

Biomechanical Etiology of The So-Called Idiopathic Scoliosis (1995 – 2007) – Connection with “Syndrome of Contractures” – Fundamental Information for Pediatricians in Program of Early Prophylactics

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Abstract: The presented article discusses biomechanical etiology of the so-called idiopathic scoliosis (1995-2007). It describes etiopathogenesis and types of scoliosis (AIS). The article describes “models of hip movements” decisive in new classification of scoliosis. In new classification there are three etiopathological groups (epg) and four types of spine deformity: 1/ “S” shaped scoliosis - I epg, 2/ “C” scoliosis - II/A epg, 3/ “S” scoliosis - II/B epg and 4/ “I” scoliosis - III epg () which were distinguished in years 2001-2004 / 2006. In all children with so-called idiopathic scoliosis exists limited adduction of the right hip or even abduction contracture of this hip often connected with flexion and external rotation contracture. The contracture, or only difference in adduction (smaller in the right hip), is connected with the “syndrome of contractures” (originally: “Siebener Syndrom” – in Eng. “seven contractures syndrome”) in newborns and babies described by many authors but thoroughly and very exactly by Prof. Hans Mau. The recent classification makes clear therapeutic approach to every etiopathological group of scoliosis and gives us possibility to introduce causative prophylaxis.

Key words: Biomechanical etiology of the so-called idiopathic scoliosis, “Syndrome of contractures”, New classification

1. Introduction

Through many years etiology of the so-called idiopathic scoliosis (AIS) was unknown. It was spoken about “etiologial factors” of scoliosis like: genetic, hormonal factors, growth abnormalities, neuromuscular influences, disorders in bones, disorders in muscle and fibrous tissue, growth rate, left – right symmetry/asymmetry (and here directional asymmetry, anti-asymmetry, fluctuating asymmetry), anterior – posterior symmetry/asymmetry (and here directional asymmetry, anti-asymmetry, fluctuating asymmetry), asymmetry in growth of spinal cord and vertebra bodies and in “asymmetry concept” – arm length, facial structure, trunk, hand & foot preference, “reducing” asymmetry with age, nervous system lateralization,

dermatoglyphics, developmental instability, “boy gait” versus “girl gait”, thoracic-spinal deformity primary as concept for idiopathic scoliosis, “complex” – “multi-factorial” – “silent” concept, CNS, immature scoliotic vertebrae, circulating factor and plenty of other hypothetic influences (list of previous etiological factors is taken from Second Round EFG 6/International Federated Body on Scoliosis Aetiology (IBSE)/ Electronic Focus Group-6 (EFG-6).

The biomechanical etiology of so-called idiopathic scoliosis was described in Lublin/Poland and presented since 15 years in many countries (Literature 1995 - 2010). In all scoliotic children we found asymmetry of movements of left and right hip. This asymmetry in result makes asymmetry of loading during gait, asymmetry of standing ‘at ease’ on left / right leg and lead to asymmetry of growth between left and right side and gives in result scoliosis. All children with so-called

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idiopathic scoliosis have the habit of permanent standing “at ease” only on the right leg. This is connected with “real abduction contracture” or only limited adduction of the right hip and because of this makes right leg “stronger”, “more stable” what is registered by child’s brain very early as “easier standing on the right leg”. The asymmetry of movements is connected with the “syndrome of contractures” in newborns and babies (“Siebenersyndrom” - Mau).

2. Clinical Signs of “Syndrome of Contractures” in Newborn, Babies and Older Children

The “syndrome of contractures” has been described primarily and in detail by Prof. Hans Mau – Tübingen/ Germany - as Siebener [Kontrakturen] Syndrom” (syndrome of seven contractures) [1, 2]. This syndrome has been also described by: Hensinger [3], Howorth [4],

Green & Griffin [5], Vizkelety [6], Komprda [7], Karski [8-13], Tarczyńska, Karski & Karska [14]. In 1932 Prof. W. Dega/Poland described the “syndrome of contractures” as “ultra positioning” of fetus [18, 19]. The causes of the “syndrome of contractures” can be related with fetus itself: heavier, longer body; or with mother conditions: small belly during pregnancy, lack of amniotic fluids, pelvic bone type: “androidal” or “platypeloidal”– inconvenient for proper fetus growth [14, 15]. Prof. Mau underlined influences of CNS on development of “syndrome of contractures” what we also confirmed in our patients “as a coincidental” causes.

Mostly we observe the left sided “syndrome of contractures”. That is connected with the “first fetus position” during pregnancy - 80% - 90% (Oleszczuk) [16, 17]. In “syndrome of contractures” according to Mau (Fig. 1) there are:

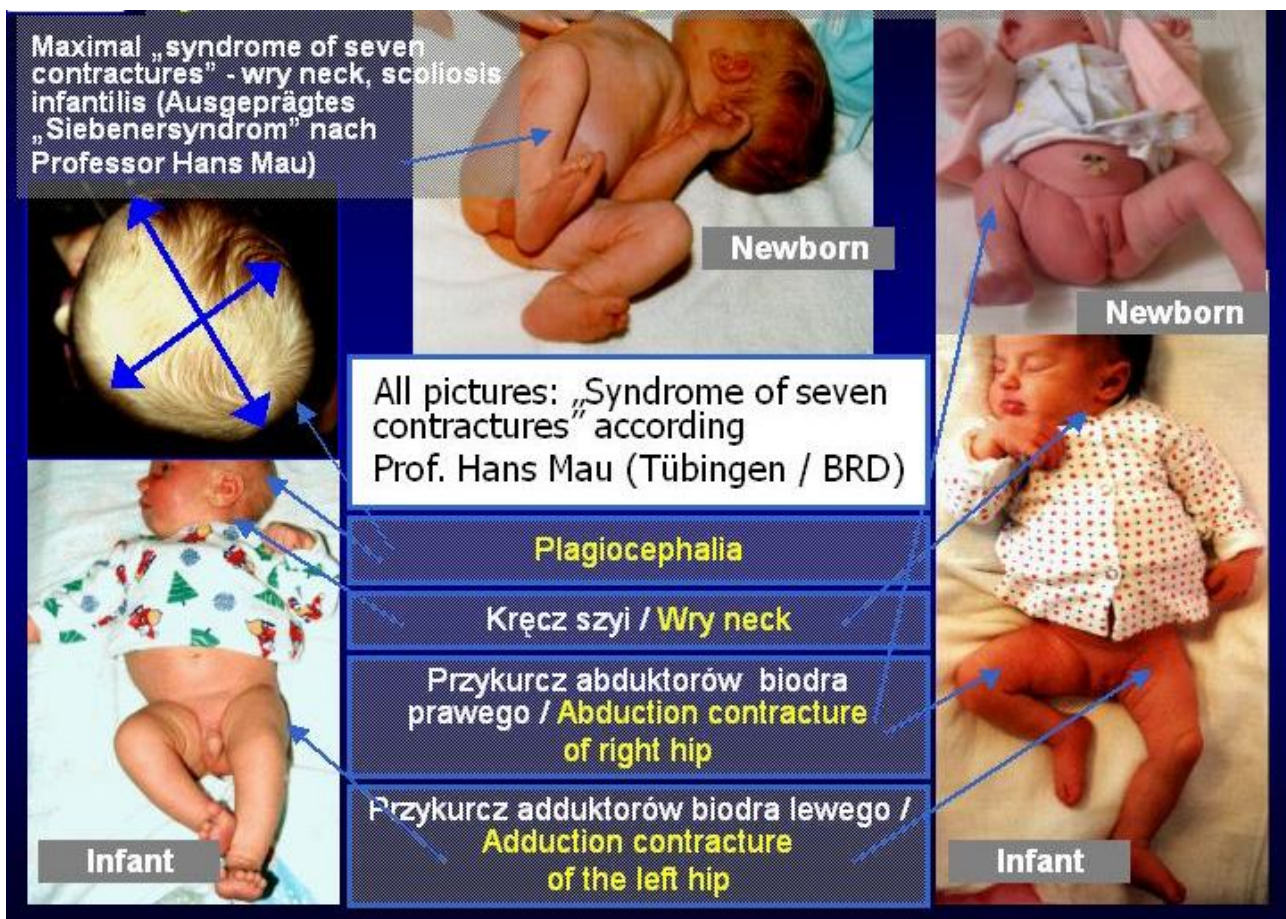


Fig. 1 Syndrome of contractures = Asymmetries -> Function -> SCOLIOSIS.

(1) skull deformity /plagiocephaly/- flattening mostly of left forehead and os temporalis, left chick atrophy, eyes - nose and ears asymmetry

(2) torticollis muscularis (wry neck)/shortening of sterno-cleido-mastoideus muscle/- usually left-sided, related with plagiocephaly

(3) scoliosis infantilis (infantile scoliosis) – other than idiopathic scoliosis. Usually recedes spontaneously at 80% of cases [20-22] or even at 100% (Mau) [1, 2]

(4) contracture (shortening) of adductor muscles of the left hip. Untreated contracture can lead to development of hip dysplasia, which primarily can be observed only at 10% of newborns [10]. The remaining 90% of dysplasia are cases of secondary deformity resulting from the contracture and are classified as “developmental hip dysplasia” (DDH - Klisič). In X-ray picture very often exist “oblique positioning of pelvis”.

(5) contracture (shortening) of abductor muscles and soft tissues of the right hip (Karski) [9-12], described as Haltungsschwäche (“weak posture”) by Mau. This contracture may cause oblique positioning of pelvic bone observed at X-ray picture of hip joints in babies. With time asymmetry in movement causes asymmetry during gait and loading; and with time asymmetry of growth and development of spine - as result: scoliosis (Karski 1995-2006) [22, 24])

(6) pelvic bone asymmetry – the oblique pelvis positioning visible during X-ray examination for hip joint screening – [see above point 4 – adductors contracture of left hip & point 5 – abductors contracture of right hip – T. Karski]

(7) feet deformities – such as: pes equino-varus, pes equino-valgus, pes calcaneo-valgus

In Lublin we also include (2006) to “syndrome of contractures” in newborn and babies excessive shank deformity (crura vara) which can lead with time to Blount disease. The development of this deformity and the causes are described in German in “Orthopädische Praxis” [Karski and coll.]. The etiological factor for Blount disease for “walking” and “standing”: children are: a/ primary in newborns excessive shank varus

deformity. b/ to early standing and walking of the child – just in 8-9 month of life, c/overweight/obesity, d/ rickets.

Because of this we speak in Lublin about “syndrome of contractures and deformities” (Karski, 2006). Knowledge about “syndrome of contractures and deformities” is especially important for pediatricians because the first symptoms are visible already in first months of child’s life and proper nursing or attending and treatment can be very important prophylactics program for shank, hips and spine.

3. Clinical Sign of “Syndrome of Contractures” in Children with So-called Idiopathic Scoliosis in Literature

To explain the stages of development of scoliosis it is useful to give presentation of the quotation from the literature about “syndrome of contractures” in context of “so called idiopathic scoliosis”. In children with developed scoliosis, many researchers saw in clinical examination such distant deformities like (Fig. 1): plagiocephaly, torticollis, asymmetry of temporal bone, tilt of pelvis and asymmetry of the whole body (Normelli, Sevastik [26], Willner (1972), Magoun (1974), Wynne-Davies (1975), Dangerfield and Col. (1995), Estève de Miguel C. (1991), Tylman D. (1995), Gardner A. (2000). Therefore all these authors confirm the connection between “syndrome of contractures” and scoliosis, however for them “the connection” was mostly unclear.

4. Other Observations Important for Biomechanical Etiology in “New History of Scoliosis”

Clinical observations indicate that progression in I epg is especially fast in children with joint laxity (special big), rickets, pelvis and lumbar spine anatomy anomalies (*spina bifida occulta*), chest and ribs deformities (*pectus infundibiliforme*). Early important clinical signs in very young children with danger of scoliosis are among others signs of “straight position of trunk (of spine)” and later “stiffness of spine” with

“flat back” and habit of permanent sitting straight up and standing “at ease” only on the right leg (Karski – 1995 - 2010).

5. Material of Children with So-called Idiopathic Scoliosis

The whole material consists of N-1450 patients examined with spine problems over the period of 25 years (1980 – 2005). 364 of patient were reported for examination but – I find there were healthy – and next in my material they constituted control group (Figs. 2-3). In this control group the adduction of both hips was symmetrical or nearly symmetrical. The axis of spine at these children was normal.

In the studied material there were patients from I epg, II/A epg, II/B epg and III epg group of scoliosis (described in chapter 6). The observed period was one to fifteen years. Age of patients was – 3-rd to 21-st year of life. The largest group was children from 6-th do 14-th year of life. Distribution of the three groups:

I epg group 593 children (41%), II/A epg and II/B epg group 333 (23%) children, III epg group 131 (9%) patients – mostly young people, congenital scoliosis 29 (2%). In about 20% of patients there were radiological signs of *spina bifida occulta* and sometimes *pectus infundibuliforme*. In about 3% slight symptoms of minimal brain damage (MBD). In 10% of patients we observed family history of scoliosis. Mothers of 2% of examined children were previously treated and some, no more than 10 person with scoliosis in observation period of 20 years were treated operatively.

6. Three Etiopathological (epg) Groups of Development of Scoliosis (I epg, II/A epg, II/B epg and III epg)

I-st etiopathological group of scoliosis (I epg) [Figs. 4-5] (Karski 2001) [“S” deformity = primary double curve scoliosis, 3D deformity].

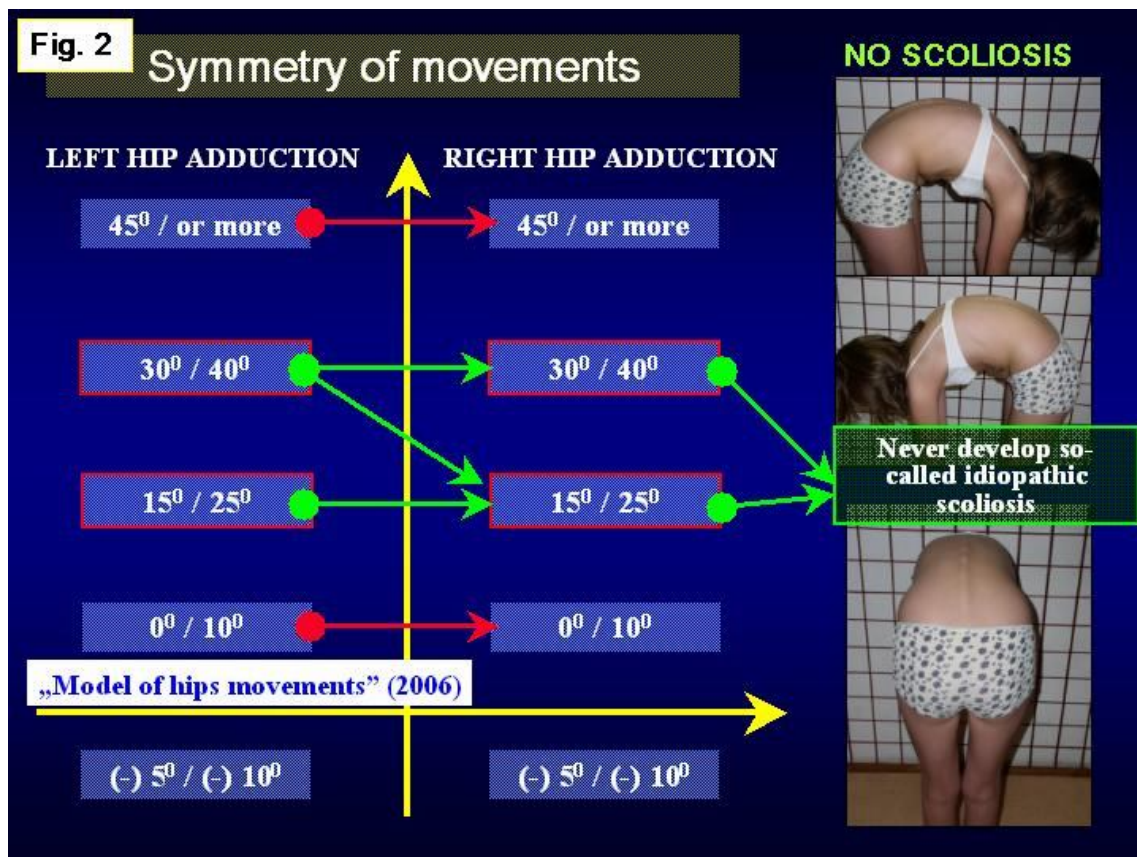


Fig. 2 Symmetry of movements.

Healthy child. Symmetry of movement of hips:


- 1/ symmetry of adduction of both hips (examination in straight position of hips)
- 2/ symmetry of internal & external rotation of both hips
- 3/ symmetry of the time during standing „at ease” on left and on right leg
- 4/ symmetry of loading of both - left & right side of body (of spine) during walking

Symmetry of movement of hips – never so-called idiopathic scoliosis.

Specific model of hips movements

Symmetry of all movements. Physiological tests for spine:


- 1/ full flexion of spine & normal axis - physiological Adams & Meyer „bending test for scoliosis”
- 2/ full flexion of spine & normal axis - physiological Lublin „side bending test for scoliosis”



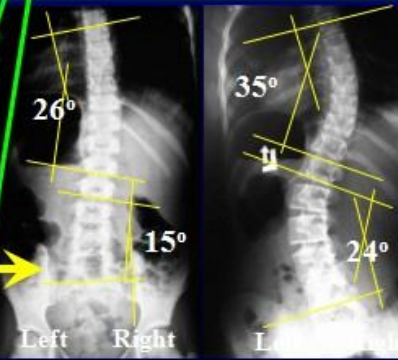
Model of hip adduction
left right

Fig. 3 Healthy child: Symmetry of movement of hips.

LEFT HIP ADDUCTION	RIGHT HIP ADDUCTION
Full movement	Contracture
45° / or more	45° / or more
30° / 40°	30° / 40°
15° / 25°	15° / 25°
0° / 10°	0°
“Model of hips movements” (2006)	
(-) 5° / (-) 10°	(-) 5° / (-) 10°



„S” scoliosis I epg / 3D /
Some cases „lordoscoliosis”
Causative: „Gait & Standing”
Progression



26° 15° 35° 24°
Left Right

Fig. 4 1-st etiopathological group [I epg].

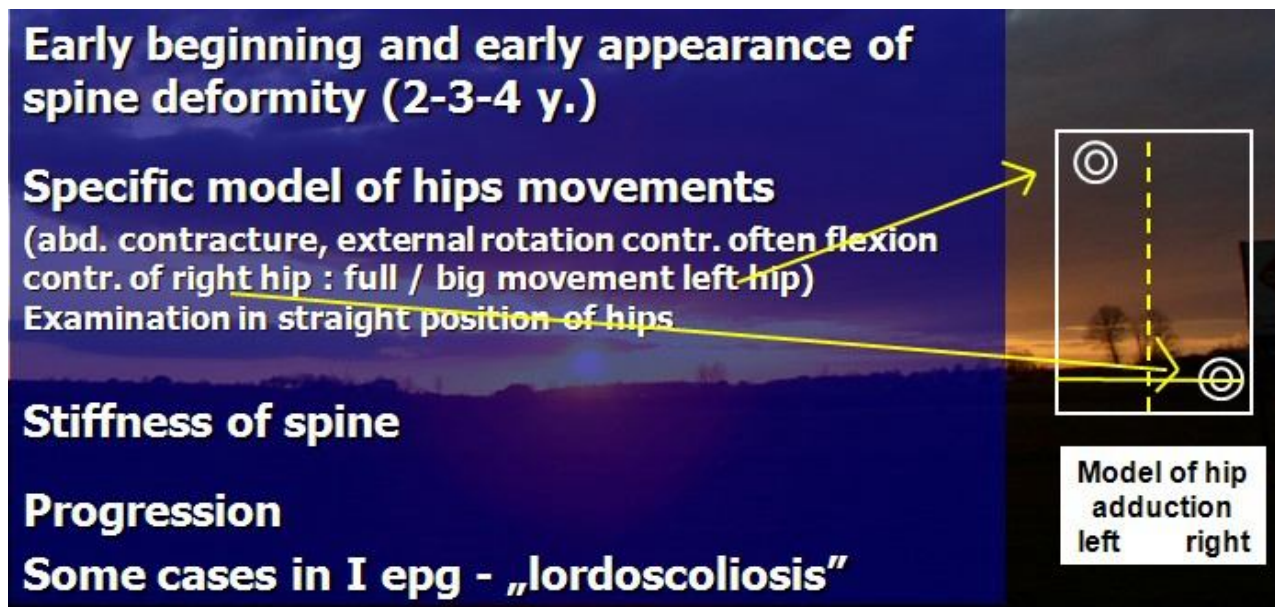


Fig. 5 I epg [“S” primary double scoliosis] – connection with gait & standing ‘at ease’ on right leg. First rotation deformity, next curves.

In children from this group there is a real abduction contracture of the right hip 5-10 degree or adduction 0 degree. The adduction of the left hip is large: 40 – 45 - 50 degrees. Examination should be introduced in extension position of the hip joint. Development of this spine deformity arise during the gait (Figs. 6-7) and because of habit of standing “at ease” only on the right leg and “these standing” lasts many years. Beginning of this type of scoliosis is just in small 3-4 years old children. The first is rotation deformity confirmed in computer gait analysis [51]. As result of rotational deformity – the spine becomes to be stiff with “flat back”. Just early in 2nd or 3rd year, the rib hump develops on the right side (*gibbous costalis*). This type of scoliosis is progressive especially in acceleration period of growth. Some cases in I epg are “lordoscoliosis”.

II-nd etiopathological group of scoliosis – II/A epg and II/B epg (Karski 2001). It is “C” left convex scoliosis - lumbar or lumbo-sacral or lumbo-thoracic as II/A epg type or double curves “S” scoliosis as II/B epg (Figs. 8-9).

In these children there is only limited adduction of the right hip in comparison the left side. Adduction of the right side is 15-20-25 degree; adduction of the left

side is 45-50 degree. Examination should be introduced in extension position of the hip joint. Firstly we observed “physiological side movement” of spine to the left by “standing ‘at ease’, next gradual fixation of “C” shaped spine curve in age of 10-13 years. Pathological influence of development of scoliosis is connected only with the permanent habit of standing “at ease” on the right leg through many years (cumulative time of standing). Beginning of lumbar or lumbo-sacral or lumbo-thoracic left convex scoliosis is when the child starts to stand and is clearly visible as told above if the child is over 10 years old. This type of scoliosis is not “paralytic scoliosis” as described by many authors [46]. It is also not “primary degenerative scoliosis” as thought some others authors. To this patients with “spondyloarthritis” we could explain - scoliosis is the first and degenerative changes occur later in 40th or 50th years of life. The scoliosis II/A epg and II/B epg are mostly without progression or it is small but in adults with lumbar pain, what is typical for *spondyloarthritis lumbalis, lumbago, ischias*. In the II/B epg there is also “S” shaped scoliosis with double curves. This “S” II/B epg scoliosis develop in children with “laxity of joints and after “harmful” exercises.

The thoracic right convex curve is the secondary one. Some cases from this (II/B epg) group are kiphoscoliosis.

III-rd etiopathological group of scoliosis (*Karski 2004* – “scoliosis without curves or with small one”.

The main symptom in this group is the “stiffness of spine”. In patients from III epg group we observe a specific models of hip movements (Figs. 10-11) and manner of standing the same time or almost the same time “on right and on left leg”. In this group clinically and in X-ray examination we see no curves or only slight deformities. We see also no rib hump or slight. These patients were mostly not treated before and through many years they did not know about the “spine problem”. In youth period they have problems

with sport activities. At adult age they show very large range of “back pain”. The patients from this group need “differential diagnosis” because some general doctors or internists diagnosed rheumatism, heart pain, circulatory problems and pulmonary illnesses like bronchitis or pleuritis, neurological or gynecologic problems.

7. “Syndrome of Contractures” Explains “Geography” of Deformities in the So-Called Idiopathic Scoliosis

“Syndrome of contractures” can provide explanation to some unanswered questions in past time in etiology of idiopathic scoliosis:

Scoliosis in I epg is connected with „Standing ‘at ease’ on right leg” and „Gait” / During gait „twisting movement of pelvis” [drawing taken from the book Orthopädiotechnik” of Prof. G. Wellmitz / Berlin]

Twisting movement of pelvis with its pathological influences / effects [rotation movement] – on growth and development of spine

Rola chodzenia i stania w patogenezie skolioz: ryc. z książki Prof. G. Wellmitza

Twisting movement of the pelvis during every step. We can treat pelvis – as first part of the spine – according to Prof. D. Schlenzka

Explanation: In situation of „contracture of right hip” it comes by the gait - to compensatory - more expressed - twisting movement of the pelvis during every step of the right leg. It means that deformity in spine in form of scoliosis (I epg & III epg) occurs.

Seitliche Schwingungen bei der Schrittabwicklung

Taken from an Italian book on scoliosis

Fig. 33. – Valutazione dell’allineamento tra bisacromiale e bisillica durante la deambulazione.

Fig. 6 Neue Untersuchung / Gang / “Standbein” PICTURE from Book of G. Wellmitz.

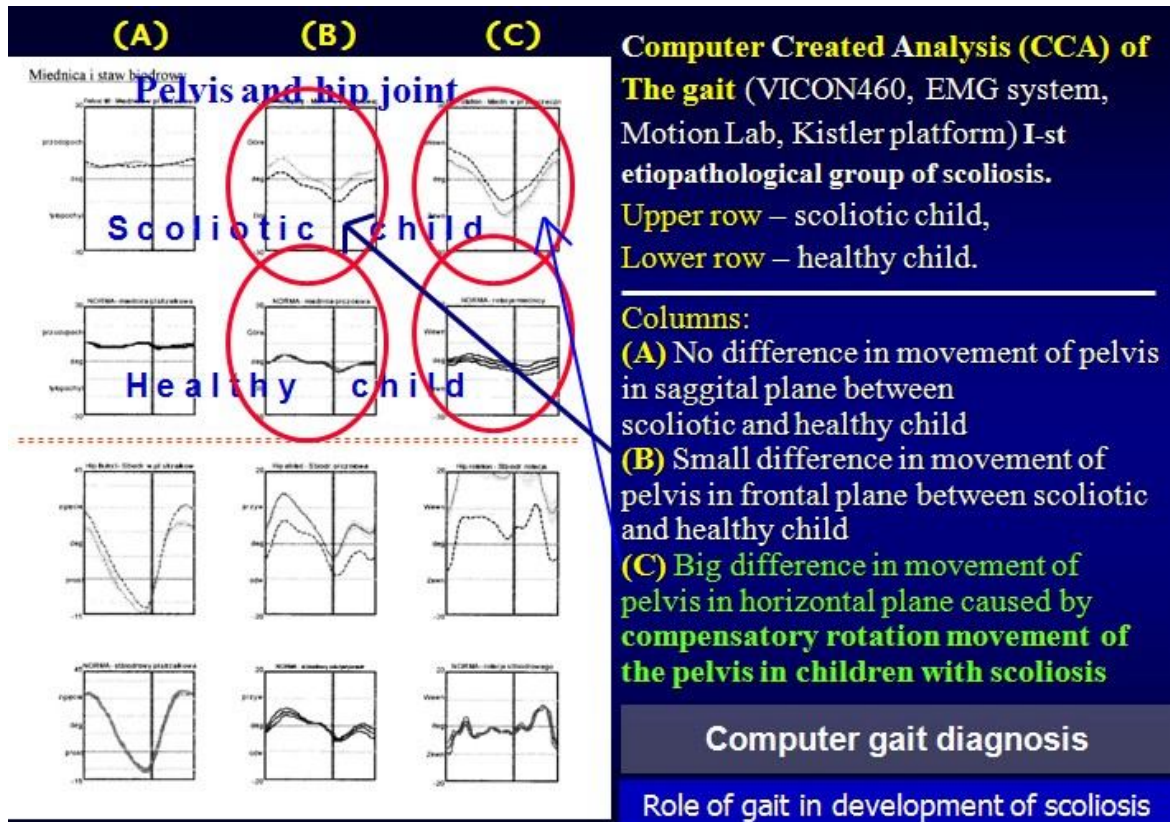


Fig. 7 Confirmation of the importance of gait in the development of scoliosis in I epg / III epg / Lublin / Warsaw / CZDz / Examination made by Dr M. Syczewska.

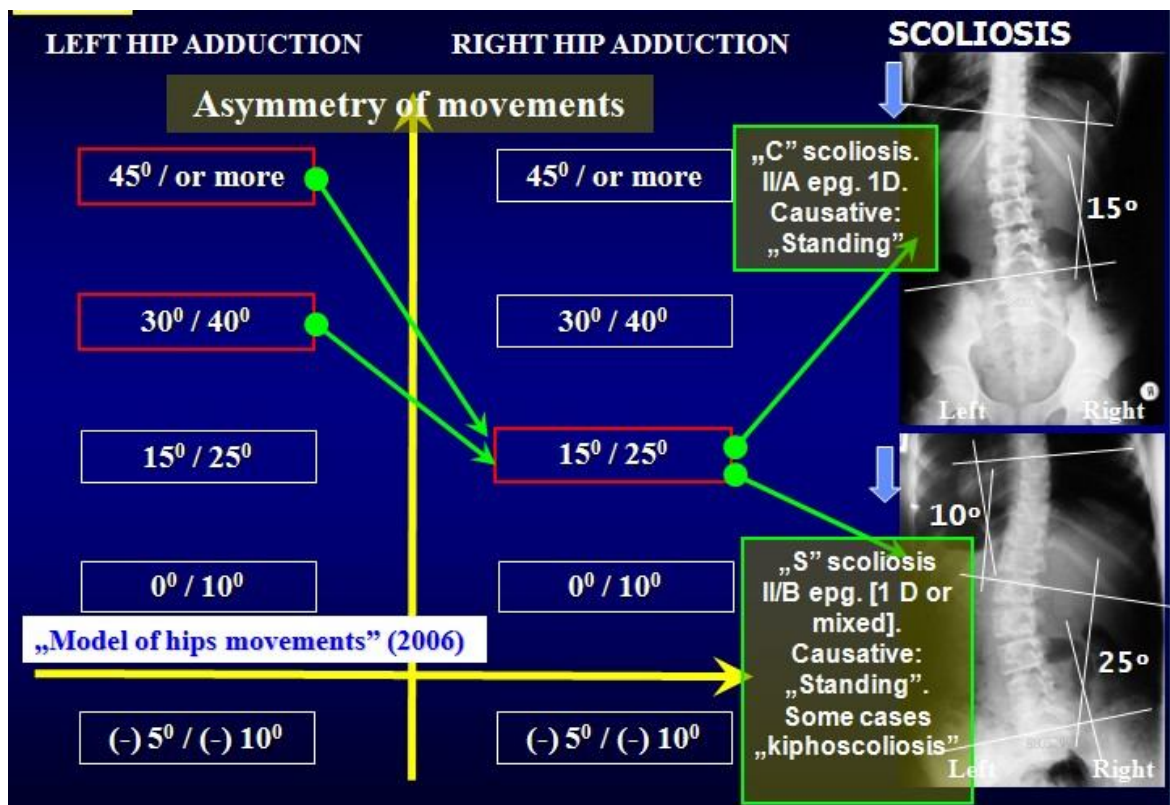



Fig. 8 2-nd etiopathological group [II/A epg & II/B epg].

Early beginning (2-3 y.) but late appearance of spine deformity (10-13 y.)
Specific model of hips movements:
 difference in adduction: small adduction of right hip : full / big adduction of left hip. Examination in straight position of hips

No stiffness of spine / good flexibility
No progression. Some cases in „S” II/B epg type are „kiphoscoliosis”. „C” II/A epg type – later „degenerative scoliosis”.



Model of hip adduction
left right

Fig. 9 II/A epg [“C” scoliosis] – connection with standing ‘at ease’ on right leg, II/B epg [“S” scoliosis, thoracic curve secondary] – connection with standing ‘at ease’ on right leg (plus: laxity of joints and/or wrong exercises in therapy).

LEFT HIP ADDUCTION **RIGHT HIP ADDUCTION** „Special type of scoliosis”

Asymmetry of movements

45° / or more	45° / or more
30° / 40°	30° / 40°
15° / 25°	15° / 25°
0° / 10°	0°
(-) 5° / (-) 10°	(-) 5° / (-) 10°

„Model of hips movements” (2006)

„I” scoliosis / III epg. Causative: „Gait”. [2D or mixed] Absent or slight curves & slight hump. Stiff spine

Adults: dominating „stiffness of spine” & back pain

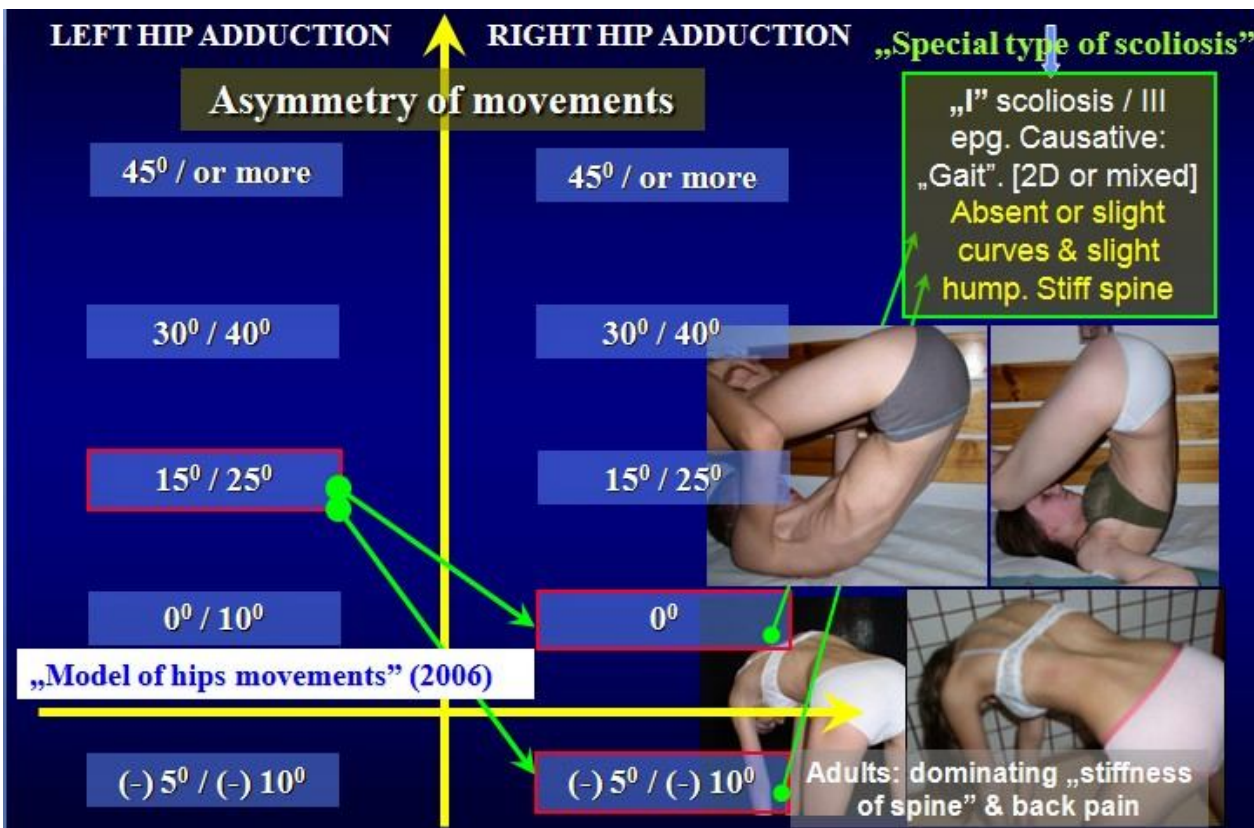


Fig. 10 III-rd etiopathological group [III epg].

- Development of scoliosis is connected with “growth period” and connected with “gait” and “standing ‘at ease’ on the right leg” (Karski).
- Scoliosis develops because of asymmetry of movement of hips, because of asymmetry of loading of right and left leg (pelvis and spine). These asymmetries are connected with “syndrome of contractures” (Mau).



Fig. 11 III epg [“I” scoliosis] – connection with gait only.

- Scoliosis occur mostly in girls because the contracture of the right hip connected with the “syndrome of contractures” comes mostly in girls (ratio boys: girls is 1: 5) [1, 2].

- Lumbar left convex and thoracic right convex scoliosis and rib hump on right side are connected with the left sided “syndrome of contractures” witch occurs at 85% - 90% pregnancies (Oleszczuk).

- The “S”, “C” and “I” types of scoliosis (I epg, II/A epg, II/B epg and III epg groups) depend on “model of movement of hips” [2006] (20, Karski).

- Progression of scoliosis in acceleration period of child’s growth is related to asymmetry of growth of bones and soft tissues [9]. Contractures (right hip abduction contracture also with flexion and external rotation contracture – Karski, [12] do not grow and do not lengthen; only bones grow. This leads to fast progression of scoliosis because of bigger biomechanical influences especially in I epg [21, 22]. The faster growth of legs than trunk was also observed by Dimeglio [25].

- No scoliosis in blind children confirmed the biomechanical influences because gait in such children protect them before scoliosis

- Absence of scoliosis in some countries (Mongolia – Prof. J. Hyanek – Czech Republic) also confirms the biomechanical influences, connected with gait and “permanent standing” on right leg in development of scoliosis. The riding on horses of many Mongolian children protects against scoliosis. The same we can observe in “cowboy” families in USA (information from USA students in Lublin Medical University, 2009 – 2010).

8. Discussion to the Biomechanical Etiology

Through years nobody could confirm the hypothetic “etiological factors” of scoliosis like described above (Tylman, Skogland&Coll., Lowe&Coll., Zarzycki&Coll., Żuk&Dziak, Ogilvie&Coll. [27, 44, 45, 46, 47, 52]. Observations from the years 1981 – 2007 show that the cause of development of idiopathic scoliosis is strictly biomechanical. Type of scoliosis is connected with “model of movements of hips” (Fig. 12). In 1995 “the causative chain of pathological factors leading to the so-called idiopathic scoliosis” was first presented in Hungary and first article in 1996 publish in *Orthopädische Praxis* in Germany [10]. The chain of development of deformity on the

example of I epg (the mostly worse type of scoliosis) is as follows: a/ it exists the asymmetry in movement between right and left hip, b/ asymmetry of loading of right and left side during gait, c/ asymmetry of time of

standing ‘at ease’ on right / on left leg – more on right, d/ as result the disturbing of spine growth and development of scoliosis.

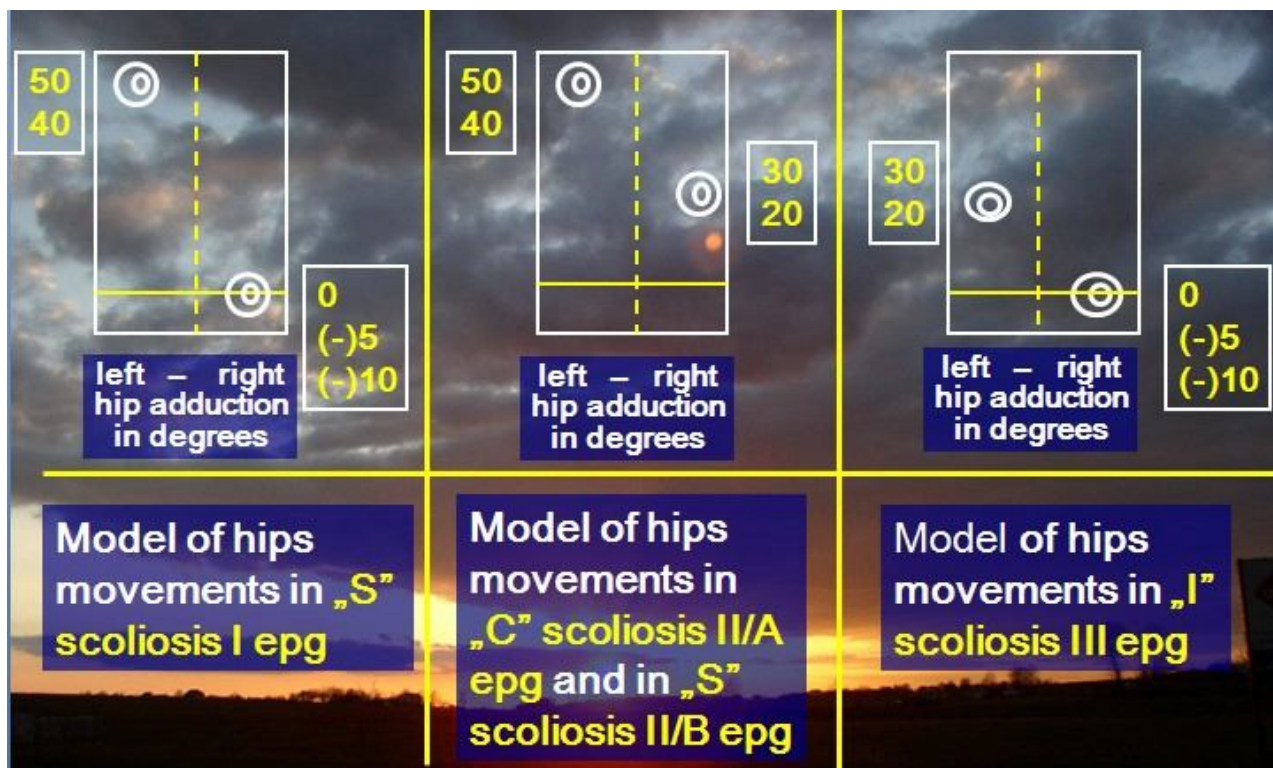


Fig. 12 Summary – New Classification / ALL GROUPS, Biomechanical aetiology (T. Karski 1995 – 2007), Specific model of hips movements and type of scoliosis [2006].

This observation makes clear that the beginning of scoliosis is early – in first years of life. In many orthopaedics books it is written that “scoliosis develops from the apex of curve”. Now it is clear that scoliosis deformity is going from the “bottom of spine” - it means from pelvis and sacro-lumbar region up to the upper regions of spine.

In I-epg the first symptoms of AIS are only clinical ones, long time before the deformity is clearly visible in X-ray examination. Well, the Cobb angle as “information about scoliosis” is not important. The anamnesis (history) and new clinical tests help with early diagnosis of AIS.

There are:

a/ it is necessary to ask parents about gravidity period and delivery period to know eventually signs of

MBD like “anterior tilt of pelvis”, extension contracture of trunk and laxity of joints.

b/ pathological “side bending test for scoliosis” (Lublin test),

c/ displacing of spinous processes under the skin during “flexion of spine” (in Adams “bending test for scoliosis” or in “Lublin test”),

d/ asymmetry in adduction of hips – limited on the right side (examination in straight position of joints),

e/ observation of permanent “stand position at ease” on the right leg,

f/ rotation test of pelvis (new Lublin test) – range of rotation to the left and to the right side – while standing with feet together – bigger movement to the right.

In children with developed AIS, by exact examination, many researchers saw such distant

deformities like: plagiocephaly, torticollis, asymmetry of temporal bone, asymmetry of the whole body described in “syndrome of contractures” [9, 48, 8, 4, 7] (*Dangerfield, Sevastik and Normelli, Green&Griffin, McMaster, Howorth, Gardner, Tylman, De Esteves*).

These observations confirm the connection between “syndrome of contractures” and scoliosis. If we take in consideration “the syndrome of contractures” in the biomechanical aetiology of the so-called idiopathic scoliosis, we can explain among others:

- 1/ gender of patients - mostly girls (“syndrome of contractures” is mostly at girls),
- 2/ three etiopathological groups of scoliosis,
- 3/ geography of scoliosis (sides of curves),
- 4/ enlargement of scoliosis in the acceleration period of child’s growth,
- 5/ the biomechanical etiology confirm also the sensibility for the “new rehabilitation exercises” which include removal of contractures (asymmetrical shortening of soft tissues).

In discussion I want to express that sometimes we observe other types of scoliosis with other curves direction, “three curves scoliosis”. Other types of scoliosis are connected mostly with wrong, strengthening-extension exercises applied for children with AIS.

Habit of “standing ‘at ease’ position on the right leg” explains also: larger deformity of *crus varum dextrum* in children, *genu valgum dextrum* in children and more often right hip arthrosis in adults (Karski 2006).

9. Conclusions

(1) The so-called idiopathic scoliosis is connected with the right hip abduction contracture (shortening of soft tissues) often plus flexion and plus external rotation contracture of this hip; or with big difference of adduction movement of both hips.

(2) The groups of scoliosis in new classification (2001 – 2004 / 2006) are divided in connection to “model of hips movements” (2006).

(3) Development of scoliosis is connected with function – “gait” and “stand position ‘at ease’ – only or mostly on right leg”.

(4) The abduction contracture of the right hip is connected with the “syndrome of contractures” of newborns and babies described precisely by professor Hans Mau from Tübingen and also by many authors - Dega, Tylman, Gardner, Burwell, Stokes, Saji&Leong, Dangerfield&Coll., Willner, Wynne-Davies, Green&Griffin, McMaster, Komprda, Magoun, Karski & Tarczyńska & Karska).

(5) The shorted soft tissues are: *tracuts iliotibialis, facia lata, m. sartorius, m. gluteus medius, m. rectus, capsule of hip joint*.

(6) Detailed examination of newborns and babies is necessary to discover symptoms of „syndrome of contractures – and it is aim for pediatrician doctors.

(7) We observe “indirect influences” between CNS and “development of scoliosis in future”. In children with MBD can exist “anterior tilt of pelvis”, extension contracture of trunk and laxity of joints what “make easier” development of scoliosis.

(8) Children in age of 2-4-6 old should be examined to discover the difference of adduction movement of hips and shape of spine in flexion (Adams test or Lublin test). In case of asymmetry of adduction and habit of standing “at ease” position on the right leg they should undergo periodical precise spine examination and should make simple, flexion exercises for spine.

(9) Asymmetry of pelvis at X-ray picture of babies (in DDH screening) should be later remembered as possible signal for “changed spine development” in children 3-4 years old and later.

(10) Early prophylactics programs should be introduced already for children 3-4-5 years old [9, 24].

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