SHORT TERM OUTCOME COMPARING CONSERVATIVE AND SURGICAL TREATMENT AMONG ADOLESCENT IDIOPATHIC SCOLIOSIS PATIENT

BY

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ABSTRACT

Adolescent idiopathic scoliosis (AIS) defined as a complex three-dimensional spinal column deformity. The treatment option is observational and surgery. Surgery was offered to patients with likelihood of progression with cobbs angle of more than 40-50 degrees. Scoliosis surgery is a high-risk surgery with possible neurological injury, however it is the treatment of choice for patients with a large curve which has been proven to be successful over the years. Therefore, this study objective is to evaluate short term outcome of the quality of life and functional outcome amongst scoliosis patient whom had undergone surgical correction compared to an observational group by using Scoliosis Research Society-30 Patient Questionnaire (SRS-30). This is a cross-sectional study involving 82 patients with 40 patients in the observational group and 42 patients who were operated within the last 10 years with a minimum of follow up of one year. We compared pre and post-operative Cobb's angle and at the last visit, patients completed the SRS-30 questionnaire. We compared the SRS-30 score between the observational group and surgery group, and evaluated the correlation between the radiographic measure and SRS-30 score. There were 79 females and 3 male patients. Forty-seven (57.3%) were Malay, thirty-three (40.2%) were Chinese and two (2.4%) were Indian. Majority of patients (48 patients, 58.5%) were Lenke's type 1 curve. Mean pre-operative Cobb's angle was 54.21 degrees and post-operative Cobb's angle was 14.88 degree. Curve correction improve significantly after surgery ($P<0.001$). The total SRS-30 overall score for the surgical group was higher compared to the observational group with self-image and appearance score were statistically significant ($P<0.001$). Curve correction however was statistically not significant in relation to SRS-30 scores. In conclusion, AIS patient who were treated surgically has higher SRS-30 score compared to the observational group. Self-Image and appearance were the most significant factor in a patient's perspective. Although the amount of curve correction did not statistically correlated with the SRS-30 score after the operation, it does however related to the clinical appearance of the patient. Hence, we can conclude that surgical outcome is significantly related to better self-image and appearance, hence a better SRS score.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Orthopaedic Surgery

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TABLE OF CONTENTS

Abstract……...ii
Approval Page……iii
Declaration……iv
Copyright Page……v
Acknowledgement……..vi
List of Tables……..ix
List of Figures…….....x
List of Abbrevations……...xi

CHAPTER ONE: INTRODUCTION……..1
1.1 Introduction…….....1
1.2 Objectives
1.2.1 General Objectives……..2
1.2.2 Specific Objectives……..2
1.2.3 Hypothesis……...2

CHAPTER TWO: LITERATURE REVIEW…….3
2.1 Scoliosis
2.1.1 Definition……...3
2.1.2 Classification……..3
2.2 Adolescent Idiopathic Scoliosis
2.2.1 Prevalence……..4
2.2.2 Natural History and Prognosis……4
2.2.3 Aetiology and Risk Factor……..5
2.2.4 Pathophysiology……6
2.3 School Screening Program……..7
2.4 Assessment Method……7
2.5 Clinial Assessment
2.5.1 History……8
2.5.2 Examination……...9
2.5.3 Radiograph……...11
2.6 Classification……14
2.7 Treatment
2.7.1 Bracing……17
2.7.2 Surgery……18
2.7.2.1 Surgery Posterior Approach……19
2.7.2.2 Surgery Antrior Approach……19
2.7.3 Future Technique……..21
2.7.4 Complication……22
2.8 Quality of Life & SRS-30……22

CHAPTER THREE: RESEARCH METHODOLOGY…….……24
3.1 Study Design……24
3.2 Data Collection……25

CHAPTER FOUR: RESULTS……...27
4.1 Result……27
4.2 Sociodemographic Data……27
4.3 Distribution According Curve Type……28
4.4 Statitiscally Analysis
4.4.1 Comparisons of pre- and post-operative Cobb's angle……..29
4.4.2 Overall score post-operative SRS-30 score……30
4.4.3 Correlation radiograph changes with SRS-30 score……31

CHAPTER FIVE: DISCUSSION AND CONCLUSION……....32
5.1 Discussion……32
5.2 Conclusion……...35

REFERENCES..……..36

APPENDIX I: PARTICIPANT INFORMATION SHEET AND INFORMED CONSENT FORM……..44
APPENDIX II: RISALAH MAKLUMAT PESERTA DAN BORANG PERSETUJUAN ATAU KEIZINAN PESERTA……48
APPEDIX III: PROFOMA……53
APPENDIX IV: SRS-30 PATIENT QUESTIONAIRE SCOLIOSIS……56
APPENDIX V: MINISTRY OF HEALTH RESEARCH ETHIC COMMITTEE (MREC) APPROVAL LETTER……63
APPENDIX VI: IIUM RESEARCH ETHIC COMMITTEE (IREC) APPROVAL LETTER……..67
APPENDIX VII: KULLIYAH RESEARCH COMMITTEE (KRC) APPROVAL LETTER……..68

LIST OF TABLES

Table 4.1 : Sociodemographic Data 24

Table 4.2: Comparison the pre- and post-operative Cobb's angles 26

Table 4.3: Overall score SRS-30 and its domain 30

LIST OF FIGURES

Figure 2.1: Image of pelvic bone for Risser Sign 12

Figure 2.2: King's and Moe Classification for idiopathic scoliosis 16

Figure 2.3: Lenke's Classification 18

Figure 4.1: Distribution of patients according to Lenke Classification 32

LIST OF ABBREVIATIONS

AAOS	American Academy of Orthopedic Surgeon
AIS	Adolescent idiopathic scoliosis
CTLSO	Cervicothoracolumbosacral orthosis
HRQOL	Health-related quality of life
IREC	IIUM Research Ethical Committee's
KRC	Kulliyyah Of Medicine Research Committee's
MIS	Minimally invasive spine surgery
MREC	Malaysia Research Ethical Committee's
MRI	Magnetic Resonance Imaging
SRS	Scoliosis Research Society
SRS-30	Scoliosis Research Society 30 questionnaire
TLSO	Thoracolumbosacral orthosis

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

Adolescent idiopathic scoliosis (AIS) is defined as a complex three-dimensional spinal column deformity. AIS is the commonest spinal curvature deformity (Gorman, Kristen & Julien, Cédric & Moreau, Alain, 2012). Scoliosis Research Society (SRS) has defined scoliosis as a lateral curvature of the spine greater than 10 degrees (10˚) as measured using Cobb's method on a standing radiograph (M Kouwenhoven, Jan-Willem & Castelein, Rene, 2009; O Andersen, Mikkel & Christensen, Steen & Thomsen, Karsten, 2006).

The incidence of AIS is most common among adolescent which affect about 80% of total cases. The incidence of scoliosis is about 0.47% – 5.2% among teenagers and school children (Konieczny, Markus & Senyurt, Hueseyin & Krauspe, Rüdiger, 2013). In Malaysia, the prevalence of scoliosis was 1.44% and increase with age. It occurs more commonly in girls compared to boys. (Sabirin, J & Bakri, Rizal & Buang, Saidatul & T Abdullah, A & Shapie, A, 2010).

In Malaysia, option of treatment varies from observation, bracing and surgery. While bracing is mostly conducted by the rehabilitation physician, surgical treatment is offered to a patient with curvature more than 40 degrees (40˚) for lumbar and 50 degrees (50˚) for thoracic. While observation is reserved for those not indicated for surgery or not keen for any surgical treatment.

Scoliosis surgery is a high-risk surgery with devastating complications such as major neurological injury leading to paralysis and permanent disability. However, this

has led to some AIS patients and family to choose for the observational and bracing treatment rather than surgical treatment. This study compares the outcome of two groups of patients, observational and surgical with the hope to assist patients and family in deciding for early surgical treatment and early referral from the primary care centre.

1.2 OBJECTIVES

1.2.1 General Objective

The aim of this study is to measure the short-term outcome in a group of Adolescent Idiopathic Scoliosis (AIS) patients who had been treated with surgical correction compared to observational treatment.

1.2.2 Specific Objectives

1. To evaluate quality of life and functional outcome by using SRS-30 questionnaire in both groups.
2. To compare the patient satisfaction domain with another domain of SRS-30 questionnaire.
3. To correlate magnitude of curve correction with quality of life in post-operative AIS patient.

1.2.3 Hypothesis

1. There is a higher score in SRS-30 for patients who are surgically operated compared to non-surgical patient.
2. Score for patient's satisfaction in their management is higher in the surgical treatment group.

CHAPTER TWO

LITERATURE REVIEW

2.1 SCOLIOSIS

2.1.1 Definition

Scoliosis is a complex rotational spinal deformity with unknown aetiology. First described by Hippocrates, the term "Idiopathic scoliosis" was described in the literature as early as in nineteen centuries. It was defined as a complex rotational, three-dimensional deformity of the spine, with thoracic or lumbar prominence, shoulder imbalance and coronal shift. It involved three planes which first is lateral curvature in the frontal plane, then thoracic lordosis in the sagittal plane and finally presence of posterior rib hump, that causes rotational deformity in the transverse plane (Ghandehari et al, 2015).

2.1.2 Classification

In simple classification, idiopathic scoliosis was classified into infantile, juvenile and adolescent. The infantile group defined from birth till three years old, the juvenile from four years old up to nine years old while adolescent type from ten to sixteen years old of age (Zhang et al, 2016; Miyake et al, 2013).

Diagnosis of Adolescent Idiopathic Scoliosis is made if patient age is more than 10 years old, with the curvature of the spine of cobb's angle more than 10 degrees and absence of other aetiologies of scoliosis.

Other aetiologies of scoliosis include neuromuscular scoliosis, congenital scoliosis and syndromic scoliosis. Neuromuscular scoliosis is a condition that is associated with the neurologic or musculoskeletal disorder such as cerebral palsy, myelomeningocele or muscular dystrophy. Most of these patients have other associated signs & symptoms that help identify the disease. Congenital scoliosis is a condition that result from vertebrae anomaly, congenital fusion or both. This kind of disease usually manifest as early before 10 years of age and can be identified clinically from plain radiograph. Syndromic scoliosis is a condition that is part of the genetic disorder such as in Marfan syndrome, osteogenesis imperfecta or neurofibromatosis. Most of this patient has clinical features suggestive of the syndromic disease. But in some cases, scoliosis may be the first manifestation in the presentation.

2.2 ADOLESCENT IDIOPATHIC SCOLIOSIS

2.2.1 Prevalence

The current prevalence of Adolescent idiopathic scoliosis (AIS) is estimated at 0.47-5.2%. Girls are more affected compared to boy with a more severe curve angle. Female to male ratio is about 1.5:1 to 3:1, with increasing of age. In general, less than 10% of a screened adolescent with scoliosis will require further treatment (L Weinstein, S & V Ponseti, I., 1983)

2.2.2 Natural History And Prognosis

The natural history of scoliosis patient are related mainly to the severity of curve magnitude, the location of the curve, the skeletal maturity and sex. Most complication for untreated scoliosis is related to the severe deformity from progressive curve, back

pain, cardiorespiratory complication and health psychological impact. Presentation with curve magnitude of fewer than 30 degrees at skeletal maturity tends not to progress. With the thoracic curve, about 50 – 75 degree, curve tend to continue to progress approximately 1 degree per year. The lumbar curve also tend to progress especially if it was associated with significant rotational deformity (Ascani et al, 1986).

Back pain in scoliosis patient is variable. It can be equal with general population (L Weinstein et al, 2003) or the severity of back pain can be chronic and greater in intensity or duration in scoliotic population compared to general population (Pehrsson et al,1991).

Mortality risk in AIS is not well recognized, however, it is known that large curve magnitude in scoliosis patient is related with severe pulmonary function. Large curve with thoracic apex has been known to cause reduced pulmonary vital capacity and result in restrictive pulmonary disease but rarely result in cardiopulmonary compromise (Pehrsson et al, 1991; King, H.A. & Moe et al, 1984).

2.2.3 Aetiology And Risk Factor

Several aetiologies were identified for development of scoliosis. Idiopathic scoliosis as its name implies, the aetiology is unknown. Genetic was believed to be the cause for scoliosis development. However, it was inconclusive whether the disorder is X-linked, multifactorial or autosomal dominant (Qiu, Yong & Zhu et al, 2009). Familial hereditary background and four pairs of twin have given significant genetic factor that accounts for the development of scoliosis (E Lonstein, J, 1994). If parents have a background of scoliosis, there are 50% risk of their children to have scoliosis (Jada et al, 2017). Besides the mentioned aetiologies, several other factors are also known to the development of AIS such as biomechanical growth modulation, dorsal shear forces and axial rotational

instability, uncoupled spinal neuro-osseous growth, postural abnormalities and hindbrain dysfunction, motor control problems, systemic melatonin-signalling pathway deficiencies, and systemic platelet calmodulin dysfunction (Kanayama et al, 1996).

2.2.4 Pathophysiology

Since the most common period of idiopathic scoliosis appears in childhood and adolescent, there is theory speculating a period of rapid growth together with disproportional growth in between anterior and posterior structures result to the development of scoliosis. As a growing child, imbalance growth of anterior structures overpowers the growth of posterior structures, and this will lead to bodies of vertebrae at apex region to move out of the way by turning to the side, finally result in rotational and forward bending deformity (Dickson, RA, 1983; Willner, S & Johnson, B, 1983). A girl with scoliosis is found to be taller and leaner compared to their peers. They are also slenderer and has a longer spine. Their spinal column are found to grow faster after puberty as compared girls without scoliosis. It is suggestive that in early adolescent, a rapid growth of anterior vertebrae results to a failure of posterior ligaments, resulting in buckling of a spine and finally cause in spinal lordosis. This segment of lordosis will translate to the side during forwarding resulting in scoliosis (Baba et al, 2017; Htwe, Kyin & Tajuddin bin Abdullah et al, 2013).

2.3 SCHOOL SCREENING PROGRAM

The school screening program was first conducted in 1962 in Delaware and widespread all around the United State of America and Canada. Japan is the only country in the world that scoliosis screening school program was mandatory by law. Meanwhile, in the South East Asia region, the scoliosis school screening program was initiated by Singapore in 1981 (Wong et al, 2010). American Academy of Orthopedic Surgeon (AAOS) and the Scoliosis Research Society (SRS) endorsed the concept of a scoliosis school screening program in 1984 to identify a child with a risk of developing scoliosis. This screening program effectively able to detect scoliosis early and plan of surgical treatment able to perform early and effectively (Labelle, Hubert & B Richards et al, 2013).

2.4 ASSESSMENT METHOD

School screening program has been widely accepted where a girl is screened twice at age of 10 years and 12 years, while boys are screen once at age of 13 or 14 years old. The clinical signs used to identify affected child are asymmetry of shoulder, disproportionate of scapula prominence, increase space in between arm and body in one side compared to opposite side, head not centred over the pelvis and Adam's forward bending test. A scoliometer is used to objectively measure a rotational deformity in Adam's forward bending test and result with trunk rotation more than 7 degrees is indicated for a referral or confirmed the diagnosis with whole spine x-ray (Labelle, Hubert & B Richards et al, 2013).

2.5 CLINICAL ASSESSMENT:

2.5.1 History

Evaluation of scoliosis patient starts with a comprehensive history and complete physical examination. The aim of assessment is to find a cause of scoliosis and identify an idiopathic type scoliosis and looking for a possible cause of rapid progressive curvature.

Detailed history includes the age of onset, history of progressive spinal deformity and how the deformity was identified. Typically, a child presents with a history of the chest wall or back asymmetry that is identified by friends, parents or during the school screening program or a routine medical checkup for boarding school or college and university. Sometimes patient may complain of disproportion of the breast, unequal shoulder balance, irregular waistline or something wrong with their dress appearance.

Other associated symptoms such as back pain, neurology symptoms or respiratory problems should be included in the history. Back pain is not a usual complain in AIS patient, however, it comes across in one-quarter of scoliosis patient who comes with back pain (Ramirez et al, 1997). However, the character of pain needs to be determine as most of the pain is benign pain and not specific back pain or not related to scoliosis. History of night pain, which relieves after taking analgesia or non-steroidal anti-inflammatory analgesia might suggest osteoid osteoma of a posterior element of a spine that cause the scoliotic deformity. Persistent back pain that is associated with constitutional symptoms such as fever or red flag sign requires immediate attention as it may be associated with infection.

Neurology assessment needs to be assessed carefully, such as a motor or sensory weakness, gait, imbalance or coordination. Bowel and bladder function also need to be evaluated as it might be related to spinal cord diseases such as syringomyelia or tethered cord.

2.5.2 Examination

Patients with scoliosis require thorough examination, which starts with adequate exposure by uses of examination gowns that opens at the back, with undergarments exposing both iliac crests anteriorly and posteriorly (O. Tachdjian, Mibran, 1997). The examination starts with inspection which needs to be done from behind and actively assess the symmetry of shoulder, scapulae, waistline or distance of arm from the trunk. From the side observe the lateral curvature of the spine. Commonly idiopathic scoliosis patient associated with reducing thoracic kyphosis. Presence of increased kyphosis might be associated with other aetiologies (Loder, Randall & Stasikelis et al, 2002).

In skin examination, Café-au-lait spots and axillary freckling present in neurofibromatosis, vascular or pigmentary changes associated with spinal dysraphism and lumbosacral dimpling also associated with occult spinal dysraphism. Skin laxity which is a common sign in Ehlers-Danlos syndrome, Marfan syndrome or osteogenesis imperfecta.

During Adam's bending test observe the prominence of thoracic or lumbar and measure the angle of trunk rotation with scoliometer. This test is done by observing patients back from behind while bending forward at the waist until the spine is parallel to the horizontal line of a floor with a position of feet are together, knee straight and arm are hanging freely. By observing the prominence of thoracic hump or lumbar side which are signs of presence of a structural scoliosis. Thoracic hump is a result of the ribcage

rotating along the thoracic spine (W. Grossman et al, 1995). The assessment of angle of trunk rotation (ATR) need to be done and it is measured with scoliometer. However, the value in ATR are not the same as Cobb's angle that are measured in a radiograph.

The hump or prominence location will give a clue of the underlying causes of scoliosis. In structural scoliosis, the rotational prominence is located over the convex side of the curve as compared in limb length discrepancy the prominence more over the concave side of the curve (Newton PO et al, 2014). The sensitivity of Adam Bending Test is largely dependent on the examiner, location of the curvature and degree of cobb's angle as a standard reference in school screening program (Côté, Pierre & G. Kreitz et al, 1998; J. Goldberg et al, 1995). Meanwhile use of scoliometer is also largely operator dependent, as reliability study has been done that showed minimal error that mainly result from the size of the ball which related to the marking of a ruler, wrong identification of the curve apex and inconsistent method of the examination test (Côté, Pierre & G. Kreitz, et al, 1998; Murrell et al, 1993).

Neuromuscular assessment needs to be done properly as a need to exclude another type of scoliosis. Looking for intrinsic muscle wasting that may suggest syringomyelia or any other type of motor neuropathy. Feet also need to be examined for any deformity such as pes cavus, hammer toe, claw toe or equinus that may suggest any neuromuscular disease. Full and thorough neurological assessment needs to be done starting from gait and including deep tendon reflexes. Abdominal reflexes are most important as any asymmetry of abdominal reflexes may indicate possible intraspinal lesion. This examination is done by a light stroke over one side of the upper, middle and lower abdomen and the normal response is shown by pulling of umbilical and contraction of the abdominal muscle (G Zadeh et al, 1995; Yngve, David, 1997).

2.5.3 Radiograph

The radiograph is the basic investigation in aiding the diagnosis of scoliosis by evaluating the aetiology of scoliosis, the curve pattern and measure the Cobb's angle and to evaluate the skeletal maturity (O. Tachdjian, Mibran, 1997; Newton PO, Wenger DR, Yaszay B, 2014; Cassar-Pullicino, Victor & Eisenstein, Stephen, 2002). A radiograph is indicated for paediatric or teenager patient which is clinically suspicious of scoliosis with a present of thoracic or lumbar asymmetry in an examination, family history of scoliosis or scoliometer reading with more than 7' in children (L Skaggs, D, 2001). It is also useful in continuously monitoring the progression of the spine in scoliosis patient during visiting an outpatient clinic.

Radiograph standard view for scoliosis patient is standing, full-length posterior-anterior (PA) and lateral view of the whole spine that expose from C7 till sacrum and iliac crest. Radiograph exposure was taken in PA view to reduce the radiation, while taken in standing can eliminate the underestimation of curve magnitude by gravity effect. Lateral view radiograph is useful in the assessment of lateral curvature in the sagittal plane. Lateral bending radiograph is required only for planning the surgery (L Skaggs, D, 2001).

Radiograph finding is to confirm the diagnosis of scoliosis with PA view. Looking for the abnormalities such as increase in soft tissue shadow surround the paraspinal region, abnormalities of vertebrae shape (wedge vertebrae, hemivertebrae) which is suggestive of congenital scoliosis, any pedicle or vertebrae body lucency or erosion that may indicate tumor or infection, widening of interpeduncular space that can be seen in syringomyelia, spinal cord tumor, diastematomyelia or spinal dysraphism. Findings typical in AIS patient is reduce in thoracic kyphosis, however, if there are

increased in thoracic kyphosis there might be another underlying pathology need to be rule out (Loder, Randall & Stasikelis et al, 2002). The typical curve in AIS patient is a right thoracic or left lumbar double curve. The direction of the curve is defined by the direction of convexity, the direction is defined by the apical vertebrae which are vertebrae most deviated and rotated from the spine midline (O. Tachdjian, Mibran, 1997).

Cobb's angle is defined as an angle that is formed from intersection of 2 parallel lines, a line formed from superior endplate of the most tilted cephalad vertebrae in particular curve with another line formed from inferior endplate of the most tilted caudad vertebrae of a given curve, and this angle is a standard quantitative monitoring of disease. However, the inter- and intra-observational measurement is high and it is approximately 5 degrees and it is not directly proportional to the severity of scoliosis and it only measures a single plane only not a three-dimensional plane a disease deformity (L Carman, D & H Browne, R & G Birch, J, 1990).

The pelvic x-ray are also used for assessment of the skeletal maturity. It is important to determine disease progression. Risser sign is a visual grading of the ossification and fusion of iliac apophyseal from anterolateral to posteromedial along the iliac crest that used to asses the skeletal maturity.

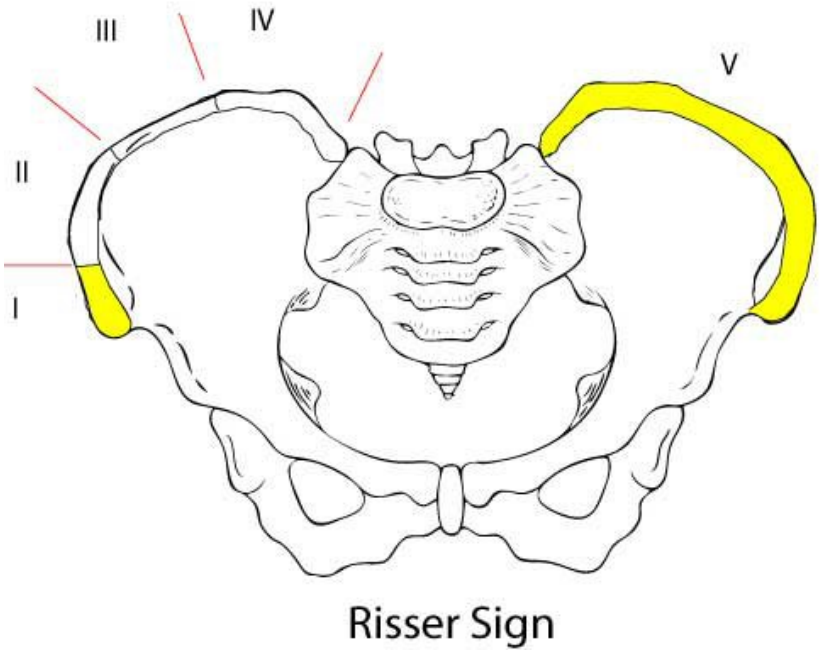

Figure 2.1 Image of pelvic bone for Risser Sign

Grade of Risser sign:

0 – no ossification

1 – 25% ossiciation

2 – 25 – 50% ossification

3 – 50 – 75% ossification

4 – more than 75% ossification

The lower grade of Risser sign, the higher risk of disease progression (Little, David & Sussman, Michael, 1994).

Magnetic Resonance Imaging (MRI) might be indicated for scoliosis patient with suggestive intraspinal pathology such as a tumour, syringomyelia, or dysraphism