The early results of the treatment of idiopathic scoliosis using the dynamic SpineCor brace

Wczesne wyniki leczenia skolioz idiopatycznych z zastosowaniem gorsetu dynamicznego SpineCor

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Key words
idiopathic scoliosis, conservative treatment, dynamic brace

Summary
Introdcution: Idiopathic scoliosis is a three-dimensional deformation of the spine. Treatment of this condition depends on many factors, with curve magnitude (Cobb angle) and skeletal maturity (Risser sign) being the most important indices. In progressing curves of <40°, bracing is recommended. Different types of braces are available, most of them are of a rigid type. The SpineCor dynamic brace is a system of elastic bands designed to directly correct the spinal column deformity without restricting motion of the spine.
Aim of the paper: The aim of this paper is to present early results of adolescent idiopathic scoliosis treatment with the SpineCor brace.
Material and methods: Inclusion criteria for brace the application included the presence of a progressing curve in a skeletally immature child (Risser 0 – 3). The SpineCor brace was applied according to the principles of the method. The study group comprised 42 patients: 36 girls, 6 boys. The mean age at brace application was 11.9 years. The mean follow-up was 11 months. The mean initial curve size in the whole group was 33.1° in the thoracic spine and 29.4° in the lumbar spine. The evaluated group was subsequently divided into different subgroups depending on: initial curve size, curve type and sex. Results were classified as correction (decrease of curve size of >=5°), stablisation (curve change +/- 5°) or progression (increase of curve size of >=5°).
Results: Mean curve size at the final follow-up was 29.7° in the thoracic spine and 25.5° in the lumbar spine. Twenty one patients improved (50%), 14 had curve stabilisation (33.3%) and 7 progressed (16.6%). The best results were achieved in curves lower than 25° Cobb angle ($p < 0.05$) - 60% of patients improved. In contrast, in the over-45° group, only 37.5% of patients improved. No significant differences were found between treatment results with regard to sex.
Conclusion: SpineCor brace seems to be a good alternative for rigid braces, especially in minor curves. It enables preservation of motion of the spine. This type of brace is easily accepted by young patients. Further follow-up is needed to present long-term results.

Słowa kluczowe
skolioza idiopatyczna, leczenie zachowawcze, gorset dynamiczny

Streszczenie
Wstęp: Skolioza idiopatyczna to trójpłaszczyznowa deformacja kręgosłupa. Leczenie uzależnione jest od wielu czynników, spośród których wielkość skrzywienia i stopień dojrzałości kostnej wydają się być najbardziej istotne. W przypadku progresujących skrzywień o kącie <40° zalecane jest stosowanie gorsetu. Dostępnych jest wiele rodzajów gorsetów, najczęściej o sztywnej konstrukcji. Gorset dynamiczny SpineCor to system elastycznych taśm, które po założeniu bezpośrednio korygują deformację kręgosłupa nieograniczając jego ruchomości.
Cel pracy: Celem pracy jest przedstawienie wczesnych wyników leczenia skolioz idiopatycznych z zastosowaniem gorsetu dynamicznego SpineCor.
Materiał i metodyka: Kryterium rozpoczęcia leczenia gorsetem była obecność progresującego skrzywienia kręgosłupa u chorych z dojrzałością kostną według Rissera 0–3. Aplikacja gorsetu odbywało się według założeń metody. Badaną grupę stanowiło 42 chorych, 36 dziewcząt i 6 chłopców. Wiek w chwili rozpoczęcia leczenia wynosił średnio 11,9 lat. Okres obserwacji wynosił średnio 11 miesięcy. Wyjściowy kąt skrzywienia w odcinku piersiowym wynosił średnio 33,1°, zaś w odcinku lędźwiowym 29,4°. Badana grupa została podzielona na podgrupy na podstawie: wielkości wyjściowego skrzywienia, lokalizacji skrzywienia, płci. Wyniki oceniano jako korekcję (zmniejszenie kąta o >=5°), stabilizację (zmiana kąta +/- 5°) lub progresję (zwiększenie kąta o >=5°).
Wyniki: Wielkość kąta skrzywienia w ostatniej kontroli w odcinku piersiowym wyniosła średnio 29,7°, zaś w odcinku lędźwiowym 25,5°. U 21 chorych skrzywienie uległo korekcji (50%), 14 osiągnęło stabilizację (33,3%) a 7 progresję (16,6%). Najlepsze wyniki osiągnięto

Authors' Contribution: A – research and work project; B – collection of data, information; C – statistical analysis; D – interpretation of data; E –preparation of manuscript; F – literature search; G – fundraising

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w grupie chorych z wyjściowym kątem <25° (p < 0,05) – 60% chorych z korekcją. Przeciwnie w grupie chorych z wyjściowym kątem >45° tylko 37,5% osiągnęło korekcję. Nie zanotowano znaczących różnic w wynikach leczenia w zależności od płci.
Wnioski: Gorset SpineCor stanowi dobrą alternatywę dla sztywnych gorsetów, zwłaszcza w przypadkach małych skrzywień. Pozwala on na zachowanie ruchomości kręgosłupa. Tego typu gorset jest dobrze akceptowalny przez młodych chorych. Niezbędne są dalsze długofalowe obserwacje celem ostatecznych wniosków.

Introduction

Idiopathic Scoliosis is a deformation of the spine occuring in the frontal, sagittal and axial planes. The treatment undertaken depends on, among other things, the severity of the curvature, the degree of bone maturity as well as accompanying conditions. Non-operational treatment is applied in the case of lateral spinal curvature of an angle of curvature that according to Cobbe is less than between 40-45° in children who have yet to achieve osseous maturity. Medical treatment covers: systematic observation, kinesitherapy, as well as the application of braces. The first documented data on the subject of the treatment of scoliosis through the application of a brace is from the sixteenth century, its author being A. Paré[1]. However, only a detailed understanding of the natural history of scoliosis allowed for the creation of an algorithm of the treatment of curvatures of the spine through the application of braces[2,3,4,5].

Indication for treatment of scoliosis by means of braces is scoliosis with an angle of curvature according to Cobbe in the range of 25 to 45° in individuals who have yet to experience skeletal maturity. The aim of the treatment by braces is the stopping of the process of curvature that occurs in the course of the growth of the spine, this is designed to prevent operations.

Traditional braces were made from stiff elements causing a constant correcting force on the curvature of the spine. The 'SpineCor' system constitutes a new solution in the treatment by the brace method, for it is a dynamic brace maintaining the possibility for movements of the spine while simultaneously restricting all the components of emerging spinal deformation.

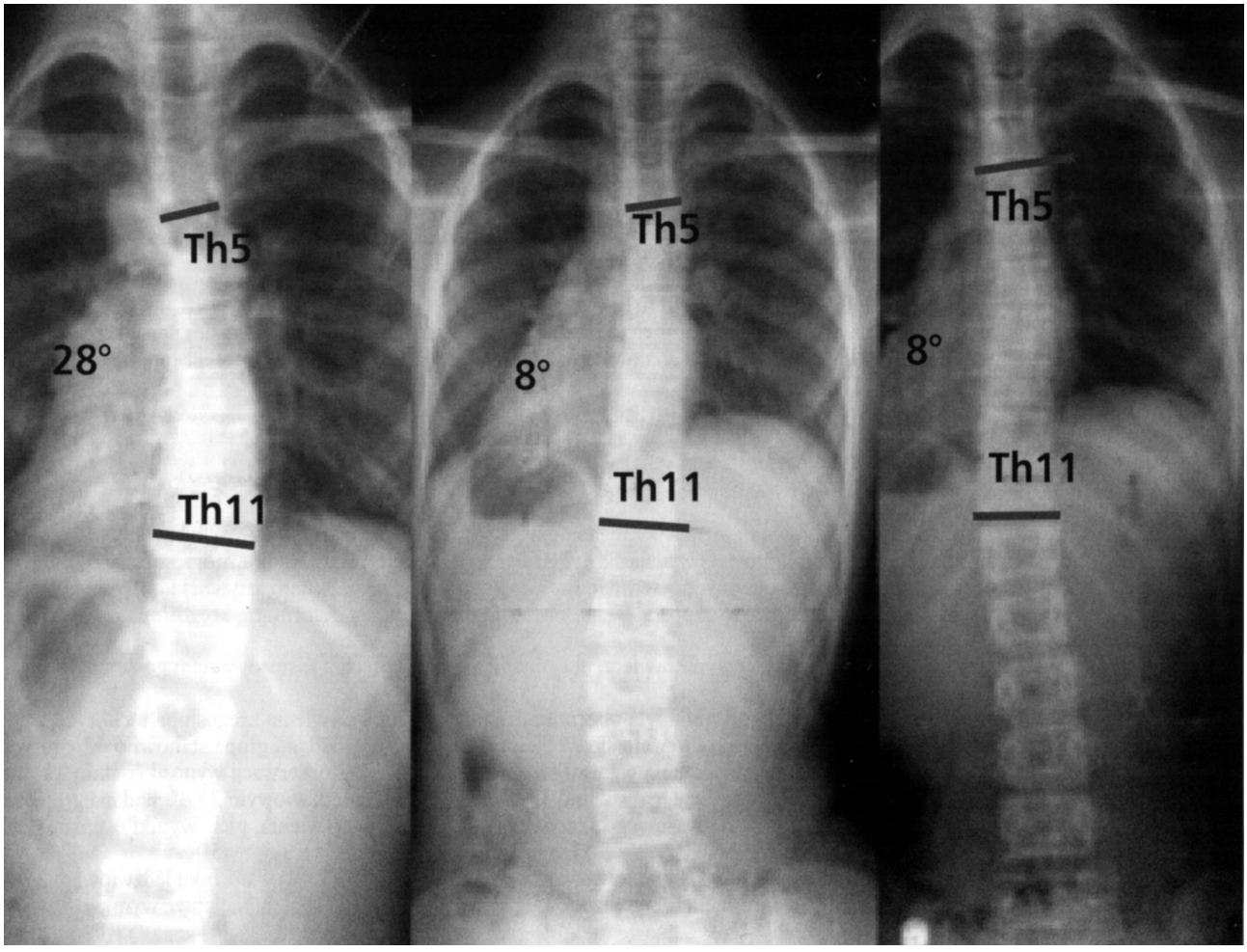

Photo 1

Patient KN, aged 12 years, female, AP x-ray of the spine before brace application, after 3 months of treatment and after 18 months of treatment

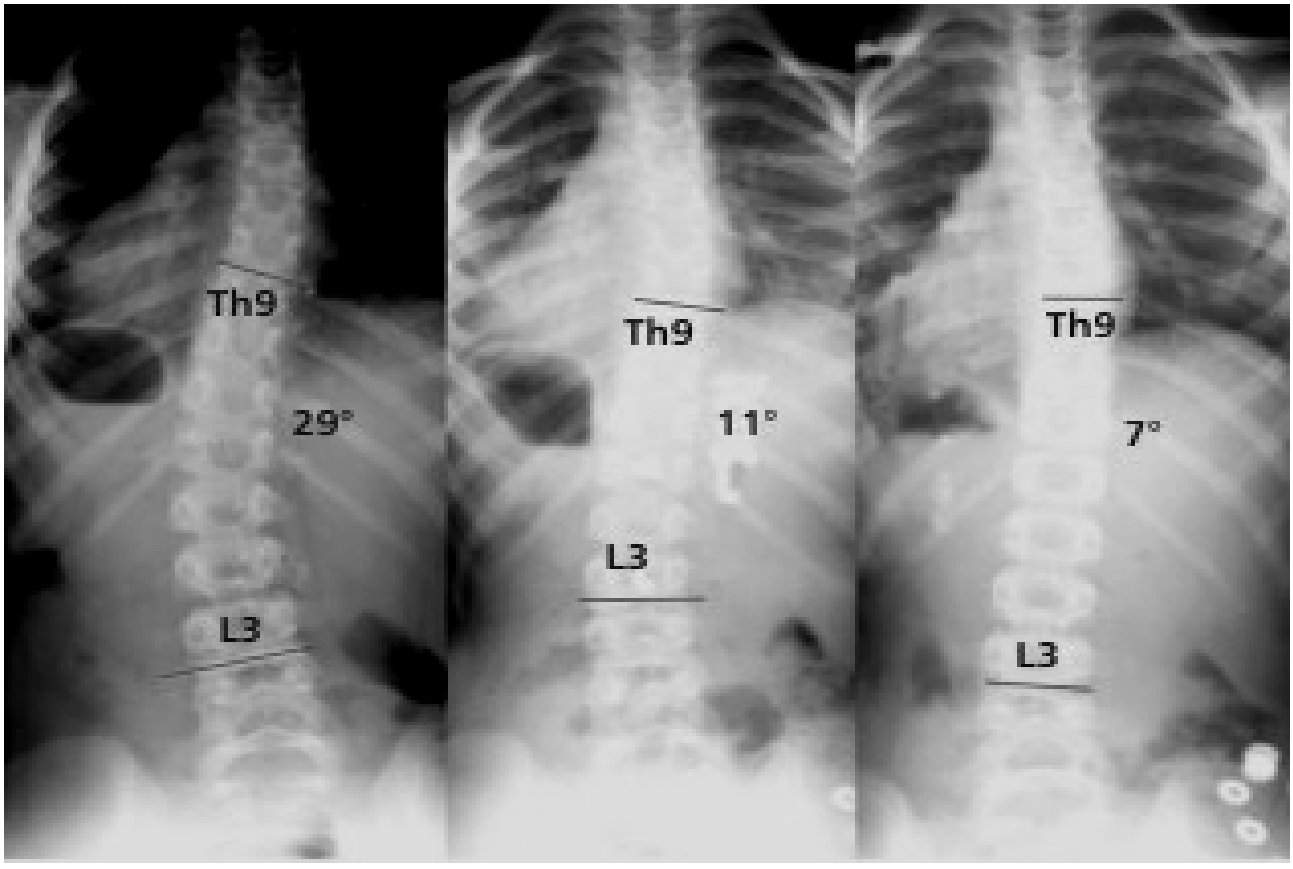

Photo 2

Patient PD, aged 11 years, female, AP x-ray of the spine before brace application, after 6 weeks of treatment and after 12 months of treatment

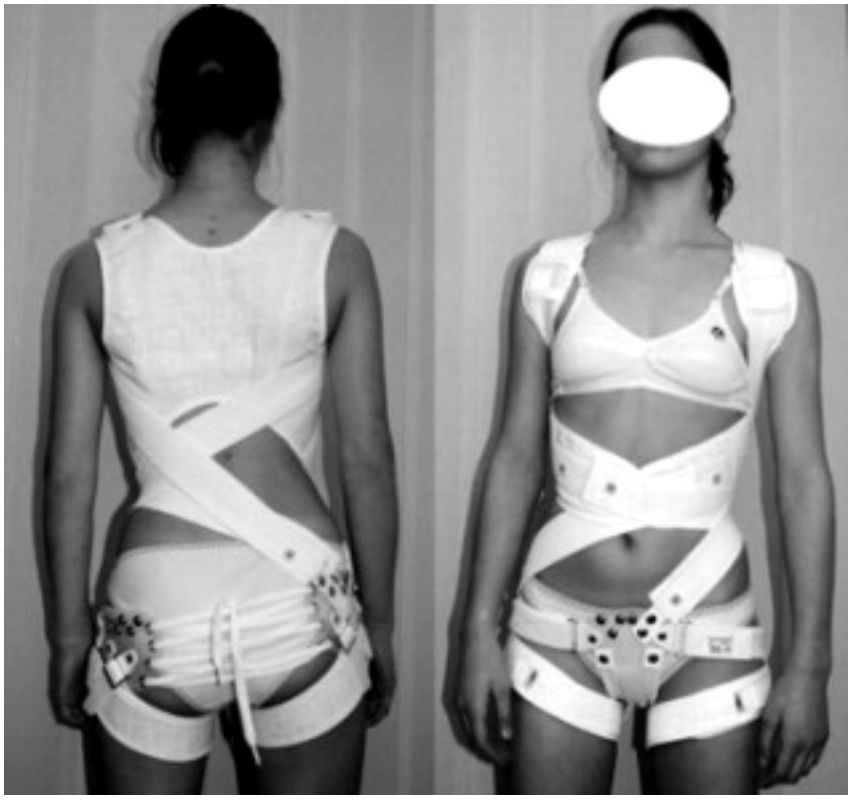

Photo 3

A patient directly after brace application, anterior and posterior view

In the course of recent years there have appeared many reports on the subject of the treatment of scoliosis through the application of braces, both those confirming[6,7] as questioning their effectiveness[8,9]. The problem is, however, a lack of clear and uniform criteria for the evaluation of patients treated in a conservative way. In 2005 a research group working at the Scoliosis Research Society (SRS) proposed a methodology for the assessment of patients treated by means of braces[10].

The aim of the work is the early assessment of the results of treatment of patients with idiopathic scoliosis through the application of the SpineCor dynamic brace according to the criteria proposed by SRS as well as traditional methods.

Materials

The research group comprised 42 patients with idiopathic scoliosis with a skeletal maturity according to Risser of 0-3. In the group there were 36 girls (85.7%) as well as 6 boys. The age of

Table 1

Inclusion criteria used in studies into the effectiveness of conservative treatment according to SRS

1. Minimum age 10
2. Skeletal maturity according to Risser
3. Magnitude of primary curvature
4. Absence of earlier brace treatment
5. Girls prior to adolescence or maximum a year after the first period

the patients at the commencement of the SpineCor brace treatment was on average 11.9 years (5.3 to 15.4 years). Amongst all those who underwent evaluation, 25 had previously been treated in a conservative way – all had kinesitherapy, besides which 6 had started treatment with the Boston brace. The largest group were those suffering from primary chest curvature – 11 (26.2), next thoracolumbar – 5 (11.9%), as well as lumbar - 3 (7.1%). The indicator of skeletal maturity according to Risser amongs those sick before the commencement of treatment is 0 (n=27), 1 in one patient, 2 in 6, and 3 in 8 patients. The minimal period of observation was 6 months, and the average period of observation was 9 months (from 6 to 24 months).

Methods

The qualification for those sick was on the basis of radiology diagnosis. Pictures of the whole spine in a p-a projection were evaluated, as well as from the side before the placing of the brace, immediately after its removal as well as during the course of the observations to ascertain the angle of curvature according to Cobbe (Photo 1, Photo 2). There was not observed in the research group any strict indications of treatment with braces. It was commenced both for those with an angle of <25° as a result of a bad figure or a high risk of progression, as in those with an angle of curvature of >45°. In this last group brace treatment was implemented both for very young patients as well as those who were just prior to reaching skeletal maturity.

The SpineCor brace is composed of a pelvic part and a vest connected together by means of four corrective bands applied differently for each type of curvature (Photo 3). The brace is applied when utilizing the SpineCor program which precisely defines the type of curvature and the way the brace should be applied. During the placing of the brace a corrective manoeuver in accordance with the morphology of the curvature is performed. The patients are obliged to use the braces for at least 20 hours a day until the moment they have reached skeletal maturity, but at least for 18 months. Those being treated should live a normal life with increased physical activity in the brace.

The positive result underlines the correction of curvature (a reduction in the angle of curvature of ≥ 5°) or its stabilization (a change in the angle +/- 5°). A negative result is considered: progression of curvature (an increase in the angle of ≥ 5°), the stopping of treatment or the necessity to operate. The research group was divided according to sex, localization of the primary curvature as well as its magnitude. As a result of localization the curvature was divided into frontal, sagittal and axial as well as primary double. As a result of the magnitude of the curvature three sub-groups were isolated, the first where the initial angle was ≤25° according to Cobbe, the second in which the angle is between 25° and 45° and the third – those ill with initial curvature of ≥45° according to Cobbe.

Table 2

Treatment results in relation to patient gender

	Number	Positive result		Negative result			End of treatment
		Correction	Stabilization	>5°	Interrupted treatment	Operational treatment	
Whole group	42	21(50%)	14(33%)	7(17%)	2(5%)	4(10%)	2(5%)
Girls	36	17(48%)	12(33%)	7(19%)	2(6%)	4(11%)	2(6%)
Boys	6	4(67%)	2(33%)	0	0	0	0

Table 3

Treatment results in relation to the initial primary curvature

Initial angle of curvature	Number	Positive result		Negative result			End of treatment
		Correction	Stabilization	>5°	Interrupted treatment	Operational treatment	
< 25°	13	8(62%)	3(23%)	2(15%)	1(8%)	0	1(8%)
25–45°	21	10(47%)	8(38%)	3(15%)	1(5%)	2(10%)	1(5%)
>45°	8	3(37%)	3(37%)	2(26%)	0	2(26%)	0

Table 4

Treatment results in relation to localization of the primary major structural curve

Type of curvature	Number	Positive result		Negative result			End of treatment
		Correction	Stabilization	>5°	Interrupted treatment	Operational treatment	
Primary chest	23	13(56%)	8(35%)	2(9%)	1(4%)	3(13%)	1(4%)
Primary double	11	5(46%)	3(27%)	3(27%)	0	1(9%)	1(9%)
Thoracolumbar	5	3(60%)	2(40%)	0	0	0	0
Lumbar	3	0	1(33%)	2(67%)	1(33%)	0	0

Table 5

Treatment results in the group of patients fulfilling the SRS inclusion criteria

	Number	Positive result		Negative result			End of treatment
		Correction	Stabilization	>5°	Interrupted treatment	Operational treatment	
Whole group	42	21(50%)	14(33%)	7(17%)	2(5%)	4(10%)	2(5%)
SRS criteria	24	13(54%)	5(21%)	6(25%)	1(4%)	1(4%)	0

Besides which there was distinguished a group of patients who fulfilled the criteria for inclusion in the research into the effectiveness of conservative treatment by braces according to SRS (Table 1) and the evaluation of the results of treatment in this group.

Results

The majority (92.8%) of those treated in the research group used the braces according to instructions. Two did not wear the brace regularly, while one patient at the initial stage of treatment incorrectly applied the tapes. The angle of curvature in the chest section of the spine before the commencement of treatment was 33.1° (10°-67°), while in the lumbar spine 29.4° (12°-52°). Directly upon the wearing of the braces the angle of chest curvature was on average 24.1° (7°-54°), lumbar curvature 22.3° (0-50°). In the period of observation these angles were respectively 29.7° (7°-62°) and 25.5° (5°-51°). In the end 21 patients achieved correction (50%) curvature stabilization in 14 (33.3%) while progression of curvature despite brace treatment was observed in 7 patients (16.6%).

From amongst the entire group 4 patients (9.5%) required surgery before the end of skeletal maturity as a result of the fast progression of the curvature, for all of these patients the initial angle of curvature was >45°. Besides which 2 of the patients in the research group finished treatment with braces as a result of reaching skeletal maturity. Only 2 patients did not accept this form of treatment of the scoliosis – the therapy was stopped before the stage of skeletal maturity was reached.

The results of the treatment for the whole research group incorporating the division according to sex is presented in Table 2.

Subsequently the research group was divided into 3 groups as a result of the initial angle of the angle of primary curvature: <25° (group I), between 25° and 45° (group II) and above 45° (group III). There were 13 patients in the first group, amongst whom over 60% had obtained correction during the course of the observations, not quite 25% stabilization while only 2 patients had observed progressive curvature. In group II there were 21 patients, 10 (47.6%) witnessed a correction of the curvature, 8 (38.1%) stabilization, while 3 (14.3%) progressed above 5° in the period of observation. The least effective treatment was observed in the group of patients with an initial curvature above 45°, from among 8 patients three (37.5%) managed a correction of the curvature, in the next 3 stabilization, and in the remaining 2 (25%) there was observed an increase in the angle of curvature. Detailed results taking into consideration the initial angle of curvature are presented in Table 3.

Besides, in the analysis there is taken into consideration the localization of the initial curvature, 4 groups of patient are distinguished: with primary chest curvature, primary double, thoracolumbar as well as lumbar. The results of treatment in these sub-groups is presented in Table 4.

In the reseach group, 24 of those treated fulfilled the criteria of treatment by a brace according to the SRS guidelines. The observation period in this group was on average 0.8 years (from 6 to 23 months). The average age in the group at the moment the brace was applied was 11.5 years (10-15.1 years), the Risser index was on average 0.5. The angle of curvature in the chest section was on average 27.8° (10°-40°), while in the lumbar section 25.9° (15° -40°). The angle directly after the placing of the brace was on average in the chest section 18.7° (7° -36°), in the lumbar section 16.2° (0°-32°). In the final control the angle was an average 23.3 (10°-49°) for the chest section as well as 19.9° (0°-40°) for the lumbar section. The detailed results for this group are presented in Table 5.

Discussion

Conservative treatment of scoliosis with the use of braces has for years generated a lot of controversy. The aim of such treatment is the change of the natural history of the illness: the stopping of progressive curvature that occurs up until the moment full skeletal maturity is reached and the eventual permanent correction of curvature. The final evaluation of treatment with a brace should be submitted within a period of two years after the end of therapy[11].

The initial results of treatment were not encouraging. Lonstein reports on the failure of treatment in 47% of patients who used a Milwaukee brace[12]. Besides Noonan et al[13] showed also that in almost a half of those ill following the end of treatment there occurred further progression of curvature, the percentage of patients who required operational treatment was 42%. The introduction of a subsequent generation of braces of the sacral-thoracolumbar type in distant periods significantly improved the results of treatment, stabilization or correction is, according to various authors, between 74-88%[14,15]. Yet equally amongst these patients, despite the gaining of reduction during the period the brace was applied, in later observation there was noted a return to the initial value of curvature[16].

The Spine-Cor brace has been used since 1993, the developers of the method recently evaluated the distant results of treatment[17]. In the period from the beginning of treatment to its finalisation from amongst 170 patients 51% achieved correction, while 8% stabilization. In somewhat over 18% despite the application of the brace, scolios is succumbed to progression in >6°, while 23% of those skeletally immature were treated though operations as a consequence of significant progression. The results in our research group were similar, significantly fewer patients underwent surgery (10% vs 23%) which is connected with the fact that currently the period of observation is very short and those ill with curvature progression undergo a detailed assessment. The developers of the methods have in addition assessed the dependence between the type of curvature and the result obtained, the most positive results (84%) were observed in lumbar curvatures; in the material analysed here there was not confirmed such a dependence which results most likely from the small number of patients in the group.

A separate analysis of the results in relation to sex resulted in an interesting observation, amongst boys only positive results were shown, correction or stabilisation. All accepted this form of treatment and complied with the recommendations. According to the control, the conservative treatment of scoliosis by a brace in a group of boys is not effective with only 1/3 of them accepting this form of treatment.

Coillard et al.[17] have also given results for a two-year period of observation from the moment treatment is terminated – amongst 95.7% of patients stabilization in curvature was shown. Besides which over 10% of this group displayed further spontaneous curvature correction.

Conclusions

1. Treatment by a Spine-Cor brace in the majority of cases gives for a permanent stabilization of curvature
2. The commencement of treatment in patients with curvature <25° and an index of skeletal maturity 0-3 extremely effectively prevents the progression of curvature.
3. The treatment of patients with an initial angle of curvature >45° can in selected cases result in the avoidance of an operation
4. Treatment in a group of boys appears as equally effective as in a group of girls
5. The aim of a conclusive evaluation is a longer period of observation – of at least 2 years from the moment the brace treatment finished.

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