

Operative Treatment of Scoliosis

Edited by George Chapchal
4th International Symposium 1971
in Nijmegen, Netherlands

273 Illustrations, 43 Tables



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Editor

CHAPCHAL, G., Prof. Dr., Hoofd van de Afd. Orthopaedie, Katholieke Universiteit, St. Radboud Ziekenhuis, Nijmegen, Netherlands, at the present time: SUVA, CH-6002 Luzern, Switzerland

Contributors

AGOSTINI, S., Prof. Dr., Istituto di Clinica Ortopedica dell Universita, Via Giustiniani, I-35100 Padova, Italia

BARCSA, CS., Orthopädische Universitäts-Klinik, Debrecen, Hungary

BARTA, O., Prof. Dr., Head of the Department of Orthopedics, University of Pécs, Hungary

BAUER, R., Univ.-Doz. Dr., Orthopädische Univ.-Klinik, A-6020 Innsbruck, Austria, Anichstr. 35

BAUMANN, J. U., Dr., Orthop. Univ.-Klinik, Neuroorthop. Abt., Römergasse 8/Basler Kinderspital, CH-4005 Basel, Switzerland

BJURE, J., Dept. Clinical Physiological Laboratory I, Sahlgren Hospital, 41345 Göteborg, Sweden

BOSSERS, G., Dr., Maartenskliniek, Sophiaweg 99, Nijmegen, Netherlands

BUCHNER, H., Wirkl. Hofrat, Prof. Dr., Provincial Special Hospital and Provincial Solar Sanatorium Stolzalpe, A-8852 Murau, Austria

CASUCCIO, C., Prof. Dr., Istituto di Clinica Ortopedica dell Universita, Via Giustiniani, I-35100 Padova, Italia

CHAPCHAL, G., Prof. Dr., Head of the Department Orthopedics, Catholic University, St. Radboud Hospital, Nijmegen, Netherlands, now SUVA, CH-6002 Luzern, Switzerland

DRDKOVÁ, S., Dr., The Institute for Social Medicine, Charles University, Praha, CSSR

ELFSTRÖM, G., Dr., Research Laboratory of Medical Electronics, Chalmers University of Technology, S-40220 Göteborg 5, Sweden

FABRY, G. H. H., Dr., Cath. Univ. Leuven/Akademisch Ziekenh. Afd. Orthop., 3041 Pellenberg, Belgium

GARSTKA, J., Dr., Institute of Orthopedics and Rehabilitation ul. Dzierzynskiego 135, Poznan, Poland

GRUCA, A., Prof. Dr., Klinika Ortopedyczna A. M. Lindleya 4, Warszawa, Poland

HARRINGTON, P. R., Dr., Texas Instit. f. Rehabilitation and Research, Texas Medical Center, 1333 Moursund Avenue, Houston, Texas 77025 USA

HENCHE, H. R., Dr., Felix Platter Spital, Burgfelderstr. 101, CH-4005 Basel, Switzerland

HIRSCH, C., Prof. Dr., Karolinska sjukhusets ortop. kir. klinik, Norrbackainstitutet, Box 6403, S-113 82 Stockholm, Sweden

IUMASHEV, G. S., Prof. Dr., Orthop. Univ. Dept. Moskva, USSR

JENTSCHURA, G., Prof. Dr., Direktor der Orthop. Klinik Lindenhof im Klinikum Mannheim der Univ. Heidelberg, 68 Mannheim 1, Germany

KAZMIN, A. I., Prof., C.I.T.O., Priorova 10, Moskva A 299, USSR

- KLISIČ, P., Dr., Special Hospital for Orthopedics and Surgery "Banjica" Mih. Avramovića 28, Yugoslavia
- KOCH, F., Dr., Orthop. Klinik u. Poliklinik d. Univ., 69 Heidelberg-Schlierbach, Schlierbacher Landstr. 200 a, Germany
- KON, J. J., Prof. Dr., C.I.T.O., Priorova 10, Moskva A 299, USSR
- KRÓL, J., Dr., Institute of Orthopedics and Rehabilitation ul. Dzierzynskiego 135, Poznań, Poland
- KUMMER, F., Dr., 2nd Medical Univ. Clinic, Garnisonsgasse 13, A-1097 Vienna, Austria
- ŁEMPICKI, A., Dr., Institute of Orthopedics and Rehabilitation ul. Dzierzynskiego 135, Poznan, Poland
- LOMIČEK, M., Dr., 1st Orthopedic Clinic, Charles University, Praha 2, Na Bojišti 1, ČSSR
- MATĚJOVSKÝ, Z., Dr., 1st Orthopedic Clinic, Charles University, Praha 2, Na Bojišti 1, ČSSR
- MAU, H., Prof. Dr., Orthop. Univ.-Klin., 74 Tübingen, Calwer Str. 7, Germany
- MERKI, A., Dr. Kantonsspital, Aarau, Switzerland
- MEZNIK, F., Dr., Orthopedic Clinic University of Vienna, Garnisonsgasse 13, A-1097 Vienna, Austria
- MONK, C. J. E., Dr., 37 South Road, Liverpool 19, England
- MORSCHER, E., Prof. Dr., Felix Platter-Spital, Burgfelderstr. 101, CH-4000 Basel, Switzerland
- NACHEMSON, A. L., Prof. Dr., Dept. Orthop. Surgery I, Sahlgren Hospital, 41345 Göteborg, Sweden
- NADRAI, A., Dr., Orthopedic University Clinic Balgrist, Forchstr. 340, CH-8008 Zürich, Switzerland
- NICOD, L., Prof. Dr., Director of the Orthopedic Hospital, Lausanne, Switzerland
- OWEN, R., Dr., Robert Jones & Agnes Hunt Orthop. Hosp., Oswestry/Shropshire, England
- PAP, K., Prof. Dr., Orthop. Univ.-Klinik, Debrecen, Hungary
- POLAKOWSKI, L., Dr., Institute of Orthopedics and Rehabilitation ul. Dzierzynskiego 135, Poznan, Poland
- ROMPE, G., PD Dr., Orthop. Klinik und Poliklinik d. Univ., 69 Heidelberg-Schlierbach, Schlierbacher Landstr. 200 a, Germany
- SCHEIER, H., PD, Dr., Am Brunnenbächli 16, CH-8125 Zollikerberg, Switzerland
- SCHREIBER, A., Prof. Dr., Director of the Orthopedic University Clinic Balgrist, Forchstr. 340, CH-8008 Zürich, Switzerland
- STAGNARA, P., Prof. Dr., Centre de Readaptation Fonctionnelle des Massues 92, rue des Massues 69 Lyon 5e, France
- STEENAERT, B. A., Dr., Orthop. Univ.-Klinik, Nijmegen, Netherlands
- VERAART, B., Dr., Bakenbergseweg 23, Arnhem, Netherlands
- WEISSER, K., Felix Platter Spital, Burgfelderstr. 101, CH-4000 Basel, Switzerland
- ZIELKE, K., Dr., Chief of the German-French Department for the Treatment of Scoliosis, Hospital Emile Roux, Tübingen, Auf dem Sand 1, Germany

Introduction

G. CHAPCHAL, Nijmegen

Once again I have the privilege of extending a cordial welcome to guests from 18 countries. The number of active and passive participants and the inscription of papers is the largest of all the symposia we have organized up to this 4th bi-annual international meeting. As this is the first symposium to be held in Nijmegen, we are delighted by this large number and the fact that guests from so many countries are present. We are proud to know that the moving of the symposium from Basel to Nijmegen caused no losses. All papers which were prepared for Basel can now be presented here in Nijmegen.

We gain satisfaction from the large number present here and their international composition, as it is always our intention to promote international contacts. Medical science can be expanded only on the basis of international cooperation.

The subject which we chose for this 4th symposium is again taken from operative surgery. It is a problem which arouses much interest and which, in spite of excellent operative methods, concerning indications still needs careful discussion. We are of the opinion that

almost all the different operative methods will find their logical place in orthopedics when we can develop a system of indications conforming with the form, ethology and progress of scoliosis. Here we intend to ascertain a clear picture of results in different stages with different forms of scoliosis and to conclude exact indications from these results.

Another question which interests the orthopedist who is dealing with scoliosis is the role of conservative treatment. Therefore, there is great interest in some papers from which one can learn about consequent conservative treatment during many years of experience.

In welcoming and thanking the active and passive participants and guests for their presence at this symposium, my thankful thoughts go to the two institutes which have made the coming days possible. We thank the University for its appreciable support and especially the firm CIBA of Basel, along with the Department of Education, who takes full responsibility for deficiencies. This support enabled us to organize a wide scientific programme and to create the possibility for personal contacts.

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Subject 1

Indication for Operative Treatment

Principles of Preventive Treatment of Scoliosis

I. I. KON, Moscow

Owing to the lack of detailed knowledge of the etiology of scoliosis, for the time being we are forced to limit the prophylaxis of this disorder to its early recognition, inhibition and arrest of its development.

This kind of prophylaxis does not involve prevention of the disorder, but "preventive treatment", beginning from the first signs of scoliosis, and having a continuous effect on its development, preventing it from progressing.

In order to study the incidence of the onset of scoliosis in different age groups, we examined 11,224 schoolchildren, 2000 of them at intervals over a five-year period, and 500 children of preschool age. It was established that scoliosis appears in early childhood with the clinical signs of spine torsion.

Since prognosis of the course and development of scoliosis is of help in choosing an optimal method of treatment, a look at a few of the main features determining prognosis of scoliosis seems justified.

1) The earlier the clinical signs of scoliosis manifest themselves, the greater the possibility of its development.

2) The development of the deformity is directly dependent on its location: thoracic and combined scoliosis progress most rapidly.

3) There are two types of scoliosis: in the first, lateral curvature takes the form of slight torsion, in the second, torsion predominates and progressive development is more common.

4) In dysplastic scoliosis, the prognosis is less favourable than in the case of congenital or idiopathic scoliosis, so that in determining the etiology neurological examination is nec-

essary. In our experience, the clearer the neurological symptoms, the worse the prognosis.

5) It is essential to take into account the "prepubertal crisis", since at this stage the deformity progresses most rapidly.

6) Decompensatory scoliosis naturally progresses more frequently than compensatory. Torsion decompensation is to be considered an unfavourable sign.

7) The age factor plays an important role in scoliosis prognosis. Scoliosis ceases to progress when the skeleton stops growing. It is essential to distinguish between the chronological age of the patient and the age of his skeleton.

Prognosis can be established more accurately on the basis of other signs with the aid of roentgenographs. Movshovich demonstrated that osteoporosis of the external part of the vertebrae on the apex of the curvature indicates further progression.

We established that in cases where intervertebral space has not narrowed on the concave side of the curvature, as is usually the case, but, on the contrary, has widened, the prognosis is unfavourable. This sign is only to be observed in children under twelve. The above-mentioned factors are influenced by the environment in which the child grows up. Thus, early recognition of the disorder and early prophylactic treatment may influence its course.

Since the results of conservative preventive treatment are to be estimated not according to the correction achieved, but rather according to the success with which progression is impeded, even a small correction of deformity as a final result of treatment is to be considered a success.

Our studies have shown that there are no longer any serious contradictions between supporters of conservative and surgical treatment. There are clear indications in favour of one or other approach depending on the sum of the factors, the most important being the degree of curvature, location of the lesion and the patient's age.

Conservative treatment can be conducted in out-patient departments or special orthopedic hospitals. Unfortunately, in the former case treatment is usually limited to physical culture therapy and sometimes wearing a corset, and does not produce very satisfactory results. The results of conservative preventive treatment can only be properly assessed in the case of stationary treatment.

The fact that it was impossible to provide prolonged hospital treatment led to the idea

of opening special boarding schools for children suffering from scoliosis, and in 1964 the first of these schools was opened on the instigation of the Central Institute of Traumatology and Orthopaedics.

The basic principles of treatment in this school are as follows: 1) a regular routine; 2) a rational diet; 3) physical activities to ensure general fitness (swimming, skiing, P. T.; 4) methods designed to reduce lateral pressure on intervertebral cartilage and the vertebral bodies low lying lesions functional corsets, plaster beds with detortional pads), and 5) therapeutic methods for improving blood supply to the bones and muscles (corrective gymnastics, heat treatment, massage, etc.).

In thoraco-lumbar scoliosis with the apex of curvature between Th₁₁₋₁₂ and L₁ m. iliopsoas are exercised on the concave side of



Fig. 1a. The girl IA-t, 1956, was admitted 3 March 67 at the age of 11½ for left dysplastic thoracic-lumbar scoliosis, stage II (angle of deformity - 29°).

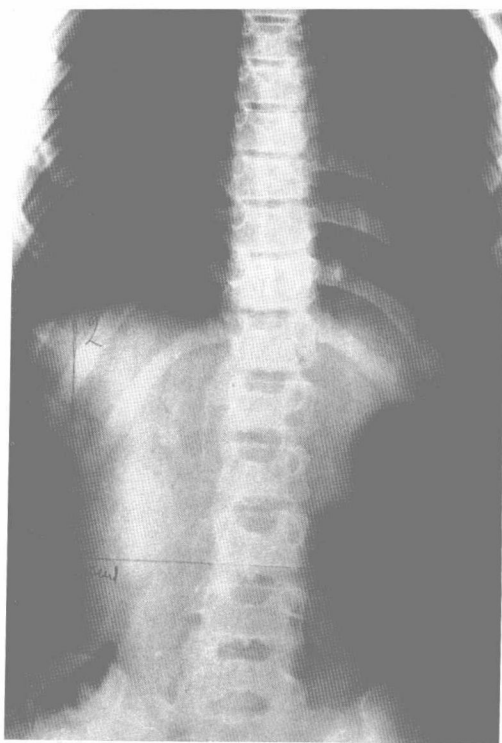


Fig. 1b. After 2 years and 10 months of treatment the defect was completely eliminated.

the curvature. Training is contraindicated in combined lumbar and in thoracic scoliosis. Over six years, 1008 scoliosis patients were treated at the school – 866 girls (86.1%) and 143 boys (13.9%). The age groups were as follows: 7 to 10 – 339 (32.6%), 11 to 14 – 621 (61.5%), over 14 – 48 (5.9%). Thus, most of the children came for treatment between 11 and 14, the age at which scoliosis most

frequently progresses. The scoliosis was congenital in 2%, dysplastic in 73% and idiopathic in 25% of cases. We estimated the results achieved by the method suggested by Stagnara. The results were considered excellent where the correction was over 5°; good where stabilisation $\pm 5^\circ$ was achieved; satisfactory where progression was from 5 to 10°, and poor where it was more than 10°.

Table 1

Number of patients	Degree	Results of Treatment			
		excellent	good	satisfactory	poor
321	I (1° – 10°)	34 (10.6%)	298 (88.5%)	3 (0.9%)	–
460	II (11° – 30°)	101 (22.1%)	322 (70.0%)	22 (4.7%)	15 (3.2%)
166	III (31° – 50°)	27 (16.4%)	101 (60.8%)	19 (11.4%)	19 (11.4%)
61	IV over 50°	11 (18.0%)	34 (56.2%)	4 (6.5%)	12 (19.3%)

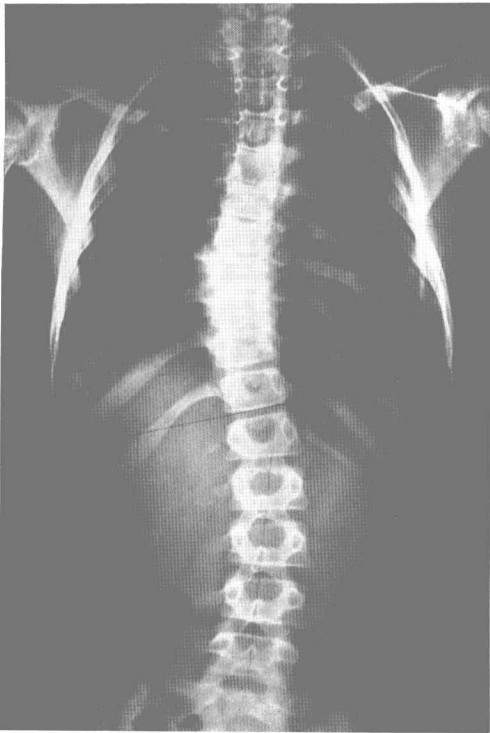


Fig. 2 a. The girl P-a, 1958, was admitted 1 Sept. 66 at the age of 8 with the diagnosis of dysplastic combined scoliosis, stage II (angle of thoracic defect – 25° ; angle of lumbar deformity – 23°).

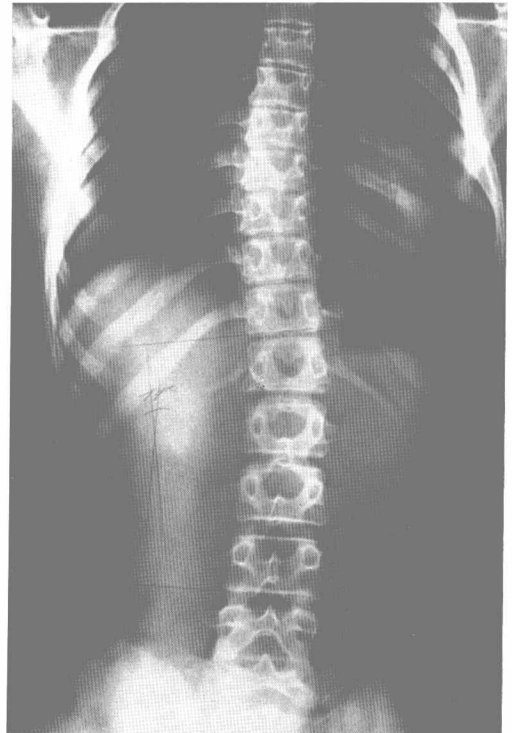


Fig. 2 b. After 5 years of treatment the defect was partially eliminated (the thoracic deformity was reduced by 10° ; the lumbar deformity – by 11°).

The results were as follows: excellent – 173 cases (17.1%), good – 741 cases (73.7%), satisfactory – 48 cases (4.73%), poor – 46 cases (4.5%).

Clearly, the greater the deformity on arrival at the school, the more difficult it is to obtain good results. Here are the results according to the degree of deformity (Table 1).

The majority of excellent and good results

were obtained in cases of thoraco-lumbar scoliosis. This is explained by effective m. iliopsoas training in all cases with this location. We can draw the following conclusion. Conservative preventive treatment of scoliosis based on a complex method of treatment and conducted in special boarding schools serves to arrest progression of spine deformity in the majority of cases.

Conservative Treatment of Scoliosis

H. SCHEIER, Zürich

We describe the conservative treatment we use in the orthopaedic Klinik Wilhelm Schult-hess in Zurich.

For correction, we use the Cotrel-Modification of the Abbott-cast. Cotrel called his modification Extension – Derotation – Flexioncast. (EDF-cast)

For maintaining the correction we use a brace which we call the Stagnara-brace. This brace consists of aluminium bars and Plexidur- or Ortholen-plates. In other cases we use the Milwaukee-brace. Generally by this means we are able to stop further progression, in occasional cases we can get a definitive correction.

We have the following indications for conservative treatment:

1) Scoliosis with curves up to 30° (Ferguson), 50° (Cobb). In these cases we are satisfied if we can stop the progression.

2) When there is a contraindication for operation even in major curves.

a) little children, because of the growth-stop in the fused spinal area.

Exception: Short congenital curves.

b) Scoliosis in which the stabilization by fusion is doubtful. (Extremely severe kyphoscoliosis in neurofibromatosis)

The Future for the Patient with Nontreated Scoliosis

A. NACHEMSON, J. BJURE, Gothenburg

It seems appropriate to start a symposium on the operative treatment of scoliosis with a review of our present knowledge of what will happen to nontreated scoliotic patients later in life.

It is well known from previous reports (2, 6) that scoliosis causes pulmonary and cardiac disturbances and already curvatures of about 60° have been noticed to cause considerable lowering of the vital capacity. In autopsy materials patients with scoliosis have been found to die at an earlier age than the average population (12).

Regarding the prognosis for patients with untreated idiopathic scoliosis in later life not much has been known until recently, when three different reports have been published at about the same time (7, 10, 11). From these it has been possible not only to evaluate the mortality and morbidity but also to demonstrate how these deformed people are living. Our material (10) consists of 130 scoliotic patients who looked for advice in Gothenburg around 1930. At that time no treatment was given. It was possible to trace 117 patients in 1965. Of these 20 were dead and the

remaining 97 replied to a questionnaire. Fifty per cent of the material consisted of idiopathic scoliosis.

The patients were asked if they had longer periods of backache and this was reported by 39 and in about the same percentage in all the different etiological groups. In this connection it should be remembered that field studies of an average Swedish population has demonstrated a 60% incidence of occasional back pain in the same age groups (8). The number of patients claiming disability compensation was 28 or 30% of those still alive, which is twenty times that of the general population. Nearly all received their compensation on grounds of cardio-pulmonary insufficiency due to the scoliosis. Another 15 patients reported serious heart- and lung troubles. Thus, nearly 50% of the followed material had some cardio-pulmonary trouble. No one was occupied in hard labour, which is the case in about 35% in a comparable normal population. On an average there was more than a 100% increase in mortality as compared to the general population also in those with idiopathic scoliosis, but it should be noticed that this material also comprised a number of less severe curves. In a selected study of patients with severe dorsal curves the increased mortality rate was about 400% compared to the general population.

In another Swedish study performed by Nilsson and Lundgren (11) from Stockholm the same findings could be demonstrated in a material of 100 idiopathic scoliosis followed for nearly 50 years. Also in their material the mortality rate was twice that of the normal population, and as in my own series the age between 40 and 50 seems to be crucial in that respect. They also reported that an extremely large proportion of women with idiopathic scoliosis did not marry. The figures for disability compensation were the same as in the Gothenburg material, about 30%. The findings with regard to morbidity and mortality were not entirely corroborated, however, in the recent follow-up study by

Collis and Ponseti (7), who reported no increased mortality or morbidity in a series of more than 200 patients with untreated idiopathic scoliosis followed for about 25 years. They too reported back pain, however, in a percentage not differing from the general population. One interesting finding in their material was that patients with thoracic curves of less than 60° remained unchanged or with very little increase after the end of growth, while curves of 60° to 80° seemed to increase a great deal, on an average nearly 30°. Curves above 80° did not increase to the same extent, nor did the double primary or lumbar curves. The difference in result with respect to mortality and morbidity at the follow-up could be due to two factors. First, that Collis and Ponseti could trace only 60% of the primary material and secondly that the patients at follow-up were younger than those in our Swedish materials, where it was possible to trace 90% of the original patients.

We have recently investigated more thoroughly with 50 patients in Gothenburg between 11 and 78 years old (1, 4). The 23 youngest were those admitted for treatment during a certain time period, while the 27 above age 30 years were selected at random, without knowing the degree of scoliosis, from the 47 surviving patients with idiopathic scoliosis earlier described (10). Since this study aimed at obtaining information about the lung function in relation to curvature and age, the material was divided in two age groups, above and below 40 years and in three groups of increasing curves, less than 60°, 60° to 99° and above 100°. In the clinical examination the patients were especially asked for any pulmonary disturbances as well as their working situation and participation in physical activities.

The clinical investigation showed a correlation between increasingly severe shortness of breath on the one hand, and increasing curvature and age on the other. Of the 23 patients older than 20 years with curves exceeding 60°, 8 received disability compen-

sation due to their scoliosis. No one was doing hard labour, nor were any of these patients actively engaged in sports. The 5 patients below 40 years of age who were unable to work all had midthoracic curves of 100° or more. None reported severe back pain.

Static and dynamic spirometry was performed in the sitting position and for predicting normal values the relative decrease in length of these patients was taken into consideration (3). Airway closure was studied in the sitting position with the ^{133}Xe bolus technique, by which it is possible to judge at what lung volume airways start to close during expiration. Regional lung function studies with ^{133}Xe -technique was also performed.

Dynamic spirometry revealed no airway obstruction in any of the 50 patients tested. With increasing curvature total lung capacity decreases and is 85% of predicted normal values in patients with curves less than 60° ; in patients 60° to 100° , 68% and in patients with curves above 100° , 52%. Also the vital capacity, the functional residual capacity and

to a lesser extent also the residual volume decrease with increasing curvature.

In 17 of the 40 patients tested with the ^{133}Xe bolus technique the airways start to close at a lung volume larger than functional residual capacity and this occurs in patients of all ages. Of the 19 patients below the age of 40 years 6 had airway closure above functional residual capacity as seen in Fig. 1 and all these had thoracic curves of 90° or more. Normally the airways start to close above functional residual capacity in subjects 60 years or older, but in younger subjects at a lung volume well below functional residual capacity (4). This means that some of our scoliosis patients normally breath at a lung volume where some of the airways already are closed, and this could be one of the etiological factors in the development of respiratory impairment.

The perfusion studies (1) showed that there is a significantly altered distribution of perfusion with increasing angulation of the scoliosis in such a way that the apical parts of the lungs obtain a greater percentage of the total

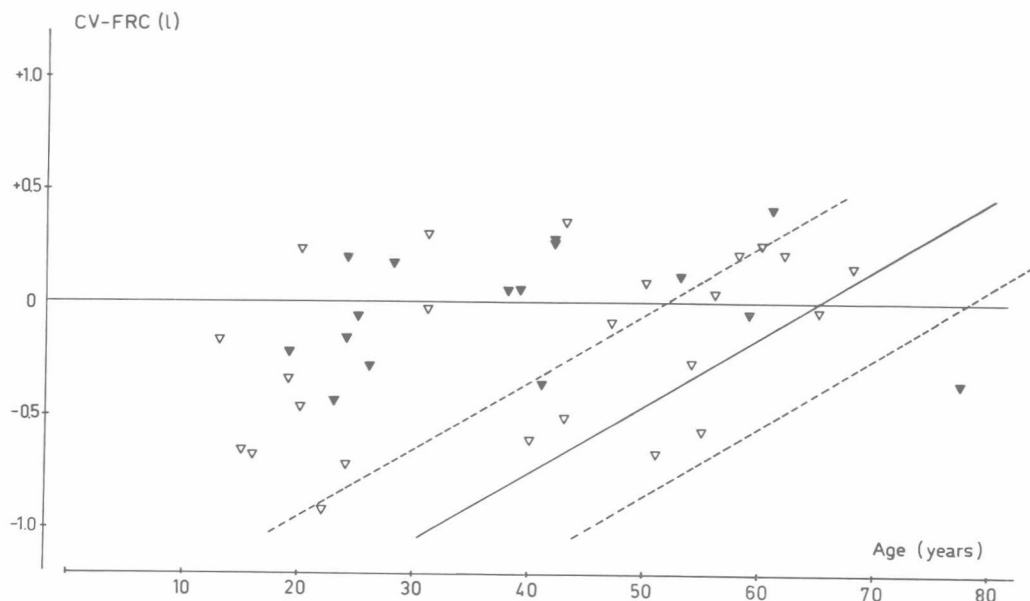


Fig. 1. Closing volume (CV) minus functional residual capacity (FRC) in relation to age. Values above zero line indicate that the airway closure occurs above FRC. Filled symbols indicate patients with a significant degree of dyspnea.

perfusion, the more pronounced the curve. For the basal parts of the lungs the reverse is true. These changes are correlated to the angulation more than to age or to side of the lungs. The most probable reason for this change in perfusion is the increased resistance in the pulmonary circulation (1).

The regional distribution of ventilation in the sitting position was studied after injection and inhalation of ^{133}Xe and the wash-out time in seconds calculated for different regions of the lungs (Fig. 2 and 3). We found no significant difference in ventilation between the convex and the concave sides. In patients with curves less than 60° the ventilation was normally distributed i. e. basal parts being better ventilated than apical parts. With increasing curvature the basal parts were less ventilated, a decrease in ventilation that happened at lower angles in patients above the age of 40 years (1). Before we end this presentation we would like to discuss if it is possible for us to do anything for the older patients that come with a severe scoliosis and where ordinary orthopedic measures are no longer possible. In an attempt to answer that question we trained a number of older subjects with idiopathic scoliosis and could demonstrate that it actually was possible to increase their physical fitness by a 3 months intensive program (5). The heart rate diminishes after training and the maximal oxygen uptake increases. All did not improve, however, and those that did not, all had a ventilatory limitation of their physical performance.

They also had the most severe curvatures. Through a maximal exercise test it is possible to select those that are unsuitable for training, because they stop working spontaneously at a relative low heart rate but with a definite dyspnea.

Although later in life we cannot change their deformity nor the pulmonary impairment, continuous physical exercise can accordingly be of value in selected patients.

From all what we have said it should, however, be clear that many of these patients are

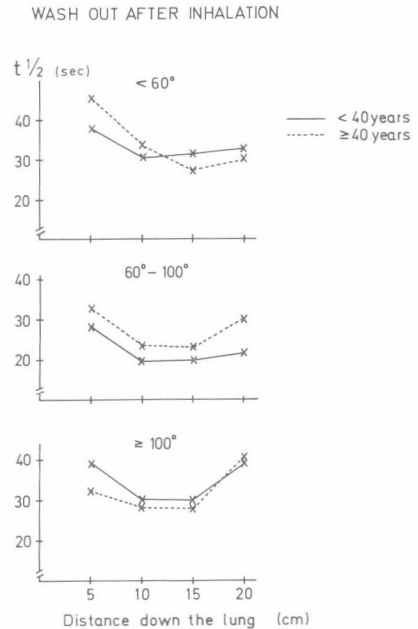


Fig. 2. Wash-out after inhalation of ^{133}Xe for patients with different curvatures and for ages below and above 40 years.

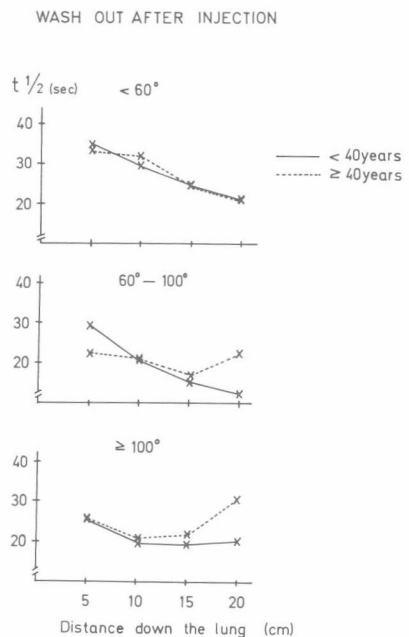


Fig. 3. Wash-out after injection of ^{133}Xe for patients with different curvatures and for ages below and above 40 years.

handicapped from a sociologic as well as cosmetic and cardio-pulmonary point of view.

If we apply our present knowledge of the end results of untreated idiopathic scoliosis to a 50-year-old female with an idiopathic dorsal curve of above 90° she will, compared to the average straight female, have the following approximate risks and physiological changes

- 3 times over mortality risk.
- 20 times working disability risk.
- 50% reduction in total lung capacity and vital capacity.
- Airway closure in the basal parts of the lungs during quiet breathing.
- Altered distribution of pulmonary blood flow and ventilation, significantly less in the basal parts.
- 1/4 chance to be married.
- No increased risk of disabling back pain.

Thus, I think it is fair to say that we all should make a real effort to prevent the curves in the young adolescents to progress. Particular attention should be given to those thoracic and probably also to the thoraco-lumbar curves in young subjects that seem to increase above 60°, while indications for correction of pure lumbar curves are less well founded. Surgery for these latter patients should not be performed too early and probably not below 70° to 80°, in which case the secondary thoracic curve will tend also to increase above 60°.

Indications for Operation

P. R. HARRINGTON, Houston

At an early age (usually adolescence) the scoliotic and deformed spine creates a mechanically vulnerable state. When the primary curvature is in the thoracic region, it can potentially involve the cardiopulmonary function and may shorten the patient's life. Several deformities in the thoracic area, without question, will place the cardiopulmonary function in a state of compromise. The

The probable prevention of future pain is not an indication, according to all long term follow-up studies so far presented.

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primary lumbar curve usually presents symptoms of fatigue, discomfort and by the fourth decade of life, disability of varying degrees. The management of the deforming spine by instrumentation, is designed to create a reasonably stable spine and thereby to eliminate the often catastrophic circumstances in the fourth and fifth decades of life. The Harrington factor is introduced as a treatment guide.

Surgical Treatment of Scoliosis

G. FABRY, Leuven

This study deals with the indication for surgery, the technique of fusion and correction and the results of the operative treatment in scoliosis from different etiologies.

The length of follow-up in these 173 cases ranged from one to nine years with an average follow-up of thirty-seven months. The average age of the patient at the time of surgery was fourteen years two months. Of the 173 cases of scoliosis, ninety-nine were classified as idiopathic, thirty as paralytic, and nineteen as congenital. Twenty-five cases did not lend themselves to an evaluation of results but have been considered in the discussion of complications.

Idiopathic Scoliosis

1) The two main indications for surgery in this group are physiological and cosmetic.

Physiological

Curves of 80° or over are very likely to produce respiratory and cardiovascular problems in young adults.

These severe curves have not usually responded to only cast correction and are, therefore, almost always an indication for surgery (Fig. 1 and 2).

A gradual correction is of utmost importance, since neurologic complications can be a threat

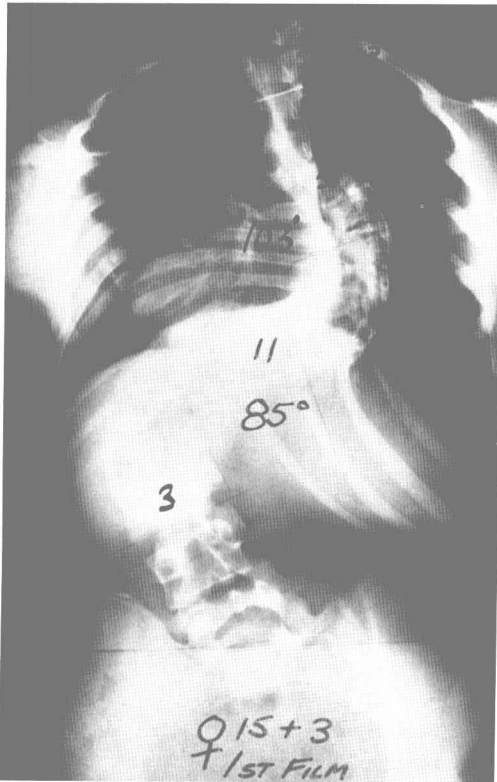


Fig. 1 Severe idiopathic scoliosis.

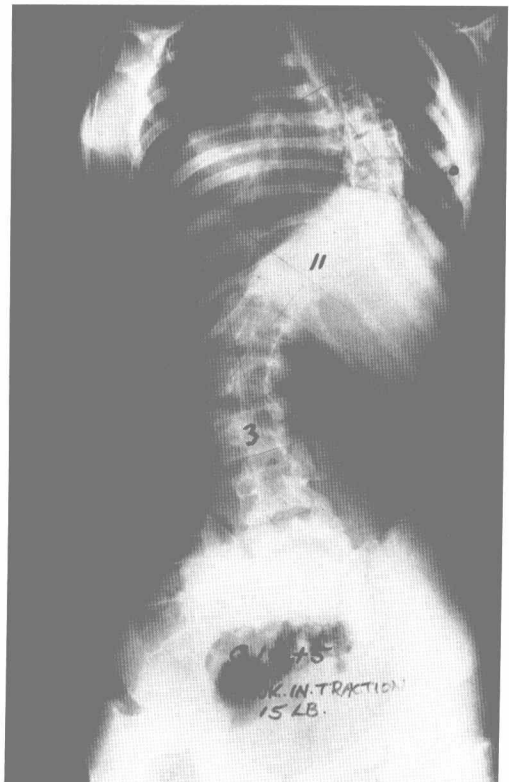


Fig. 2 Correction after one week of traction with 7 kg.