ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN — POLONIA
VOL. LII, 14 SECTIO D 1997

Katedra i Klinika Ortopedii Dziecięcej Akademii Medycznej w Lublinie
Kierownik: prof. dr hab. Tomasz Karski

TOMASZ KARSKI

Hip abductor contracture as a biomechanical factor in the development of the so–called "idiopathic scoliosis". Explanation of the etiology

Przykurcz odwiedzeniowy biodra jako czynnik biomechaniczny w rozwoju tzw. „skolioz idiopatycznych". Wyjaśnienie etiologii wady

Until 1995 the cause of the idiopathic scoliosis had not been discovered (1, 3, 5, 12, 13, 14, 18, 19, 24, 26). In 1995 the author presented the etiology of the so–called "idiopathic scoliosis" at the Orthopaedic Congress in Szeged, Hungary (9), at the Orthopaedic Congress in Szekszard (1997) (7) and published his observations in Polish and German (10, 11) in 1996.

This article is trying to explain the following questions: the cause and development of scoliosis, why idiopathic scoliosis occurs most often with girls, why the thoracic region is particularly affected to the right side and why scolioses intensifies in the period of growth acceleration.

THE INFLUENCE OF CONTRACTURE ON THE DEVELOPMENT AND GROWTH OF A CHILD. SYNDROME OF CONTRACTURES

In order to explain the pathomorphology of the scoliosis so far described as "idiopathic scoliosis", it is necessary to go back to the pathology of the hip and pelvis region in the newborn and baby period. In etiology of CDH, 85% to 90% of cases of dysplasia appear in the "syndrome of contractures" (2, 4, 6, 8, 17, 24). Mostly, it is dysplasia of the left hip, sometimes without changes in the sonography (6, 8).

At the same time in the "syndrome of contractures" there is abduction contracture of the right hip, the body asymmetry, plagiocephaly, torticollis etc. The abduction contracture of the right hip, which persists and gets fixed, becomes the main reason of the pathology of the pelvis and the spine with children at the age of 6 to 10 and still more at the age of 12–16–18 in the first and second period of the growth acceleration.

THE DEVELOPMENT OF SCOLIOSIS

The above–mentioned abductor contracture of the right hip (mostly!) is an important biomechanical factor in the development of scoliosis. This is a primary factor. The secondary factors are extension exercises, which makes scoliosis worse. The additional factors are: weakening of the ligaments and capsules, weakening of the muscle, unwillingness to practise sport, genetic, neurogenic and hormonal laxity, rickets, subclinical cerebral palsy, anatomical changes in *facies auricularis* and in *processi articularis* L4–LS–S1 (25).

The abduction contracture of the right hip is in fact a limitation of adduction in comparison to the left side, which with age becomes fixed, especially in the time of growth acceleration, it causes the inequality of legs, the oblique position of the pelvis, and most importantly and decisively–disturbing of the gait. Disturbing of the gait is unnoticeable for parents and doctors, but causes abnormalities of growth in the complex: the hip – the pelvis with the sacrum bone – the lumbar spine.

In the case of a patient with developmental scoliosis at each step, in the stand phase the right part of the pelvis is blocked in its movement because the right hip is fixed to the pelvis by abductor contracture. So, the compensatory movement in the lumbar, sacro–lumbar or lumbothoracic part of the spine occurs and this develops lumbar, sacro–lumbar or lumbothoracic scoliosis to the left side. This process takes a long time and is hardly visible for some years; scoliosis develops guilefully and gradually.

The "abduction contracture" is often associated with slight flexion contracture of *m. rectus* and *m. ilio-psoas* of the right hip and later also associated with the contracture of the soft tissue – ligament and para-vertebral muscles in the right lumbar region, i.e. the concave side of scoliosis and the left thoracic region, therefore also in concave side of scoliosis.

In children aged 6–8 with idiopathic scoliosis, there is a range of anthropometric changes as plagiocephaly, shortening of the left leg, pelvis obliquity which was also described by Willner (1972) (21), Wynne–Davies (1975) (22) and Magoun (1974) (15), Dangerfield and others (3). In children aged 6–8 years

the symptoms of the asymmetry of the hip and the waist become more visible, the lumbar scoliosis, or sometimes both, lumbar and thoracic gets fixed. At the same time one observes that the extension movement of the spine from the "flexion position" takes place with the lateral movement (Karski, 1996). This "functional phenomenon" is the first symptom of the on–coming scoliosis. Discovering this phenomenon requires the experience of an orthopaedic surgeon.

Processi spinosi Th-7-8-9-10-11-12 become invisible at the flexion of the spine. This part of spine gets straight and stiff (disappearance of the physiological thoracic kyphosis by flexion). This happens when the child starts to walk more from about 6 years of age, but mostly at 10–15 years, especially in the time of growth acceleration, which was also observed by Stirling and collaborators (20).

The scoliosis in the lumbar and later in the thoracic part of the spine cannot develop without a rotation and torsion deformity. This rotation is a result of the properties of the segmental lateral movement of the spine.

MATERIAL

The complete material comprises 6,751 children and adolescents aged from a few weeks to 18 years, examined personally by the author in 1975–1996. This number includes 2,581 newborns and babies with hip problems i.e. with dysplasia, adduction–abduction hip contractures. Within this material I have examined 328 older children (70%) with lumbar scoliosis (10°–15°) and some children (30%) with the beginning of thoracic scoliosis (10°–20°). In all these patients I diagnosed the abduction contracture, i.e. lack of adduction proved in the extended position of the right hip and associated slight flexion contracture. I did not see other severe illnesses or disorders. The children with scoliosis seemed to be normal, and without severe illnesses or disorders like cerebral palsy, neuro–fibromatosis, Ehlers–Danlos syndrome, etc.

THE METHOD OF CLINICAL EXAMINATION OF THE ABDUCTOR CONTRACTURE

The passive movement of adduction in the hips was examined, with the children lying on their side at the edge of a stable bed, with their backs to the orthopaedics surgeon (Figs 1, 1a). During the whole examination the hip must be all the time in full extension, the knee in extension or in flexion, the leg in 0–rotation or 5° in out–rotation. The examination shows the differences in the range of adduction.

The observations indicate that the difference in the adduction of both hips is the first and deciding factor. In the situation when the difference of adduction of both hips is bigger, the scoliosis appears earlier and can be larger (Tabs 1, 2). Certainly, the secondary and additional factors also have their influence, but in my opinion, they do not carry more than 20% of the beginning impact of development of scoliosis.

Tab. 1. Development and progression of the so–called "idiopathic scoliosis". The difference in the adduction of both hips is the deciding factor for development of scoliosis

Passive adduction of the right hip (in the straight position of the joint)	Passive adduction of the left hip (in the straight position of the joint)	The character of scoliosis Children's age 6–8 years
–5° (abduction contracture 5°)	25°–35°	primary scoliosis L–20°, Th–20° large progression
0°	25°–35°	primary scoliosis L–15°, Th–15°, large or moderate progression
5°	25°–35°	primary scoliosis L–10°, Th–10°, slight progression
10°	25°–35°	primary scoliosis L–5°–10°, without progression
15°	25°–35°	slight scoliosis, without progression, without scoliosis

Tab. 2. The range of the adduction movement of both hips as a deciding factor for the development of the lumbar and thoracic scolioses

Passive adduction of the right hip (in the straight position of the joint)	Passive adduction of the left hip (in the straight position of the joint)	The character of scoliosis Children's age 6–8 years
–5° (–10°)	30°–35°	Early occurrence of lumbar and thoracic scolioses. Rapid increase of scolioses at the spurt of the growth
0°	30°–35°	Early occurrence of lumbar and thoracic scolioses. Rapid increase of scolioses at the spurt of the growth

L – lumbar, Th – thoracic

RADIOLOGICAL SYMPTOMS

The first symptom is the oblique position of the pelvis of the babies commented on as the "wrong position of the baby body during the X–ray examination". Other symptoms are disturbances in the growth of the pelvis, especially the sacro–lumbar region observed in 6–10–year old, and especially 12–17–year–old children. Sometimes we can see a "shift" of the 5th lumbar body of the spine to the left side and the first symptoms of lumbar scoliosis. Also oblique position of the bone sacrum with its apex is going to the right side, especially when *facies auricularis* is not fixed well enough.

The lumbar scoliosis to the left side sometimes appears as an angular deformity at L-5 – S-1, and even after as a subluxation L-4 – L-5. The radiological details of structural lumbar and thoracic scoliosis are widely known (Fig. 2).

PREVENTION AND TREATMENT

The therapy of scoliosis is very difficult and it is very important to discover the dangers of the deformity by children aged 7–9 years and to apply preventive measures. Consequently it is necessary to diagnose the "abduction contracture" of the right hip and cure it through redression, physiokinesis and thermo–therapy. Very important are physical exercises (10, 11, 16). With some children (23 patients), we remove the abduction contracture with surgery (7). The operation includes fasciotomy of *fascia lata*, fascia of *gluteus medius*, fascia of *m. tensor fasciae latae* and desinsertion of *m. rectus*. If thoracic scoliosis in older patients (13–17 years old) has already developed, we also recommend surgery and later gymnastics although we do not expect the diminishing of scoliosis. However, also in these children parents notice levelling of the front part of the chest, slight diminishing of *gibbus costalis* and renormalizing of the waist symmetry.

The role of some sports in the treatment is extremely important, especially of stretching flexions–rotations excercises (judo, tae–kwon–do, aikido).

In the group of treated children aged 6–8–10 years with both lumbar and thoracal scoliosis after 1–2–3 years of good exercises we see diminishing of scoliosis.

Observations from the last years prove that it is very harmful to do extension exercises of muscles extensor of the trunk in prone position of the child. The activity of the muscles, acting straightly on the both scolioses increase the malformation and cause the straight contracture of the spine.

DISCUSSION

My observations explain that the so–called "idiopathic scoliosis" arises because of disturbances of the spine growth together with abnormalities in the sacro––pelvis–lumbar region caused by the abduction contracture of the hip (9, 10, 11).

This accounts for the appearance of the sequential deformities. Till 1995 the orthopaedic literature had either provided no explanation of the etiology (1, 12, 13, 14, 18, 19, 21, 24, 26), or spoke about genetic disturbing of the spine growth (5, 13), or looked for neurogenic or hormonal causes (19). Only Wynne–Davies (22), Magoun (15), Dangerfield et al. (3), Willner (21) describe a set of anthropometric symptoms which I have also observed, but they do not write about the symptom of the difference of the hip adduction in an extended position of the hip joint. Stirling (1996) and others (20) describe the set of observations of the development of scolioses during the "adolescent growth spurt" and their conclusions coincide with these of the present author. Only Malawski (16) writes about the pathomechanics and treatment of scoliosis in the way similar to my point of view.

CONCLUSION

1. The etiology of the so–called "idiopathic scoliosis" is very complex, but the primary cause for its appearance in the hip, pelvis and spine region, is caused by abduction contracture of the hip. This is the basic cause, but there are certainly other coexistent factors.

2. Lumbar scoliosis and thoracic scoliosis come in a sequence:

a) "abduction contracture" mostly of the right hip is the first cause, hidden and invisible, leading to further deformities;

b) in the second stage there appears a disturbance in the growth of the pelvis–sacro–lumbar region and the development of lumbar or sacro–lumbar scoliosis to the left side;

c) in the third stage secondary thoracic scoliosis develops to the right side.

3. The more frequent appearance of the so–called "idiopathic scoliosis" in girls coincides with more frequent dysplasia or only "syndrome of contractures" of the hips in the same gender (adduction contracture of the left hip and abduction contracture of the right hip).

4. The etiology of the so–called idiopathic scoliosis coming from the theory of the abductor contracture of the right hip explains, why scoliosis develops faster during the period of growth acceleration. The bones are growing large and longer, the abductor contracture gets fixed and its influence is bigger.

5. The cause of development and fixation of lumbar and thoracic scoliosis are changes in the spine, the arrest of the growth of the spine body on the concave side, the weakness of the muscles on the convex side of the scoliosis but, first of all, the contracture of the soft tissue, i.e. paravertebral muscles and ligaments, on the concave side of the scoliosis.

6. Therefore, it is very important to discover the dangers of the contracture in children aged 6–8–10 and to treat this contracture effectively, by means of redressions–stretching exercises.

7. Our observations from the last year seem to indicate that operative removing of the abductor contracture of the right hip and intensive flexion–rotation exercises slow down the development of severe scolioses in adolescents and cure small scolioses in small children.

8. The above-mentioned explanation of the pathomechanics of the development of scoliosis and the character of the developed scoliosis and especially of its progress and secondary influences will be in continued observation and research.

REFERENCES

1. Adams J.C.: Outline of orthopaedics. Edinburgh–London–New York, Churchill/Livingstone 175, 1976.
2. Bjerkreim I.: Congenital dislocation in the hip joint in Norway. A clinical–epidemiological study, A/S Holstad–Trykk, Oslo 1, 1974.
3. Dangerfield P. et al.: Stature in Adolescent Idiopathic Scoliosis (AIS). 14 Meeting EPOS, Brussels, 5–April, Papers and Abstracts 210, 1995.
4. Dega W.: Badania z dziedziny etiologii wrodzonego zwichnięcia biodra. Chir. Narz. Ruchu, 144, II – 1932.
5. Filio N.A., Thompson M.W. after Zarzycki D. et al.: Naturalna historia bocznych skrzywień kręgosłupa. Chir. Narz. Ruchu i Ortop. Polska, LVII, Suppl. 1, 9, 1992.
6. Green N.E., Griffin P.P.: Hip dysplasia associated with abduction contracture of the contralateral hip. J.B.J.S. 62–A, 1273, 1982.
7. Karski T.: The next step investigations of the so–called "idiopathic scoliosis", early and late clinical and radiological changes. 40th Congress of the Hungarian Orthopaedic Association, 19–21.06.1997, Szekszard, Abstracts 105, 1997.
8. Karski T.: Wczesne leczenie wrodzonej dysplazji stawu biodrowego. Chir. Narz. Ruchu i Ortop. Polska LIII, 91, 1988.
9. Karski T.: Contracture of the pelvis and hips region in the development of scoliosis. Biomechanic reasons. Etiology of the so–called "idiopathic scoliosis". Annual Meeting of the Hungarian Orthopaedic Association, June 8–11 1995, Szeged, Hungary, Abstracts 38, 1995.
10. Karski T.: Kontrakturen und Wachstumstorungen im Hüft– und Beckenbereich in der Ätiologie der sogenannten "idiopathischen Skoliosen" – biomechanische Überlegungen. Orthopadische Praxis 32, 155, 3/1996.
11. Karski T.: Przykurcze i zaburzenia rośnięcia w obrębie biodra i miednicy przyczyną rozwoju tzw. „skolioz idiopatycznych". Rozważania biochemiczne. Chir. Narz. Ruchu. i Ortop. Polska, LXI 1: 143, 1996.
12. Kaczmarczyk J. et al.: Leczenie operacyjne idiopatycznych skolioz typu wczesnodziecięcego metodą Harringtona z odroczoną spondylodezą. Chir. Narz. Ruchu i Ortop. Polska LVII, Supl 1: 66, 1992.
13. Kane W.J, Moe J.H. after Zarzycki D. et al.: Naturalna historia bocznych skrzywień kręgoslupa.Chir. Narz. Ruchu i Ortop. Polska LVII, Supl 1: 9, 1992.
14. Łokietek W.: Idiopathic scoliosis. Surgical and experimental investigations Catholic University of Louvain, Faculty of Medicine, 1, 1982.
15. Magoun (1974) [in:] Normelly H.: Asymmetric rib growth as an aetiological factor in idiopathic scoliosis in adolescent girls, 1 Stockholm, 1985.
16. Malawski S.: Własne zasady leczenia skolioz niskostopniowych w świetle współczesnych poglądów na etiologię i patogenezę powstawania skolioz. Chir. Narz. Ruchu i Ortop. Polska LIX, 3: 189, 1994.
17. Mau H.: Zur Ätiopathogenese von Skoliose, Hüftdysplasie und Schiefhals im Säuglinsalter. Zeitschrift f. Orthop, 601, 1979.
18. Nowakowski A.: Postępy w diagnostyce i leczeniu skoliozy idiopatycznej u dzieci i młodzieży. Chir. Narz. Ruchu i Ortop. Polska LX, 6, 445, 1995.

19. Skogland L.B., Miller A.: On the importance of growth in idiopathic scoliosis. A radiological and biomechanical study, Biomechanics Laboratory, Sophies Minde Orthopaedic Hospital, University of Oslo, Norway, Oslo, (in manuscript), 1980.
20. Stirling A.J. et al.: Late–onset idiopathic scoliosis in children six to fourteen years old. JBJS, Sept., 78–A, 1330, 1996.
21. Willner (1972) [in:] Normelly H.: Asymmetric rib growth as aetiological factor in idiopathic scoliosis in adolescent girls, 1, Stockholm, 1985.
22. Wynne–Davies (1975) [in:] Normelly H.: Asymmetric rib growth as an aetiological factor in idiopathic scoliosis in adolescent girls, 1, Stockholm, 1985.
23. Vizkelety T.: Le development du toit cotyloidien aprés reduction sanglante des luxations congenitales de hanche. Revue Chir. Orthop., Supp 2, 61, 248, 1975.
24. Vizkelety T.: Aktuelle Probleme der angeborenën Hüftluxation und Hüftdysplasie. Lecture in Lublin, 29.11.1980 (Author's manuscript), 1980.
25. Zarzycki D. et al.: Naturalna historia bocznych skrzywień kręgosłupa. Chir. Narz. Ruchu i Ortop. Polska LVII, Supl. 1, 9, 1992.
26. Żabiński S. et al.: Dynamika rozwoju niskostopniowych skrzywień kręgosłupa w dwuletniej obserwacji. Chir. Narz. Ruchu i Ortop. Polska, LVII, 177, 1992.

Otrz.: 1997.10.28

STRESZCZENIE

W pracy autor przedstawia własne obserwacje dotyczące etiologii tzw. „skolioz idiopatycznych" u dzieci i młodzieży. Zgodnie z wieloletnimi badaniami przyczyną tzw. „skolioz idiopatycznych" jest przykurcz odwiedzeniowy biodra, przeważnie prawego. Deformacje, które występują w „łańcuchu zniekształceń", rozpoczynają sie już u noworodków i niemowląt i polegają na istnieniu tzw. „zespołu przykurczów". Zespół ten był opisany przez Mau, Green–Griffina i innych. Przykurcz przywodzicieli lewego biodra może prowadzić do dysplazji tego stawu. W tym samym czasie u tych dzieci istnieje przykurcz odwodzicieli biodra prawego, który dotychczas nie był zauważany, oceniany ani leczony. Ten przykurcz, dokładnie mówiąc jedynie niedobór addukcji (ocena przy stale wyprostowanym biodrze), rozpoczyna sekwencję deformacji, poczynając od miednicy i kości krzyżowej. Przykurcz odwodzicieli biodra prawego powoduje czynnościowe wydłużenie prawej kończyny, czynnościowe skrócenie lewej kończyny i, co najważniejsze, zaburzenie chodzenia. Te zaburzenia chodu są główną i zasadniczą przyczyną rozwoju skoliozy lędźwiowej – lewostronnej. W następnym etapie rozwija się skolioza piersiowa prawostronna. Niekiedy obie skoliozy – lędźwiową i piersiową – widzimy już u dzieci w wieku 5–6 lat, a decydujące w rozpoznaniu jest wtedy zdjęcie rentgenowskie, obejmujące miednicę i kręgosłup, wykonane w pozycji stojącej. Boczne skrzywienie kręgosłupa, podobnie jak wrodzona dysplazja biodra, przeważnie dotyczy dziewcząt. W pracy autor przedstawia wczesne i późne kliniczne i radiologiczne objawy, a także podaje wskazówki profilaktyczne i lecznicze.

Fig. 1

Fig. 1a

Figs 1, 1a. Monika J., No 821117, 15 years old. Test examination of abductor contracture of the right hip. During the examination the hip must be in full extension. The examination shows the differences in the range of adduction. Difference in the adduction informs about the progression of the scoliosis

Fig. 2. Aleksandra S., No 890429, 8 years old. Lumbar scoliosis to the left side and thoracic scoliosis to the right side. Hip abductor contracture of the right side shows in reality 0° adduction, on the left side adduction is 30°