# Evaluation of the results of growing instrumentation in the management of idiopathic scoliosis in children after two years follow up

*Thesis Submitted in Partial Fulfillment*

*for the M.D. Degree (Orthopaedics)*

By


**Ayman Milad Zakhary**

M.B.B.Ch. (Ain-Shams)
M. Sc. Orthop. (Cairo)


## Under Supervision Of


## Prof. Dr. Naguib Basha

Prof. of Orthopaedic Surgery
Cairo University

## Prof. Dr. Alaa Mohy El Din

Prof. of Orthopaedic Surgery
Cairo University

## Prof. Dr. Hazem Sebaie

Assistant Prof. of Orthopaedic Surgery
Cairo University



Faculty of Medicine
Cairo University
2009

# Acknowledgment

First and foremost, I thank god for giving me the strength to finish this study.

Secondly, I would like to thank Prof Dr. Naguib Basha, my supervisor for his professional and morale support, and giving me the required guidance and consistent inspiration to finalize the research.

Also, I would like to thank Prof Dr. Alaa Mohy, for his support and encouragement. My gratitude should extend to Assistant Prof Dr. Hazem Sebaie for his clinical and moral support in this study.

Last but not least, I would like to thank all the staff and my colleagues in Orthopedic Department Cairo University – Pediatric unit and The Spinal Unit at The Student's Health Insurance (Abu El-reish) Hospital. Without their help, this study wouldn’t have been finished.

# Abstract

Idiopathic scoliosis has been considered as one of the most common deformity facing the orthopedics surgery today accounting for a significant proportion of the young population below the age of 16 years.

The aim of this study is; to determine the success of single rod spinal instrumentation without fusion in maintaining and correction of deformity while allowing for continued spinal growth through consecutive distraction moreover, to compare its efficacy, safety and tolerability to dual rod spinal instrumentation.

The study enrolled 15 patients with average age of 6 years and 7 months. The average follow up period was 3.14 years. Cobb's angle has improved from pre-operative to post initial surgery by 45.5% and from pre initial surgery to last follow up by 51.61%. Spinal growth measured from T1 to S1 has improved from pre-operative surgery to post initial surgery from 268mm to 303 mm. These results were comparable to other recent studies using double rod technique.

This study describes the evolving technique of single rod which is under continuous changes. More time and experience is needed to reach a unified method for management

**Key words:** scoliosis, spinal instrumentation, single rod

# Table of Content

# List of Figures

# List of Tables

# Introduction

# Introduction

The intelligent management of idiopathic scoliosis requires the treating physician to understand concepts of etiology, natural history, and the varied operative and non-operative treatment options. Even though the term idiopathic is still appropriate, more is known about the etiology and the natural history of the condition.

The natural history studies have given us valuable information on the risks of curve progression and therefore better understanding when recommending treatment options. ***(Weinstein ,1985)***

Non-operative (cast, bracing and electrical stimulation) treatment had bad results, ***(Price et al ,1990)*** The surgical management of scoliosis has seen some of the most dramatic changes over the past few years. There has been an explosion in the development of new techniques with the appearance of more sophisticated surgical implants, improved anesthesia, and better understanding of correction of the spinal deformity.

The new techniques have helped our patients to gain better corrections of their deformities while spending less time in the hospital. The goal in this study is to review the current concepts in the management of idiopathic scoliosis and attempt to make sense of the numerous options available today. ***(Akbarnia ,2005)***

The aim of this study is to determine the success of instrumentation without fusion using consecutive distraction for controlling severe deformities in young children while allowing for spinal growth. Our aim as well is to determine the safety and tolerability of the newer designs of spinal instrumentation as a useful alternative for this difficult problem and to compare the results of our methods with previously reported ones.

# Anatomy and Biomechanics of Vertebral Column

# Anatomy and Biomechanics of Vertebral Column

The spine is the segmental column of vertebrae that constitutes the major sub-cranial part of the axial skeleton. Its individual elements are united by a series of intervertebral articulations to, form a firm but flexible shaft that Supports the trunk and its appendages while providing a protective covering for the neural elements

A typical vertebra consists basically of an anterior or ventral part, the body and posterior or dorsal vertebral (neural) arch which is extended by lever like processes and encloses a vertebral foramen; occupied in life by neural elements and associated vessels. The opposed surfaces of vertebral bodies are strongly bound to each other by inter-vertebral discs of fibrocartilage ***(Snell, 1996)***. Fig.1 shows vertebral character which is detailed below

**-The vertebral body** is roughly cylindrical, with wide variation in shape, size, and proportions in the different regions of the column of the same species. Its two surfaces are flattened and display a peripheral smooth zone formed from the annular epiphysial disc, within which the surface is roughened.

**-The vertebral arch** has on each side a vertically narrower anterior part, the pedicle and behind this the broader lamina. Two transverse processes, superior and inferior articular processes and single spinous process project from the broader lamina.

**-The two pedicles** are short, thick and rounded pars projecting posteriorly from the body at the junction between lateral and dorsal surfaces, and nearer to the superior surface, so that the concavity above the pedicle is shallower than the one below it. These concavities are the vertebral notches; when vertebrae are articulated together by their discs, adjacent notches enclose an inter-vertebral foramen.

**-The two laminae:** are broad, vertical, plate-like and directly continuous with the pedicles. They curve backward and medially to fuse in the midline with the spinous process, thus completing the vertebral foramen.

**-The spinous process:** is a dorsal projection and often downwards junction of the laminae. It varies much in .size, shape and levers for muscle direction. They are which extend the vertebral column or, to a lesser extent, rotate it.

**-The articular processes:** paired; superior and inferior, project from the arch at the junction of pedicle and laminae. The superior articular processes project upward and bear surfaces which face dorsally and often laterally; the inferior processes bulge downward and their articular facet are directed forwards and often somewhat medially. Thus, the articular processes of adjoining vertebrae meet to form synovial joint which, while permitting a limited degree of movement, are particularly concerned in guiding and restricting the range of movement between vertebrae.

**-The transverse processes:** project laterally from the junction of pedicle and laminae, and they serve as levers for the muscle and ligaments concerned in rotation and lateral bending of the spinal column. In the thoracic region they also articulate with the ribs ***(Snell, 1996)***.

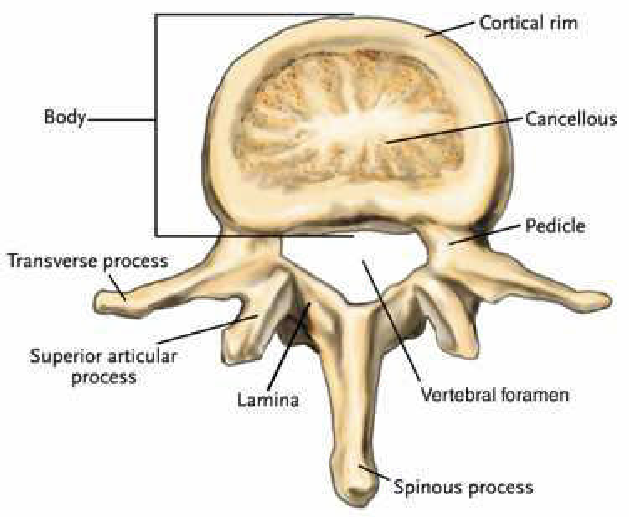


**Fig. 1** Vertebral characters, *Snell, 1996*

## Articulations of the Spine

### Articulations of the vertebral arch

### Facet joint:

The facet joints are formed by the articulation of the inferior processes of one vertebra with the superior articular processes of the next one.

**Syndesmoses:**

The Syndesmoses between the vertebral arches are formed by paired sets of ligamenta flava, inter-transverse ligament, inter-spinous ligament and unpaired supra-spinous ligament.

**The ligamenta flava:**

It connects laminae of adjacent vertebrae in the vertebral canal, their predominance tissue is yellow elastic, whose, almost perpendicular fibers descend from the lower anterior surface of the laminae to the posterior surface of the one below it. ***(Gray, 1967)***.

**The intertransverse ligament:**

They are sheets of fibrous tissue join the transverse processes along their adjacent borders in the thoracic region blend with the intercostal ligaments. Being most distinct between the lumbar transverse processes they may isolated here as membranous band.

**The intraspinous ligaments**

They are relatively weak sheets of fibrous tissue uniting spinous processes along their adjacent borders they are well developed only in the lumbar region and they fuse with the supraspinous ligament.

**Supraspinous ligament**

It lies in the midline. It run posterior to the posterior edge of the spinous processes to which it is attached and bridges the interspinous space. Some of the fibers of the ligament are derived from the posterior part of the interspinous ligaments. It extends from the spinous process of the seventh cervical vertebra to the end of the sacral spinous crest. It resists forward bending of the spine ***(Park 1985)***. Fig.2 shows articulation of the vertebral column

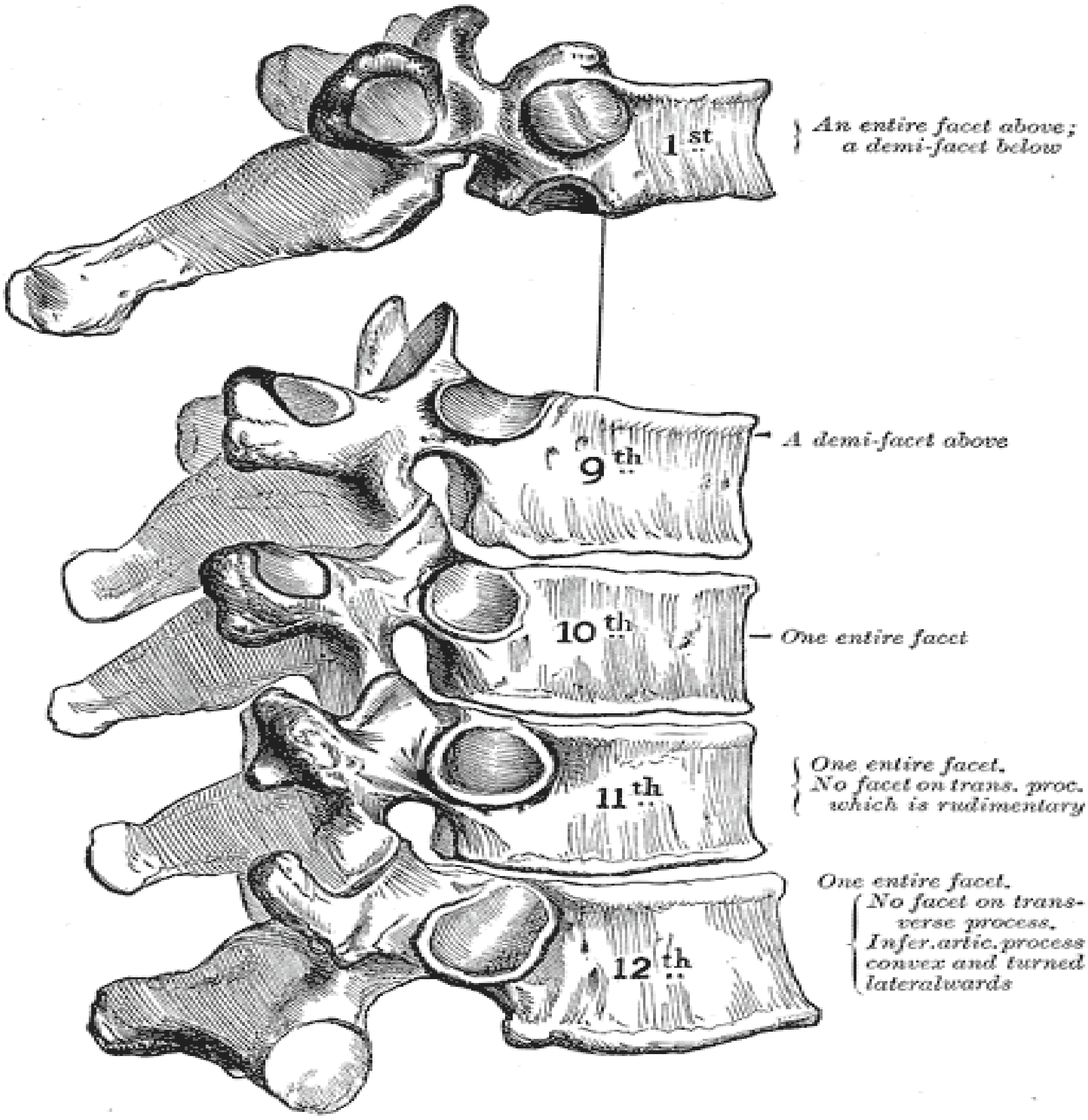


**Fig. 2** Articulation of the vertebral bodies, *Gray, 1967*

## Articulation of the vertebral bodies:

### The intervertebral disc

It is secondary cartilaginous joint or symphysis, the upper and lower surface of each vertebral body are covered by a thin plate of hyaline cartilage.

Each intervertebral disc consists of a central nucleus pulposus surrounded by peripheral anulous fibrosus, two layer of cartilage which covers the top and bottom aspects of each disc, each is called the vertebral end plate. The vertebral end plate separates the disc from the adjacent vertebral bodies ***(Bernhardt and Bridwell, 1989)***.

The vertebral end plate is a layer of cartilage about 1 mm thick covers the area on the vertebral bodies encircled by the ring apophysis ***(Eyrimng, 1969)***.

The function of the disc is to allow movements between the vertebral bodies and to transmit loads from one vertebra to the next. On the rocking movement there is compression of the annulus in the direction of movement and stretching of the annulus on the opposite side ***(Bernhardt and Bridwell, 1989)***.

### The anterior longitudinal ligament:

It is strong band that extend along the anterior surface of the vertebral bodies from the skull to the sacrum. It is narrowest, cord like, in the upper region and broader caudally, also relatively thicker and narrower opposite the vertebral bodies than at the level of the intervertebral symphysis. ***(Williams and Warwick, 1989)***.

### The posterior longitudinal ligament:

The posterior longitudinal ligament is representing throughout the vertebral column. It extends from the skull to the sacrum, but expands laterally over the backs of the intervertebral discs to give it a serrated or saw like appearance ***(Bernhardt and Bridwell, 1989)***.

As the deformity of idiopathic scoliosis is three-dimensional, resulting from viscous-elastic buckling of the spine in both the coronal plane (producing a lateral bend) and the transverse plane (an axial rotation or tensional buckling) to an approximation of Ruler's laws, While this buckling process is essentially physical, for a progressive deformity to ensue, it is a requirement that the buckling process occur during the phase of spinal growth. Thus the product of spinal buckling can be seen as progressive three-dimensional shape deformation. Reciprocally, observation of this deformation process facilitates an understanding of its pathogenesis as well as treatment. There-fore, both biomechanical and biological factors are important. ***(White and Panjabi 1990)***