

## Design and Development of Alternative Method to Bracing Used for Treatment of Adolescent Scoliosis

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### Abstract

**Background:** Scoliosis is an abnormal curvature of the spine that is associated with postural disorder and pain when affected individuals are walking or standing erect.

**Aim:** The aim of this study is to design and develop an alternative method to bracing that will be used to conservatively manage adolescent scoliosis effectively and efficiently by reducing Cobb angle and pain.

**Materials and Methods:** materials needed are; Orthopaedic bed, Metal bars, Orthopaedic Foam, Fabrics, Metal pads, Metal bolts and nuts, Metal pipes. The methods followed are fabrication of six-spring patient's bed with the metal bars and then fixing six-spring foam on the bed. It was followed by fabrication/formation of metal pads for application of force on the patient's spine, while lying down on the bed-system and then attachment of the foam pads to the metal pads. Three stands with a bolt and nut for attachment of the metal pads were fabricated and the components were fixed together.

**Result:** The mechanical bed-system comprised of a metal bed, mattress, counter pressure pad, adjustable screws and metal stand.

**Discussion:** Although, bracing, casting and physiotherapeutic manipulations can reduce the Cobb angle of scoliosis over a period of time (months). However, this device had ushered in a new dimension to the treatment of adolescent scoliosis.

**Conclusion:** The mechanical bed-system exerts more and tolerable pressure to the spine than the bracing and casting method, hence a better outcome.

**Keywords:** Scoliosis; Adolescence; Treatment; Mechanical Bed-System; Manipulation

### Introduction

Scoliosis had been defined as a sideways curvature of the spine that occurs most often during the growth spurt just before puberty. Scoliosis can be seen as a 'C' or 'S' shaped curve of the spine that can be caused by conditions such as cerebral palsy and muscular dystrophy, with majority of it not having a known cause, thereby referred to as idiopathic scoliosis [1]. Scoliosis causes the spine to bend to one side and can affect any part of the spine, but the most common regions are at the level of the chest and the lower back [2]. It often appears in children (adolescent). In most cases, treatment is not needed, as the curve corrects itself with growth. However, based on the degree of curvature and the age of the child, a treatment that combines bracing and physical therapy is often recommended [3-5]. Most cases of scoliosis

are mild, but some children develop spine deformities that continue to get more severe as they grow. Severe scoliosis can be disabling, as it can reduce the amount of space within the chest, making it difficult for the lungs to function properly and also cause painful conditions [2,4,5]. Children who have mild scoliosis are monitored closely, usually with X-rays, to see if the curve is getting worse (increasing Cobb angle). In many cases, no treatment is necessary. Some children will need to wear a brace to stop the curve from worsening. Others may need surgery to keep the scoliosis from worsening and to straighten severe cases of scoliosis. Signs and symptoms of scoliosis may include: Uneven shoulders, one shoulder blade that appears more prominent than the other, uneven waist, one hip higher than the other [2,4,6].

Individuals with scoliosis tend to have a postural disorder and also walk with pain. Different treatment options available for rehabilitation of individuals with scoliosis may include: spinal manipulation with braces and various physiotherapeutic procedures. A good result can be achieved in pediatrics and adolescent scoliosis cases than in adult cases because of ossification period/skeletal maturity. However, the combination of spinal manipulation and various physiotherapeutic procedures used to correct the curvatures associated with scoliosis might not give required results most times [6,7]. In this study, we intend to design a mechanical bed-system that will exert a greater, tolerable and adjustable pressure on the spine, thereby give a faster, easier, effective and efficient correction of abnormal spinal curvatures (scoliosis). The mechanical bed-system is to comprise of an orthopaedic bed, foam, three metal stands with adjustable screws and nuts, and three metal pressure pads padded with foam and leather.

Most individuals with scoliosis face a prolonged rehabilitation period, using conservation method of treatment like braces and casting. The rehabilitation of such patients does not give the desired outcome at times because of less effectiveness and efficiency of bracing system which is prone to abuse of the treatment by patients and also does not apply the required force to the spine, especially in adolescent cases [2,8]. Hence, it has become imperative to design and develop a method of conservatively treating scoliosis that will take less time, apply a higher but tolerable force, ensure patient's compliance because the treatment will be administered to patients while on hospital admission and thereby give an effective and efficient treatment/rehabilitation of such individuals.

However, risk factors for developing the most common type of scoliosis include: Age, sex, family history and occupation. Signs and symptoms of scoliosis typically manifest during the growth spurt that occurs just prior to puberty. Although both genders develop mild scoliosis at about the same rate, research has shown that the female gender have a much higher risk of the curve worsening and requiring treatment. Scoliosis like some other medical conditions can run in families, but most children with scoliosis might not have a family history of the disease. People whose daily job involves prolonged standing or standing in a wrong ergonomic position may be predisposed to scoliosis.

The Scoliosis Association of the United Kingdom describes five main types of scoliosis as: Congenital scoliosis; which when the spine does not form correctly before birth. Early-onset scoliosis appears between birth and 10 years, adolescent idiopathic scoliosis; which occurs as the child grows, leading to a curving and twisting of the spine without a known medical cause, degenerative scoliosis; this can affect adults due to wear and tear of the skeletal system, whether or not they already have scoliosis, Neuromuscular scoliosis stems from a problem with the muscles or nervous system, Scheuermann's kyphosis, where the front sections of the vertebrae grow more slowly than the back sections, making them smaller, Syndromic scoliosis is linked to one of a range of syndromes, including Marfan's syndrome and trisomy 21.

Most children with scoliosis have a mild curve that may not require treatment. The professional caregiver usually recommend following up every 4 to 6 months to monitor the curve (Cobb angle) of the spine in clinic and periodically with X-rays [1,2]. However, scoliosis presenting with large curves (Cobb angle) tend to get worse with time and hence require immediate intervention/treatment before skeletal maturity is attained by the individual. The sex of the patient is also taken into consideration, as scoliosis is likely to gradually get worse in females than males. The location of the curve is also considered during treatment plan, as curves located in the center part of the spine are likely to get worse compared with curves in the lower or upper sections of the spine. Age of the patient is another important factor

of consideration during scoliosis treatment because the risk of the curve worsening is lower if the person had attained skeletal maturity (bones have stopped growing).

However, according to Christian Nordqvist and William Morrison, Bracing is commonly recommended for children with a scoliosis curve measuring 25 to 40 degrees. Scoliosis braces cause the muscles to weaken or atrophy because they aren't used

**Materials and Methods**

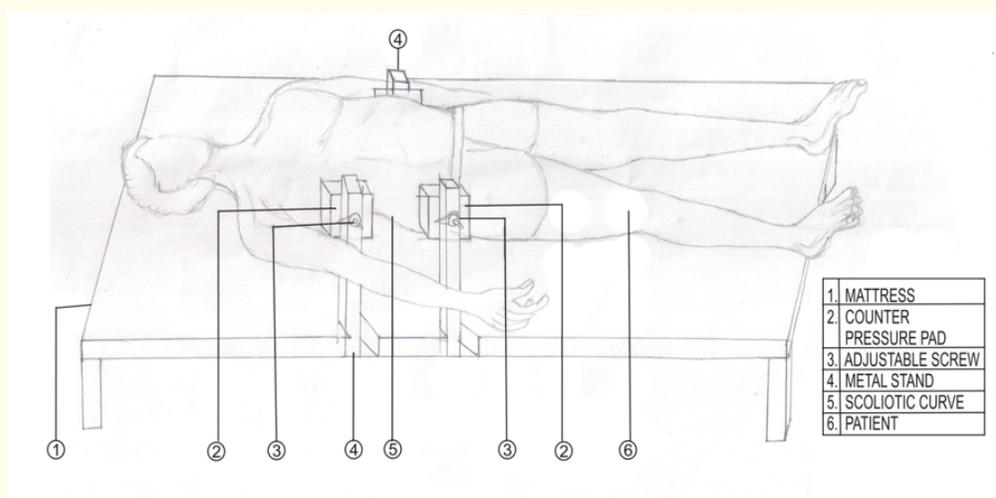
The materials needed to achieve this work are: Orthopaedic bed, Metal bars, Orthopaedic Foam, Fabrics, Metal pads, Metal bolts and nuts, Metal pipes.

The methods to achieve this study are:

1. Fabrication of iron six-spring patient's bed with the metal rods and pipes (stainless-steel).
2. Fixing six-spring foam on the bed.
3. Fabrication/formation of metal pads for application of force on the patient, while lying down on the bed-system.
4. Attachment of the foam pads to the metal pads.
5. Fabrication of three metal uprights/stands with a bolt and nut for attachment of the metal pads.
6. Fixing of all the components together.

**Result and analysis**

The diagram in figure 1 shows the schematic diagram of the mechanical bed-system, comprising of mattress, counter pressure pad, adjustable screws, metal stand and a patient with scoliosis curve fit on it. The mattress is to give comfort when the patient is lying down. The counter pressure pads are to give a counter pressure to the pressure applied by the pressure pad on the metal stand labeled [4]. The adjustable screws make provision to move the pressure pads up and down as may be wanted. The metal stands make provision for attachment of the pressure pads. The parameters for evaluation of the effectiveness of the device will include: associated pain before and after use of the designed mechanical bed-system, degree of associated curve (cobb angle) before and after use of the mechanical bed-system, postural appearance before and after use of the mechanical bed-system. The patient is expected to stay on the device for six hours in a day that will be continuous for the first two weeks and then ten hours in a day that might be intermittent for the third and fourth week. This device is expected to give a desired result within 3 - 4 weeks of use, depending on the severity of the scoliosis.



**Figure 1:** Mechanical bed-system for treatment of adolescent idiopathic scoliosis.

### Discussion

Scoliosis is one of the major postural challenges associated with the skeletal system. It at times affects the functional abilities of affected individuals due to associated pain and discomfort. Effective management/rehabilitation of affected individuals is not usually easy, especially in adolescent and adults. Studies have shown that bracing, casting and physiotherapeutic manipulations can reduce the Cobb angle over a period of time (months) [6,7], unlike this device that is expected to give remarkable improvement with 3 - 4 weeks. Patients also may not adhere to instructions given to them by the caregiver and abuse their brace, which obviously will affect treatment outcome, but patients treated with this device will be on hospital admission and monitored to ensure that treatment plan is followed strictly. It is now believed that this device had given rise to a new method/technology that can stop and also reduce scoliosis curves more effectively and efficiently.

### Conclusion

Studying the effectiveness and efficiency of methods used in rehabilitation of individuals with scoliosis is very pertinent as this will give rise to advancement of existing methods and development of new methods that will give a better treatment outcome and make life easy for affected individuals. This study looked at developing a mechanical bed-system will exert more and tolerable pressure to the spine than the bracing and casting method, hence give a better treatment outcome.

### Bibliography

1. <https://www.webmd.com/back-pain/causes-scoliosis#1>
2. Timothy G and Alex N. "Everything you need to know about scoliosis" (2020).
3. Maja F and Josette B. "Etiological Theories of Adolescent Idiopathic Scoliosis: Past and present". *Open Orthopaedic Journal* 11 (2017): 1466-1489.
4. Konieczny MR., et al. "Epidemiology of adolescent idiopathic scoliosis". *Journal of Children's Orthopaedics* 7.1 (2013): 3-9.
5. Longworth B., et al. "Prevalence and predictors of adolescent idiopathic scoliosis in adolescent ballet dancers". *Archives of Physical Medicine and Rehabilitation* 95.9 (2014): 1725-1730.
6. Schultz AB., et al. "Measurement of spine morphology in children, ages 10-16". *Spine* 9.1 (1984):70-73.
7. Omev ML., et al. "II Idiopathic scoliosis and spondylolysis in the female athlete. Tips for treatment". *Clinical Orthopaedics and Related Research* 372 (2000): 74-84.
8. Baker RJ and Patel D. "Lower back pain in the athlete: Common conditions and treatment". *Primary Care* 32.1 (2005): 201-229.
9. Taylor L., et al. "The Risk of curve Progression and Surgery in African Americans with Adolescent Idiopathic Scoliosis". *Spine Deform* 5.4 (2017): 250-254.
10. Dolan LA., et al. "Bracing in Adolescent Idiopathic Scoliosis Trial (BrAIST): Development and Validation of a Prognostic Model in Untreated Adolescent Idiopathic Scoliosis Using the Simplified Skeletal Maturity System". *Spine Deform* 7.6 (2019): 890-898.

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