

Research article

Biomechanical etiology of the so-called idiopathic scoliosis (1995 – 2007). Causative role of “gait” and “permanent standing ‘at ease’ on the right leg”. New classification. Principles of new therapy and causal prophylaxis

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Abstract

The article describes the biomechanical causes of the development of the so-called idiopathic scoliosis (1995 – 2007), known widely as adolescent idiopathic scoliosis (AIS). The observations conducted in the years 1985 – 1995 and later prove that the development of spinal deformity is connected with “gait” and habitual and permanent “standing at ease” only on the right leg. The scoliosis appears as the secondary deformity because of the asymmetry of “the length of time” of standing ‘at ease’ between the right and the left leg, more on the right leg. The type of scoliosis is connected with adequate “model of hips’ movements” [MHM] (*T. Karski*). MHM enables the new classification (2001-2004 / 2006). There are three groups and four types of scoliosis. The origins of asymmetries movements of hips is coming from the “syndrome of contractures” in newborns and babies described by Prof. Hans Mau.

The new classification clarifies the therapeutic approach and provides the possibility to introduce causative prophylaxis.

Key words: Biomechanical etiology. “Syndrome of contractures”. “Gait” and “standing” as causal factors. New classification.

1. Introduction. Through many years the etiology of the so-called idiopathic scoliosis (AIS) was unknown and as hypothetic factors were mentioned: genetic and hormonal factors, growth abnormalities, neuromuscular influences, disorders in growth of bones, disorders in muscle and fibrous tissue and plenty of other influences (*Normelly H., Sevastik J. & Diab K., Dangerfield P. and coll., Burwell G. and coll., Adams, Meyer, Tomaszewski and coll., Skogland LB and coll., Lowe TG. and coll., James W. and coll., Zuk T. & Dziak A., Malawski S., Tylman D., Saji M. & Leong J., Stokes I., Zarzycki and coll. Skwarcz and coll., Bialik V., Robinson C. M. & McMaster. Rapala K.*).

The “biomechanical causes in development of scoliosis” were for the first time presented in 1995 on Orthopedic Congress in Hungary. The first publication was in *Orthopädische Praxis* in Germany in 1996. The etiology is connected with **a/** asymmetry of movements in the left and the right hip – restricted in right joints, **b/** next connected with gait – lack of movement during gait in the right hip is compensatory transmitted to the pelvis and to the spine and **c/** with the asymmetry of time of “standing at ease” on the left versus the right leg – longer on the right leg. This asymmetry of movements of hips and next asymmetry of function is connected with the “syndrome of contractures” in newborns and babies (*Originally in German - “Siebenersyndrom” – in English - Seven Contractures Syndrome – Prof. Hans Mau*).

2. Information about “The Syndrome of Contractures”. The reason of the biomechanical influences in the development of scoliosis is to explain in context of the “Syndrome of Contractures and Deformities” [SofC&D]. (in 2006 it was added the eighths deformity – varus shank deformity and the authors called this syndrome SofC&D). This syndrome is observed also by others authors in many cases of newborns and babies.

It was very often present a question – when start to develop scoliosis. Our answer - in the period of life when the child start to independent stand and walk start to develop the scoliosis. The role of standing on the right leg is important and can be observed in very early period of child’s activity. The authors had the opportunity to see – that the child stand ‘at ease’ on the right leg after two weeks of walking and standing (observation of the author in 2011).

The “Syndrome of Contractures” (**Fig. 1**), as spoken above has been described by many authors (*Hensinger, Howorth, Green & Griffin, Vizkelety, Komprda, Karski, Tarczyńska, Karski & Frelek-Karska*) but in detail by *Prof. Hans Mau – Tübingen / Germany - as Siebener [Kontrakturen] Syndrom*”.

The “left sided syndrome of contractures” mostly appears as a result of the position of fetus in mother uterus on the left side and it is in 80% - 90% cases of gravidities (Jan Oleszczuk). The list of deformities and asymmetries in the “Syndrome of Contractures” according to Mau:

1. skull deformity (*plagiocephaly*) - flattening mostly of left forehead and *os temporalis*,
2. *torticollis muscularis (wry neck)* / shortening of sterno-cleido-mastoideus muscle/,
3. *scoliosis infantilis* (infantile scoliosis) – other than idiopathic scoliosis,
4. contracture (shortening) of the adductor muscles of the left hip,
5. contracture (shortening) of the abductor muscles and soft tissues of the right hip (Karski), described as *Haltungsschwäche* (“weak posture”) by Mau. With time, the asymmetry in movement causes asymmetry during

“gait” and loading; and makes asymmetry of time of standing ‘at ease’ – more on the right leg (Karski 1995-2006),

6. pelvic bone asymmetry – the oblique pelvis positioning visible during X-ray examination for hip joint screening (**Fig. 2a, 2b, 2c**) – [see above points 4 & 5],

7. Foot deformities – such as: *pes equino-varus*, *pes equino-valgus*, *pes calcaneo-valgus*.

As spoken above in 2006 the authors (T. Karski and J. Karski) added excessive varus shank deformity (*crura vara*) to the “Syndrome of Contractures”, which with time and special conditions can lead to Blount disease. The development of this shank deformity and its causes is described in German in “Orthopädische Praxis” [1994, Karski et all.]

3. Clinical signs of “the syndrome of contractures” in children with the so-called idiopathic scoliosis in literature. Some authors already in the past 20th century have seen the “symptoms of asymmetry” not only in region of pelvis and spine but also located in different parts of the body of the child with the “idiopathic scoliosis”. Here are quoted the observations:

a/ Willner (1972) in Normelly “... in general the left leg tends to be shorter than the right in childhood and this leads to development of the left convex lumbar curve. Pelvic obliquity has been observed in structural scoliosis”.

b/ Magoun (1974) in Normelly “... asymmetry of temporal bones has also been associated with scoliosis”.

c/ Wynne-Davies (1975) in Normelly “... plagiocephaly has been considered to be closely related to infantile idiopathic scoliosis”.

d/ Dangerfield P. “...Plagiocephaly in children with scoliosis – as unexplained symptom”

e/ Estève de Miguel C. (1991) “the difference in the length of extremities, /.../ pelvic tilt – secondary scoliosis”.

f/ Tylman D. (1995) “...tilt of pelvis is important sign of development of scoliosis”.

g/ Gardner A. (2000) “... so-called idiopathic scoliosis commonly occurs in combination with a characteristic pattern of soft tissue asymmetries in the hip and pelvis region”.

4. Other accompanying deformities, and accompanying illnesses influencing the development of the so-called idiopathic scoliosis

In the period of more than 20 years we have observed other risk factors in scoliosis: rickets, pelvis and lumbar spine anatomy anomalies (*spina bifida occulta*), chest and ribs deformities (*pectus infundibiliforme*) which have influence for development of spine deformity. Also we find the indirect influence (**Fig. 3**) from central nervous system (CNS) as “straight position of the trunk (of spine)”, anterior tilt of pelvis and joint laxity, in babies and small children (with minimal brain dysfunctions or with ADHD) which can later enable development of scoliosis (Karski, 1995 – 2007).

5. Material of children with so-called idiopathic scoliosis. The material from the years 1985 to 2014 consists of children and adults with scoliosis (N = 1950 patients). From the clinical point of view and from the perspective of the planned treatment there are two groups of children with spinal problems: 1/ the children with scoliosis and various advanced curves not primary treated – ca. 30 % of patients in ours Out-Patient Clinics in period of more than 25 years, 2/ the children treated for 2 – 6 years through the old, that mean wrong / harmful exercises – ca. 70 % of patients with advanced scoliosis.

The second group of patients has diminished significantly in Poland in last 5 years.

In the material there are all types of scoliosis – that is: “S” I epg scoliosis with stiff spine, “C” II/A epg and “S” II/B epg scoliosis with flexible spine and “T” III epg scoliosis – without any big curves but with stiff spine (*Karski 2007 / 2012*).

The control group consisted of 360 children from the 25 year period presented by parents with the problem of scoliosis, but clinically and radiologically showing no scoliosis, no asymmetry of the hips’ movement (*T. Karski, 2006*).

6. New classification based on biomechanical etiology. Three etiopathological (epg) groups, four types of scoliosis connected with the “model of hips’ movements”

I-st etiopathological group of scoliosis [“S” - I epg – 3D] (Fig. 4) (*T. Karski- observations 1995 – 2007/2015*). It is “S” deformity, with double curve scoliosis, stiffness of spine. The cause of the deformity is: gait and permanent standing ‘at ease’ on right leg. The clinical signs in this group are: stiffness of spine with flat back caused by rotation deformity, as a first symptom of scoliosis, but the origin of this deformity lies not in the shoulder (*Burwell and coll.*) but in the pelvis – see the figure 4. Restricted movements in the right hip (insufficient: adduction, internal rotation and extension) are transmitted “as compensatory movements” to pelvis and spine. This permanent rotation movement in intervertebral joints makes permanent distortion in this joints and with time they cause “rotation deformity of spine” and stiffness. Both curves appear at the same time and very early, at the age of 2 or 3. *Gibbus costalis* also appears early in life. In some cases patients in the “S” I epg group we see lordoscoliosis. This type of scoliosis is progressive especially during the acceleration period of growth.

II-nd etiopathological group of scoliosis – II/A epg (1D) and II/B epg (2D or mix) (Fig. 5). (*T. Karski- observations 1995 – 2007/2015*). In this group appear “C” left convex curve - lumbar or lumbo-sacral or lumbo-thoracic (II/A epg type) or double curves “S” scoliosis (II/B epg type). The thoracic right convex curve appears as secondary one. In this group children present a limited adduction of the right hip in comparison to the left side. Adduction of the right side can be 10 to 20 – 25 degrees; adduction of the left side 35 to 50 degrees. Examination should be performed in extension of the hip joint. The left convex “deviation movement” of spine in “standing position on the right leg” is the first clinical symptom, but with the time come to gradual fixation of “C” shaped spine curve with clinical and X-ray changes typical for scoliosis. The left convex scoliosis is initiated when the child starts to stand on the right leg and it can start to be in 2-nd year of life. The pathological influence of standing on the right leg is the results only “cumulative time of standing” over many years. Scoliosis becomes clearly visible when the child is over 8 - 10 years old.

The thoracic right convex curve appears only in some children as the secondary deformity. In some cases patients from this “S” - II/B epg group we see kyphoscoliosis. This II/A and II/B type of scoliosis is not paralytic as described by many authors. It is also not “a primary degenerative scoliosis” as referred to by others. All patients with “*spondyloarthrosis*” or with *spondyloarthrosis lumbalis*, *lumbago*, *ischialgia*, that’s with degenerative changes, first have “C” type II/A epg scoliosis or “S” type II/B epg scoliosis in their youth, but it in this period of life frequently remains undiagnosed.

III-rd etiopathological group of scoliosis (2D or mix) (Fig. 6) (*T. Karski- observations 1995 – 2007/2015*) – “scoliosis with little or no curvature”. This group is a special type of “scoliosis”. In these patients

there is a real abduction contracture of the right hip of from 5 to 10 degrees or adduction 0 degree (examination in straight position of the joint), but the adduction of the left hip is also small and it is 10 - 20 to 30 degrees. The spinal deformity is characterized only by “stiffness” and this deformity is connected with one function – only with gait. Standing “at ease” on the right leg has no influence because the stability reached while standing on the left or on the right leg is similar and the right leg is not chosen for permanent standing. In this group there is no curves, or only slight deformities. We also notice little or no rib hump. So, there can be “scoliosis without any curves” or with “sight curves” – and these are clinically unimportant.

These patients mostly were not treated previously and for many years they did not know about their spinal problem. Nevertheless, they have problems with sport in their youth. In adulthood they demonstrate a very large range of back pain. Older patients from this group need differential diagnosis because some general doctors or internists diagnose rheumatism, heart pain, circulatory problems and pulmonary illnesses like bronchitis or pleuritis, neurological or even gynaecological problems.

7. Discussion about the “Syndrome of contractures” to clarify the character of the so-called idiopathic scoliosis. The “syndrome of contractures” can provide explanation to some previously unanswered questions about the etiology of the so-called idiopathic scoliosis:

- The development of scoliosis is connected with “growth period” and connected with gait and standing ‘at ease’ on the right leg (T. Karski, J. Karski)
- Scoliosis develops because of asymmetry of hips’ movement and due to the asymmetry of load on both legs (pelvis and spine) during walking and due to the asymmetry in the length of standing time - left versus right leg - more on the right leg. These asymmetries are connected with the “syndrome of contractures” (Mau, Karski),
- Scoliosis occurs mostly in girls because the abduction contracture (or limited adduction) of the right hip is connected with the “syndrome of contractures” occurring mostly in girls (ratio boys: girls is 1: 5).
- Lumbar left convex and thoracic right convex scoliosis and rib hump on the right side are connected with the left-sided “syndrome of contractures” which occurs in 85% - 90% of pregnancies (*Jan Oleszczuk*).
- The new classification of the so-called idiopathic scoliosis – “S” I epg, “C” II/A epg, “S” II/B epg and “T” III epg in connected with the “model of hips’ movement” [T. Karski, 2006] and other causes such as laxity of joints, anterior tilt of pelvis, extension contracture of the spine in babies - MBD, ADHD (T. Karski, 2007).
- The progress of scoliosis during the acceleration period is related with the asymmetry of growth of bones and soft tissues. The contractures in the right hip - abduction contracture, also flexion and external rotation contracture (*T. Karski, J. Karski*) do not grow and do not lengthen; only bones grow, so the biomechanical influence becomes bigger. This leads to a fast progress of scoliosis resulting in greater biomechanical influences especially in I epg. The relatively faster growth of legs as compared to the trunk was also observed other many authors.

- The absence of scoliosis in blind children confirms the biomechanical influences (gait) in the development of scoliosis. Totally other manner of gait - no lifting of legs and no physiological movement of the pelvis, protects against scoliosis.
- Absence of scoliosis in some countries for example in Mongolia (confirmed by *Prof. J. Hyanek* from the Czech Republic, who spent 2 years in Mongolia – personal information). My explanation is that the biomechanical influences (gait) in the development of scoliosis are not present in children in Mongolia because horse riding protects them from this spinal deformity.
- Also there are no cases of scoliosis in Okinawa in Japan (personal information from *Prof. A. Staniszew*, the president of “Karate Okinawa Association in Poland”) because in Primary Schools 70% - 80 % of physical education is devoted to karate, that is mainly stretching exercises. My explanation - that stretching exercises lead to the symmetry of movements and the symmetry of development of the whole body (trunk, hips) and its movements and the symmetry of load and growth.
- Many authors claim that “scoliosis develops from the apex of the curve”. Now it is clear that the scoliotic deformity progresses from the “bottom of the spine”, that is from pelvis and sacro - lumbar region towards the upper spine.
- The “new rehabilitation exercises” which include removal of contractures (other words - asymmetrical shortening of soft tissues) confirm the biomechanical concept of the etiology.
- If biomechanical etiology of AIS and the principles of new treatment were widely accepted and put into practice, the term “natural history of scoliosis” would not exist any more.

It should be noted that we sometimes observe other types of scoliosis like: reversal of curves direction, or “triple scoliosis” (rare). Our explanation - other types of scoliosis are connected with incorrect, harmful strengthening-extension exercises applied in AIS.

The habit of standing ‘at ease’ on the right leg explains also the larger deformity of *crus varum dextrum* in children, *genu valgum dextrum* in children, and more frequently right hip arthrosis in adults (T. Karski 2006).

8. New tests for scoliosis. In the diagnosis of scoliosis we should use known old tests (Adams & Meyer test) but also new tests (**Fig. 7**) such as “side bending test for scoliosis”, checking of habit of standing (right versus left leg), Ely-Duncan test (other - Thom test, other - Staheli test), pelvis rotation test (new test – 2006), “adduction of hips test – similar to Ober test” and others, presented below in detail.

The list of new tests for early the discovery of scoliosis:

1/ Test of adduction of both hips (in extension position of the joints – like Ober test). Limited adduction of the right hip, often accompanied by flexion contracture of the hips/the right hip (Ely Duncan test, or Staheli test, or Thom test), often accompanied by external rotation contracture of the right hip. This test should be performed in the straight position of joints.

2/ Bending test for scoliosis - Adams/Meyer - test – widely known. Round shape is good but stiff spine indicates the beginning of scoliosis.

3/ Side bending test for scoliosis - Karski/Lublin Test. It is a modified "Adams/Meyer Test". It has been used for 20 years in Slovakia and according to an orthopedic surgeon. Tissovsy from Bratislava explain - "...this side bending test for scoliosis is more convenient - because increases the sensitivity and specificity of the tests”,

4/ Rotation movements of the body - comparison of the left and the right rotation range movements of pelvis and shoulder (even the whole body) in "standing position" of the child with feet close together (a new test - 2006).

5/ Especially important observation is connected with "standing at ease" - on the right / versus left leg. The permanent standing on the right leg is a cause of scoliosis [the influence is connected with the time length of standing]. Standing on the left leg is safer for the spine because it is never "permanent". Standing on the right leg is "dangerous" because it is "permanent".

6/ The symmetry or the asymmetry of waist (old observation, but very important). If the waist is deeper in the left upper part of thorax, it is typical for I epg "S" double scoliosis - *with stiffness of the spine and with gibbous costalis*. A deeper waist in the right lower part is typical for II/A "C" scoliosis and for II/B "S" double scoliosis (thoracic secondary). In the last group (III "I") we never observe asymmetry of waists but only stiffness of spine. Gibbous costalis is minimal or do not exist.

7/ Illnesses (e.g. rickets) should be diagnosed because they accelerate the development of scoliosis.

8/ Anatomical abnormalities of the spine (*spina bifida occulta, pectus infundibuliforme*). If present – there is the danger for a faster development of spinal curves.

9/ Body build type - asthenic and picnic - bad, athletic - good.

10/ Willingness / intention to participate in sports, if present - good, if absent - bad.

9. New rehabilitations exercise (Fig. 8). Firstly, it must be stated that all extension exercises, all so-called "strengthen exercises" were and are wrong and harmful. All patients coming to our Department after such therapy were only with huge deformity, with bigger hump and stiffness of the spine. To explain these undesirable results of treatment the term "the natural history of scoliosis" was coined. The proper solution of the spinal problem, in my opinion, is an early prophylactics based on the biomechanical etiology of scoliosis. This therapy must be based on the new exercises which are beneficial for the treatment but specially for prophylaxis of scoliosis. They include all exercises removing contracture in the region of hips, of pelvis and in the spine such as flexion - rotation exercises practiced as early in life as the age of 3 or 4.

The principles for the new rehabilitation exercises:

a/ the removal of contracture of the right hip,

b/ the removal of flexion contracture of both hips particularly in the right hip,

c/ the removal of contracture on the concave side of both curves – lumbar left and thoracic right,

d/ the removal of extension contracture - "stiffness of spine" in the thoracic part or in the whole spine - lumbar and thoracic,

e/ the active daily participation in sports at school and home (kung fu, taekwondo, karate, aikido, tai chi, yoga),

f/ the sitting position at school and at home – only relaxed, never straight-up,

g/ sleeping especially during the first ten years of life on side in fetal position,

h/ standing on both legs – has no influence on the spine, standing "at ease" on the left leg – has positive influence on the spine, it protects against scoliosis because standing on the left leg is never permanent. Also the standing in the positions "*uchi hachi ji dachi*" or "*kiba dachi*" (in abduction and in internal rotation of hips - terms from Karate) is safe for the spine.

i/ the corset mostly for children from the I-st epg group - ["S" double scoliosis] – the model according to Cheneau or "Lublin model" (in our study 15% - 20% of children).

j/ in some children from II/A and II/B epg of scoliosis we advise a support (insert) for the left shoes 1 cm to 2 cm (only after clinical examination).

10. Conclusions.

1. The etiology of the so-called idiopathic scoliosis (AIS) is strictly biomechanical and originates in the asymmetrical movements of the hips which influence the spine during gait and in permanent standing 'at ease' on one right leg.
2. The groups of scoliosis in this new classification (2001 – 2004 / 2006) are determined by adequate model of hips' movements (T. Karski, 2006). In the new classification there are three etiopathological (epg) groups and four types of the so-called idiopathic scoliosis.
3. The first group (I epg) – double "S" scoliosis with rib hump - is connected with asymmetry of movement of pelvis and spine while walking, with asymmetry of time standing – more and longer on the right leg, what make influence for spinal growth. The lumbar and thoracic curves appear at the same time, sometimes very early at the age of 3 to 6. In I epg - the first symptom is the rotation deformity which causes "stiffness" of the spine with three stages: a/ disappearance of processus spinosi Th6 - Th12 (T. Karski); b/ flat back and flattening of the lumbar spine (*Tomaschewski & Popp, Palacios-Carvajal, Vlach et al., T. Karski*); c/ lordotic deformity in the thoracic part of the spine (Adams, Meyer). This type of scoliosis is progressive. Because of severe deformity, some cases in this group are called "lordoscoliosis"
4. The second group - II/A epg – "C" scoliosis or II/B epg - "S" scoliosis - is connected only with the habit of permanent standing 'at ease' on the right leg since the first years of life. In this group (II/A epg) the first and the only one is the lumbar or sacro-lumbar or lumbo-thoracic left convex scoliosis. Among these children we neither see rotation deformity with essential stiffness of the spine, nor any thoracic curve, nor rib hump and if any, these are not important clinically. In II/B epg "S" scoliosis, the lumbar curve is the first, the thoracic the second. Some cases in this group are "kyphoscoliosis".
5. The scoliosis "I" III epg group is only with "spinal stiffness" and adult patients are to be diagnosed with back pain. This type of scoliosis involves very small if any curves or rib hump. The II/A epg, II/B epg and III epg groups of scoliosis are non-progressive.
6. The development of scoliosis is connected with function – gait and standing position 'at ease' – only or mostly on the right leg. In the absence of influences originating in gait and the absence of the factor of permanent standing 'at ease' on the right leg, the scoliosis (AIS) would not develop.
7. The asymmetry of movements of the hips (that's the restricted adduction of the right hip and in extreme cases 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 / Germany and also by many authors - *Dega, Tylman, Gardner, Sevastik, Normelli, Burwell, Stokes, Dangerfield, Saji & Leong, Willner, Wynne-Davies, Green & Griffin, McMaster, Komprda, Magoun, Barlow T. G., Heikkilä E., Karski T., Karski J.*
8. In early screening of children aged 3 – 6, it should be discovered whether there is a difference of adduction movement of the hips and what character has the shape of the spine in flexion. In these

- small children it is particularly important to perform the Adams test, which is the bending test for scoliosis, or the Lublin test – the side bending test for scoliosis.
9. If there is an asymmetry of adduction and the child is habitually standing “at ease” on the right leg, they should undergo periodically a precise spinal examination and should do simple, flexion exercises for the spine as already as in the age of 2 – 4 and in all years to come.
 10. Radiographic asymmetry of the pelvis in babies (in DDH screening) should be considered a risk factor for the future development of spine in children aged 3-4 and later.
 11. In small children a curve even of 5 degrees (X-ray) and “stiff spine” should be recognized by doctors as an important actual sign of the problem of scoliosis.
 12. All at-risk children should be included in a program of early prophylactics: sitting physiologically (relaxed), never straight up; sleeping in foetal position and standing “at ease” on the left leg or on both legs. Early prophylactic should also include such exercises as: karate, kung fu, taekwondo, tai chi, aikido, yoga etc.
 13. New prophylactics is possible and effective - but it should be started very early, in small childhood, already in preschools and during the first years of primary school.

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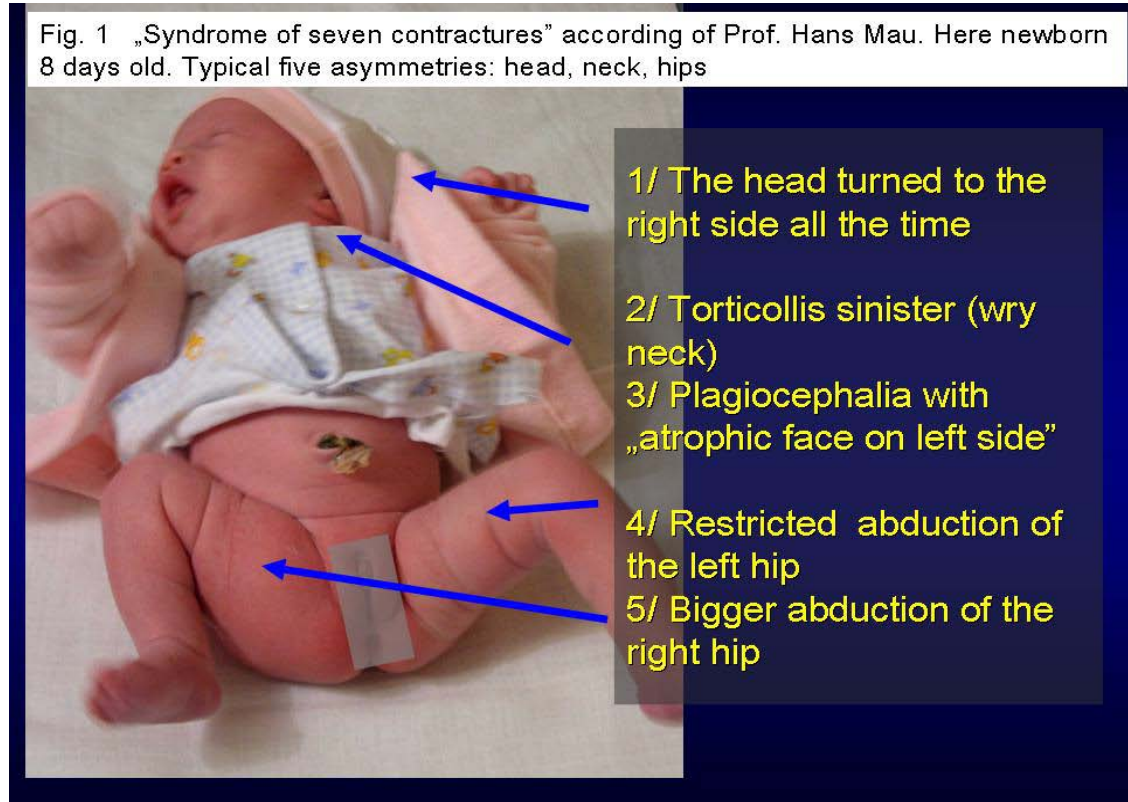
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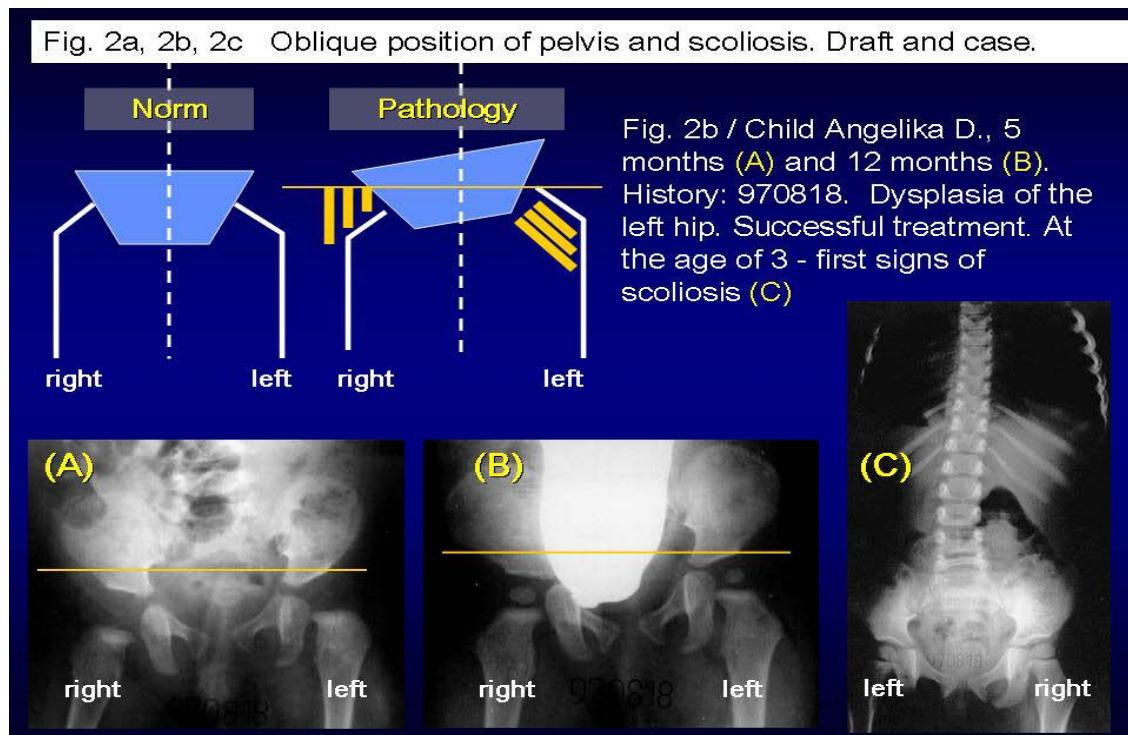
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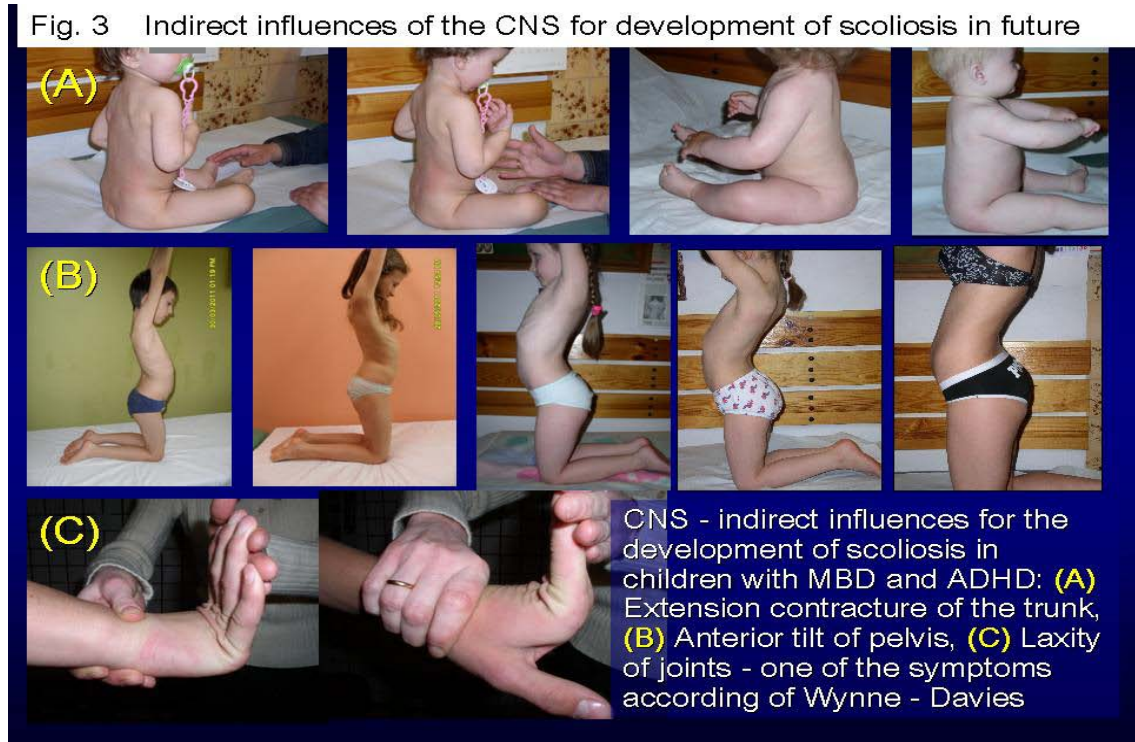
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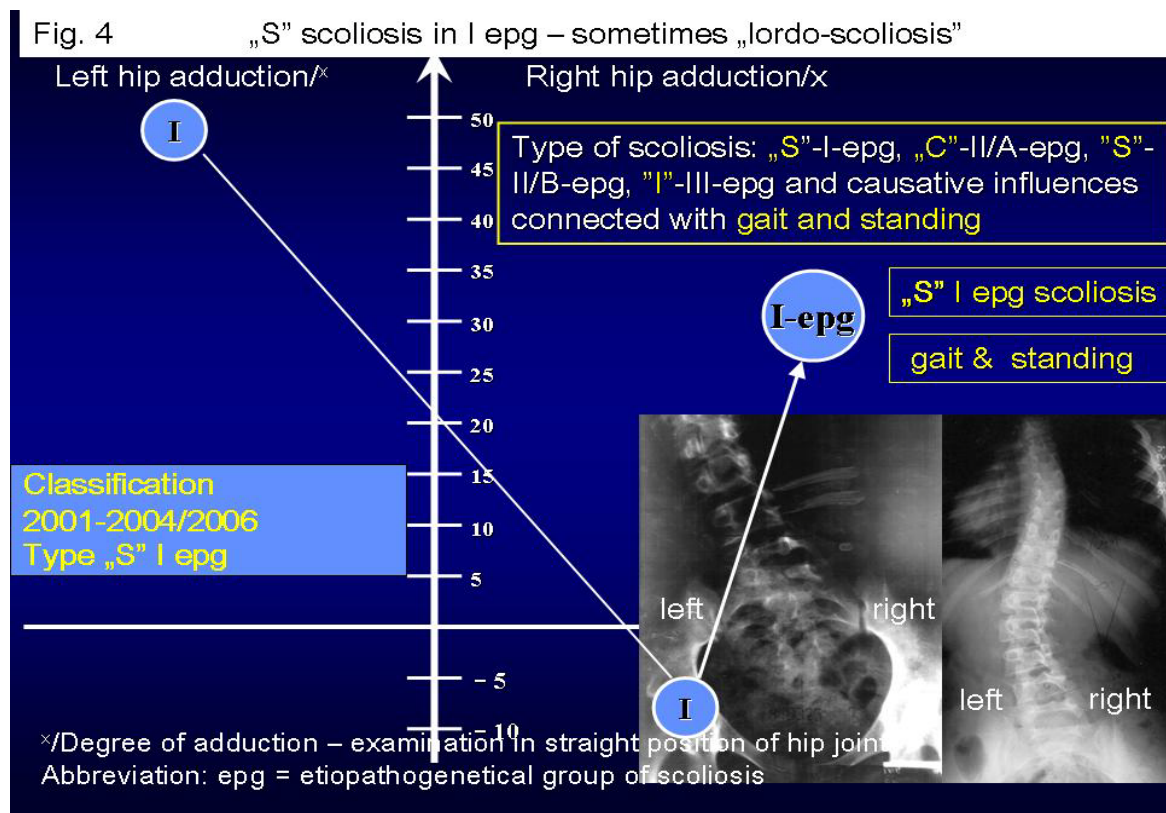
(Fig. 1) The child with the „syndrome of contractures” - asymmetry of head, of neck, pelvis and hips



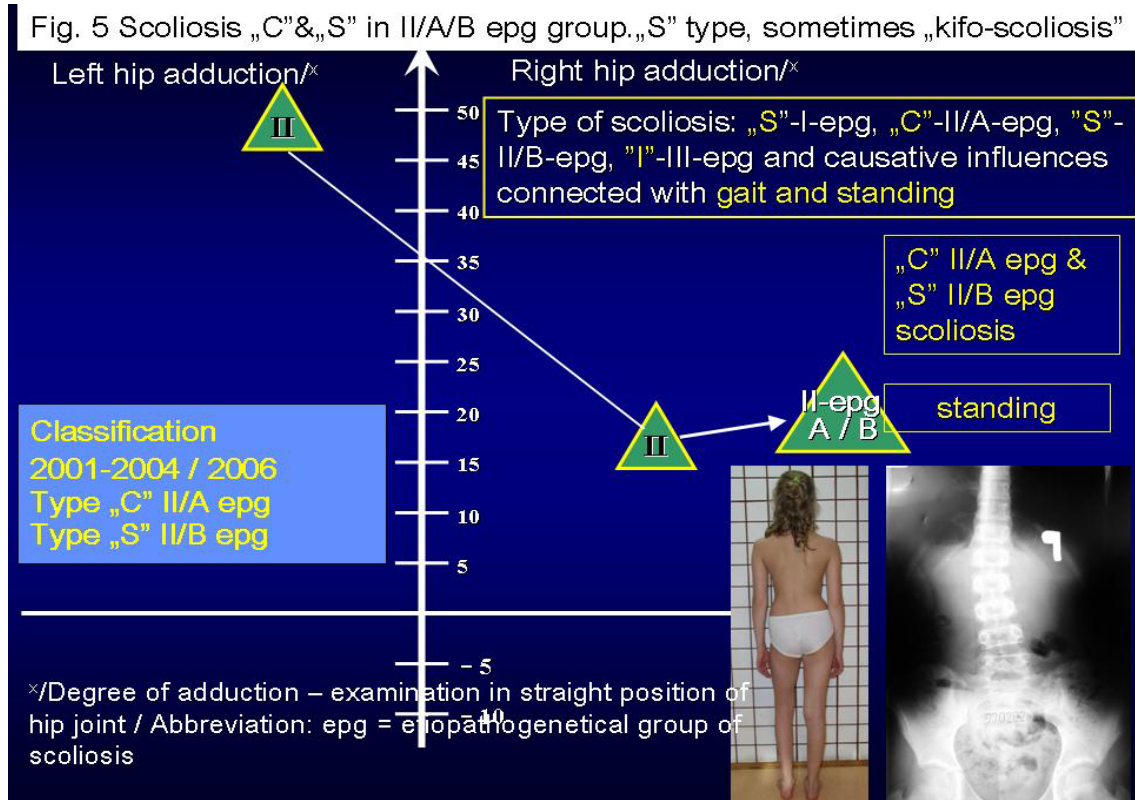
(Fig. 2a, 2b, 2c) Schema / draft of asymmetry of pelvis. The child with pelvic asymmetry (2a, 2b) and next with the beginning of scoliosis (2c)



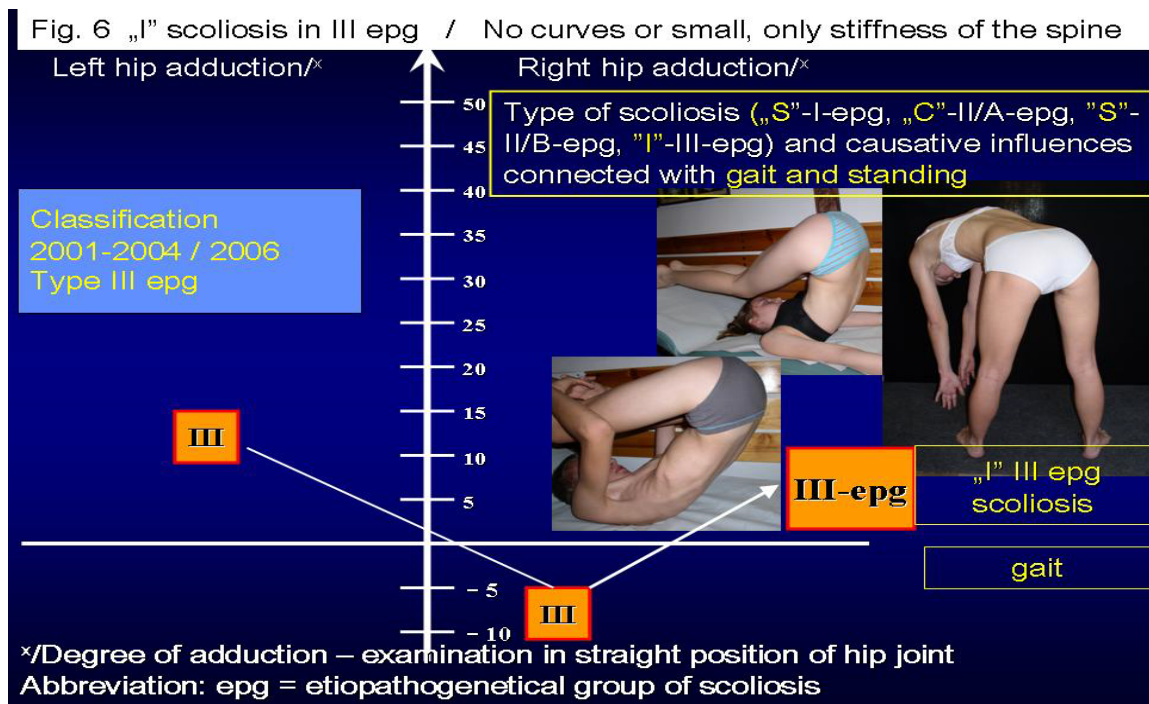
(Fig. 3) Indirect influences of CNS for development of scoliosis in future



(Fig. 4) Model of hips movements in I-st epg - “S” shaped double scoliosis. Causative factors: gait & standing. Scoliosis develops from the “bottom of the spine”, from pelvis and sacro - lumbar region towards the upper spine.



(Fig. 5) Model of hips movements in II/A epg and II/B epg - “C” shaped scoliosis or “S” shaped scoliosis. Initially physiological deviation deformity, after 10 years – scoliosis. Causative factor – standing



(Fig. 6) Model of hips movements in III epg - “stiffness of spine” in lumbar and thoracic part of spine. Rotation deformity. Small curves and small rib hump but substantial spine stiffness. Causative factor - gait.



(Fig. 7) New tests for screening for scoliosis



(Fig. 8) New rehabilitations exercises in prophylaxis of scoliosis