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SCOLIOSIS: REVIEW OF DIAGNOSIS AND TREATMENT

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Abstract: Scoliosis is a spinal deformity consisting of lateral and rotation of the vertebrae. The causes of scoliosis are varied and classified broadly as congenital, neuromuscular, idiopathic and spinal curvature cause by secondary reasons. The essential components of diagnostics are patient history, physical examination, and radiographs. The scoliometer is a very useful and safe tool in diagnostic and management of scoliosis. The treatment scoliosis is based on age, curve management and risk of progression. It includes observation, orthotic magnitude and surgical correction with fusion. These and other authors' observations indicate that bracing is the most efficient non-surgical method of treatment for idiopathic scoliosis patients with 25°-45° curvature according to Cobb.

Key words: scoliosis, classification, diagnosis, treatment.

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Introduction

Scoliosis is a sideways curvature of the spine that occurs as a person's body grows. Scoliosis is often defined as a simply frontal plane deformity of the spine $> 10°$ [1]. The deformity is much more complex and includes significant transverse and sagittal plane components [2, 3]. Most causes of scoliosis are mild, but some children develop spine deformities that continue to be more severe as they grow. Severe scoliosis can be disabling. A special severe spinal curve can reduce the amount of space within the chest, making it difficult for the lungs to function properly.

What causes scoliosis?

In over 80% of cases, the cause of scoliosis is unknown – a condition called idiopathic scoliosis. The American Academy of Orthopedic Surgeons in cooperation with the Scoliosis Research Society describe four different types of scoliosis [1, 2]:

1. Congenital. This type of scoliosis occurs during fetal development. It is often caused by one of the following:
   - a failure of the vertebrae to from normally;
   - an absence of vertebrae;
   - a partially formed vertebrae;
   - a lack of separation of the vertebrae.

Patients with congenital scoliosis must be evaluated for cardiac and renal abnormalities [4]. A six-year-old girl with thoracic severe congenital scoliosis is shown Fig. 1. The defects in formation of thoracic spine produce deformity of spine.

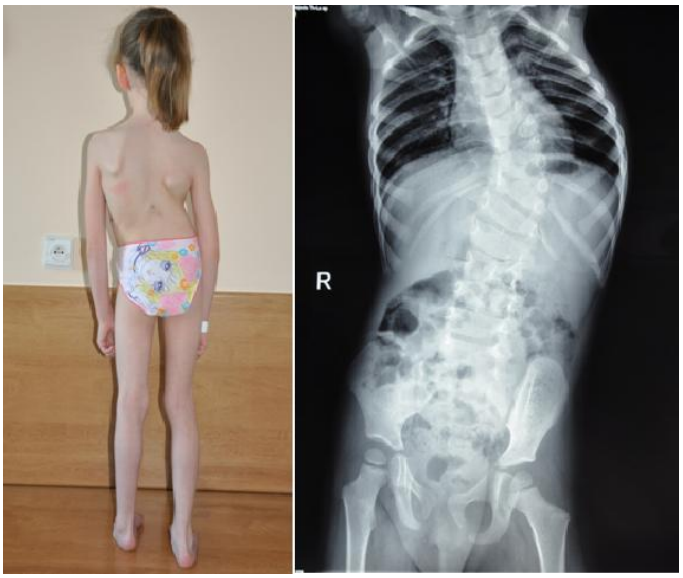

Fig. 1: Congenital scoliosis. This girl has thoracic-lumbar congenital scoliosis with severe deformity (own material).

2. Neuromuscular. This type of scoliosis is associated with many neurological conditions, such as the following:
   - cerebral palsy;
   - spina bifida;
   - muscular dystrophy;
   - neurofibromatosis, this is a genetic condition that affects the peripheral nerves that causes changes to occur in the skin, called *café-au-lait spots*.

Surgical treatment cannot be avoided in most cases of progressing neuromuscular scoliosis. However, there is a place

for conservative management which consists of physiotherapy and bracing. Orthotic treatment can prevent the collapse of the trunk and improve the sitting position. The results of the Swedish National Health Care Quality Program for prevention of hip dislocation and severe contractures in cerebral palsy [5], introduced in 1994, appear promising. Between 1994 and 2005, in Sweden and Norway, the program saw a reduction of the number of neurogenic scoliosis cases by about 60%. Such monitoring and preventive system should be widely introduced.

3. Idiopathic. The cause of this type of scoliosis is unknown. There are three types:
    - infantile, this type of scoliosis occurs from birth to age 3;
    - juvenile, occurs in children between ages 3 and 10;
    - adolescent, this type of scoliosis occurs in children between ages 10 and 18. This is the most common type of scoliosis.
4. Secondary or functional scoliosis:
    - differences in leg lengths;
    - hereditary conditions that tend to run in families;
    - injury;
    - infection.

Symptoms

Small curves often go unnoticed until children hit a growth spurt during puberty, and there are more sings (Fig. 2), such as:

- tilted, uneven shoulders, with one shoulder blade protruding more than the other;
- prominence of the ribs on one side;
- uneven waistline;
- one hip higher than other.

Physical examination

The standard screening test for scoliosis is the "Adam's forward bend test". During the test, a child will bend forward with feet together, knees straight and arms hanging free. The doctor will observe a child from the back, looking for a difference in the shape of the ribs on each side.

With a child standing upright, the doctor will also check, what the doctor can see, if the hips and shoulders are level, and if the position of the head is centered over the hips. The doctor will check for limb – length discrepancies, abnormal neurological findings, and other physical problems.

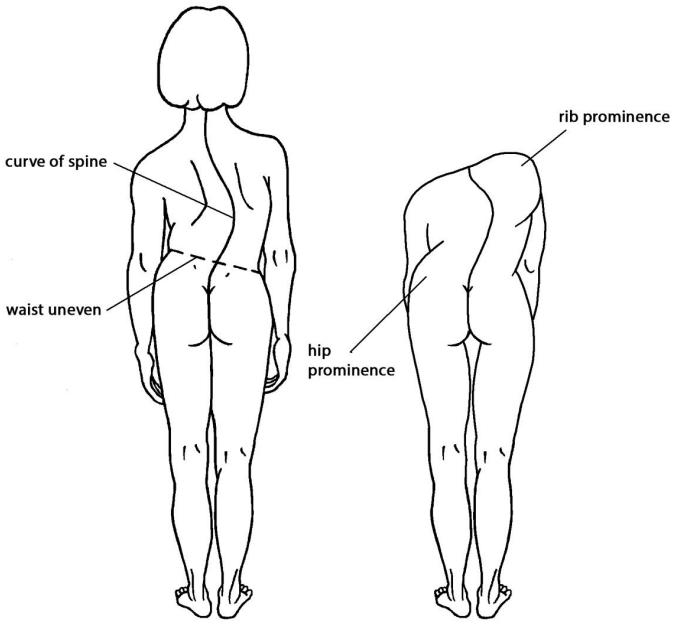

Fig. 2: Symptoms of scoliosis (own drawing).

Imaging test

Plain x-rays can confirm the diagnosis of scoliosis and reveal the severity of the spinal curvature. Radiographs are indicated if the scoliometer reading is greater than 7° (Fig. 3). Scoliometer has an application in examining children with scoliosis and is most widely used in the USA for school screening [3]. The clinical measurement of the angle of trunk rotation using a scoliometer can predict the degree of the angle of the curve scoliosis [6, 7].

Fig. 3: The scoliometer shows truncal asymmetry (own material).

Radiographs should be made on 36-inch film and taken standing. The Cobb angle is the most widely adopted technique to quantify the magnitude of spinal deformity [2]. Scoliosis is defined as a lateral spinal curvature with Cobb angle of 10° or more [2,3].

Management principles

A diagnosis of scoliosis often causes apprehension. We should reduce this anxiety because scoliosis is usually equated with treatment by braces or surgery. The indications for treatment should be individualized; however, some generalizations can be made. In general, the treatment of scoliosis depends on the severity of the curve:

$> 25°$ – the halting of scoliosis, rehabilitation treatment, observe;

$25 - 45°$ – brace treatment is indicated for immature patients where progression is defined as a documented increase of 5 or more degrees;

$> 45°$ – surgical treatment.

Our experience in treating scoliosis.

The prevention of scoliosis and rehabilitation program. The malfunctions leading to scoliosis are connected with the asymmetry of the load on both lower limbs and specific unconscious habit of standing. The are some situations, which prevent scoliosis [8,9]:

- the habit of standing on the left leg or on crossed legs;
- the habit of sleeping in the fetal position with the knees against the chin;
- the intense practicing of sports.

The aim of the exercises is to remove the contractures on the concave side of the scoliosis. The exercises to counteract the contractures of the tissues on the concave side of the lumbar scoliosis: bending with the maximum rotation to the left side – 50 – 100 – 200 times daily (Fig. 4).

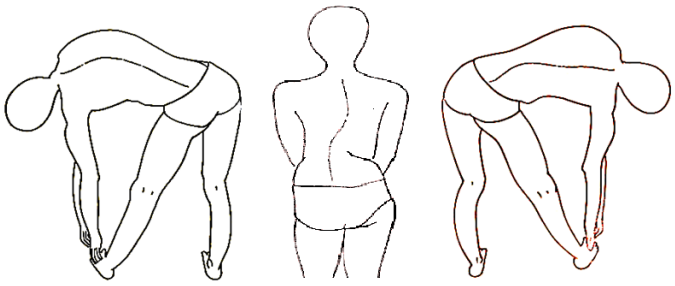

Fig. 4: Bending exercises to the left and to the right leg correct scoliosis (own drawing).

Brace treatment is indicated for immature patients with curves of $25° - 45°$. Bracing usually slows or stops the progression of most spinal curvatures [10–14].

Correcting scoliosis utilizing surgical and non-surgical methods should be three-dimensional and include the restoration of physiological thoracic kyphosis [15]. The main problem is the scoliosis progression in a patient. It has been proven that the best way to stop it is a back brace. Invariably, the most important impact on treatment success is consistency and conscientiousness in wearing an orthopedic corset.

In the assessment of the progression of the curvature on the basis of angles determined according to Cobb in the study group of 51 patients aged between 9 to 18 years (84% females) of orthopedic brace wearers, we revealed a considerable curtailing of the process (Fig. 5). The main

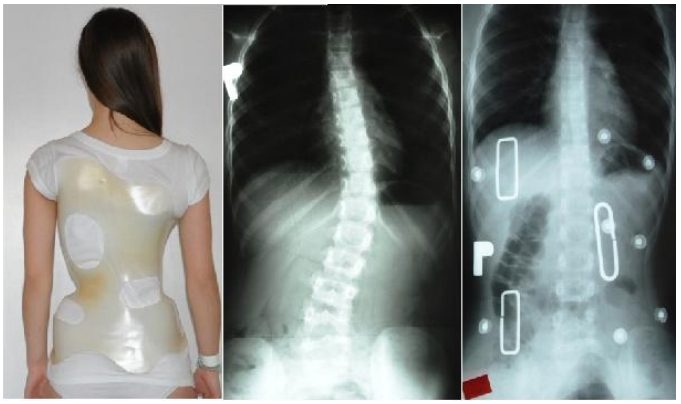

Fig. 5: The principle of thoracolumbar brace action (own material).

issues in the group are pain and damage to the skin during treatment. Our results confirm that the majority of patients treated with this method get used to the new situation without feeling an excess of negative experiences during that time. In addition, the number of hours a corset is worn per day does not have any effect on the intensity of pain [16–19]. A careful measurement in the form of gypsum negative or computer scan plays a key role in each type of corset. This has a significant impact on the quality of usage, which translates into the number of hours spent daily in a corset. Bracing is the most effective evidence-based non-surgical method for the treatment of adolescent idiopathic scoliosis [20].

Surgical treatment

Surgery is recommend if a child's curve is greater than 45°-50° or if bracing did not stop the curve from reaching this point. A surgical procedure called "spinal fusion" will significantly straighten the curve and then fuse the vertebrae together, so that they heal into a single, solid bone. Metal rods are typically used to hold the bones in a plane until the fusion happens. The rods are attached to the spine by hooks screws, and for wires [21,22].

In the years 2001-2014 we operated using the Cotrel-Debousset method, 42 patients aged 13 – 18 years (83% females) with scoliosis greater than 50°. The average correction of curve after operation was about 51% (Fig. 6).

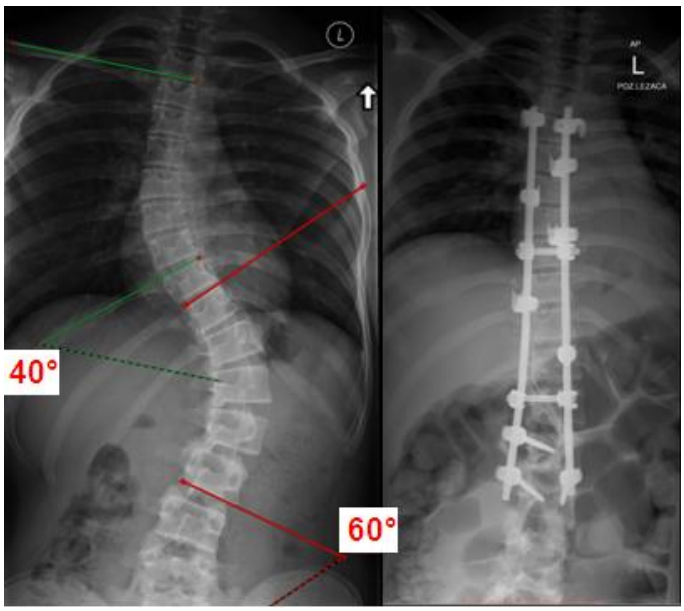

Fig. 6: Correction and fixation of thoraco – lumbar scoliosis utilized dual rods, pedicle screws and laminar hooks (own material).

Spinal fusion is very successful in stopping the curve from increasing. Surgery is also able to straighten the curve significantly, which improves the patients appearance [23]. Most children can return to sporting activities within 6 to 9 months after surgery [3]. Spinal fusion does not increase the risk of complications for girls during any future pregnancies or deliveries.

Secondary scoliosis

Scoliosis usually resolves itself when the underlying problem is corrected. There are no bone changes; the scoliosis is flexible; and the rotational elements are minimal. The common causes are leg length inequality (Fig. 7 and 8).

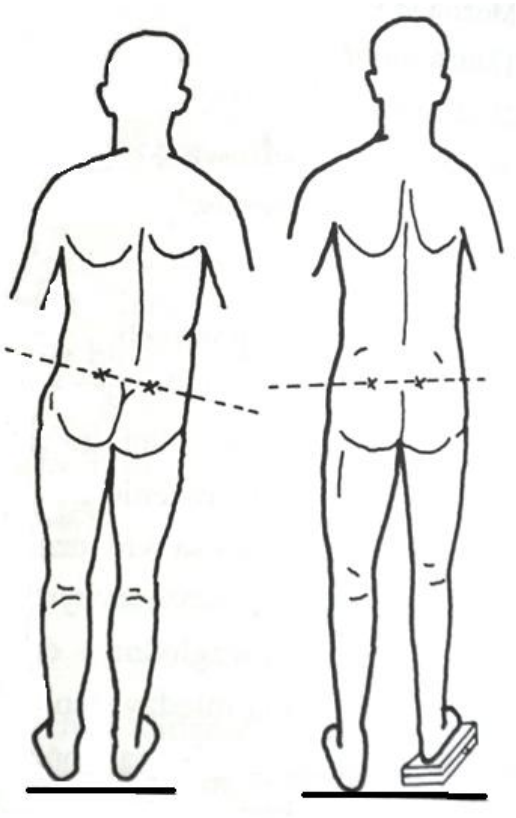

Fig. 7: Secondary scoliosis (own drawing).

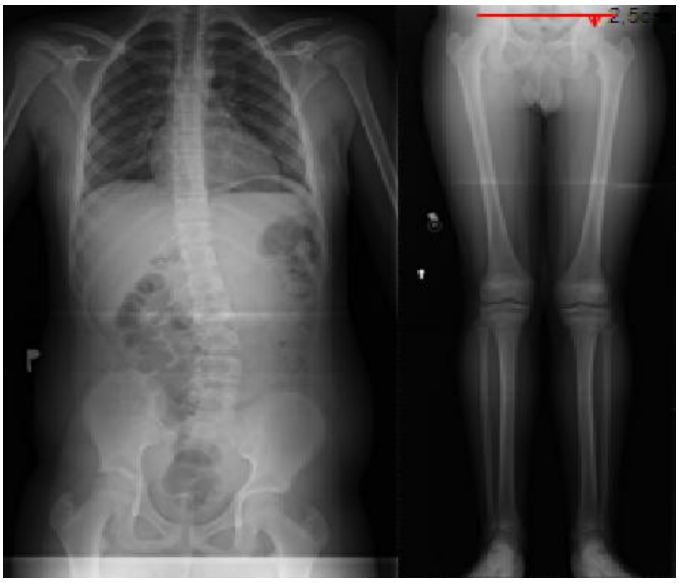

Fig. 8: X-ray picture patient with short right leg (2,5cm) producing secondary Scoliosis (own material).

Literature

[1] Scoliosis Research Society Web site. Available at: http://www.SRS.org/htm/glossary/medterms.htm. Accessed December 2003.

[2] Xiong B., Sevastik J.A., Hedlund R., Sebastik B. Radiographic changes at the coronal plane in early scoliosis. *Spine*, (19):159–164, 1994.

[3] Staheli L.T. *Practice of Pediatric Orthopedics.* LWW Press, 2nd edition, Philadelphia, 2006, pp. 159-164.

[4] Janicki J.A., Alman B. Scoliosis: Review of diagnosis and treatment. *Paediatr Child Heealth*, (9):771–776, 2007.

[5] Hagglund G. CPUP – Swedish National Health Care Quality Programme for prevention of hip dislocation and severe contractures in CP. Accessed 15 October 2007 from the website: www. cpup.se.

[6] Krawczyński A., Kotwicki T., Szulc A., Samborski W. Kliniczny i radiologiczny pomiar rotacji kręgów u cho-

rych ze skoliozą idiopatyczną. *Ortop Traumatol Rehabil*, (8):602–607, 2006.

[7] Bunnell W.P. An objective criterion for scoliosis screening. *J Bone Joint Surg*, (66A):1381–1387, 1984.

[8] Karski T. *Skoliozy tzw. idiopatyczne – etiologia, rozpoznawanie zagrożeń, nowe leczenie rehabilitacyjne, profilaktyka.* KGM, Lublin, 2002, pp. 1-211.

[9] Karski T. Biomechanical etiology of the so-called idiopathic scoliosis (1995-2007). three groups and four types in the new classification. *J Now Physiother*, 14(2):69–79, 2013. doi:10,4172/2165-7025.S2-006.

[10] Rowe D.E., Bernstein S.M., Riddick M.F., Adler F., Emans J.B. Gardner-bonneau the efficacy of nonoperative treatments for idiopathic scoliosis. *J Bone Joint Surg Am*, (79):664–674, 1997.

[11] Karpiński M., Kamińska M. Skolioza idiopatyczna. *Pediatria po dyplomie*, (15):75–79, 2011.

[12] Schiller J.R., Thakur N.A., Eberson C.P. Brace Management in Adolescent Idiopathic Scoliosis. *Clin Orthop Relat Res*, (468):670–678, 2010.

[13] Winiarski A., Zarzycki D., Koniarski A., Kalciński M. The natural history of idiopathic scoliosis. *Ortop Traumatol Rehabil*, (7):1–7, 2005.

[14] Negrini S., Donzelli S., Lusini M., Minnella S., Zain F. The effectiveness of combined bracing and exercise in adolescent idiopathic scoliosis based on SRS and SOSOSRT criteria: a prospective study. *BMC Musculoskelet Disord*, (16):263, 2014. http://www.biomedcentral.com/1471-2474/15/263.

[15] Kotwicki T., Szulc A., Dobosiewicz K., Rąpała K. Patomechanizm progresji skolioz idiopatycznych – znaczenie fizjologicznej kifozy piersiowej. *Ortop Traumatol Rehabil*, (4):758–765, 2002.

[16] Rahman T., Bowen J.R., Takemitsu M., Scott C. The association between brace compliance and outcome for patients with idiopathic scoliosis. *J Pediatr Orthop*, (25):420–422, 2005.

[17] Lenssinck M. L., Frijlink A.C., Berger M.Y., Bierman-Zeinstra S.M., Verkerk K., Verhagen A.P. Effect of bracing and other conservative interventions in the treatment of idiopathic scoliosis in adolescents: a systematic review of clinical trials. *Phys Ther*, (85):1329–1339, 2005.

[18] Sapountzi-Krepia D.S., Valavanis J., Panteleakis G.P. et al. Perceptions of body image, happiness, and satisfaction in adolescents wearing a Boston brace for scoliosis treatment. *J Adv Nurs*, (35):683–690, 2001.

[19] Bridwell K.H., Shufflebarger H.L., Lenke L.G., Lowe T.G., Betz R.R., Bassett G.S. Parents' and patients' preferences and concerns in idiopathic adolescent scoliosis: a cross-sectional preoperative analysis. *Spine*, (25):2392–2399, 2000.

[20] Kwiatkowski M., Mnich K., Karpiński M., Domański K., Milewski R., Popko J. Ocena satysfakcji pacjentów z leczenia skoliozy idiopatycznej gorsetem piersiowo – lędźwiowym. *Ortop Traumatol Rehabil*, (17):111–119, 2015.

[21] Smoczyński A., Smoczyński M., Łuczkiewicz P., Pankowski R., Pobłocki K. Operacyjne leczenie bocznego idiopatycznego skrzywienia kręgosłupa zmodyfikowanym sposobem Harringtona podłukowymi pętlami drutu. *Ann Acad Med Gedan*, (37):103–110, 2007.

[22] Nowak R. A contemporary approach to surgical treatment of scolioses. *J Orthop Trauma Surg Rel Res*, (13):31–45, 2009.

[23] Gorzkowicz B. Ocena jakości życia u pacjentów ze skoliozą idiopatyczną leczonych operacyjnie metodą Cotrela – Dubousseta. *Ann Acad Med Stetin*, (2):25–31, 2011.

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