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ORIGINAL PAPER

EVALUATION OF THE EFFECTIVENESS OF CHÊNEAU BRACE TREATMENT FOR IDIOPATHIC SCOLIOSIS – OWN OBSERVATIONS

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ABSTRACT

Introduction. Progressive nature of scoliosis significantly affects the development and functioning of a young organism. The extensive interest of medical experts in spinal deformities stems from their high incidence in the population of youth (2–3%), health consequences resulting from the disease progression as well as high economic and social costs.

Aim. Evaluation of the effectiveness of the Chêneau brace in the treatment of idiopathic scoliosis**.**

Materials and methods. The research material comprised 302 patients treated in the Chair and Teaching Hospital of Rehabilitation and the Provincial Children's Hospital in Ameryka near Olsztyn, for idiopathic scoliosis, ranging in ages from 8 to 17. The observation period was from 2 to 5 years. Qualification for orthopedic brace was conducted according to the recommendations of an international group of experts. We analyzed radiograms in the antero-posterior projection taken during the treatment and assessed the Cobb angles. The treatment was finished after skeletal maturity was achieved.

Results. At the stage of research material analysis some patients were excluded for the following reasons: lack of skeletal maturity – 66 (21.8%), interrupted treatment – 110 (36.4%), co-existing diseases impacting on the clinical course of scoliosis – 47 (15.5%). The study group, i.e. 79 patients, who completed their treatment, were

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divided into sub-groups depending on the effect of their treatment. 20 patients improved (24.7%), 18 (22.2%) were stable, 9 (11.1%) worsened, and 32 (41.9%) were qualified for surgical procedure.

Discussion. Meta-analyses of international literature have shown that bracing is an effective therapeutic method for idiopathic scoliosis. However, our studies have shown that a large number of patients decide to finish their therapy too early or do not undertake brace treatment at all.

Conclusions. A large number of patients in the lowest mean age group (12.4 years) who were eventually qualified for surgical procedure is disconcerting. The best outcome of the Chêneau brace treatment was achieved in the group of the highest mean age of 14.3.

Key words: idiopathic scoliosis, Chêneau brace, treatment effectiveness.

INTRODUCTION

Scoliosis is a progressive condition, which significantly affects the development and functioning of a young organism. The extensive interest of medical experts in spinal deformities stems from their high incidence in the population of youth (2–3%), health consequences resulting from the disease progression as well as high social and economic costs [6, 10, 24, 26, 28]. At present, we have at our disposal conservative therapeutic methods of a determined efficiency: kinesitherapy, electrostimulation and bracing. Each of these methods has undergone a specific evolution and currently modifications of the original procedures are applied. In the case of II degree scoliosis, braces from the TLSO group (Thoraco-Lumbo-Sacral Orthosis) are most frequently used clinically. Among them, the Chêneau brace, due to its high effectiveness, occupies a special position. The major function of this orthosis is to correct a 3-dimensional deformity of the spine and back by multipoint pressure zones and inhibiting the disease progression [11, 26]. Studies carried out so far have shown that wearing a brace changes the natural course of scoliosis [8, 16, 26] and allows the patient to avoid a surgical procedure [20, 26, 27, 28].

AIM

The aim of the research was the evaluation of the Chêneau brace treatment results in the management of idiopathic scoliosis.

MATERIALS AND METHODS

To evaluate scoliosis correction achieved with the Chêneau orthopedic brace in patients treated in the Department of Rehabilitation and the Provincial Children's Rehabilitation Hospital in Ameryka near Olsztyn we analyzed the course of therapies of

302 patients. Patients qualified for the research were treated between 2003 and 2008, and their medical documentation was stored in the computer system Q-Klinika. At the stage of detailed analysis, we excluded from the research 66 (21.8%) patients in whom full skeletal maturity had not been observed, i.e. they continued treatment, and 110 (36.4%) patients who had not completed their treatment, i.e. they had not shown up for check-ups despite medical recommendations. The latter group is rather numerous and this is unexpected. Some of these patients, i.e. 54 (17.8%), having received the recommendation for the brace, never came for a control examination. Thus, we can assume that this form of therapy was not acceptable for them, despite the information provided both to the patients and their parents by the ordering physician concerning the consequences of not undertaking the treatment. We also excluded those patients who had co-existing diseases affecting the progression of scoliosis, namely: paresis, Scheuermann's disease, muscular dystrophy, genetic syndromes (Tab. 1).

Tab. 1. Patients excluded during research material analysis

Cause	number
No skeletal maturity	66 (21.7%)
Interrupted treatment	110 (36.1%)
Co-existing diseases	47 (15.4%)

79 patients qualified for bracing completed their treatment. Qualifying procedure carried out at the Department was consistent with the recommendations of the international group of experts from SOSORT (Society on Spinal Orthopaedic and Rehabilitation Treatment) [18]. These recommendations concern the skill and experience of the physician recommending a brace, cooperation of the rehabilitation team – physician, physiotherapist and, in this case, a technician fabricating the brace, choosing one center fabricating braces and systematic control examinations of patients and braces. When analyzing this group of patients, we examined radiograms taken in the antero-posterior projection in order to assess spinal curvature measured according to the Cobb method, skeletal maturity (the Risser sign) and vertebral rotation according to the Nash-Moe method. Girls comprised the majority of patients in this group – 58 (73.4%), there were 23 (29.1%) boys.

Depending on the therapeutic results this group of patients was divided into sub-groups, i.e. patients who: 1) improved, 2) were stable, 3) progressed, 4) were qualified for surgery (Tab. 2). Improvement was defined as the decrease of the curvature angle by more than 5° measured by the Cobb method using X-ray image; stabilization was assumed when the change of the angle amounted to ±5°; whereas progression when after treatment the curvature angle progressed beyond 5° in com-

parison to the initial one, but the final Cobb angle did not exceed 40°. Patients qualified for surgical procedure showed the Cobb angle exceeding 40° after treatment. All patients, simultaneously to bracing, underwent kinesitherapy based on asymmetric exercises with elements of proprioceptive neuromuscular facilitation (PNF). The introduction to the exercises was carried out in hospital environment during at least 21-days rehabilitation courses in the Teaching Hospital and at the Rehabilitation Department. All patients were recommended to wear the brace for 20–23 hours a day, with a break for exercises and personal care activities. Systematic check-ups of the braces and patients were carried out within the out-patient system, and, when necessary, the brace was modified in the center in which it had been fabricated.

Tab. 2. Treatment results

Group of patients	Number
Total	79
Improvement	20 (25,3%)
Stabilization	18 (22.7%)
Progression	9 (11.3%)
Qualification for surgery	32 (40.5%)

RESULTS

Patients in whom improvement was observed comprised 20 patients, ranging in ages from 12 to 16. At the out-set of the treatment the mean age of the patients was 14.35, mean Cobb angle was 33.5° (23–45°), median rotation was 3 (1–4) and skeletal maturity according to the Risser sign was 3 (0–4). The observation period was on average 2.6 years (2–5). The Cobb angle decreased on average by 9.8° (4–27°), leading to the mean curvature angle of 21.8° at the completion of the treatment (Tab. 3). In this group of patients, single curve scoliosis appeared in 7 cases, out of which 6 were thoraco-lumbar (4 right-sided and 3 left-sided), and 1 was a typical right thoracic scoliosis. In the remaining 13 cases, scoliosis was assessed as double curve, and the analysis concerned the primary curve. The group in which stabilization was observed consisted of 18 patients, 7 of whom had single curve scoliosis and 11 double curve scoliosis. At qualifying for treatment the mean age of the patients was 13.8 years (13–17), mean Cobb angle was 32.6° (22–39°), median rotation 2 (1–3), median skeletal maturity 2 (0–4) and observation period on average was 2.4 years (1–4) (Tab. 4). Patients in whom bracing did not produce expected results were, on purpose, divided into two groups: patients who progressed and the therapeutic result did not exceed 40° and patients qualified for surgical procedure.

Tab. 3. Description of group with improvement

Factor	Number
Patient's Mean age in years	14.3 (12–16)
Mean curvature angle in degrees	33.5
Median rotation	3
Median skeletal maturity	3
Mean observation period in years	2.6 (2–5)

Tab. 4. Description of the group with stabilization

Factor	Number
Patients' mean age in years	13.8 (13–17)
Mean curvature angle in degrees	32.6 (22–39)
Median rotation	2 (1–3)
Median skeletal maturity	2 (0–4)
Mean observation period in years	2.4 (1–4)

The mean age in the group which progressed was 13.7 (13–15), mean Cobb angle progression 7.7° (4–12°), median initial rotation 3 (2–4), median rotation after completed treatment 3 (3–4), median initial skeletal maturity 0 (0–3) mean observation period 3.7 years (2–5) (Tab. 5). The completion of treatment in this group was connected with a larger curvature angle than at qualifying for bracing, but the final result allowed the patients to avoid surgery, which should be seen as a therapeutic success.

Tab. 5. Treatment results of in the group with progression

Factor	Number
Patients' mean age in years	13.7 (13–15)
Mean progression angle in degrees	7.7 (4–12)
Median initial rotation	3 (2–4)
Median rotation after completed treatment	3 (3–4)
Median initial skeletal maturity	0 (0–3)
Mean observation period in years	3.7 (2–5)

Patients qualified for surgery comprised the largest group (32) of the youngest patients – mean age 12.4 years (6–15), with a low degree of skeletal maturity – the median initial Risser sign was 0 (0–3) and with the largest progression – mean progression angle 15° (1–37°) (Tab. 6).

Tab. 6. Description of the group finally qualified for surgery

Factor	Number
Patients' mean age in years	12.4 (6–15)
Mean progression angle in degrees	15 (1–37)
Median initial rotation	3 (1–4)
Median rotation after completed treatment	3 (2–4)
Median initial skeletal maturity	0 (0–3)
Mean observation period in years	2.3 (1–4)

DISCUSSION

Chêneau brace is an orthosis unwillingly accepted by youth in adolescence because of esthetic and functional reasons. Patients' and their parents' awareness of the consequences of not treating scoliosis is frequently insufficient and the brace is considered as an element making every day life activities difficult, especially by girls. This results in not undertaking treatment, no determination to wear braces and not observing medical recommendations [28]. Attempts to install pressure detectors within the brace walls, which measured the contact time of the pads and the body, were an interesting and innovative solution towards the verification of the brace wearing time. Unfortunately, technical problems prevented a common application of such solutions [2, 9]. A physician supervising the treatment has no possibility to control kinesitherapy the patient is required to do. A therapeutic success to a large degree depends on adjusting kinesitherapy to the degree and type of scoliosis, doing the exercises systematically, as well as on patients' and their families' awareness and motivation. Meta-analyses of international literature have shown that bracing is an effective therapeutic method for idiopathic scoliosis [21, 28]. Brace, as any other type of orthosis used for a long time, disturbs bathyesthesia and changes proprioception. The pads correct spinal deformities. However, they do not enable the patient to mobilize deep muscles and intercostal muscles. They also do not impact on the elongation of the spine. Frequent stimulation of the neuromuscular system by specific movement patterns and breathing exercises should be an integral part of brace therapy. The more frequent stimulation in the form of short movement or breathing sequences during the day is, the higher the probability of posture deformity correction or stabilization. In order to analyze the treatment course precisely, it is worthwhile to introduce a thorough supervision of kinesitherapy

and to modify physiotherapists' work with the patients wearing orthopedic braces. Further, it is important to verify patients' and their families' active involvement in a movement therapy and the wearing of braces systematically. This can be done by employing control protocols.

Our studies have shown that a large number of patients (36.4%) decide to finish their therapy too early, i.e. before achieving skeletal maturity, or do not undertake brace treatment at all. These results may have been influenced by changing the physician and the treatment center by the patients. Informing the physician who issues the recommendation for the brace about changing the center providing the treatment should be considered as a good practice. It would contribute to collecting more reliable statistical data. Some patients do not accept the diagnosis they just learned about or actually deny that their disease exists. According to the literature such reactions may be manifested by as many as 50% of patients [4]. A large percentage of patients in whom the intended therapeutic effect was not achieved is a disturbing result. The group of patients finally qualified for surgical treatment comprises the largest and youngest group, as well as least advanced with respect to skeletal maturity (Risser sign). Rapid progression, and consequently a short observation period, point to a significant instability of curvatures in this group.

International literature on this subject is not uniform. Publications concerning the efficiency of braces are of diverse scientific value and reliability because of not observing EBM (Evidence Based Medicine) principles and SRS (Scoliosis Research Society) recommendations concerning research conducted on braces used in scoliosis. The SRS recommendations concern qualifying patients for a study group so that groups compared from various centers were homogenous because it is significant for the analysis and reliability of the research.

Inclusion criteria for the research on the effectiveness of conservative treatment according to SRS are as follows: minimum age 10, Risser sign 0–2, initial curvature 25–40°, no previous bracing treatment, girls before puberty, or maximum one year following the first menstruation [19]. Our study does not meet the above mentioned criteria; however, qualifying patients for bracing is performed according to the recommendations formulated by SOSORT.

In 2005 a meta-analysis of international literature was carried out focusing on evaluating the effectiveness of conservative treatment methods for scoliosis, including bracing. Out of 436 articles only 3 discussed randomized studies and 10 with a control group. However, only 5 referred to bracing [13]. A comparison of a group treated with bracing with the control group without treatment showed a significant improvement with bracing, from 50% to 70% [16]. Research on the effectiveness of braces (Charleston Bending Brace, Milwaukee, USA) as a supplementary treatment for exercising did not show a therapeutic effect. The results of both groups did not differ statistically [22]. A comparison of bracing only with exercises did not show any difference between the compared groups [1]. However, a comparison of bracing with electrostimulation showed a higher

effectiveness of the former therapy [23]. A comparison of various braces did not point to a significant advantage for any of them [5, 15, 28].

Comparison of results of research comparable methodologically, carried out globally and in Europe

USA: In 1995 studies performed by SRS showed that wearing a brace gave better therapeutic results than observation alone and no therapeutic intervention [16].

IRLAND: Research conducted by Goldberg [7] on the effectiveness of braces, both the Milwaukee brace and American equivalent of the Chêneau brace (TLSO group), showed that bracing had no impact on the number of performed surgical procedures. The research was carried out with a control group. In the control group the number of performed surgeries amounted to 28.1%, whereas in the group treated with bracing to 24%, which is not a statistically significant difference.

JAPAN: Japanese studies were carried out on a large group of 328 patients. In 20 (6.1%) patients, scoliosis progression exceeding 50° was observed. They were qualified for surgery. The mean age of initiating bracing treatment in the group qualified for surgery was 13.4, the Cobb angle was 48.5°, and the age when surgery was performed was 16.0, whereas the angle of curvature after the completed treatment with bracing was 62.2° [14].

SPAIN: Research carried out in Spain comprised a group of 157 children qualified for bracing. During the observation period, 13 patients did not complete the therapy, whereas 6 were qualified for surgical treatment. Thus, the frequency of surgery was at the level of 3.8%. Assuming that the patients who did not complete the therapy would also undergo surgical treatment, the need to perform surgery was at the level of 12.1% [20].

ITALY: Studies conducted in Italy were prospective. The groups were carefully analyzed according to the degree of curvature and with respect to achieving a minimal and maximal aim. A group of 112 patients was analyzed. The studies were completed by 108 patients, ages: 13.2 ± 1.8, with the Cobb angle of 23.4° ± 11.5°. 1 person underwent a corrective procedure, which makes for the frequency of surgery at the level of 0.9%, and assuming that the patients who did not complete the treatment would also undergo surgery – at the level of 4.5%. The minimal aim was achieved in 99%, and the maximal in 84% [17].

GERMANY: Retrospective studies of the patients treated with the Chêneau brace between 1993 and 1996 in the Clinic in Bad Soberheim comprised 343 girls, with the mean curvature angle of 33.4°, 41 patients underwent surgery, which makes for 11.9% [27, 28] (Tab. 7).

Tab. 7. Percentage of patients treated surgically for idiopathic scoliosis in the cited articles

Country	Italy	Japan	Germany	Spain	USA	Poland – own research
Number of patients	112	328	343	157	153	79
Percent of surgeries (%)	4.5	6.1	11.9	12.1	24.0	41.9

When evaluating the factors which contribute to a positive therapeutic effect of treating idiopathic scoliosis with a brace, most authors point to a proper fitting of the brace as a necessary condition to achieve correction [3, 20, 25]. A good initial correction with the brace is listed as the second factor. In order to evaluate an initial correction, X-ray should be taken and the Cobb angle assessed – the correction of the Cobb angle should amount to approximately 50% of its initial value. This allows us to assume that a positive final effect will be achieved. A very interesting study was published by researchers from Austria. They showed that fitting a brace properly and a good correction with it, is associated with a positive final effect. Proper fitting, but poor initial correction with the brace is associated with stabilization, whilst poor fitting is always associated with progression of the condition [12].

CONCLUSIONS

1. A large group of patients does not accept the Chêneau brace treatment and they do not undertake treatment by his method.
2. A significant group of patients does not observe the principles of using the Chêneau brace.
3. A large percentage of patients in the lowest mean age group of 12.4 qualified finally for surgical treatment is a disturbing phenomenon.
4. The best therapeutic results with the Chêneau orthosis were achieved in patients in the highest mean age group of 14.3 years.
5. Treatment with the Chêneau orthosis is associated with a natural development of idiopathic scoliosis and results in a worsening therapeutic effect in the periods of the disease progression.

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