Three Dimensional Correction of Adolescent Idiopathic Scoliosis

A Thesis

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بسم الله الرحمن الرحيم

قالوا سبحانك لا علم لنا
إلا ما علمتنا إنك أنت العليم الحكيم

البقرة
آية ٣٢

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This work is dedicated to

My Parents

My wife, Sara and Ali

My brothers and sister

Abstract

Adolescent idiopathic scoliosis is a three dimensional deformity of the spine with lateral curvature measuring more than 10° with vertebral rotation and frequently associated with hypokyphosis. It arises in otherwise healthy children at or around puberty. Posterior instrumentation and fusion using hybrid technique (transpedicular screws distally at the lumbar or lower thoracic spine and hooks proximally) was used for correction of scoliosis in three planes by ISOLA spinal instrumentation system.

Key words:

Adolescent idiopathic scoliosis, Posterior instrumentation and fusion, hybrid technique, ISOLA.

Aim of this work:

- Review the literature about: Scoliosis terms, spinal anatomy, biomechanics, and theories of the aetiology, pathology, natural history, clinical, radiological features of idiopathic scoliosis with emphasis on decision making in scoliosis treatment and highlighting contemporary 3rd generation of scoliosis instrumentations as well as methods of intraoperative spinal cord monitoring.

- To perform a prospective study upon forty patients with adolescent idiopathic scoliosis using a spinal system providing three-dimensional correction namely the ISOLA system.

- Analysis of the results and the efficacy of this method of treatment in correction of scoliosis in three planes with average one year follow up.
- To assess the complications of this method of treatment.
- To discuss the results obtained in this study comparing it to results of other studies using relevant methods.

List of Abbreviations:

3-D	3-Dimension
AIS	Adolescent idiopathic scoliosis
AP	Anteroposterior
ATI	Angle of trunk inclination
AVR	Apical Vertebral Rotation
AVT	Apical vertebral Translation
C	Cervical vertebra
CD	Cotrel – Dubousset
CSL = CSVL	Central sacral line = center sacral vertical line
CT	Computed tomography
CTLSO	Cervico-Thoraco-Lumbo-Sacral Orthosis
EMG	Electromyography
Fig	Figure
IAR	Instantaneous Axis of Rotation
L	Lumbar vertebra
Lat	Lateral
LIV	Lower Instrumented Vertebra
Lt	Left
M.R.I	Magnetic Resonance Imaging
MEP	Motor evoked potential
N	number
NMEP	Neurogenic motor evoked potential
PA	Posteroanterior
PHV	peak height velocity

PIF	posterior instrumentation and fusion
Postop	Postoperative
Preop	Preoperative
Rt	Right
S	Sacral vertebra
SRS	Scoliosis research Society
SSEP	Somatosensory evoked potential
T	Thoracic vertebra
TL	ThoracoLumbar
TLSO	Thoraco-Lumbo-Sacral Orthosis
TSRH	Texas Scottish Rite Hospital
UIV	Upper Instrumented Vertebra
VATS	Video assisted thoracoscopic surgery
VSP	Variable Screw Placement

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Introduction:

Scoliosis is derived from the Greek word ‘skoliosis’, which means curvature. According to Scoliosis Research Society it signifies coronal plane deformity (lateral curvature) of the spine measuring more than 10º with rotation of the vertebrae within the curve.
(Qiu et al, 2005)

Scoliosis should be conceptualized as a three dimensional deformity though; twisting of the spine is coupled with curvature producing deformity in both coronal and sagittal planes.
(Perdriolle et al, 2001)

Scoliosis is actually relatively common compared to other musculoskeletal diseases, affecting approximately 2%-3% of the population. It is a morbid process resulting from a wide variety of pathological conditions. In the great majority of patients the cause and the underling mechanism remain obscure (idiopathic scoliosis). Adolescent idiopathic scoliosis is by far the most common type of scoliosis. And as its name implies, adolescent idiopathic scoliosis occurs between the ages of 10 and skeletal maturity. **(Albanese, 2002)**

The treatment of patients with adolescent idiopathic scoliosis (AIS) begins with an estimation of curve magnitude and an estimation of the probability for curve progression. The major determinant of curve progression is the patient's age (both chronological and bone development). Secondary determinants include sex of the patient and rotation of the spine. Once these determinants are assessed, the treating physician can formulate a treatment strategy. **(Newton and Wenger, 2006)**

Although some doubt the effectiveness of brace treatment, the two most widely accepted nonoperative techniques for (AIS) are observation and bracing. Scoliosis braces of many different styles have been developed, the common goal being to modify spinal growth by applying an external force. **(Castro, 2003)**

The goals of surgery for spinal deformity are to correct or improve the deformity while maintaining coronal, sagittal balance and shoulders leveling, improving or at least not harming the function of the lumbar spine, preserving or improving pulmonary function and minimizing morbidity. Cessation of curve progression is achieved with bony fusion between the affected vertebrae while the correction is held and supported by spinal instrumentation until healing is complete. This should be achieved with fusion as few segments as possible. **(Freeman, 2003)**

The posterior approach to the spinal column is the most commonly used. It is familiar to all spinal surgeons and offers a safe and extensile approach that exposes the entire vertebral column and universally applicable to all curve patterns. **(Newton and Wenger, 2006)**

Spinal instrumentation has revolutionized the surgical treatment of (AIS). The true breakthrough in surgical management of scoliosis came in early 1950s when Harrington introduced the first effective posterior instrumentation system for scoliosis. **(Harrington, 1962)**

For more than 30 years, use of the Harrington distraction rod has been the standard surgical treatment for idiopathic scoliosis. Despite its success, the Harrington instrumentation system has several disadvantages. The average coronal curve correction in idiopathic scoliosis is approximately 30%, 15% at two years and twenty years respectively. With the Harrington distraction rods the distraction force is applied only at the two laminae where the hooks are seated. If a load exceeds the strength of the lamina, fracture and loss of correction can result so there is a need for postoperative casting. Distraction inevitably leads to poor control of the sagittal plane and loss of some degree of lumbar lordosis. **(Helenius et al, 2003)**

In the early 1970s Luque introduced the 2nd generation of scoliosis instrumentation, which included sublaminar wires attaching Harrington rods to the spine to improve its stability and more correction of the rotational deformity. **(Luque, 1982)**