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NARRATIVE REVIEW

Bracing and exercise-based treatment for idiopathic scoliosis

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Review

Summary *Background:* Various conservative therapies are available for treating adolescent idiopathic scoliosis (AIS), however, the disparities between them and the evidence of their efficacy and effectiveness is still unclear.

Objectives: To evaluate the effectiveness of different conservative treatments on AIS.

Methods: A literature-based narrative review of the English language medical literature.

Results and conclusions: The most appropriate treatment for each patient should be chosen individually and based on various parameters. Bracing has been found to be a most effective conservative treatment for AIS. There is limited evidence that specific physical exercises also an effective intervention for AIS. Exercise-based physical therapy, if correctly administered, can prevent a worsening of the curve and may decrease need for bracing. In addition, physical exercises were found to be the only treatment improving respiratory function. Combining bracing with exercise increases treatment efficacy compared with a single treatment. Additional, well-designed and good quality studies are required to assess the effectiveness of different conservative methods in treating AIS.

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Introduction

Scoliosis is a spinal deformity consisting of lateral curvature, rotation of the vertebrae and a flexible or rigid

deformity in the frontal plane (de Baat, 2012; Janicki and Alman, 2007). It was first described by Hippocrates and the term “scoliosis” was first used by Galen (AD 131–201). Generally, patients present with a spinal deformity or more

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likely chest wall and back asymmetry (Janicki and Alman, 2007). There are several types of scoliosis, each with its own specific characteristics. Adolescent idiopathic scoliosis (AIS) comprises approximately 80% of diagnosed scoliosis cases. Other known types of scoliosis are congenital (10%) and neuromuscular (5%–7%) (Thomson and Lehnert-schroth, 1992).

Prevalence of scoliosis in the general population is 0.3%–15.3%. The significant difference in the prevalence is due to different testing techniques, samples and definitions of scoliosis (Kowalski et al., 2001). The prevalence of AIS is 2%–3% in children 10–16 years of age. The female to male ratio is equal to one in adolescents with spinal curvatures of 10°; in spinal curvatures > 30°, the ratio increases to 10 females to every male. Scoliosis in females tends to progress more often (Lenssinck et al., 2005). In adolescents diagnosed with mild AIS (Cobb angle < 25°), only 10%–15% have progressive curves and only 2%–4% of the diagnosed patients progress to severe scoliosis (Cobb > 45°) (Asher and Burton, 2006; Reamy and Slakey, 2001).

The risk of curve progression in AIS and hence its treatment and prognosis is based on remaining spinal growth (Janicki and Alman, 2007). The most reliable method of monitoring growth is simple height measurements. It is also important to look at other markers of growth and maturity (chronological age and skeletal age measured by the Risser sign), including signs of puberty (Bunnell, 1986; Tanner and Whitehouse, 1976).

Although the clinical manifestations of AIS have been well described, the etiology and pathogenesis remain unknown (Machida, 1999). Recently, investigations into the cause of AIS have focused on the structural elements of the spine, spinal musculature, collagenous structures, the endocrine system, central nervous system, and genetics. At present, no convincing mechanism has been established as to the cause of AIS (Machida, 1999).

Genetic factors are known to play a role, as observed in twin studies and singleton multigenerational families (Miller, 2007). A similar curve pattern was observed in twins with scoliosis (Inoue et al., 1998). A recent study of monozygotic and dizygotic twins from the Swedish twin registry estimated that overall genetic effects accounted for 38% of the observed phenotypic variance, leaving the remaining 62% to environmental influences (Grauers et al., 2011). In addition, Kindsfater et al. (Kindsfater et al., 1994) reported that the level of platelet calmodulin in skeletally immature patients with a progressive spine curve is significantly higher than in those with a stable curve. Machida et al (Machida and Imamura, 1996) found significantly decreased nighttime melatonin levels in adolescents with progressive curves, whereas normal levels were shown in adolescents with stable curves. To date, the dominant hypothesis states that the etiology of AIS is multi-factorial with significant genetic predisposition, imbalance between anterior and posterior spinal growth, abnormalities in connective tissues and skeletal muscles, muscle contractile mechanisms and neurological disturbances (Dickson et al., 1984; Murray and Bulstrode, 1996). Due to genetic predisposition, with a higher incidence of AIS in siblings (seven times) and offspring (three times) of scoliosis patients, children with a familial history of scoliosis should be carefully screened.

Various conservative treatments of AIS are available; however evidence of their efficacy and effectiveness is still unclear. Therefore, herein we summarize the present knowledge of two conservative treatments of AIS: exercise-based physical therapy and brace treatment. Since aesthetics is an important aspect in AIS, it will also be discussed.

Methods

PubMed, Google Scholar and PEDro databases were searched from inception until September 2014 using a predefined search strategy. Databases were searched for the following key words: "scoliosis"; "spine"; "spinal deformities"; "idiopathic"; "adolescent"; "etiology"; "treatment"; "aesthetics"; "exercise"; scoliosis-specific exercises; "physiotherapy"; rehabilitation"; and various combinations. Titles and abstracts of all articles mentioning at least one of the key words were reviewed. Included in this review were studies in the English language of any design or methodology dealing with conservative treatments of AIS. There were no search limitations. Reference lists of all articles retrieved in full were also searched.

Excluded were articles reporting on spinal surgery, alternative and integrative medicine or pharmacological interventions for scoliosis. Study protocol articles and articles without available full text were also excluded.

All published material was critically analyzed. We are aware that this traditional approach to narrative reviews has much more potential for bias than systematic reviews or meta-analyses; however, we endeavored to be inclusive and open-minded.

Results

Goals of AIS management

Adolescents with AIS experience no or a few complaints at a young age. Less than 35% of patients experience a certain degree of back pain (de Baat, 2012). In these patients back pain reduction is an initial and primary goal. Improvement of pulmonary function (vital capacity) is also crucial (de Baat, 2012; Weiss et al., 2006).

Because AIS is primarily a cosmetic deformity, it is important to identify the patient's thoughts as to their appearance. The self-perception of a patient and whether they are happy with their appearance is important in the decision-making process (Janicki and Alman, 2007). Treatment is based on the desire to change the shape of the back or prevent the deformity from worsening. Therefore, the primary aim of AIS management is to halt curvature progression.

According to a consensus by Scoliosis Orthopedic and Rehabilitation Treatment (SOSORT) experts, esthetic improvement is one of the main goals of scoliosis treatment. In a recent study on the importance of physical deformity in patients with AIS, "severity of deformity" consistently ranked as the most important clinical consideration when proposing surgical treatment (Zaina et al., 2009b).

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