MEASUREMENTS VARIATIONS IN SCREENING FOR SCOLIOSIS

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Background: Recently, an increase of scoliotic patients is a major problem for medical health services, calling for proper counter measures school screening and treatment to be started without delay. Accurate noninvasive measurements of spinal curvature are crucial in detecting scoliosis in school and assessing therapeutic intervention. Purposes: The purposes of the current investigation is to early identify scoliosis by screening which permits the more progressing curves to be treated by physical therapy and determine intra and inter- therapist reliability for measuring spine angle with two dimensional motion analysis. Material and Methods: Forty-two subjects with Adolescent Idiopathic scoliosis (12 females, 29 males), age (13.4 ± 1.43) years, weight (49.08 ± 5.77) kilograms, length (154 ± 8.67) centimeters divided into 2 groups A=Thoracic and B= Thoracolumbar were evaluated by both 2-D video motion analysis and x-ray. Results Based on the findings of the present study the measurement obtained from spine track system and cobb's angle measurement from X ray with AIS patients ICCs values Thoracic are 0.86,0.83 and 0.73 for Thoracolumbar are 0.79, 0.89 and 0.78 for first, second and third testers respectively. Measurements made by the same or different investigators with the 2D spinal track generally have well to high reliability. The intra-tester reliability is slightly higher than inter-tester reliability.

Conclusion. Differences in agreement between physical therapist were relatively minor. These results indicate that physical therapists are able to assess 2D motion analysis noninvasive method reliably for repetitively assessing spinal angle.

Key Words: School screening, Reliability, Scoliosis, 2-D motion analysis, X-ray
INTRODUCTION

Posture is the attitude which is assumed by body segments in relation to each other to maintain stability and balance with minimum effort and least strain during performing certain activity. Good posture is a state of muscular and skeletal balance, which protects the supporting structures of the body against injury and progressive deformity; it can be maintained by adjusting the position of the head and limbs in relation to the trunk. (Grobowski, 2003).

Scoliosis is a complicated deformity that is characterized by both lateral curvature and vertebral rotation. The initial age, gender, pubertal status, and initial curve magnitude were used as risk factors to predict the probability of curve progression to more than 30° at skeletal maturity. (Tan, et, al, 2009). There is no sufficient etiological data in the literature for the prevalence of scoliosis in several geographical areas especially in GCC countries. (Corea, et al 1993)

An increase of scoliotic patients is a major problem for medical health services, calling for proper counter measures and treatment to be started with out delay (Mooney, et al 2000). The combined effects of heavy loads in school bag, position of the load on the body, size and shape of the load, load distribution, time spent carrying, physical characteristics physical condition of the individual and bad posture were hypothesized as factors which were associated with these problems. (Wileznski, 2006)

Adolescent Idiopathic Scoliosis (AIS) is the most common type of scoliosis, accounting for 80% of all cases; it is more common in female adolescent (95%) than in male adolescent (Benameur, et al 2003). when the deformity is mild. Pain, difficulty sitting or standing, stiffness and spinal rigidity are often associated with scoliosis muscle spasm, or rib prominence on one side and leg length discrepancy, which often results in gait dysfunction. Curvature of AIS can progress to cause significant trunk deformity and eventually cardiorespiratory compromise but also, cosmetic and emotional problems. Grivas B and Marine (2007). Early detection and evaluation has led to successful management of scoliosis (El –Sayyad, 2005).

School screening for scoliosis as a part of the health care system has expanded rapidly during the past decade and has been important in improving the understanding of this partially understood spine deformity (Grivas, et al 2008). A positive health effect of the screening programme would be the alleviation of anxiety in knowing (or believing) that surgery has been avoided by the more moderate option of controlling the progression of the spinal curvature by bracing. .While it is acknowledged that being screened and evaluated for a possible spinal curve may be accompanied. It is alarming that almost half of the school children reported complaints of muscle soreness, neck and/or shoulder and of the back. Gender, psychosomatic factors and the perceived weight of the bag were the main factors associated with the occurrence of complaints. Early identification of high-risk young patients with idiopathic scoliosis is mandatory in order to apply efficient treatment (Soultanis, et al
The incidence of scoliosis in third world countries is unavailable because lack of survey studies on epidemiology of scoliosis (El–Sayyad, 2010). Although its predictive value has not been established to the satisfaction of all, scoliosis screening has been an important factor in improving knowledge about this spinal deformity. (El-Sayyad, 2000; Filo. et. al. 2009).

The purpose of school screening is to identify most or all the individuals with unrecognized idiopathic scoliosis. (Bunnell, 2005) In his study supports the screening program as it allows the nonoperative management and further suggests that in order to reduce the inflated cost of screening, re screening should be done of borderline cases rather than referring those for further management Conservative treatment may alter the natural history of scoliosis. (Richardson, L 2003). Moreover, the results of school screening programs provide valuable data regarding the prevalence and the natural history of idiopathic scoliosis. (Elvin M, et al 2008). On the other hand, approaching the ‘psychological’ issue from a different viewpoint it could be stated that any negative impact of early diagnosis is intrinsically linked to the absence of effective therapies and failure of professional education and support; given appropriate resources to treat effectively. (Donald, et al (2008). Even in the absence of effective strategies and lack of support from the medical community available in some cultures, early on knowledge of the diagnosis provides patients with the tools to educate and help themselves. (Hansen, et al 2003)

Objective measurement of spinal curvature are crucial in evaluating, there are several methods available using surface topography to estimate the spinal curves in adolescent scoliosis patients. (El-Sayyad, 1988 and Soultanis, et al 2009) planning treatment (Weiss H et al 2006), follow up (El-Sayyad, and Conine,1994), and assessing curve progresses in adolescent idiopathic scoliosis. (El-Sayyad,1986). The best means of assessing patients for scoliosis also has been debated. (Donnelly M, et al 2007). The Adams forward-bending test, Radiologic evaluation, Moiré topography, the scoliometer, and the humpometer were used. The most commonly performed test in school screening is the Adams forward-bending test, yet its effectiveness in school screening has been questioned.

Various radiographic and clinical factors are important in Physical therapy intervention and surgical planning. Hackenberg L, et al (2003) For adolescent idiopathic scoliosis, an analysis of the end, neutral, and stable vertebrae are of paramount importance for understanding spinal deformity management and determining the distal fusion level. Additionally, the development and comparison of optimal surgical techniques (Chan C, et al 2009), requires reliable, reproducible radiographic parameters The full-spine radiographic examination remains the standard procedure for the assessment of scoliosis Exposure to diagnostic radiation in patients with adolescent idiopathic scoliosis may result in a small but significant increase in cancer rates. The risk of a fatal tumor for each examination in males is 4.075 (Aulisa1, et al 2009). The purposes of this investigation is to early identify scoliosis by screening which permits the more progressing curves to be treated by physical therapy and determine intra and inter- therapist reliability for measuring spine angle with two dimensional motion analysis.

**Material and Methods**

In April 2008, the physical therapy research committee at Gulf College of Allied Health Sciences endorsed the concept of school screening for the early detection of scoliosis.
School Screening Program

School Screening set up on a district basis (Ajman and Sharjah) 85 schools (100 students from each) after obtaining permission from the local authorities, because such a program is not legislated in United Arab Emirates. All the interested parties (parents, Principles, school staff, and nurses) were informed and when it was necessary, they were further educated by distribution of informative material and lectures. The cooperation of the screening staff with the parents, the pupils and the teachers were essential for the acceptance of this voluntary program and thus for a success. School screening programs should also meet specific criteria. They should be rapid, accurate, low-cost, use tests which are easily reproducible and have low false positive and false negative results.. Early identification of high-risk young patients with idiopathic scoliosis is mandatory in order to apply efficient treatment. (El-Sayyad, 1986)

Preparation for School screening

One month before visiting a school the head-master (Principle) was informed about the program by the Principle Investigator and educational material was distributed. The parents were asked to sign a consent form and the pupils were asked to fill particular forms regarding their personal data. The program was performed once a week, during the school period phase I (September 2008 -to June 2009) and phase II September 2009 -to (June 2010).

Subjects

Forty-two subjects with Adolescent Idiopathic scoliosis (12 females, 29 males), age (13.4 ± 1.43) years, weight (49.08 ± 5.77) kilograms, length (154 ± 8.67) centimeters divided into 2 groups A=Thoracic and B= Thoracolumbar were evaluated by both 2-D video motion analysis and X-ray Design and Flow of Participants throughout Trial (Fig .1.)

Inclusive criteria

Having a mild to moderate scoliotic curve (Cobb angle ranged from 10 to 30 degree). Having a significant translational and/or rotational deformities of the thoracolumbar spine with point value ranged from (11-20) according to posture index scale

Exclusive criteria

- True leg length discrepancy.
- Previous spinal surgery.
- Associated pathologies that may interfere with maintaining an erect standing posture such as cerebellar or inner ear disorders.
- Associated pathologies of lower limbs that may interfere with the global posture as foot, knee and hip deformities.
- Obese subjects.
Fig. 1. Design and Flow of Participants throughout Trial

Table 1: Characteristics of subjects with AIS.

<table>
<thead>
<tr>
<th>Scoliosis</th>
<th>N</th>
<th>Age (years)</th>
<th>Weight (Kg)</th>
<th>Height (Cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ±SD</td>
<td>Mean ±SD</td>
<td>Mean ±SD</td>
</tr>
<tr>
<td>Thoracic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>♂</td>
<td>11</td>
<td>14.00 ±2.82</td>
<td>53.84 ±4.27</td>
<td>160.22 ±2.63</td>
</tr>
<tr>
<td>♂</td>
<td>6</td>
<td>13.60 ±3.86</td>
<td>51.62 ±6.51</td>
<td>146.24 ±4.28</td>
</tr>
<tr>
<td>Thoracolumbar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>♂</td>
<td>19</td>
<td>12.66 ±5.85</td>
<td>50.47 ±10.01</td>
<td>156.31 ±8.30</td>
</tr>
<tr>
<td>♀</td>
<td>6</td>
<td>14.84 ±3.01</td>
<td>49.65 ±7.81</td>
<td>148.49 ±5.74</td>
</tr>
</tbody>
</table>
Preparation of the subjects:

They were informed about the measurement of spinal angles by spinal track motion analysis; Anthropometric measurements were measured by meter and weight scale before measurements; Subjects of AIS were evaluated clinically before the measurement. Subjects were informed that they would be wearing hospital gowns to allow exposure their backs. Each subject given certain instructions before assessment as the following instruction during the experiment.

Measurements

Prior to examination the screening staff collected the filled forms and personal data for every pupil (date of birth, sex, stage of puberty, eye and hair color, height, weight, handedness) and socioeconomic parameters (parent’s age, origin and profession) were recorded. Groups of 25-30 pupils were subsequently invited into the examination room. Children were wearing their trousers and a plain T-shirt. Firstly, the child was inspected in a standing position for possible deformities of the extremities, shoulder or pelvic asymmetry, lateral body inclination and asymmetry of the distance of the elbows from the trunk. Then, bending test in standing and sitting position was performed. In Adams forward-bending test, the patient bends forward at the waist with knees straight and arms together and hanging toward the floor, and the back parallel to the floor. The examiner looks along the axis of the spine for Rotatory asymmetry of the trunk. A difference of 8 mm in height between sides is considered abnormal. Asking the child to freely bend forward hanging his hands to the ground, keeping arms opposed, feet together and knees straight for the inspection of a possible hump. Standard posteroanterior (PA) and lateral views of the entire spine are used for the initial evaluation. Standing films X-ray because they show the characteristics of the curve under gravity, with its compensation and torso-pelvic relationships. Supine, coned-down views of the anomalous region are especially helpful for visualizing defects and their patterns, while bending films allow evaluation of rigidity or flexibility of the curves and their adjacent motion segments.

Examiner’s skills and experience are important factors in screening outcome Grivas B and Marine (2007). Forty two subjects with scoliosis participated in this study; they were referred from orthopedic physician. The initial age, gender, pubertal status, and initial curve magnitude were used as risk factors to predict the probability of curve progression to more than 30° at skeletal maturity. (Soultanis, et al 2009) criteria idiopathic scoliosis subjects from mild to moderate degree of scoliosis (5°-30°). Evaluation begins with a thorough history, physical examination (Fig.2.)

Fig.2. Physical Examination of the back
and postural analysis, forward bending and hanging in wall bar to differentiate between mild and moderate (Fig.3.)

**Forward Bending Test**

- **Patient position**
  - Patient with shirt off and spine fully visible
  - Forward bending with feet together and knees straight
  - Allow arms to hang down freely (or palms opposed)

- **Examiner position**

  Observe patient from behind abnormal findings: Unilateral changes Rib cage elevation on one side prominent unilateral lumbar paravertebral muscle

![Fig.3. Examination on the wall bar](image)

**Instrumentation and measurements**

Images of the back for each subject in two views (Antero posterior and lateral view) were taken. Each subject was asked to stand on the x-ray device to the vertical table and both arms beside body when taken the anterior posterior view and when taken lateral view both arms behind back and each subject is taken deep breathing before the two views (Richarboxon, 2003).

**Lateral view**

After the patient finished the x-ray assessment the cobb angle calculated by the investigator to ensure reliability of cobb angle measurement:

- Locate the top vertebra of the curve. It is the highest one whose superior surface tilts to the side of the concavity of the curve to be measured.

- Locate the bottom vertebra. It is the lowest one whose inferior surface tilts to the side of the curve to be measured.
Erect intersecting perpendicular from the superior surface of the top and the inferior surface of the bottom vertebrae of the curve. The selection of the end vertebrae and the top and bottom vertebrae is aided a study of the disc spaces. All of the vertebrae in a given curve will show widening of the disc space on the convex side of the curve. The angle formed by these perpendiculars is the angle of the curve.

Passive markers

Light-weighted passive reflective markers indifferent sizes and shapes depending on the application (Fig. 4). The choice of marker size or shape depends on several factors, such as distance to measurement object, size and specific shape of measurement object, choice of measurement points to be captured and type of marker placement. Markers with half sphere of 2.5mm and 4mm were be used in the present study. In order to improve standardization and reduce the possibility of markings on the skin being visible to the next tester, alcohol was used to clean the skin at the site of marker placement after each trial.

- Just front to right and left tragus.
- Between the eyes.
- Right and left acromion processes.
- Epi-ternal notch.
- Zyphoid process.
- Right and left anterior superior iliac spine (RASIS&LASIS).
- In the middle of the distance between RASIS and LASIS.
- Right and left knee.
- Center of the left and right ankle (talus).
- In the middle of the distance between both heels.
- In the middle of the distance between RASIS and right posterior iliac spine (RPIS).
- Lateral malleolus.

On the spinous processes of C7, T2, T5, T7, T9, T11, L1, L3, S1

![Fig.4 Measurements of Angle of Spinal Curvature by spin track](image)

In this study video analysis motion 2D capture system was used to measure angle of spinal curvature of scoliotic subjects by using reflective marker to be placed over 9 spinous process to determine the curve, they are silver in colour and of 4mm square surface area and
adhered to the spinous process by using adhesive double face plaster. In the inter and intra rater trial, three physical therapist measured the spinal angle for patients with idiopathic scoliosis (42) twice each with one week in between using the 2 D Video Motion Analysis.

Data analysis

All analyses were conducted using SPSS statistics package, version 10.0. Descriptive statistics were used for means and standard deviations. Paired t-test was used to analyze significant differences in measurement by using 2D Spine track motion analysis and x-ray photogrammetry. All statistically significant differences were determined with a confidence interval of 95% and thus at up <0.05.

Results

Based on the findings of the present study the measurement obtained from spine track system and cobb's angle measurement from X ray with AIS patients found that highly correlated (+0.84). The results of the current study, showed that the measurement of thoracic angle was x ray measurements (17.54 ± 4.58), and spinal track (16.81±1.59) with no significant differences where the t-value was (-.34) and the p-value was (0.77). Spearman's rho correlation for thoracic group was performed to reveal that there was strong correlation between x-ray and spine track where the r value equals (0.84) and had an associated probability value of (0.001) for spine track measurement.

Table .2. Mean and SD for the thoracic level for group (A).

<table>
<thead>
<tr>
<th>Thoracic Group</th>
<th>X-ray</th>
<th>Spine track</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>17.54</td>
<td>16.81</td>
</tr>
<tr>
<td>SD</td>
<td>±4.58</td>
<td>±1.59</td>
</tr>
<tr>
<td>t-value</td>
<td>-0.34</td>
<td></td>
</tr>
<tr>
<td>P-value</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

*SD: standard deviation, t-value: t-test, P-value; probability, S: significance, NS: non-significant.

Fig.(5): Mean and ±SD of the thoracic group.
Spearmen’s rho correlation for thoracolumbar group (B) **Thoracolumbar** was performed to reveal that there was strong correlation between the two measurements where the r value equals (+0.86). By spine track measurement, the lumbar angle was (14.50 ± 4.37) and x-ray measurement was (14.12 ± 3.90). The results showed that there was no significant difference between the two measurements.

Analysis of variance for repeated measures Intra tester reliability:

Intra-tester Reliability:

Intra-examiner and inter-examiner reproducibility of spinal angle measurements: Intra-tester Reliability Table (3), present the ICC for each of the three tester for measuring spinal angle. ICCs values Thoracic are 0.86,0.83 and 0.73 for Thoracolumbar are 0.79, 0.89 and 0.78 for first, second and third testers respectively.

**Table (3): Intra-tester reliability for cervical AROM for each of the three testers**

<table>
<thead>
<tr>
<th>Spinal Angle</th>
<th>ICC(2,1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st Tester</td>
</tr>
<tr>
<td>Thoracic</td>
<td>0.86</td>
</tr>
<tr>
<td>Thoracolumbar</td>
<td>0.79</td>
</tr>
</tbody>
</table>

1. Inter-tester Reliability

Table (4) and present the ICC(2,3) for the three tester for the Measurements of spinal curvature at the first and second times of measurements. For the first time of measurements, ICCs values are 0.81 for Thoracic, 0.85 for extension, 0.81 for Thoracic. For the second time 0.86 for Thoracolumbar the first time of measurements, ICCs values are 0.75. For the second time 0.84.

**Table (4): Inter-tester reliability for spinal angle for the first and second time of measurement.**

<table>
<thead>
<tr>
<th>Cervical motion</th>
<th>ICC(2,3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st Time</td>
</tr>
<tr>
<td>Thoracic</td>
<td>0.81</td>
</tr>
<tr>
<td>Thoracolumbar</td>
<td>0.75</td>
</tr>
</tbody>
</table>
Repeated measures ANOVA for spinal angle: Application of two way randomized block ANOVA revealed no statistical significant difference for first time of measurement, where F value within subjects was 1.656 and (P=0.2) and F value between subjects was 5.219 and (P=0.0001) and no statistical significant difference for second time of measurement, where F value within subjects was 3.08 and (P=0.054) and F value between subjects was 39.45 and (P=0.0001) as shown in table (5,6).

**Table (5): Results of ANOVA spinal angle (1st time).**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within Subjects</td>
<td>68.267</td>
<td>2</td>
<td>34.133</td>
<td>1.656</td>
<td>0.1999</td>
</tr>
<tr>
<td>Between subjects</td>
<td>3120.7</td>
<td>41</td>
<td>76.76</td>
<td>5.219</td>
<td>0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>1195.7</td>
<td>82</td>
<td>14.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4384.4</td>
<td>125</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table (6): Results of ANOVA for spinal angle (2nd time).**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within Subjects</td>
<td>17.156</td>
<td>2</td>
<td>8.578</td>
<td>3.08</td>
<td>0.054</td>
</tr>
<tr>
<td>Between subjects</td>
<td>3186</td>
<td>41</td>
<td>109.86</td>
<td>39.452</td>
<td>0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>161.51</td>
<td>82</td>
<td>2.785</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4246.2</td>
<td>125</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The analysis of data revealed the following findings: Repeated spinal angle measurements of a subject made by the same or different investigators with the 2D spinal tracks generally have well to high reliability. The intra-tester reliability is slightly higher than inter-tester reliability.

**Discussion**

Based on the findings of the present study the measurement obtained from X ray and from spine track system with AIS patients found that highly correlated with cobb's angle measurement. These results suggested accepted of null hypothesis that stated that there is no significant difference between two measurements of patients with AIS. These results revealed that the spine track measurement system is a good device for measuring the angle of
spinal curvature in physical therapy clinic for follow up of adolescent idiopathic scoliosis patients. Because of the high variability between researchers who used to measure the angle of spinal curvature.

A variety of alternative supplementary spinal diagnostic procedures for measuring scoliosis found a good correlation with Cobb's angle measurements. (El-Sayyad, 1986) who developed integrated shape investigation system, has found a good correlation between lateral asymmetry of spinal curvatures and Cobb's angle measurement. As well as, (El-Sayyad, 1988 &1993) using moiré topography for measuring angle of spinal curvature in a comparative study with X-ray in patient with AIS found a good correlation between the two measurements. Also these findings were in agreement with a researcher evaluated the lateral asymmetry of spine. (Hackendarg, 2003) with AIS patients by using raster stereography and Cobb's angle measurements and concluded that a high correlation between the two measurements. In addition to number of radiographs can be reduced considerably both in conservative and operative clinical courses.

It is well-documented that the incidence of scoliosis progression increases with an increase in curve magnitude. (Lonstein 1988) showed a direct correlation between the magnitude of the original curve and the incidence of progression. Highest probability of progression occurred in girls, who among other factors, had a Cobb angle of more than 16 degree. Two students have had a Cobb angle of more than 25, it is likely that without the screening programme, the majority of these students would have required surgery, without which their curves would have progressed to become severe curves with poor cosmesis and possible cardiopulmonary complications (Pruijis J, et al 1994).

The ICC model was used to assess the reliability of spinal track measurement of scoliotic angle. This model was selected as it has the ability to accurately estimate the degree to which multiple measures of the same subject agree with one another. The intra examiner reliability of the spine track system reading in this study was good to very good. The mean differences between readings were less than 4° and it is believed that differences are well within the accepted error range for angle assessment. The inter examiner reliability of spine track was good as the mean differences between readings were less than 4°. Inter-observer and intra-observer variation. It should be noted that measurement of the Cobb angle itself is subjected to systematic measurement error. Interpreting ICC and defining values of ICCs which could be considered as the minimum for acceptable reliability is an arbitrary process. Various authors have made recommendations that ICC value of 0.4 – 0.75 is considered as good reliability, and > 0.75 is considered as excellent reliability (Hayes et al 2001), while other considered the lower limit of accepted reliability to be higher than 0.6. This explains that the lower limit of acceptable ICC value is dependant upon the purpose of the study according to the author’s point of view.

The main concern of discussion here is that no sufficient evidence except for a study done in Saudi Arabia is available to support the hypothesis that GCC countries have demographic significance over prevalence of the disease (Corea J, et al, 1993). Hence the authors strongly suggest that early school screening program should be carried out in this part of the world which provides the opportunity to diagnose the condition and make further referral for appropriate medical care. It will also provide the appropriate educational material for specific guidelines for conducting school screening programs.
A lack of randomized controlled trials and/or observational studies of the outcomes in an organized screening programme make it challenging to correlate screening per se with outcome in terms of curve sizes and quality of life. A shortcoming of this analysis is the inability to quantify the positive health effects in terms of curve sizes. Ideally, the effectiveness of the screening programme would be best shown by a decrease in the number, or proportion, of large curves in the participating population, as well as a reduction in surgical rates. The analysis would also have been strengthened by a follow-up period beyond the two years currently analyzed. It would be useful to measure the health effects in quality-adjusted life-years.

The available evidence suggests that early detection screening leads to early institution of conservative treatment (bracing) and a reduction in surgical rates. The evidence also suggests that without screening, there will be an increase in large curves and surgical rate. However, there have been no controlled studies that explored the relationship between the degree of curve size reduction, and/or surgical rates, and screening. With the information gathered, coupled with some evidence of the natural history of scoliosis locally, certain assumptions were made when comparing the screening programme with the alternative of not having a screening programme.

Conclusion
The information gained in this study might be useful for objective calculation and quantification of the angle of spinal curvature and documentation. These results indicate that physical therapists are able to assess 2D motion analysis noninvasive method reliably for repetitively assessing spinal angle. Repeated spinal angle measurements of a subject made by the same or different investigators with the 2D spinal track generally have well to high reliability. The intra-tester reliability is slightly higher than inter-tester reliability.

References

Appendix (I)
PARENT INFORMATION LETTER

Dear Parent/Guardian,

Season’s Greetings to you.
This is to bring to your notice that Physical Therapy Research & Development Committee as a part of community service is conducting a free scoliosis screening program under the guidance of eminent and qualified professionals from Gulf Medical College.

1. Principal investigator: Prof. Dr. Mohsen El-Sayyad
2. Co-investigator: K. Praveen Kumar
3. Co-investigator: Pradnya Dhareshwar

At __________________________________, on ______________

Scoliosis is a problem that can affect the spine of any child due to bad habit or posture. The purpose of the screening program is to detect possible abnormal curvature of the spine in children. If the condition is detected early and appropriately treated, progressive spinal deformity may be prevented. The screening test is very simple and can be performed in less than a minute. A trained professional will check your child’s back by observing it while your child is standing and bending forward.

To assure a proper view of the back, we will request that students expose their backs during screening. It is recommended that boys wear a shirt that can be easily removed. Girls should wear a bra, bathing suit top, or halter-top under a blouse or sweater. We would also like to bring to your notice that girl students will be screened only by female professionals. Though it is not mandatory there is no objection if any of the parents would like to be present during the screening.

You will be contacted if there is any reason to have your child reexamined or requires further care. If identified any problem during the screening the child will be offered free of cost treatment at Physical Therapy department of Gulf Medical College Hospital & Research Centre, Ajman.

Your cooperation is essential to help us make the program run smoothly. If you have any objections to having your child participate in the screening program, please inform to the school authority in writing.

Sincerely,

Prof. Dr. Mohsen El-Sayyad
Principal Investigator
Director of Physical Therapy Research & Development Committee
Gulf Medical University
Ajman, UAE.

I agree/disagree to get my son/daughter, Mr./Ms._________________________________ screened during the scoliosis screening program on the mentioned date.

Parent signature
To,

22/09/09

The Principal,
Mr. K.N.N. Pillai,
Sharjah Indian School,
Sharjah.

Dear Sir/Madam,

The science exhibition program held at Gulf Medical College was one of our programs to motivate and encourage scientific thinking of the students from various schools over UAE. We believe that any University should cooperate and extend their services and expertise to help solve problems in the society.

Scoliosis is a condition of developing abnormal curvature of spine which affects many children, teenagers and adults. This condition tends to develop in the early age of life and if left undiagnosed and untreated can lead to deleterious effects which can make the individual disabled. If scoliosis can be identified at an early stage it can be treated easily. This screening program at the school level is performed successfully in various countries like USA, Canada, Singapore, Australia, Saudi Arabia, Egypt etc. We at the Gulf Physical Therapy College, Ajman would like to conduct this screening program at your school with appropriate set up for female and male students. Screening program will be carried out under the guidance of eminent and qualified professionals like,

4. Principal investigator: Prof. Dr. Mohsen El-Sayyad  
5. Co-investigator: K. Praveen Kumar  
6. Co-investigator: Pradnya Dhareshwar

We would like to perform a preliminary evaluation on girls between age 10 & 15 (Grades 5 & 9) and boys between age 13 & 17 (Grades 8 & 11). All the female students will be screened by female professional staff and male students by male professional staff.

In this context we would like to seek your permission for the same.

Thank you for cooperation and consideration,

Prof. Dr. Mohsen El-Sayyad  
Principal Investigator  
Director of Physical Therapy  
Research & Development Committee  
Gulf Medical University  
Ajman, UAE.
Appendix (III)

PERSONAL AND DEMOGRAPHIC DATA COLLECTION SHEET

Name of the school: __________________________ Grade: ________________

Name of a student: __________________________ Age/Sex: ________________

Height ______________ Weight ______________

1. Any complaint of backache? ___________ Duration of backache: _______
2. Any medical treatment taken for the same: ________________________________
3. How do you carry your school bag? ______________________________________
4. Approximate weight of the school bag: ________________________________
5. Do you watch television or work on the computer: ______________________
6. Approximate time of watching TV &/or working on PC: ____________________
7. What is the most comfortable position while watching TV: ________________
8. Do you change your position while watching TV and how often? __________
9. Any sports activities: __________________ Indoor or outdoor: ________________
10. Duration of sports activity: __________________________
11. Have you notice any change in your posture: ____________________________
   I. Shoulder level: _______________ II. Limb length: _______________
   III. Pelvis: ___________________ IV. Any other: ________________________

Assessment: 1. Post

………………………………………….. Front Back Side
…………………………………………..
…………………………………………..
…………………………………………..
…………………………………………..
…………………………………………..

2. Forward bending test
…………………………………………..
…………………………………………..
…………………………………………..

3. Limb length discrepancy

………………………………………….
a) Standing
b) Supine

3. Moire topography

Remark: ____________________________________________________________

____________________________________________________________________

Investigator
Appendix (IV)

To,
The Director,
The Ethical Committee,
Gulf Medical College,
Ajman, UAE.

Dear Sir,

This is to bring to your notice that Physical Therapy Research & Development Committee, as a part of community service is going to conduct a free functional scoliosis screening program under a team of eminent and qualified professionals mentioned below:

1. Principal investigator: Prof. Dr. Mohsen El-Sayyad
2. Co-investigator: K. Praveen Kumar
3. Co-investigator: Pradnya Dhareshwar

Scoliosis tends to develop in the early age of life and if left undiagnosed and untreated can lead to deleterious effects which can make the individual disabled. If scoliosis can be identified at an early stage it can be treated easily.

The screening program which we are aiming at is going to be a preliminary study carried in the assigned schools (List attached) in the hope that this may be moved to other emirates if we find a good response and a significant result. Parent information letter will be sent for approval. Before the final screening program, a 10-15 mins of presentation will be given to all the students regarding the disease, epidemiological study, its ill effects and importance of early screening giving relevant references. After the presentation we will arrange for the convenient dates for the screening. Students will come to us class by class on purely voluntary basis. We will arrange for an easily accessible place for the students where they can change and get examined.

The whole process of screening will take not more than a minute per student. The investigator will sit behind the student facing his/her back. Each student will be asked to stand and then bend forward and the back will be screened for any abnormal curve or a hump. The findings will be recorded along with the student’s personal data.

At the end of each day of screening, the students with abnormal findings will be picked up and will be rechecked by the principle investigator, Prof. Dr. Mohsen El-Sayyad. All the students who have functional scoliosis of mild or moderate variety will be offered free Physical Therapy treatment after a letter to the parents. Attaching herewith, a copy of Project Proposal for your approval. Kindly do the needful.

Thanking you,

Prof. Dr. Mohsen El-Sayyad
Principal Investigator
Director of Physical Therapy
Research & Development Committee
Ajman, UAE
Spinal Deformities In Children

Attention parents,

- Does your child carry heavy school bag on his/her shoulder/s?
- Does he/she watch television for hours together without even moving a bit?
- Does he/she like to play on computer or play station without bothering about the time?

Then, it might be a serious problem or can be one in near future.

We are talking about a common spinal dysfunction which is seen in school going children because of some of the reasons listed above. One of such serious issue is development of functional scoliosis.

Scoliosis is a medical term that describes a lateral (sideways) curve of the spine. Two to 5 percent of children between the ages of 10 and 15 — when the bones are growing the fastest — have these curves. The incidence of scoliosis is equal in boys and girls. It is often first detected when the young person is around age 11.

What can happen?

Although many curves are minor, progressive scoliosis can lead to disabling spine deformities. Did you know…?

- From 5 to 10 of every 100 young people from ages 9 to 14 will develop scoliosis.
- Most cases of scoliosis are mild and do not need any treatment except for regular examination.
- A few cases do need treatment so that other problems will not develop in later years.
- The best way to find and control scoliosis is to look for it often during the years when your bones are growing the fastest.

If the curve increases, you eventually may have back pain, lose flexibility, and appear bent over which may not be cosmetically acceptable. You also may be more likely to develop arthritis, respiratory infections, and heart problems as you grow older.
Why screening?

Parents are unlikely to detect curves at an early stage. In addition, many children ages 10 to 15 don’t see a primary-care provider routinely. For those reasons, screening for Scoliosis becomes essential need of the society. When you're having a regular health checkup… ask your health care provider to check for scoliosis.

Procedure of screening:

As a responsible member of this society, we at the Gulf Medical University, provide a free service to screen the school going population as a part of our research project. This screening takes less than a minute. But it is essential to avoid the adverse effects of the dysfunction for the rest of your life.

The health care provider will sit or stand behind you. He/she will inspect your back in standing and in bent position. The girls and boys will be screened separately. If there is any scoliosis it will be picked up in standing as lateral deviation and in bent position as a hump.

Treatment:

If the screening team agrees that you show signs of having scoliosis, your back may be further investigated to measure the degree of curve like taking X Ray. Treatment is individual. The best suitable care will be provided to you in the Physical Therapy Department of Gulf Medical College and Research Centre.

REMEMBER…

You can find scoliosis early, if you know exactly what to look for.

- Check often for signs of scoliosis between ages 9 and 14 years, when growth is rapid.
- Take part in your school’s screening program if available.
- Take action promptly if your school tells you that you may have signs of scoliosis.
- With early checking and early treatment, a mild scoliosis can stay mild and not affect you later in life.
- Treatment is available at our hospital to help control scoliosis.
- Find and treating scoliosis is a team effort. You are a key member of the team!
Appendix (V)
Information Sheet

Name: ..............................................................................................................

Code No: ..............................................................................................................

Age: ......................................................................................................................

Weight: ...................................................................................................................

Height: ....................................................................................................................

Body Mass Index: ...................................................................................................

Telephone No: ...........................................................................................................

Date of Recording: ..................................................................................................

Comment: .................................................................................................................