebral Anomalies Studied, The Incidence Of Spina Bifida Was Very High In Western Odisha Population. As Folic Acid Deficiency Is A Major Factor Responsible For This Defect, The High Incidence Of Spina Bifida Could Be Correlated To Dietary Deficiency Of Folic Acid In This Group. Multiple Factors Like Poverty, Illiteracy, Lack Of Awareness And Inaccessibility To Healthcare Facility Could Be Responsible For The High Incidence Spina Bifida In This Community.

The Pax-1 Gene, Which Is Expressed In All Prospective Sclerotomal Cells Of Epithelial Somites Seems To Play An Essential Role In Development Of Vertebral Column1. Failure Of Expression This Gene Could Also Be A Factor For The High Incidence Vertebral Anomalies, Which Needs To Be Studied To Establish Its Genetic Association.

References


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