

## Case Report

# Evolutionary Complexity and Complications, With Age Related Changes in Human Vertebral Column

Vennila G.<sup>1</sup>, Nathiya S.<sup>2</sup>

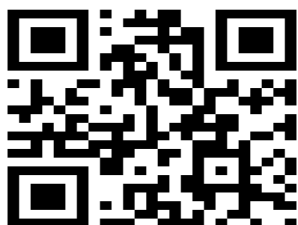
<sup>1</sup>Department of Anatomy, Karpagam Faculty of Medical Sciences and Research, Othakkal Madanpam, Coimbatore, Tamilnadu, India – 641 032.

<sup>2</sup>Department of pharmacology, vinayaka missions kirubanandha variya medical college, salem.

### ABSTRACT

Evolution does explain the erect human spine. One of the riddles of mammal evolution explained: the strong conservation of the number of trunk vertebrae. The adaptive morphological evolution for improved performance in a specific function, as well as phenotypic responses to changing performance regimes due to varying selective pressures. Several disciplines are required to provide relevant information on the big picture behind structural diversity and evolutionary patterns underlying it. To support the increased weight on each vertebra in the upright position, the human vertebral column became S-shaped and the lumbar vertebrae became shorter and wider. The lumbar and pelvic regions of the spine suffer from the pressure exerted on it by our upright posture. A lifetime of stress leads to numerous back problems, such as hernia of the vertebrae, scoliosis, lower back pain and other back disorders. Our analysis suggests that by age related complications in upright posture and common remedies. The objective of our study was to investigate involving evolutionary changes causes, common complication in people with diagnostic technique and tips for how to avoid the problems.

**Keywords:** Erect Human Spine, Pressure exerted, Hernia, Back Problems and Remedies



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### Address for Correspondence:

**Vennila G.**

Department of Anatomy, Karpagam Faculty of Medical Sciences and Research, Othakkal Madanpam, Coimbatore, Tamilnadu, India – 641 032.

Email: vennila.g1988@gmail.com

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### INTRODUCTION

The evolution of human bipedalism approximately four million years ago has led to morphological alterations to the human skeleton (1). The defining property of humans and other vertebrates is the vertebral column, housing as it does a multifaceted sensory-response system integrating every aspect of movement, form, and function (2). The vertebral column and its high evolvability are considered to be of central importance for the evolution of vertebrates, the mammalian vertebral column is highly variable, reflecting adaptations to a wide range of lifestyles that sufficient individuals with transitional vertebrae survive to allow eventual evolutionary changes of trunk vertebral numbers(3). The major function of vertebral

column is protection of spinal cord; it also provides stiffening for the body and attachment for the pelvic girdle and many muscles. In human an additional function is to transmit body weight and standing. To support the increased weight on each vertebra in the upright position, the human vertebral column became S-shaped and the lumbar vertebrae became shorter and wider (4). Many of the fascinating examples resulting from millions of years of evolution are known from the vertebrate lineage of chordate animals. Because of the vast range of body plan diversifications that have arisen, knowing vertebrate evolutionary morphology is crucial for exploring the structural basis reflecting processes of adaptive (but also neutral) evolution. As such,

especially functional systems that form the core of the survival of vertebrate organisms can be expected to best reflect the processes of variation, natural selection and adaptation (5).

As a result of bipedality, the pelvis was formed into a wide saddle-shape that transferred the weight of the abdomen to the legs. But this change also narrowed the birth canal, making it harder to give birth. Apes such as chimpanzees have no such problem (6). The consensus among evolutionists seems to be (and has been for at least a century) that the morphological complexity of organisms increases in evolution, although almost no empirical evidence for such a trend exists (7). A principle proposed in the last century by Herbert Spencer, and offered recently in a new form by the thermodynamic school of evolutionary thought, predicts that complexity should increase in evolution as a consequence of the accumulation of perturbations (8). But in the past 600 million years, the evolution of much larger and more complex organisms has transformed the biosphere. One of the most important features underlying evolutionary increases in animal and plant size, complexity and diversity has been their modular construction from reiterated parts (9).

Human Vertebral column is characterised by a variable number of curves, in quadrupeds the column is curved in a single arc, which acts somewhat like a bow spring in locomotion, in human this primary curve is modified y three more: 1) A sacral curve, which the sacrum curves backwards and helps support the abdominal organs, 2) A anterior cervical curve, which develops soon after birth as the head is raised, and 3) A lumbar curve, also anterior which develops as the child sits and walks.

The lumbar curve is a permanent characteristic only of humans and their bipedal forebears, though a temporary lumber curve appears in other primates in the sitting position. The cervical curve disappears in human when the head is bent forward but appears in other animals as the head is raised (10). The form of the vertebral column is definitely related to its function as a supporting rod, a base for attachment of body and limb muscles, and a protection of the spinal cord and nerves. Primitively composed of a series of simple undifferentiated blocks, it progressively becomes complicated through development of articular processes giving added strength and greater mobility. Simultaneously, the centrum and the neural arch become adapted to withstand tension and compression stresses which vary with the

movements possible in different regions of the column. These movements are partially determined by the plane of the zygapophyses and the nature of the intercentral articulation, together with the action of the axial muscles and ligaments (11).

Low back pain is the evolutionary price that we humans have paid for going from a four-legged creature to an up-right, two legged one. And, it is an expensive price. A recent study places the costs – medical, surgical and lost income - generated by low back pain in excess of \$90 billion a year. Low back pain is the most common reason for disability in individuals under the age of 45 years old. At some point during our lifetime, 80% of us will have had an episode of significant low back pain (12). The complex composition of the human spine, Bone, discs, muscles, ligaments, tendons and various other tissues are arranged like a three-dimensional puzzle to make up the spine. The complex make up can easily mask the exact cause of low back pain (13). In the course of evolution there has certainly been an obvious conflict in aims between the need for essential stability and the desired or necessary mobility. These mutually self-limiting mechanisms are reflected in the highly specialized architecture of the ligamentous apparatus and vertebral joints. We conclude that the human vertebral column seems to be an optimized compromise of evolution (14). The present study provides the details of causes of back pain from evolution to modern life style and simultaneously practices of day today life to avoid or reduce the problems of lower back pain. The present study focused on the major complications of back pain along with trauma, physiological changes, diagnosis, and other common remedies.

#### METHODS:

Case no:	Sex	Age	History of trauma	Other complications
1	Female	69	No	Yes
2	Female	58	Yes	No
3	Male	70	Yes	No
4	Male	55	No	Yes
5	Male	65	Yes	No
6	Male	61	No	Yes
7	Male	58	Yes	No
8	Female	55	No	Yes
9	Female	52	No	Yes

**Table 1:** Sex, Age, History of trauma & other complications

This is acquired data for consecutive patients who underwent back pain treatment like surgery, medicines and following exercise. We have

included nine patients reports for our data. From these nine patients, four females and five males, age group between 50 to 70 years, because they are having clear diagnostic reports.

Other complications	Percentage (%)
cardiac arrest	1.8
spinal cord deficit	0.9
nerve root injury	3.6
optic deficit/blindness	0
vessel/organ injury	0.8
pneumothorax	2.7
unplanned staged surgery	1.8

**Table 2:** Other complications

**Investigations:**

**Changes in the Cerebrospinal Fluid:**

Table-3 contains the degree of block on manometry and the protein content of the Cerebrospinal Fluid in nine cases. Three of the patients had a complete of almost complete block with elevation of protein content of cerebrospinal fluid to 150,200 and 175 mg/100ml. A partial block of sticky manometric was recorded in three patients with protein content of 30,100 and 20mg/100ml. Disc prolapse and degenerative disease can causes a complete spinal block but in early stage of conditions the manometrics and Protein content of cerebrospinal fluid may be normal and in later stages of neurological disability may be at most a partial block or a slight increase in the protein content.

Case no:	Manometric results	Protein content of C.S.F (mg/100 ml)
1	No block	55
2	No block	not recorded
3	Partial block	30
4	Complete block	150
5	Almost complete block	200
6	Complete block	175
7	Partial block	100
8	Partial block	20
9	No block	50

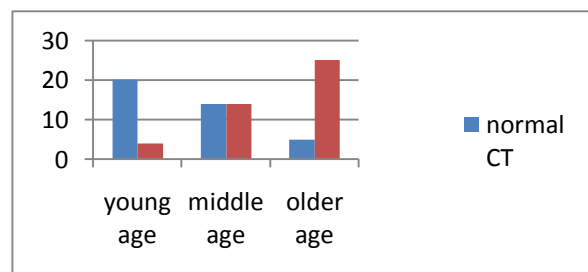
**Table 3:** Manometric changes and protein content of CSF

**RADIOLOGICAL INVESTIGATIONS:**

The clinical features of prolapsed thoracic discs, degeneration of lumbar discs are little value in positive diagnosis, some of the radiographic changes form of a reliable guide, and it should be possible by means of make a pre-operative diagnosis in the majority of cases.

Case no	Radiography Reports
1	Radiography showed dense mottled calcification of the nine –tenth nucleus pulposus without narrowing of the disc space.
2	Spotty calcification in anterior portion of nucleus pulposes of the eighth-ninth disc.
3	A sagittal Computed tomographic (CT) scanning cervical spine image showing irregular outline, anterior and posterior wall end plates, peaking, sub-chondral multiple small cysts, sclerotic changes and narrowed multiple level disc spaces mainly at C5, 6. There is loss of normal c spine curvature.
4	Dense calcification in the nucleus of eighth-ninth disc with a thin plaque of calcification in the arachnoid, 1 cm long by 1 mm thick, at the first lumbar vertebra,
5	Granulation calcification in the nucleus of the eighth- ninth disc without narrowing.
6	No calcification was seen,
7	Most thoracic and lumbar vertebrae was seen, but no calcification.
8	A sagittal CT scanning cervical spine image showing osteopenic changes, loss of c-spine lordosis, anterior vertebral body osteophytes with inferior peaking at the level of C4, 5 & 6.
9	A sagittal CT scanning cervical spine image showing irregular outline, anterior and posterior wall end plates, peaking and sub chondral multiple small cysts, Sclerotic changes and narrowed multiple level disc spaces mainly at C4-5, loss of normal c-spine curvature and mild kyphotic changes at C3-6 level.

**Table 4:** Radiological investigations



**Figure 1:** Comparison of normal and degenerative changes in age vice

**DISCUSSION:**

**Low Backache:** Among all the maladies afflicting the human race backache ranks second, next only to headache and common cold. It is known to affect 8/10 people. Posterior displacement of one disc and backache was 1<sup>st</sup> described in the year 1911.

Arrangement of your spine into a s-shaped structure: These 33 – bones are not arranged in a straight line but are arranged in the form of an s-shaped curve. In the early part of our childhood when we crawled on all the four limbs our spine also had a c- curve, As the child gradually learns to stand and walk on 2 limbs , c – curve gives way to the s – curve. Our backs were basically

designed to walk on all the four – limbs, not on 2 – limbs. Our backs are not designed for sitting, 60% of life is spent while sitting. Sitting is more stressful than standing; because pressure on the disc is increased by 11 – times while pressure during standing is increased by three times, lying down produces least stress. We are largely responsible for the common low backache which accounts for nearly 80% of the cases. 20% direct causes: related to the spine like infections, tumour, tuberculosis, osteoporosis, spondylosis, fracture spondy – listhesis, etc. Not related to spine: Problem in other systems like the genitourinary tract, gastro – intestinal tract, prolapsed of the uterus, chronic white discharge in female etc. 80% common causes are

1. Repeated physical and mental stress
2. Poor postural habit
3. Improper lifting of weights.

Common Low back pain: (80%)

1. Sprain : Sudden stretching and tearing of ligaments and tendons of the spine
2. Strain : sudden or unaccustomed activity
3. Disc related problems: due to sudden Disc rupture or slip or gradual due to improper postures, ageing and improper back care.
4. Sciatica: Pain radiating along the sciatic nerve, numbness in the leg and feet, bladder and bowel disturbance.

Common causes of LBA:

1. Spine infection
2. Trauma
3. Malignancy – severe excruciating unremitting low backache, does not respond to the conventional treatment, there will be significant loss of appetite, weight etc.,
4. Arthritis
5. Deformities of spine.

Exercise of the back:

After the successful completion of the treatment methods doctor advises you to undertake the exercise therapy after the complete cessation of pain. Exercise; serve the role of putting your spine back to its normal shape.

Yoga: Yoga is of great help as it is primarily a stretching exercise and helps to make your muscles, and ligaments supple. Yoga does enormous good to your back, it has mainly a stretching effect. The mobility of your spine also improves tremendously meditation helps in better mind control and thus keeps the stress away. Ekpadawana mukthasana and pawana mukthasana help to stretch the lower back muscles and the thigh muscles. Ardhakati sarvangasana in yoga, strengthen the lower anterior abdominal wall muscles.

Paschimothasana, stretch the spinal and hamstring muscles. Makarasana, in yoga helps to develop the upper and lower back extensor muscles. Ardhatibhujangasana yoga is known to develop the spinal muscles. Bhujangasana yoga helps to develop the spinal extensor muscles. Jatarasana yoga helps to stretch the side muscles of the chest and abdomen.

Simple screening test to rule out major basic problem; It is possible for you to find out for yourself by some simple test, whether for back ache is major or not and whether you need to see your doctor or you can manage on your own. 1. In the supine position, try and extend your great toe first without resistance and against resistance offered by your hand. 2. If there is weakness or extension, then you have developed a neurological complication due to compression of the nerve or cord due to disc slip. 3. Test the sensation of your skin over the foot toes and leg by using a cotton wool or a sharp pin, if there is loss of sensation then the conclusion is the same. 4. There are only situations other than bladder, bowel, and sexual dysfunction in which surgery is must for managing common low backaches.

In occupational back ache due to poor posture in a work environment, due to improper chair in sitting pain is felt in the following areas in the order of frequency; Head- 14%, Neck and shoulder – 24%, Back – 57% this is because most of the office chairs make you assume a c- curve posture instead of the s- curve posture. This puts enormous pressure on the spine and disc (15). Given an aging population in India and greater expectations for a high quality of life, spinal deformity is a health care problem of increasing importance.

## CONCLUSION

The present study provides the details of who are suffering from back pain, with previously having the problem of trauma, disc prolapsed or age related degeneration. Trauma conditions we could not avoid, but occupational back pains can be rectified by our self improvement like regular diet, with conscious walking and exercises. Prevention is better than cure.

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