

A STUDY ON FUSED VERTEBRAL BODIES ALONG WITH OSSIFIED VERTEBRAL LIGAMENTS

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ABSTRACT: Congenital or acquired anomalies are common in the vertebral column and site for many orthopaedic disorders which may be pathological or developmental deformity leading to instability, kyphosis, low back pain, scoliosis, Ankylosing spondylitis, forestier's disease, myelopathy. In present study, done on 50 dried sets of vertebral column bones, of unknown age and sex in the Department of Anatomy, BMCRI, Bangalore. We noted 10 had fused bodies of vertebrae at different levels along with ossification of ligaments of vertebrae's among which 6 were at thoraco-lumbar level, 3 at cervical level and 1 thoracic level giving it an appearance of bamboo/poker spine. The knowledge of this variation is important because of the probability of clinical manifestations associated with the abnormal vertebrae.

KEYWORDS: Ossification of anterior longitudinal ligament (OALL), Posterior longitudinal ligament (OPLL), Interspinous ligament (OISL), Supraspinous ligament (OSSL), Ankylosing spondylitis (AS)

INTRODUCTION: The human vertebral column plays an important role in maintaining upright posture, stability, weight transmission and adapted to protect the spinal cord. The ligaments which hold the vertebrae are Anterior longitudinal ligament, Posterior longitudinal ligament, Supraspinous ligament and interspinous ligament. The adjacent vertebrae are held together by intervertebral disc. The Anterior longitudinal ligament is strong, broad fibrous band, covers and connects anterior aspects of bodies of vertebral and intervertebral disc, extends from anterior arch of atlas to pelvic surface of sacrum. It helps to maintain the stability and prevent the hyperextension of vertebral column. The Posterior longitudinal ligament interconnects the vertebral bodies and intervertebral disc posteriorly with in the vertebral canal, which limits the flexion of vertebral column and resists the gravitational pull. The Supraspinous ligament is a strong fibrous cord, which connects apices of spinous processes from C7 to sacrum. The Interspinous ligament is thin membranous, interconnects the spinous process.¹ At the points of attachment to the tips of the spinous processes fibrocartilage is developed in the ligaments leading to ossification or calcification of the ligaments.²

Any pathological condition of vertebral column may be developmental or acquired and associated with neurological signs which leads to low back pain, discomfort and stiffness.

MATERIAL AND METHODS: During routine osteology classes conducted for first year undergraduate medical students in Department of Anatomy, BMCRI, 50 dried bone sets of vertebral column (Each set contain 7-cervical, 12-thoracic, 5-lumbar and 1-sacrum) irrespective of

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age and sex were collected and observed for fusion of vertebral bodies along with ossified vertebral ligaments and subjected for radiological investigations.

OBSERVATION AND RESULTS: Out of 50 dried sets of vertebral column, 10 had fusion of vertebral bodies at different level like 6 at thoraco-lumbar level, 3 at cervical level and 1 thoracic level along with ossified anterior longitudinal ligament (OALL), posterior longitudinal ligament (OPLL), supraspinous ligament (OSSL), interspinous ligament (OISL). Fusion of vertebral bodies.

Cervical Level: Fusion of vertebral bodies seen between C2-C8- Partially fused-C2-C5, obliteration of intervertebral space- C6-C7; calcified interveterbral disc –C4-C6.

Thoracic Level: Fusion seen between T3-T6- obliteration of intervertebral space between T4-T5; calcified interverbral disc –T3-T4.

Thoraco-lumbar Level: Fusion seen between T3-L5 – giving appearance of bamboo spine.

DISCUSSION: Ankylosing spondylitis (AS) -progressive inflammatory, stiffening of the joints-axial skeleton especially the joints of the sacroiliac and lumbar vertebrae, causes ossification of all ligaments, may involve thoracic and cervical vertebrae. Joints involvement leads to permanent damage like stiff spine limiting all spinal movements with compression of spinal roots. Bamboo spine is seen in x-ray as a result of fusion of vertebral bodies.³ A strong association has been found that there is agenetic predisposition with AS- patients have HLA –B27 positive in their laboratory findings. HLA complex gene is located on chromosome 6.²

Ossification of ALL in cervical region (C2-C6) may compress the larynx or trachea and lead to immobility or mucosal thickening of larynx, dysphagia (Epstein).⁴

Rresnick et al⁵ and Rresnick, Shaul and Robins⁶ coined the term diffuse idiopathic skeletal hyperostosis for forestier's disease and ossification of the spinal ligaments has been considered as a part of this entity. They defined diffuse idiopathic skeletal hyperostosis as showing calcification or ossification along the anterior to anterolateral aspect of four contiguous vertebral bodies.⁷

OPLL is common in the Asian population and accordingly, genetic factors are considered to be an important factor for the incidence. There have been many studies on collagen genes, including on the human collagen A2 gene (COL11A2).

Koga et al⁸ reported that the gene is located at chromosome 6p nearby human leukocyte antigen region, and seriously involves in development of OPLL. Maeda et al,⁹ also reported sex-specific association of COL11A2 haplotype in male OPLL patients. In addition, retinoic X receptor β and collagen 11A2 were also reported to be closely related with OPLL. Bone morphogenic protein (BMP) induces the formation of ectopic bones and cartilage, and is considered to play an important role in the pathogenesis of OPLL. More specifically, BMP-2 stimulates differentiation of ligament cells of OPLL patients, and induces ossification by increasing alkaline phosphatase activity and stimulating DNA and procollagen Type I carboxyl-terminal peptide synthesis. Transforming growth factor (TGF)- β was also considered to be an important factor for OPLL formation, but Kawaguchi et al⁹ reported that TGF- β 1 polymorphism is not related to onset of

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OPLL, but is related to extension of ossification. In addition, insulin-like growth factors, connective tissue growth factors, growth hormone-binding proteins, platelet-derived growth factors and interleukin-7 are considered to be implicated in the development of OPLL.

Etiology of OPLL is still unknown but genetic, hormonal, environmental and lifestyle factors have been considered to be related with development of OPLL. Radiological analysis of plain radiograph, CT and MRI is essential, at the early stage, most of OPLL patients do not have symptoms, complain mild pain, discomfort, or numbness in hands.¹⁰ As OPLL grows, symptoms increase in severity due to compression of the spinal cord and nerve roots. The most common symptoms in the early stages of OPLL include dysesthesia and tingling sensation in hands, and clumsiness. With the progression of neurologic deficits, lower extremity symptoms, such as gait disturbance may appear.¹¹ OPLL patients show symptoms of myelopathy caused by spinal cord compression rather than radicular pain due to nerve roots compression. About 80-85% of OPLL patients experience a slow progression, but the symptoms become suddenly aggravated or even quadriplegia may appear by mild injuries.¹²

ISL, SSL ossification of lumbar vertebrae can lead to compression of the cauda equina- leading to abnormal bowel & bladder control, sensation of numbness in perineum & weakness in the thighs.¹³

Albert Oppenheimer inferred that ossification of ligaments is a mode of healing ligaments when there is a sustained increase of tension due to tear of ligaments in trauma.¹⁴

CONCLUSION: Simple radiograph and MR images may be helping in assessing normal or fusion of vertebral bodies and ossification of vertebral ligaments. Both genetic and environmental (trauma) factors play a role in pathogenesis of Ankylosing spondylitis, Forestier's disease leading to stiff spine, back pain, restriction of thoracic mobility during normal respiration. So by these abnormal bones we can emphasize students about its clinical significance.

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AT THE LEVEL OF CERVICAL VERTEBRAE



Fig. 1: Fused vertebral bodies at cervical vertebral (C2-C7) level



Fig. 2: Ossified interspinous and supraspinous ligaments

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Figure 3: A plain radiograph of cervical vertebrae taken in AP and LATERAL views showing ossified paraspinous, anterior and posterior longitudinal ligaments with fused vertebral body at the thoracic vertebrae level.

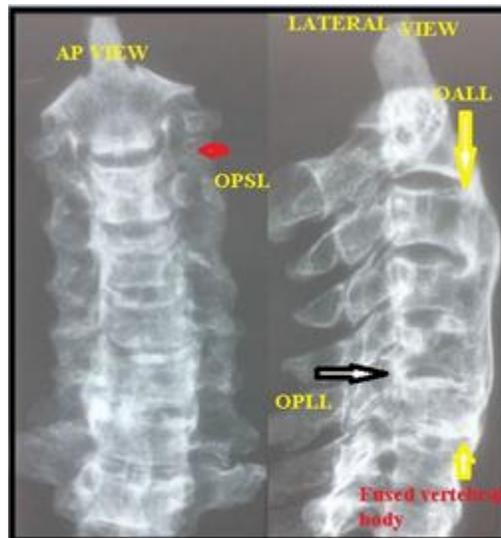


Fig. 3

Figure 4: Fused vertebral body (T3-T6) with ossified anterior longitudinal ligament at thoracic vertebrae.



Fig. 4

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Figure 5: A plain radiograph of thoracic vertebrae taken in LATERAL view showing ossified anterior longitudinal ligament at the thoraco-lumbar level.



Fig. 5

Figure 6: Fused vertebral bodies from T3-L5 with ossified anterior longitudinal, inter spinous and supraspinous ligaments at thoraco-lumbar level.



Fig. 6

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Figure 7: A plain radiograph showing bamboo spine appearance of vertebral column at thoraco-lumbar level.



Fig. 7

Number of specimens	Fusion of vertebral bodies seen	Level of fusion
50	10(20%)	Cervical-3(0.3%) Thoracic -1(0.1%) Thoraco-lumbar-6 (0.6%) TOTAL-10

Table 1: Details of dry vertebral column specimens

Level of vertebrae	OALL	OPLL	OISL	OSSL
CERVICAL(c2-c7)	+	+	+	+
THORACIC(T2-T6)	+	-	-	-
THORACO-LUMBAR (T3-L5)	+	+	+	+

Table 2: Ossification of ligaments

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