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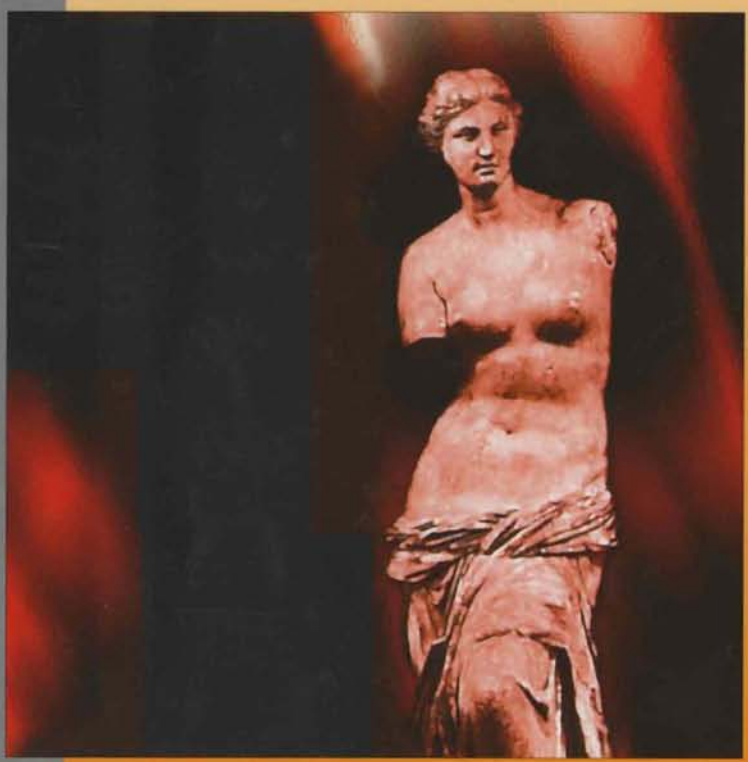

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Preface

This is the first of a series of Instructional Course Lectures (ICL) Books of the International Society **O**n **S**coliosis **O**rthopaedic and **R**ehabilitation **T**reatment (**SOSORT**). In the contents of this book the reader can find the SOSORT STATUTES and become familiar with the aims of the creation of this society. This will hopefully be the initiation of a series of books on conservative scoliosis treatment and a valuable library for SOSORT. The philosophy of the commencement of such ICL book series is the achievements of an ultimate aim, the improvement of early detection and non operative treatment of the patient care pathway for scoliosis.

For this endeavor, a number of eminent clinicians and scientists around the world, who are devoted and high-quality "students" of scoliosis, are involved and contributing with their fabulous work.

There is no doubt that this book is not able to cover every aspect of the issue. However, the future volumes of this series of books will continuously complete the latest relevant knowledge.

In this volume there are chapters reporting on various aspects of the current state of the following topics: IS aetiology, recent trends on scoliosis research, genetics, prevention-school screening, various methods of physiotherapy, various types of braces, the inclusion criteria for conservative treatment, together with the SOSORT guidelines for conservative treatment, clinical evaluation and classification, study of the surface after brace application and outcomes for each brace.

Our belief is that doctors dealing with spinal deformities and in particular with scoliosis, ought to be efficient in treating the disease from "A–Z", that is, to be familiar with all the existing therapeutic strategies.

We hope that the book, by its distribution to the attendees of the 5th International Conference on Conservative Management of Spinal Deformities at the Eugenidou Foundation, April 3–5 2008, Athens, Greece, will be disseminated around the world. Thus the important idea of proper conservative treatment of scoliosis will re-emerge, which in the past decades has been somewhat overlooked in favor of surgery, which is anyway necessary when indicated.

We would like to express our deep appreciation to all the authors and co-authors for spending their valuable time in order to share with us their profound knowledge on the issue. We would also like to express our gratitude to IOS Press publishers for making our dream a reality.

Dr Theodoros B. GRIVAS, MD
23 September 2007, Athens, Greece

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Concepts on the Pathogenesis of Adolescent Idiopathic Scoliosis. Bone Growth and Mass, Vertebral Column, Spinal Cord, Brain, Skull, Extra-Spinal Left-Right Skeletal Length Asymmetries, Disproportions and Molecular Pathogenesis

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Abstract. There is no generally accepted scientific theory for the causes of adolescent idiopathic scoliosis (AIS). Encouraging advances thought to be related to AIS pathogenesis have recently been made in several fields including anthropometry of bone growth, bone mass, spinal growth modulation, extra-spinal left-right skeletal length asymmetries and disproportions, magnetic resonance imaging of vertebral column, spinal cord, brain, skull, and molecular pathogenesis. These advances are leading to the evaluation of new treatments including attempts at minimally invasive surgery on the spine and peri-apical ribs. Several concepts of AIS are outlined indicating their clinical applications but not their research potential. The concepts, by derivation morphological, molecular and mathematical, are addressed in 15 sections: 1) initiating and progressive factors; 2) relative anterior spinal overgrowth; 3) dorsal shear forces that create axial rotational instability; 4) rotational preconstraint; 5) uncoupled, or asynchronous, spinal neuro-osseous growth; 6) brain, nervous system and skull; 7) a novel neuro-osseous escalator concept based on a putative abnormality of two normal polarized processes namely, a) increasing skeletal dimensions, and b) the *CNS body schema* - both contained within a neuro-osseous timing of maturation (*NOTOM) concept*; 8) transverse plane pelvic rotation, skeletal asymmetries and developmental theory; 9) thoraco-spinal concept; 10) origin in contracture at the hips; 11) osteopenia; 12) melatonin deficiency; 13) systemic melatonin-signaling pathway dysfunction; 14) platelet calmodulin dysfunction; and 15) biomechanical spinal growth modulation. From these concepts, a collective *model* for AIS pathogenesis is formulated. The central concept of this model includes the *body schema* of the neural systems, widely-studied in adults, that control normal posture and coordinated movements with frames of reference in the posterior parietal cortex. The *escalator concept* has implications for the normal development of upright posture, and the evolution in humans of neural control, the trunk and unique bipedal gait.
Key words. Idiopathic, scoliosis, pathogenesis, spine, spinal cord, brain, ribs, pelvis.

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Idiopathic Scoliosis and Chaos

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Abstract. At growing ages, the progression of the idiopathic scoliosis with a curve under 25° outlines many features related to the chaos theory. The image of the scoliosis calls to mind the "strange attractors" of the chaotic spine. We describe the 7 main characteristics of the dynamical scoliotic system classified as chaotic. It is an open set system, unpredictable, multi-factorial complex, discontinuous with thresholds that you can model, and it is an inter-phase between childhood and adult time. The chaotic model enables us to understand more the progression of the idiopathic scoliosis. It positively modifies the speech with the patient and its family as well as the therapeutic treatment.

Keywords: Scoliosis, Idiopathic, Chaos, Progression

Introduction

According to SRS definition, we are talking about scoliosis when Cobb angle is more than 10o. We know the linear progression of the curves of more than 25°, thanks to Madame Duval Beaupère and the vicious circle of the scoliosis at this curve rate described by Ian Stokes.

For more than 50 years, the scoliosis specialized physicians from the entire world focalized on etiologic elements, predicting the evolution of the scoliosis between 10° and 25°. Despite the computing progress, the result is a failure. We are still unable to predict the progression of a scoliosis between 10° and 25°.

The deterministic chaos theory [1,3,11] enables us to explain easily to the patient our ignorance about the evolutivity of the scoliosis under 25B°, and the necessity of regular medical visits until the moment the evolution is going to become linear according to Mrs Duval Beaupere's laws. That kind of scoliosis will be the one we will refer to as "chaotic scoliosis".

We explain it to the patient insisting on the necessity to watch after the scoliosis. The different treatments proposed and especially physiotherapy cannot avoid the "earthquake" resulting the progressive chaotic scoliosis, but are indeed an "anti seismic" building in a risky zone. The objective is to realize an early conservative orthopedic treatment, as painless as possible for progressive scoliosis.

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How Can We Achieve Success in Understanding the Aetiology of AIS?

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Abstract. A cure to prevent scoliosis from developing does not seem to be available in the near future. Primarily this is because of a lack of understanding of the aetiology of this devastating disease or cosmetic deformity. While extensive research has been performed in this area over the past 100 years many experiments have been poorly designed because they have been developed on the premise that patients with AIS all have the same, single underlying cause despite much evidence to the contrary. Consequently, much of the data in the literature can be challenged and perhaps explains the lack of significant progress. Certainly, the results from this previous research suggest strongly that a new approach needs to be adopted or the same confusing results will continue to be collected and little progress will be made. There are certain areas of research that hold the greatest potential for success in finding a cure. These are identified in this paper and included in a theoretical research laboratory. It is suggested that this laboratory need not be theoretical if modern, cheap communication systems were readily adopted throughout the world and if people were willing to share ideas readily and contact each other regularly. In perhaps an unconventional way, the emphasis of this paper is on finding a cure to prevent scoliosis from developing and uses the area of research into the aetiology of scoliosis as the platform for discussion.

Keywords. Adolescent idiopathic scoliosis, aetiology, cure

Introduction

Scoliosis, with its lateral curvature of the spine and vertebral rotation, has been a recognized problem for literally thousands of years with records describing the deformity dating back to Hippocrates. It is not hard to imagine that recognition dates back even further as the changes that occur to the spine are significant, easily recognized and cannot be ignored. By definition, scoliosis is a disease but is more often referred to as a cosmetic deformity because it does not appear to affect function unless the curve is sufficiently large to impinge on the lungs and heart in particular and affect cardiovascular function. In this way, treatment becomes an 'elective' issue. The cosmetic aspect of the deformity though has led to the somewhat derogatory term of 'hunchback' and patients (and many parents) wish for the curve to be corrected.

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Mechanical Modulation of Spinal Growth and Progression of Adolescent Scoliosis

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Abstract. It is unclear why some children with a small magnitude scoliosis at the onset of the adolescent growth spurt develop a progressive curve. Normally the skeleton grows symmetrically, presumably because genetic and epigenetic factors regulating growth to maintain growth symmetry despite activities and environmental factors causing asymmetrical loading of the spine. This chapter reviews the recently published data relating to the notion that progression of scoliosis is a result of biomechanical factors modulating spinal growth ('vicious cycle' theory). Quantitative data exist for the key variables in an analysis of scoliosis curve progression. In a predictive model of the evolution of scoliosis simulating the 'vicious cycle' theory, and using these published data, a small lateral curvature of the spine can produce asymmetrical spinal loading that causes asymmetrical growth and a self-perpetuating progressive deformity during skeletal growth. This can occur if the neuromuscular control of muscle activation is directed at minimizing the muscular stress (force per unit cross section), although other activation strategies may produce differing spinal growth patterns. Mechanical modulation of vertebral growth is a significant contributor to the progression of an established scoliosis deformity. Quantitative simulation of this mechanism demonstrates how therapeutic interventions to alter neuromuscular control of trunk muscles or otherwise modify spinal loading may alter the natural history of progression.

Keywords. Scoliosis, Progression, Biomechanics, Growth

1. Introduction

The idea that progression of scoliosis deformity could be predicted and prevented is attractive. However, both the identification of individuals at risk for progression, and prevention of progression of the deformity present challenges because of the unknown etiology of idiopathic scoliosis, and unknown mode of progression. The similarity between natural history of progressive scoliosis of different causes (idiopathic, congenital and neuromuscular) which all progress rapidly during rapid growth [1] points to similar mechanism of progression, despite differing initial causes. Progressive post-natal skeletal growth deformities including scoliosis are often attributed to the 'Hueter-Volkmann Law' of mechanically modulated endochondral growth (increased compression slows growth and vice versa). According to this concept, a lateral curvature of the spine causes it to be habitually loaded asymmetrically, which produces asymmetrical growth and consequent increased deformity in a 'vicious cycle' (See Figure 1) [2,3,4].

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School Screening as a Research Tool in Epidemiology, Natural History and Aetiology of Idiopathic Scoliosis

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Abstract. The aim of school screening is to identify most or all the individuals with unrecognized idiopathic scoliosis (IS) at an early stage when a less invasive treatment is more effective. However like other medical screening programs it has not escaped controversy about its value. The present study summarises the contribution of school screening in research of IS epidemiology, natural history and aetiology. Such contribution is beyond the original aim of school screening but is very important to expand our knowledge and adequately understand the pathogenesis of IS. The role of biological factors such as the menarche, the lateralization of the brain, the handedness, the thoracic cage, the intervertebral disc, the melatonin secretion, as well as the role of environmental factors such as the light and the impact of the geographical latitude in IS prevalence were studied in children referred from school screening. The present study provides evidence to support that school screening programs should be continued not only for early detection of IS but also as a basis for epidemiological surveys until we learn much more about the aetiology of IS.

Keywords. Idiopathic scoliosis, school screening, epidemiology of idiopathic scoliosis, natural history of idiopathic scoliosis, aetiology of idiopathic scoliosis

Introduction

The goal of scoliosis school screening (SSS) is to detect scoliosis at an early stage when deformity is likely to go unnoticed [1] and a less invasive treatment is more effective [2], although it is not a diagnostic process.

There is skepticism and the worth of SSS programs for the purposes of health care has been challenged. Unfortunately this is the view of epidemiologists and public policymakers who view SSS at a macro level [1]. They consider the scoliosis impact in total health care to be low, the prevalence low, the specificity of the screening test low, the false-positive rate high, and the cost of screening excessive. For them, screening for scoliosis is not indicated [3, 4, 5].

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Scoliosis and the Human Genome Project

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Abstract. Understanding the cause of a disease or disorder is key to developing effective and humane strategies for early intervention and treatment. School screening programs have made it possible to demonstrate the high prevalence of childhood scoliosis, worldwide, and to reliably identify spinal curvatures early in the disease process before progression to a fixed structural deformity. Unfortunately, effective early interventions have not been established. Developing strategies to prevent scoliosis has been compromised, in general, by lack of understanding of its causes on a case by case basis. Information about genetic loci associated with disorders including scoliosis is emerging rapidly, since completion of the human genome sequence in 2003. These data can be used to identify children at high risk for developing spinal deformities and to design strategies for prevention.

Keywords. Scoliosis, spinal deformity

Introduction

Scoliosis, a common disorder among human populations, has a prevalence of 3000-5000 per 100,000 individuals by the age of eight to ten years [1]. For every 100 patients in whom scoliosis is detected, up to ninety percent are given a diagnosis of 'scoliosis of unknown origin' or 'idiopathic scoliosis' (IS). Paradoxically, this nonspecific diagnosis stems not from a lack of knowledge about factors that cause scoliosis but at least in part because, as Hippocrates noted two millennia ago, so many different factors can cause spinal deformities [2]. Scoliosis ranging from mild to severe occurs in children in response to environmental factors as diverse as psychological distress [3], trauma [4], back injuries [5,6], surgery [7], cancer treatments including radiation and chemotherapy [8,9], infection [10], tumors [11,12], birth injury [13] and fetal alcohol syndrome [14].

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How to Improve the Effectiveness of School Screening for Idiopathic Scoliosis

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Abstract. The value of school screening for idiopathic scoliosis (IS) has been questioned recently, because of its high false positive referrals and its excessive cost, although in areas where screening programs exist, fewer patients ultimately require surgery for IS. In a typical school screening setting there are numerous factors which can determine the effectiveness. The present study identifies some of these factors and provides evidence based recommendations for the improvement of school screening effectiveness. After reviewing all the research papers which originated from the Thriasio school screening program and published in peer-review journals, specific suggestions for the organization, the optimal age of screening according to the geographical latitude, the best examined position, the standardization of referrals, the follow up of younger referrals with trunk asymmetry and the reduction of the financial cost are made. We strongly suggest the introduction of these recommendations to all the existing school screening programs in order to improve their effectiveness and to reduce the negative impact they may have on families and on the health system.

Keywords. Idiopathic scoliosis, school screening, effectiveness of school screening

Introduction

School screening for IS, although it has been practiced for many years around the world, it has not escaped controversy about its value. Scoliosis screening has proven effective in many ways, and it is considered beneficial among the Orthopaedic community, as it is reported in the Consensus Paper which has been published by the Society on Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT) [1]. Furthermore, it provides the opportunity for early diagnosis and conservative treatment, which is often missed in the absence of screening [2]. In their most recently published joint information statement on scoliosis screening, the American Academy of Orthopaedic Surgeons, Scoliosis Research Society, Pediatric Orthopaedic Society of North America and American Academy of Pediatrics do not support any recommendation against scoliosis screening, given the available literature [3]. Unfortunately, a number of problems prevent it from being universally accepted. The low prevalence of IS, the high false positive referrals and the excessive cost, both direct and indirect, are raised by the negativists as reasons to abandon school screening programs.

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Clinical Evaluation of Scoliosis During Growth: Description and Reliability

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Abstract. The clinical evaluation, even today, remains a central point in the diagnosis, prognostic definition and treatment prescription regarding scoliosis. The clinical evaluation of a scoliotic patient has been established for a long time, but it has not been standardized. The aim of the present work is to report the most common clinical measures for the assessment of scoliosis, explain the usefulness of each clinical measurement, and report the repeatability and limits in order to help the physician in making appropriate clinical choices.

Methods. The height of the hump, the angle of trunk rotation, the sagittal and frontal profiles, and the Trunk Aesthetic Clinical Evaluation (TRACE) have been fully described, and their reliability and repeatability have been assessed.

Results. The measures analyzed showed good reliability and repeatability on the intra-operator basis. The inter-operator repeatability is usually not that good.

Conclusion. The main measures of the clinical assessment of scoliotic patients have been tested, and their reliability has been evaluated. The knowledge of measurement error, as well as intra- and inter-operator reliability, are essential for the clinical evaluation and treatment of scoliosis. This is an unavoidable basis for decision making in the assessment and the treatment of scoliosis.

Keywords: scoliosis evaluation, ATR, sagittal assessment, aestethic

Introduction

The clinical evaluation, even today, remains a central point in the diagnosis, prognostic definition and treatment prescription regarding scoliosis. An early diagnosis allows a long-term programming of periodic controls for cases of progressive structural scoliosis. Therefore, the main goals of such clinical evaluation are the early detection, assessment of the progression potential, definition of an early and appropriate conservative treatment aimed at avoiding progression and the related risk on surgery, improvement in the aesthetic impact and avoidance of health risks.

The clinical evaluation of a scoliotic patient has for a long time been established, but it has not been standardized. It is basically a morphological analysis based on the surface measures taken by a physician through means of selected devices, along with his/her clinical practice and the identification of a few landmarks. Certain clinical

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3-DEMO Classification of Scoliosis: a Useful Understanding of the 3rd Dimension of the Deformity

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Abstract The third-dimension of scoliosis represent a great challenge for clinicians used to think in two dimensions due to the classical radiographic representation of the deformity. This caused problems in everyday clinical approaches, and led to the development of new bidimensional classifications (King, Lenke) who tried in different ways to face these problems, mainly in a surgical perspective. Recently, some three-dimensional classifications have been proposed, all developed in laboratory by bioengineers. In this paper we present the existing classifications of scoliosis, both bi-dimensional and three-dimensional and we thoroughly discuss the 3-DEMO (3-D Easy Morphological) that has been first presented years ago, and recently thoroughly published; this classification has been developed by clinicians with the main aim of being understandable and easily applicable to everyday clinical life.

Keywords. adolescent idiopathic scoliosis, classification, three-dimensional.

1. Classifications for Adolescent Idiopathic Scoliosis

Classification schemes help clinicians to organize their thoughts about a clinical problem and to design appropriate methods of treatment. Thus, classification systems not only organize an approach to a problem and suggest a method of treatment but also may provide an estimate of the outcome of a particular treatment.

The first proposed classification for scoliosis relates to the location of the various curves according to the apex vertebra, and has been initially developed by Schulthess in 1905 [1], refined by Ponseti [2] and confirmed by the terminology committee of the Scoliosis Research Society [3]. This classification undoubtedly is bi-dimensional and based on AP radiographs. Nevertheless, it served its scope of communication among specialists, and it probably is the most widelly used classification even today, because of its simplicity based on pure morphology. According to this classification is possible to recognize: a cervical scoliosis (scoliosis having its apex at a point between C1 and the C6-C7 disc; a thoracic scoliosis (a scoliosis that has his apex at a point between the

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Inclusion and Assessment Criteria for Conservative Scoliosis Treatment

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Abstract. The efficacy of brace or conservative treatment in adolescent idiopathic scoliosis is controversial due to variations in inclusion and assessment criteria. This makes the interpretation of brace studies and their comparisons difficult. The Scoliosis Research Society recently introduced new standardized inclusion and assessment criteria for future brace studies. The inclusion criteria include: age 10 years or older at initiation of bracing, Risser sign 0-2, primary curve magnitude 25 to 40 degrees, no prior treatment, and females either premenarche or less than one year post-menarche. The assessment criteria include: percentage of patients with $\leq$ 5 degree curve progression and percentage of patients with $\geq$ 6 degree curve progression at skeletal maturity, percentage of patients who had surgery or recommended before skeletal maturity, percentage of patients with curves exceeding 45 degrees at maturity, and a minimum of 2 years follow-up beyond skeletal maturity for those patients felt to have been successfully treated. All patients treated irregardless of compliance are to be included in the results (intent to treat).The use of these criteria should assist in the determination of the effectiveness of brace treatment, as well as accurate comparison between patient groups and different braces.

Keywords: Brace or orthotic treatment; adolescent idiopathic scoliosis; inclusion criteria; assessment criteria.

Introduction

The efficacy of conservative or brace treatment in adolescent idiopathic scoliosis (AIS) is one of the most controversial topics in pediatric orthopaedics. Although braces have been used for nearly 45 years, there are no definite conclusions. There have been numerous previous studies that have summarized the results of brace treatment [1-35]. Many studies have supported the effectiveness of brace treatment in preventing curve progression and the ultimate need for surgical intervention [1– 4, 7–10, 13–15,17–24,26 –30,32–36]. Others have suggested that brace treatment may not be effective [6, 11, 12, 16, 25, 31]. A major problem in the interpretation of these studies is that the inclusion criteria have varied considerably from one study to another. The age range at initiation of bracing, inclusion of both males and females, the patients maturity

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Indications for Conservative Management of Scoliosis (SOSORT Guidelines)

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Abstract. This guideline has been discussed by the SOSORT guideline committee prior to the SOSORT consensus meeting in Milan, January 2005 and published in its first version on the SOSORT homepage: http://www.sosort.org/meetings.php [1]. After the meeting it again has been discussed by the members of the SOSORT guideline committee to establish the final 2005 version submitted to Scoliosis, the official Journal of the society, in December 2005. This chapter is a republication from the original paper published in "Scoliosis" BioMed journal and it is included in this book due to its high importance.

Keywords. Idiopathic scoliosis, guidelines, conservative treatment. SOSORT

Definition

Scoliosis is defined as a lateral curvature of the spine with torsion of the spine and chest as well as a disturbance of the sagittal profile [2].

Etiology

Idiopathic scoliosis is the most common of all forms of lateral deviation of the spine. By definition, it is a lateral curvature of the spine in an otherwise healthy child, for which a currently recognizable cause has not been found. Less common but better defined etiologies of the disorder include scoliosis of neuromuscular origin, congenital scoliosis, scoliosis in neurofibromatosis, and mesenchymal disorders like Marfan's syndrome [3].

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Specific Exercises in the Treatment of Scoliosis – Differential Indication

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Abstract. Different methods of physiotherapy are applied in scoliosis management and different opinions exist about the efficacy of conservative scoliosis treatment. Because this divergence of opinions corresponds to a great variety of standards applied, it is not surprising that also the results of conservative treatment greatly differ. Scoliosis normally does not have such dramatic effects that immediate surgery would be indicated. Moreover it is clear that functional and physiological impairments of scoliosis patients--including pain, torso deformity, psychological disturbance and pulmonary dysfunction-- require therapeutic intervention.
The triad of out-patient physiotherapy, intensive in-patient rehabilitation (SIR) and bracing has proven effective in conservative scoliosis treatment in central Europe. Indication, content and results of physiotherapy are described and discussed in this paper. The differential indication of methods of physiotherapy assigned to current "Best Practice" is documented here as well.

The positive outcome of current "Best Practice" conservative management validates a policy of offering conservative treatment as an alternative to scoliosis patients, including those for whom surgery is discussed.

Keywords. Scoliosis, conservative treatment, physiotherapy, rehabilitation

Introduction

Scoliosis is a term used to describe lateral curvature of the spine [1]. Most cases involve thoracic vertebrae, whose axial rotation fosters three-dimensional deformities of the torso [2,3,4]. A resultant loss of rib cage-spine coupling patterns leads to restrictive lung disease secondary to reduced chest wall compliance (CCW); CCW and vital capacity (VC) are inversely correlated with curvature magnitude down to a Cobb angle of ten degrees [5]. Even when resting VC is found to be normal, respiratory challenge reveals reduced exercise capacity even in children with mild curvatures [6,7]. Symptoms of thoracic scoliosis may include shortness of breath, recurrent respiratory infection, chronic pain and psychological distress [5,8,9,10,11]. In severe cases, death may result from right-sided heart failure, however it does not occur in most scoliosis patients and does not occur in those patients with detection during adolescence. The impact of mild to moderate respiratory distress occurring in thoracic scoliosis has not been examined, but recent studies have shown that in non-scoliotic adults reduced exercise capacity is a better predictor of mortality than diabetes, heart disease, and smoking [12,13,14]. Although there are many known causes of scoliosis, spinal

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Scientific Exercises Approach to Scoliosis (SEAS): Efficacy, Efficiency and Innovation

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Abstract. SEAS is an acronym for "Scientific Exercises Approach to Scoliosis". Main characteristics of SEAS are team approach and cognitive-behavioural approach because in our view these are two indispensable elements in chronic disease rehabilitation. In this article we describe the main differences between SEAS approach and other exercise techniques as well as theoretical bases and therapeutic goals. We illustrate practical application of SEAS concept and scientific results in order to reduce the patient's progress of scoliosis so that a brace would be needed. When compared to usual care , improvement of scoliosis parameters and balance normalization in scoliosis patients.

Keywords. Idiopathic scoliosis, physical exercises, conservative treatment

1. The Scientific Exercises Approach to Scoliosis

SEAS is an acronym for "Scientific Exercises Approach to Scoliosis" [3, 4]. As we are used to see in software products, after the acronym there is a dot followed by a number, to indicate the protocol version and the year in which substantial changes were introduced. We now use version ".06". Although SEAS originated long ago (about 30 years)[8, 9, 10], it has been continuously updated so to meet contemporary needs. An exercise-based approach remains updated only if it isn't based on a rigid original idea but can update itself by following acquisitions proposed by the scientific world.

Among the more well-known exercise treatments are the ones of Mézières, Sohier and Klapp [11, 12] that have remained almost unchanged over time, while others, more dynamic, like the Global Postural Rehabilitation according to Souchard, or Schroth [13, 14, 15, 16], have changed over time with the stimulus of new proposals claimed by the original authors and their followers (however, it must be said that today only Schroth [15, 16, 13, 14] and Dobosiewicz [17, 18, 19], together with SEAS[3, 4], have results published in indexed literature).

Hhowever, these innovations are directly suggested by the present leader's intuition, and that some exercises remained basically unchanged since the beginning, contrary to SEAS, which regulates its changes according to evidence coming from new

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Scoliosis Intensive Out-patient Rehabilitation Based on Schroth Method

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Abstract. Conservative management of idiopathic scoliosis (IS) and other spinal deformities is a real alternative to surgical treatment. Most of adolescent with IS can be managed conservatively with high safety. Many infantile and juvenile cases show also a good immediate response to conservative care, which can be considered a sign of good prognosis. Only patients showing a continue deterioration even treated conservatively with efficient techniques should be considered candidates to surgical correction and stabilization. Rehabilitation (including specific exercises) and bracing are usually involved in conservative care of IS. In this paper we describe our personal approach in conservative scoliosis care regarding rehabilitation. Bracing has been described in a different paper also published in the present book. Specific exercises can change the signs and symptoms in scoliosis patients. Specialists in physiotherapy for spinal deformities teach the patient how to perform a routine of 'curve pattern' specific exercises with the purpose to facilitate the correction of the asymmetric posture and to teach the patient to maintain the corrected posture in daily activities. Principles of correction are based on those developed by the German physiotherapist K. Schroth.

Keywords. Scoliosis, physiotherapy, specific exercises, Schroth

Introduction

Although supported by 'old disciplines' like rehabilitation and bracing, conservative management of idiopathic scoliosis and other spinal deformities has gained more and more interest during the last years due to a better definition of the treatment protocols, the development of more specific techniques and the increase of scientific papers reporting outcomes.

The foundation of the SOSORT reflexes this interest. In the SOSORT, three main groups have proposed different rehabilitation protocols all well described in the present book. Since 1968 we have been using similar protocols and techniques than the German school represented currently by the Asklepios Katharina Schroth Rehabilitation Center (AKSK). Weiss has fully described protocols and techniques in his book 'Best practice' in Conservative Management [1]. The objective of this paper is to present our particular approach and to describe the principles of specific exercises

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Dobosiewicz Method Physiotherapy for Idiopathic Scoliosis

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Abstract. The method developed since 1979, comprises active 3-dimensional auto-correction, concerning the primary curve mobilization towards the correction of the curvature, with special emphasis on the kyphotization of the thoracic spine, carried on in closed kinematic chains, and developed on a symmetrically positioned pelvis and shoulder girdle, followed by active stabilization of the corrected position, and endured as postural habit. The positions for exercising and the movements involved are described in details. Small, moderate and important curves can be managed with DoboMed, however the effectiveness of the therapy depends on the curve flexibility and patient's compliance. DoboMed has been used as a single therapy or together with bracing, as well as preparation for scoliosis surgery. The published results demonstrated that the DoboMed has a positive influence on inhibition of the curve progression in idiopathic scoliosis, the improvement of respiratory functions, assessed by the spirometric values, and the general exercise efficiency evaluated using ergospirometry.

Keywords. Dobosiewicz method, idiopathic scoliosis, physiotherapy, active kyphotization

1. History

The idea of the method was developed in 1979. Initially it was realized tentatively on an out-patient group. It was continually modified. The method has been used by Dobosiewicz since 1982 as the main strategy of therapy of out-patients with scoliosis. Next, it has been used in the Department of Rehabilitation as stationary scoliosis intensive rehabilitation (in-patients). Patients were admitted to the department for a 3-4 weeks period and have been undergoing an intensive rehabilitation. Next, they have been continuing specific exercises at home and have been controlled in an out-patients' clinic. In case of necessity, the patients were re-admitted to the Department of Rehabilitation for another 2-3 weeks period.

Since the beginning, the method has been used as a single therapy or combined with bracing (Cheneau brace) [1].

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Function of the Respiratory System in Patients with Idiopathic Scoliosis: Reasons for Impairment and Methods of Evaluation

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Abstract. The paper presents the review of pathological changes which develop within the respiratory system in patients with structural progressive idiopathic scoliosis. The impairment of the function of the respiratory system is one of the principal impact of idiopathic scoliosis on the general health and function, as well as on the quality of life. Although the fatal outcomes of respiratory failure are usually prevented by a successful conservative treatment or by the spinal surgery, the reduction of the volume of the thorax, the restriction of the thorax, as well as decreased efficacy of the respiratory muscles are still a major issue (problem) for many patients with structural scoliosis that may lead to respiratory insufficiency or failure. The papers presents main functional tests to assess the respiratory impairment and the basic rules for interpretation of the results of the examination.

Introduction

Idiopathic (IS) scoliosis is the abnormality of the spine with direct effects on the shape and mechanics of the thoracic cage. The deformity of the thoracic spine in scoliosis is responsible for the respiratory dysfunction. The relationship between deformities and altered pulmonary function has been known since the time of Hippocrates [1]. A reduction in vital capacity (VC) in severe scoliosis was first reported by Schneevegt in 1854 [2].Numerous studies have shown that the level of respiratory dysfunction was dependent on the thoracic curvature value and the degree of the thoracic cage deformation. Figure 1 presents an anatomical base for respiratory failure in thoracic idiopathic scoliosis, illustrated by CT scans of the thorax, made at the level of the Th8 vertebra.

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Side-Shift Exercise and Hitch Exercise

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Abstract. We use side-shift exercise and hitch exercise for the treatment of idiopathic scoliosis. Outcomes of side-shift exercise used for the curves after skeletal maturity or used in combination with part-time brace wearing treatment are better than the natural history. Side-shift exercise and hitch exercise are useful treatment option for idiopathic scoliosis.

Keywords. Idiopathic scoliosis, exercise, side-shift, hitch

Introduction

Since 1986, we adopted side-shift exercise and hitch exercise for the treatment of idiopathic scoliosis. Our indications of physical therapy are:

1. Curves too small for brace treatment (e.g., Cobb angle < 25°)
2. Curves after skeletal maturity that include curves after weaning of the brace (e.g., Risser sign IV or V, post menarche > 2 years)
3. Combined with part-time brace wearing treatment (e.g., Cobb angle > 25°, Risser sign 0 to IV)

We describe methods and outcomes of the treatment.

1. Methods of the Treatment

1.1. Side-Shift Exercise

Side-shift exercise was originally described by Mehta [1]. The exercise consisted of the lateral trunk shift to the concavity of the curve. Lateral tilt at the inferior end vertebra is reduced or reversed, and the curve is corrected in the side-shift position (See Figure 1). Patients are instructed to shift their trunk repetitively to the concavity of the curve and hold the side-shift position for 10 seconds while they are standing and to maintain the side-shifted position while they are sitting.

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"FITS" Concept Functional Individual Therapy of Scoliosis

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Abstract. Functional Individual Therapy of Scoliosis - FITS concept may be used as a separate system of scoliosis correction, a supportive therapy to bracing, children preparation to surgery and also shoulder and pelvic girdle correction after surgical interventions.

Taking into account the dysfunctions accompanying scoliosis, the authors of the concept propose an individually adjusted programme of exercises depending on a curvature angle and a result of clinical examination of a patient. On this basis both general and specific goals are set.

FITS concept consists of two stages:

- Elimination of myofascial restrictions which limit a three-plane corrective movement, by using different techniques of muscle energization.
- building new corrective posture patterns in functional positions;

By sensory motor balance training and exercising the lower trunk stabilization we can start teaching corrective breathing (with the scoliosis convexities) and adjust corrective movement patterns (in open and close chains). A selection of corrective movement patterns will depend on a type of scoliosis, a direction of spine rotation and a place of building functional compensation.

Every corrective pattern includes three components: flexion/extension (the saggital plane correction), elevation/depression (the frontal plane correction) and external/internal rotation (the transverse plane correction). In the processs of therapy the corrective movement patterns are being changed depending on curvature angle behaving and clinical picture of a patient.

Keywords. Idiopathic scoliosis, three-plane correction, sensory motor balance training , corrective breathing, functional compensation, corrective movement patterns

According to the authors, the most important factor in conservative management of idiopathic scoliosis is an individualization of the therapy. After careful examination of the patient, the exercise program can be established for each child. The therapy aims not only to apply a passive correction of the deformity but attempts to accomplish the correction in an automatic fashion. Mechanical obstacles to curve correction need to be removed, for example muscle contractures and articular dysfunctions. The child should learn to manage to maintain a corrected posture.

The postural reeducation is an active process of attaining and maintaining proper posture. It requires a child to establish and consolidate the postural habit. Proper education is necessary to establish such a habit therefore maintaining good posture automatically is not possible even taking under consideration great power and endurance of postural muscles. Scoliotic children frequently have impaired body awareness. They perceive scoliotic posture as a natural one. They feel any attempt to

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Brace Treatment for Adolescent Idiopathic Scoliosis

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Abstract. Adolescent idiopathic scoliosis (AIS) presents as an abnormal curvature of spine with vertebral rotation. It may impact the patient for their entire life. Approximately 0.25% of adolescents will require treatment. Brace treatment is the most commonly used non-surgical treatment for AIS. Its goal is stop the progression and maintain the curve at an acceptable level through the high risk growth phase of adolescence. However, its effectiveness is controversial and the actual biomechanical action of the brace is not fully understood. Recently, the Scoliosis Research society (SRS) created a standard criterion for AIS brace studies. However, to evaluate the effectiveness of the brace treatment, the spine flexibility, in brace correction and patient's compliance should also be included in a study. Although bracing has been used for more than 50 years, there are still many unknowns. How much wear time per day is needed for an optimum treatment outcome? How much brace tightness is optimal? What is the best weaning protocol? What is the best method to determine the curve flexibility? How much in-brace correction is needed to obtain good results? Without accurate and precise methods to objectively measure or answer the above questions, it is misleading to state whether or not brace treatment is effective. Therefore, a lot of research is still required before one can answer the effectiveness of the brace treatment.

Keywords. Scoliosis, Brace Treatment

1. Introduction

Adolescent Idiopathic Scoliosis (AIS) is a three-dimensional deformity of the spine associated with vertebral rotation within the curve and with unknown cause. This lateral curvature affects the rib cage and presents as deformities of the trunk. It is usually detected between about age ten and skeletal maturity, with females comprising approximately 70% of cases. Approximately 2-3% of adolescents have scoliosis and 10% of these may require treatment. Cosmesis is one of the primary reasons to motivate adolescents with AIS to seek treatment [1,2]. Parental concern about their child's future pain and disability are also factors pushing them to seek medical advice [3]. Compared to non-scoliotic controls, most patients with untreated AIS do not lose function. However, AIS patients have an increase in pain prevalence. Symptoms that commonly occur in association with scoliosis include pain [4] and psychological stress [5]. If scoliosis is left untreated and a large curve develops, it can injure both the lungs and heart causing significant health problems. Treatment modality depends on the

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Biomechanical and Clinical Perspectives on Nighttime Bracing for Adolescent Idiopathic Scoliosis

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Abstract. The present review article aims at providing an update on the basic science and clinical information underlying the use of nocturnal braces for adolescent idiopathic scoliosis. The use of nocturnal braces has been dictated by the encouraging results recorded by some studies on part-time bracing, combined with increasing concerns on poor patient compliance noted with the use of full-time bracing. The cardinal feature of nighttime braces lays in their ability to hypercorrect the scoliotic curvature, thereby eliminating the asymmetric water accumulation that occurs in the apical and adjacent intervertebral discs, thus restoring a close-to-normal force application through the Hueter-Volkmann principle and preventing curve progression. The two nighttime braces mostly used hypercorrect the spine through different mechanisms, one acting by bending the spine and the other by the application of opposing forces. Based on the clinical results available, nighttime braces constitute an attractive option for single-major lumbar/thoracolumbar curves not exceeding 35° in magnitude. Multi-center, randomized studies using strict criteria set forth by the Scoliosis Research Society and the Study group On Scoliosis Orthopaedic and Rehabilitation Treatment are needed to better define the role of nocturnal bracing in the conservative treatment of adolescent idiopathic scoliosis.

Keywords. Adolescent idiopathic scoliosis, conservative treatment, nighttime braces, nocturnal braces

1. Introduction

With regard to treatment of adolescent idiopathic scoliosis (AIS), the only potentially effective alternative to operative correction and fusion is orthotic management alone[1], or coupled with exercises[2-4]. The cervicothoracolumbosacral orthosis (CTLSO) was the first to be used in a full-time mode to treat scoliosis conservatively, albeit with modest success[5].

Problems with patient compliance and poor self-image[6] and the questionable results of the Milwaukee brace prompted the need for the development of underarm braces (thoracic-lumbar-sacral orthoses, TLSO) in curves with an apex at T8 or below. The prototype TLSO, the Boston brace, developed by Hall and Miller in the mid

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The Chêneau Concept of Bracing – Actual Standards

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Abstract. In-brace correction and compliance are the main predictors of a successful outcome of brace treatment in the management of patients with Idiopathic scoliosis. The latest CAD / CAM or module based bracing concepts, related to a proper classification have lead to a better in-brace correction and have made the braces easier to wear for the patient. Nevertheless, the latest developments on the market do not allow successful treatment in every case.

The latest biomechanical models of brace correction therefore may lead to a differential indication for certain concepts described in this paper. Thoracic curves with Cobb angles < 50° may be treated with the best possible success with the latest Chêneau derivates enabling a real 3D-correction including also the sagittal correction of the spine. The application of those braces demands a proper classification of curve patterns.

Thoracic curves with Cobb angles > 50° demand to increase the force vector from dorsal with the ventral counteraction of subclavicular pads both sides, although this may be at the cost of sagittal correction.

The percentage of in-brace correction is a good indicator for brace action, however in the individual case this is not always the most important factor.

Keywords. Scoliosis, Chêneau brace, CAD / CAM, Rigo-Chêneau brace, Chêneau light, Rahmouni Style brace

Introduction

The effectiveness of brace treatment in the management of patients with Idiopathic Scoliosis cannot be denied anymore. Curve corrections are possible [1], vast clinical improvements have been described [1,2] and the prevalence of surgery in patients treated conservatively is significantly less [3,4,5] than in patients without any treatment [6]. However, the studies on bracing differ a lot (Curve pattern, age, maturation and Cobb angle), which makes them hardly comparable [7].

Additionally, if one believes in the self reports of different technicians, they seem to be able to achieve similar results with a variable number of approaches. Their success seems to depend on what is deemed to be the most important outcome factor. One approach maybe effective with respect to in-brace correction whereas a competitor maybe more effective when clinical appearance and function are regarded as the most important factors of a successful outcome. Each technician has a different aim, but all braces have at least something common: All principles of treatment have their failures!

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The Chêneau Concept of Bracing – Biomechanical Aspects

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Abstract. Current concept of bracing must take in consideration both the three-dimensional (3D) nature of Adolescent Idiopathic Scoliosis (AIS) and its pathomechanism of progression. A modern brace should be able to correct in 3D in order to break the so called 'vicious cycle' model. Generally speaking, it is necessary to create detorsional forces to derotate in the transversal plane, to correct the lateral deviation in the frontal plane and to normalize the sagittal profile of the spine. Breathing mechanics can be used to fight against the thoracic structural flat back.
The original Chêneau brace was introduced at the end of the 70's and its principles were based more in anatomical observations rather than in biomechanics. A further evolution , enunciating new principles, has allowed a higher standard, improving in brace corrections and trunk modelling. This biomechanical principles have been developed under the name of Rigo-Chêneau-Syatem® (RSC) and used later in latest brace models like the Chêneau light® with reduced material, and similar in brace corrections. Experience is also important to improve the end results. The blueprints to built the brace according to the anatomorradiological pattern are very helpful.

Keywords. Scoliosis, Chêneau brace, Rigo-Chêneau brace, Chêneau light

Introduction

In a previous paper, 'The Chêneau concept of bracing – Actual standards', indications for treatment, basic biomechanics, different Chêneau derivates and in-brace correction have been discussed. The etiology and pathogenesis (cause/s and first event/s) of Adolescent Idiopathic Scoliosis (AIS) is still not known. Prevention would be possible only according to some hypotheses and theories. Consequently, the theoretical basis for bracing is more closely related to the current knowledge on the pathomechanism of progressive AIS and its three-dimensional (3D) nature rather than its etiology. Some factors for progression have been well established and new ideas for the 3D correction of scoliosis have been developed. These factors and ideas will be explored in more detail in the present paper.

The 3-D nature of scoliosis seems to be very important to not only correct the scoliotic spine. The 3-D Chêneau braces applied today enable the patient to achieve

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Passive and Active Mechanisms of Correction of Thoracic Idiopathic Scoliosis with a Rigid Brace

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Abstract. Contemporary bracing developed numerous novel technical solutions to most of main aspects of the correction of structural progressive idiopathic scoliosis. This paper presents a short review on principal biomechanical rules for the three dimensional scoliosis correction. Apart from the tissue transfer, which is a known passive mechanism of rigid bracing, the other passive mechanisms are described, containing the "cherry stone" distraction effect, the thoracic derotation and the bending. A demanding technical construction of the orthosis enables active mechanisms to develop: the corrective factor of the vertebral growth, hypercorrection-oriented trunk movements and respiration, as well as the anti-gravitational mechanism, by which postural reflexes maintain the curve correction, proximally and distally out of the limits of the brace. We believe that systematic investigations unfolded in the area of neurophysiological aspects of postural control of the spinal balance will continuously improve the fascinating capabilities of the active scoliosis autocorrrection assisted by the brace.

Key words. Idiopathic scoliosis, thoracic scoliosis, correction with brace, mechanism of brace action.

Pathology of thoracic scoliosis

We describe the passive and active mechanisms of corrective bracing on the example of single structural right thoracic idiopathic scoliosis, with non structural lumbar component. Such curve repartition, involving one structural and two compensatory curvatures, may be called a three-curve scoliosis, after Christa Lehnert-Schroth (see Figure 1). Thoracic scoliosis usually presents the apical region at Th8, Th9 or Th10 vertebrae. The physiological thoracic kyphosis is often reduced in this area, while pathological compensatory hyperkyphosis develops in the adjacent proximal thoracic spine, and often in the upper lumbar segments. The trunk imbalance is usually to the convex side, so the left hemipelvis protrudes laterally and produces asymmetry of the waists. The rotational deformity, which may be moderate in the upright position, becomes evident in the forward bending. Scoliometer is a useful tool for monitoring trunk rotation throughout the period of bracing. Shoulder imbalance and pelvis rotation appear as secondary body asymmetries. Radiography reveals the upper most tilted vertebra (upper limit

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Lyon Brace

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Abstract. For the last 60 years, the impressive progress of the scoliosis surgery has hidden the development of the conservative orthopedic treatment. The stabilization of the scoliosis, which implies the safeguarding of a spine as mobile as possible, remains a valid objective. The Lyon Brace management combines 3 techniques

A reduction of the scoliosis using a plaster cast fixed on an EDF (Elongation Derotation Flexion) Cotrel's frame. It carries through a flow of the musculoligamentar structure of the concavity.

A contention by Lyon Brace. Orthesis without any cervical superstructure is adjustable, symmetric, see through and active. The elongation between the two scapular and pelvic girdle leads to a disc decompression which makes easier the 3D correction of the curves. The individual moulding (custom made) is actually electronic using a "full 3D imaging" system by Orten. To every 14 types of Lenke's classification matches a specific blue print.

A specific physiotherapy combining the consciousness of the deformity, suppling up of the retracted elements of the concavity, compensatory suppling up of the girdles, improvement of the vital capacity based on exhalation, reharmonisation of the static, static strengthening in order to facilitate the ability to be still in a corrected position, kyphotisation proprioceptive exercises to stimulate the maturation of the postural system. We advise the scoliotics to practice sport during the treatment period.

The long term follow up confirms a global effectiveness indication of 0,89 with the rib hump declining by half. When we treat scoliotics with Cobb angle less than 45°,surgical treatment can be prevented in 98% of the patients.
In France 60% of the families agree with this stringent treatment which becomes easier thanks to its ambulatory realization and the excellent formation of the partners, the physiotherapists and the orthesist.

Keywords. Scoliosis, Lyon brace, results, management, orthotics, plaster cast, physiotherapy[1]

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Treatment of Early Adolescent Idiopathic Scoliosis Using the SpineCor System

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Abstract .The purpose of this prospective observational study was to evaluate the effectiveness of the Dynamic SpineCor System for adolescent idiopathic scoliosis in accordance with the standardized outcome criteria proposed by the Scoliosis Research Society Committee on Bracing and Nonoperative Management. The SpineCor System is the first and only truly dynamic brace, which provides a progressive correction of Idiopathic Scoliosis from 15° Cobb angle and above. The new therapeutic approach is based on a new concept upon the etiology and pathogenesis of idiopathic scoliosis; a pathology of the neuro-musculoskeletal system in growth and maturation. This prospective observational study was carried out on a group of 639 patients (92.3% females) having idiopathic scoliosis treated with the SpineCor brace.

Five hundred and eighty three patients met the criteria for inclusion, and 234 patients were still actively being treated. Overall, 349 patients have a definitive outcome. All girls were premenarchal or less than 1 year postmenarchal. Assessment of brace effectiveness included (1) percentage of patients who have 5 degrees or less curve progression, and percentage of patients who have 6 degrees or more progression; (2) percentage of patients who have been recommended/undergone surgery before skeletal maturity; (3) percentage of patients with curves exceeding 45 degrees at maturity (end of treatment); and (4) Two-year follow-up beyond maturity to determine the percentage of patients who subsequently underwent surgery. Successful treatment (correction, >5 degrees, or stabilization, ±5 degrees) was achieved in 259 (74.2%) of the 349 patients from the time of the fitting of the SpineCor brace to the point in which it was discontinued (or at the time of the surgery). Fifty one immature patients (14.6%) required surgical fusion while receiving treatment. Eight mature patients out of 298 (2.7%) required surgery within 2 years of follow-up beyond skeletal maturity. The conclusion drawn from these findings is that the SpineCor brace is effective for the treatment of adolescent idiopathic scoliosis. Moreover, positive outcomes are maintained after 2 years because 151 (93.2%) of 162 patients stabilized or corrected their end of bracing Cobb angle up to 2 years after bracing.

Key Words: adolescent idiopathic scoliosis, conservative treatment effectiveness, SpineCor system, standardized outcome criteria

Concept

The new therapeutic approach is based on a new concept upon the etiology and pathogenesis of idiopathic scoliosis; a pathology of the neuro-musculoskeletal system in growth and maturation.

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The SPoRT (Symmetric, Patient-oriented, Rigid, Three-dimensional, active) concept for scoliosis bracing: principles and results

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Abstract. The biomechanical action of an orthesis for the conservative treatment of AIS has two goals: correction and stabilization. These goals have been pursued through very well established principles of correction, developed over the years, divided in terms of efficacy (the correct positioning of pushes, as well as through escape ways and proper drivers of the forces and stops) and acceptability (compliance, perfect body design, maximal freedom in the ADL). To achieve all these goals, the Sforzesco brace has been developed through progressive changes and verification. Finally, we discovered we had something new, and summarised it in the SPoRT acronym: Symmetric, Patient-oriented, Rigid, Three-dimensional, active. The SPoRT concept always requires a customised construction of the brace according to the patient's individual requirements. It's possible to apply CAD-CAM technologies, which usually allow us to obtain the best results in this case, but without using pre-built forms stored in databases, as is usually done. Once done, a final test must be made on the patient so as to change the first theoretical project and adapt it in the best possible way, depending on the real interaction between the body and the brace. The results that are today available on the SPoRT concept relate to the Sforzesco brace and necessarily are short-term, because the first treated patients are now reaching the third-year follow-up examination and haven't yet completed their treatments. According to first studies we can state that: tte Sforzesco brace is more effective than the Lyon brace after six months of treatment; the Sforzesco brace is equally effective as Risser Plast brace.

Keywords. adolescent idiopathic scoliosis; brace; orthosis.

1. Theoretical basis of the SPoRT concept

The biomechanical background for scoliosis correction is the "vicious cycle" concept proposed by Stokes. According to Heuter-Volkmann law saying that an increase of compressive loads on a fertile epiphysis reduces growth, while on the contrary an increase of distractive force accelerates growth, it will happen that, in a scoliotic curve, loads asymmetry will cause a growth reduction on the concavity side of vertebral plate and an increase on the convexity side. Braces should reverse it, to allow a proper growth in the concave side of the curve.

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The Boston Brace System Philosophy, Biomechanics, Design & Fit

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Abstract. The Boston Brace System developed in the early 1970's by Dr John Hall and Bill Miller, CPO, is a logical, multidisciplinary approach to the treatment of idiopathic scoliosis. The Brace itself is but one component of the Brace system. The clinical team consists of patient, family, orthopedist, orthotist, physical therapist and nurse. Each team member needs to have a working knowledge of each others discipline, and educate the patient on his/her roll of the treatment plan. If the patient is not educated and understands the process, the logic behind the process and the critical roll they play- then the whole system has been compromised. The Boston Brace itself is one of the most widely studied orthosis used in the conservative management of scoliosis. It has been shown that orthotist training and skill, as well as the ability to assess and modify the fit in 3D have a positive influence on patient outcome. This chapter will discuss the philosophy, biomechanics, design, fit and adjustments necessary for a successful outcome. By following the basic tenants of the system, and maintaining the patient focus, the goal of having a stable spine in adulthood can be obtained. It takes a team effort. This outline will take about how to construct and evaluate the orthosis to maximize fit and function.

Keywords. Boston Brace, adolescent idiopathic scoliosis, brace design, orthosis

Philosophy

The Boston Brace System developed in the early 1970's by Dr John Hall and Bill Miller, CPO, is a logical, multidisciplinary conservative approach to the treatment of idiopathic scoliosis. Initial designed to replace the leather girdle of the Milwaukee orthosis, Miller and Hall found that by removing the super structure for certain curves, the Cobb reduction improved[1]. They started with lower curves; and then, as their competence with the system improved, they systematically addressed higher level curves [1-5]. Today, the Boston, and its various designs, is used to treat most curves from T6 apex to L4. It is designed to be a full time (16 hrs/day or more) wearing system. Studies show 50% reduction of the curve is generally received while standing, this correction, has been shown to increased in a TLSO design when the patient is supine.[3, 5-8].

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Cosmetic Outcome after Conservative Treatment of Idiopathic Scoliosis with a Dynamic Derotation Brace

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Abstract. Improved cosmesis is a major concern for the adolescents with Idiopathic Scoliosis (IS). We hypothesized that if we correct the rotation simultaneously to the lateral curvature of the spine with a dynamic brace we may decrease the asymmetry of the back and ultimately improve the cosmetic appearance of the scoliotic child.

Thirty six scoliotic children (32 girls and 4 boys) with a mean age of 13.9 (range 12-17) years, a mean Cobb angle of 28,2° (range 19-38°) and a mean ATI 7,8° (range 4°-17°) were studied. The examined children were divided in 3 subgroups according to the curve type. All children wore the Dynamic Derotation Brace (DDB), which is a modified Boston brace with antirotatory blades, for 23 hours per day, for a minimum duration of 2 years. The ATI was assessed using the Pruijs scoliometer at baseline and at the end of treatment.

ATI was improved statistically significant in the thoracolumbar ($p<0.01$) and lumbar region ($p<0.013$) of double curves and in the thoracolumbar ($p<0.018$) and lumbar region ($p<0.027$) of thoracolumbar curves. ATI improvement in the thoracic region was not statistically significant either in double curves ($p<0.088$) or in thoracolumbar curves ($p<0.248$). For right thoracic curves, ATI improvement was not statistically significant for all the examined regions.

The above findings indicate that in double and thoracolumbar curves, a deforming torsional force is present, blocked by the antirotatory action of the blades of the DDB, and seems to be more active in the "lower" spine.

In conclusion, DDB improves the cosmetic appearance of the back of IS children with all but right thoracic curves.

Keywords. Idiopathic scoliosis, conservative treatment, surface deformity, Angle of Trunk Inclination, Dynamic Derotation Brace, cosmetic outcome in Idiopathic Scoliosis

Introduction

Improved cosmesis is a major concern for the adolescents with Idiopathic Scoliosis (IS) [1]. Traditionally, conservative treatment with a brace aims at prevention of curve progression beyond surgical limits, and its effectiveness is evaluated by radiographic measurements, namely the Cobb angle and vertebral rotation. The patient satisfaction,

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End-growth results of bracing and exercises for adolescent idiopathic scoliosis. Prospective worst-case analysis

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Abstract *Background* In the literature the rate of surgery for AIS (Adolescent Idiopathic Scoliosis) of 30° ranges from 22.4% to 31% when braces are used, versus the natural history rate of 28.1%. When a complete conservative approach is used (braces and exercises), this rate decreases to the range of 3.8% to 7.3%. All these studies are retrospective.

Aim The aim was to evaluate the final results of a prospective set of patients treated in a center fully dedicated to a complete conservative treatment (exercises and braces) of AIS.

Materials and Methods This is an everyday clinical, retrospective study on a prospective data base. The population included 112 AIS patients, 13.2±1.8 years old, with 23.4±11.5° Cobb degrees at the start of treatment. All the patients had been treated with a full set of conservative treatments, including exercises, according to their individual needs. We used the SEAS (Scientific Exercises Approach to Scoliosis) protocol and the ISICO approach, while the orthosis used included: Risser cast, and the Lyon, Sforzesco-SPoRT, Sibilla-Chêneau and Lapadula braces. The patients had been followed up by the same physician, braces had been made and exercises had been applied by the same team. The outcomes were established for each single patient: The absolute aim was to avoid surgery, while the minimal and optimal outcomes were defined according to the starting curve. An efficacy analysis and worst-case analysis had been performed.

Results The rate of surgery was 0.9% (efficacy analysis), and 4.5% (worst case); the minimal outcomes had been obtained in 99% of patients and the optimal ones in 84%. Overall, the curves over 40°, which numbered eleven at the start of observation, were reduced to three. In total, eight patients exited the presumable area of risk in adulthood (final curve over 30°). The treatment produced a statistically significant reduction in the worst curves, and the best results have been obtained in the curves over 40°.

Conclusion Provided the use of a complete conservative approach, there is very little doubt that it is possible to reduce the rate of surgery in AIS treatment.

Keywords. adolescent idiopathic scoliosis; brace; exercises; end-growth results.

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Quality of Life after Conservative Treatment of Adolescent Idiopathic Scoliosis

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Abstract. As an important consideration in medical care, health-related quality of life (HRQoL) refers to the patient's ability to enjoy normal life activities. When assessing the effectiveness of conservative treatment of AIS, HRQoL variables are more important than the radiographic results or pulmonary function. The present study examines the impact of conservative treatment in HRQoL of the AIS patients.

Thirty-two female patients with a mean age of 13.5 (range 12-16) years, a mean Cobb angle of 29.4° (range 21-38°) and a mean angle of trunk inclination (ATI) 7.9° (range 5°-18°) were treated with a full time application of a modified Boston brace and occasionally physiotherapy, for a minimum of 2 years. HRQoL was measured with the Brace Questionnaire (BrQ) at baseline and at the end of treatment. Correlations were determined by the Pearson correlation coefficient, with $p<0.05$ considered significant.

AIS patients scored lower in all the domains of BrQ at the end of treatment. This difference was statistically significant for the mean overall score of BrQ and for the domains of general health perception, physical functioning, emotional functioning, self-esteem and aesthetics, bodily pain and social functioning. The scores in the domains of vitality and school activity were not affected.

The HRQoL immediately after the end of conservative treatment of AIS is found to have been negatively affected. Because of limitations in study design, this finding does not necessarily implicate the conservative treatment itself, but highlights the importance of HRQoL measurement in assessing how AIS patients perceive the impact of their disease.

Keywords. Adolescent idiopathic scoliosis, health related quality of life, conservative treatment

Introduction

As an important consideration in medical care, health-related quality of life (HRQoL) refers to the patient's ability to enjoy normal life activities. HRQoL is a multi-dimensional construct composed of functional, physical, emotional, social and spiritual well-being [1] and has therefore become a leading criterion in many outcome studies alongside physical and economic factors. In the course of this development, the concept of HRQoL is clearly listed as outcome parameter in many medical societies' guidelines [2].