Pulmonary Function in Middle-Aged Patients With Idiopathic Scoliosis With Onset Before the Age of 10 Years

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Abstract

Study Design: Consecutive patients with idiopathic scoliosis diagnosed before age 10 attended a clinical follow-up at least 10 years after treatment.
Objectives: To evaluate the pulmonary function in adulthood after treatment with brace or surgery before maturity.
Summary of Background Data: Long-term studies of these patients have not been published.
Methods: One hundred twenty-four patients (69% of the original group) underwent radiography, spirometry, and answered symptom questionnaires. A total of 73 patients had spirometries before treatment enabling longitudinal evaluation. Overall, 68 braced only (BT) and 56 surgically treated (ST) were analyzed in detail. A population-based control group was used.
Results: At follow-up, the mean age was 41.5 years and the mean curve size 36 degrees (26% of the curves >45 degrees). The full patient group had a significantly reduced pulmonary function (as measured by the forced vital capacity [FVC], percentage of predicted) compared with the control group, mean 85% versus 102% (p < .0001). Both subgroups of BT and ST patients showed a significant reduction, more in the ST than the BT group (means 79% and 90%, respectively, p = .0003). The most important risk factor for a low lung function at follow-up was a low initial FVC value. Initial curve size correlated with pulmonary function both before treatment and at follow-up. Most surgically treated patients, who had larger curves before treatment, did not improve their pulmonary function after surgery.
Conclusions: Both braced and surgically treated patients had reduced pulmonary function at the age of around 40 years. The pulmonary function did not worsen over time in most patients. There was no difference in terms of symptoms between patient groups and controls. Initial curve size was found to be of great importance for pulmonary function. Initial spirometry and follow-up in selected patients is important.
Level of Evidence: III.
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Keywords: Idiopathic scoliosis; Treatment; Follow-up; Long term; Pulmonary function

Introduction

Earlier long-term studies of scoliosis showed a grim prognosis with pulmonary function deficit and shortened life span [1,2]. A study of mortality in idiopathic scoliosis, published in 1992, evaluated different ages of onset. It was established that mortality in adolescent idiopathic scoliosis did not increase compared with the general population, whereas patients with onset *before* the age of 10 years were found to have a poorer prognosis [3]. Mortality was significantly increased in this group of untreated patients with earlier onset, which was considered to relate to partly prohibited lung development before adulthood, leading to lower number of alveoli [4,5].

Careful, regular controls of curve progression and treatment with a brace and/or surgery are used with the aim of minimizing any deterioration in pulmonary function in adulthood. However, studies of adolescent idiopathic scoliosis indicate that pulmonary function is reduced a short time after wearing a brace [6-8], probably because of increased stiffness of the thoracic cage. Furthermore, restricted growth during bracing in late childhood and/or degenerative changes in the lung tissue could also be regarded as a risk for reduced pulmonary function in adulthood.

In an earlier study of patients with adolescent idiopathic scoliosis 25 years after surgery or brace treatment, we reported that pulmonary function was almost normal, with forced vital capacity of 84% and 89% respectively of predicted normal value [9]. Interest now focuses on the children with scoliosis with onset before the adolescence, where recent publications have focused on pulmonary function during or recently after the termination of treatment [10,11].

The aim of this study was to explore the *long-term outcome* of pulmonary function in patients with idiopathic scoliosis with onset before age 10, which falls under the current definition of early-onset scoliosis [12]. Specific questions for the study were as follows: 1) Is the pulmonary function within normal limits in middle age? 2) Is the longitudinal development of the pulmonary function different from age-related change? and 3) What are the risk factors for a decline in lung function exceeding normal aging? How important is curve size and treatment duration?

Materials and Methods

Patients

The Gothenburg Scoliosis Data Bank, which contains consecutive information about all patients with scoliosis at the Department of Orthopedics at Sahlgrenska University Hospital, Gothenburg, Sweden, between 1966 and 1994, was used to identify the study population that fulfilled the following criteria: 1) a diagnosis of idiopathic scoliosis made before the age of 10 years and no other related disorders/spine anomalies, 2) treatment completed no later than at maturity with either a brace (at least 6 months) or surgery, 3) start of treatment between 1966 and 1992, and 4) at least 10 years since maturity or surgical procedure.

Of the 179 patients identified as the original study group, 124 (69%) accepted the invitation to participate in a follow-up. Fifty-five patients (31%) did not attend or complete the follow-up; that is, 7 patients could not be located, 3 were deceased, 1 did not respond, 43 did not accept the invitation, and 1 did not complete the examination.

The brace treatment, initiated due to curve progression and curve sizes between 24 and 45 degrees depending on residual growth, was performed with a Milwaukee brace until 1974 and thereafter a Boston brace. The brace was worn for 22 to 24 hours daily until skeletal maturity, defined as Risser 4 [13] and a skeletal age of 16 years for girls and 18 for boys [14]. Patients with insufficient effect of bracing or curve progression despite bracing underwent surgery.

Patients with larger curves, above 45 degrees for thoracic, thoracolumbar, or double primary curves and above 50 degrees for lumbar curves, were, after evaluation of residual growth, either operated on with distraction and fusion or, in case of significant growth left, initially braced in order to postpone surgery. Until 1995, surgery was performed by use of the Harrington instrumentation and thereafter with the Isola system.

One hundred seven patients were brace treated before maturity, 49 with a Milwaukee brace and 58 with Boston brace. Sixty-eight of the braced patients did not receive any further treatment until maturity; that is, they were braced alone. Thirty-nine patients were initially braced but later operated on, of which 33 were operated before maturity and the remaining 6 shortly after maturity, before the age of 22 years. These six had either a remaining significant curve at the end of bracing (n = 3) or curve progression after maturity (n = 3).

Seventeen patients were operated immediately. In total, 56 patients were operated on, by use of Harrington instrumentation in 53 and Isola in 3 patients.

The study period covered a long time period, from the start of treatment of scoliosis with modern strategies in the late 1960s until the 1990s. Even if the indications for and regimen of treatment were not changed during the time period, the patients that were treated in the earlier period of the study period were referred later for treatment, that is, with larger curves, than in the later study period. The postoperative regimen was different in the earlier treatment period, with 2 weeks of bed-rest, surgery performed in two sessions, and postoperative brace wear during 6 to 12 months.

Patients were analyzed both as the total group (n = 124) and in subgroups according to whether they had undergone surgery or not, that is, braced only ("Brace," n = 68) or surgically treated ("Surgery," n = 56). The patients that were braced and later underwent surgery were found to have a start-off with larger curves than those braced only and they were therefore more similar to the patients operated without prior brace treatment than to the braced-only patients.