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Idiopathic Scoliosis
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Highlights

Evaluation of Three FIFA
Significance of Anatomy

Discovering Thoughts, Inventing Future

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Combining Data From Injury Surveillance and Video Analysis Studies: An Evaluation of Three FIFA World Cups™

By Jaakko Ryynänen, Louis Leventer, Lars Peterson, Hannu Kautiainen, Jón Karlsson, Mats Börjesson & Colin W Fuller
Sahlgrenska University, Sweden

Abstract- *Objective:* To analyze the playing actions and match circumstances which involve physical contact between players and lead to injuries in men's World Cup football.

Design: Prospective injury surveillance and video analysis of matches in three FIFA World Cups.

Setting: 2002, 2006 and 2010 FIFA World Cups™.

Participants: Players and team physicians at the 2002, 2006 and 2010 FIFA World Cups™.

Main outcome measures: Contact injury risk incidents linked with an injury and contact injury incidents without linkable injury.

Results: Three hundred and four contact injuries were reported and 671 contact injury risk incidents were identified from the video recordings. One hundred and twenty-eight (42.1%) of the reported contact injuries were linkable with a contact injury risk incident.

Keywords: *soccer, sporting injuries, epidemiology, video analysis.*

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Combining Data From Injury Surveillance and Video Analysis Studies: An Evaluation of Three FIFA World Cups™

Jaakko Ryynänen [α], Louis Leventer [σ], Lars Peterson [ρ], Hannu Kautiainen [ω], Jón Karlsson [¥], Mats Börjesson [§] & Colin W Fuller [χ]

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Conclusions: The limitations of combining injury report data with data obtained through video analysis make the results of the present study difficult to interpret. There is limited evidence that the current definition of an injury risk incident, as defined in the FIA methodology, is adequate for linking match events with injuries. Future studies are needed that provide more reliable methods for identifying injuries using video recordings.

Keywords: soccer, sporting injuries, epidemiology, video analysis.

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I. Introduction

Football is one of the most popular sports in the world, but it also carries a significant risk of injuries.[1-6, 7, 8] Therefore research on the epidemiology and prevention of football injuries is of major importance. In a four-step model for injury prevention in sports, van Mechelen, suggested that preventive measures should be based on knowledge of the etiology and the mechanisms of injuries.[9]

Video analysis of injuries in football has been increasingly used for describing injury circumstances or playing actions leading to injury.[10, 11, 14-18, 24, 25] investigating the mechanisms of injuries,[12, 13, 27] and for studying tackles.[15, 26] In addition, video analysis has been used for assessing the accuracy of referees' decisions and assessing whether the laws of the game should be modified in order to prevent injuries.[22, 23] The methods have, so far, been more useful for describing playing situations and athlete/opponent movements than evaluating joint biomechanics.[28]

Andersen et al. described a video-based method, FIA (Football Incident Analysis), for analysing what were referred to as "injury risk incidents" using football-specific variables.[16] According to the FIA methodology, an injury risk incident referred to any situation in which the match was interrupted by the referee, a player was on the ground for more than 15 seconds, or a player appeared to be in pain or received on-pitch medical treatment.[14, 16,18, 23, 29] Previous studies combining injury data, based on reports from the medical teams, and injury risk incident data, obtained by FIA, have shown that linking non-contact injuries with injury risk incidents is more difficult than linking contact injuries with injury risk incidents.[14, 18] FIA, which was developed as a descriptive tool for analysing playing actions leading to injury risk incidents, has since been applied in several studies.[14, 18, 23, 29] When using FIA, injury risk incidents are defined according to 19 variables, each with two or more categories related to playing actions preceding the incident.[16] To date, no clear patterns for the playing situations leading to injuries have been identified that link FIA incidents with resultant injuries; however, the

injury risk associated with individual variables has not previously been studied.

Fuller et al.[15] performed video analysis of all tackles in three FIFA tournaments. They were able to identify certain tackle parameters that were associated with a higher risk of injury than others.[15] Their methods did not, however, take into account match events or the circumstances leading up to the tackles. Tscholl et al.[26] combined the FIA and the tackle analysis video methods and found that certain tackles were more frequently sanctioned by the referee than others.[26] However, they found that the factors leading to injury risk incidents (as defined in the FIA methodology) and the factors leading to injuries to be different, and thus, questioned whether equating injury risk incidents with the risk of injury was valid.[26]

The playing actions leading to injury risk incidents, as defined in the FIA methodology, have not yet been analysed using video recordings in top-level international male football. As the injuries sustained during the three most recent men's FIFA World Cups, and the match circumstances in which these injuries occurred, have been extensively studied based on injury report data and match statistics,[1, 4, 7, 30, 32, 39] performing an additional video analysis of the circumstances leading to these injuries might add to the understanding of the circumstances and playing actions leading to football injuries in top-level football.Such a study would also provide an insight into the benefits and limitations of the current methods of video analysis and enable evaluation of whether current video analysis methodologies complement or conflict with results from injury surveillance studies.

The aims of the present study were to:

1) analyze, using current video analysis methodologies, the playing actions and match circumstances that involve physical contact between players and lead to injury in men's World Cup football and to
2) assess whether the variables used for FIA have independent injury predictive value when compared to data obtained from injury surveillance studies.

II. Material and Methods

The study cohort consisted of complete video recordings of all 192 matches played during the 2002, 2006 and 2010 men's FIFA World Cups™, 441 injury reports of the match play injuries sustained during these three tournaments, as well as match statistics for all the matches provided by FIFA's official website.[36]

a) Definitions of injury and injury risk incident

An (FIFA) injury was defined as any physical complaint incurred during a match that received medical attention from the team physician regardless of the consequences with respect to absence from match play or training.[1-4, 7]An (FIA) injury risk incident was defined as any situation in which the match was interrupted by the referee, or a player was on the ground for more than 15 seconds, or the player appeared to be in pain or received medical treatment (as defined in the FIA methodology).[14, 16,18, 23, 29]A contact injury was defined as any injury resulting from physical contact between players, and a contact injury risk incident, was defined as an injury risk incident that resulted from physical contact between players.

b) Injury surveillance reporting

The post-match injury report forms, completed by team physicians, have been presented in previous studies of FIFA tournaments.[1-4, 7]Only contact injuries were included in the present study, as non-contact injuries have previously been shown to be difficult to link with FIA injury risk incidents,[14, 18] and as most injuries in men's World Cup football result from contact between players.[1-4, 7] The injury surveillance reporting followed the consensus statement for injury definitions and data collection procedures for epidemiological studies on football injuries.[20] Ethics approval for the injury surveillance study was obtained.

c) Video analysis and linking injuries with injury risk incidents

All contact injury risk incidents were reviewed, using FIFA video recordings of all matches by one author (LL), who was experienced in video analysis. In order to identify the contact injury risk incidents associated with post-match injury reports, the details of each contact injury risk incidentwere compared to the FIFA injury surveillance reporting data in terms of the time of incident, the player's shirt number, and the injury type and location. The following eight established FIA variables (categories), [16] with some minor modifications, were used in the analysis:

- Ball possession (defence or attack).
- Attack type (set play, breakdown attack, long attack including long pass, long (organized) attack).
- Degree of balance in opponents' defence (good, average, poor)
- Player's position (defender, midfielder, forward, goalkeeper)*
- Player's action with the ball (dribbling, heading, deflecting the ball, kicking the ball, goalkeeper action, no action with the ball)**
- Player's movement intensity (high intensity, low intensity).
- Player's attention (towards primary duelist, the ball, team mate, other)***
- Referee's decision (foul, non-foul)****

*Modification: The number of playing positions was reduced to the four general categories, in order to allow comparison of the results with those obtained from a previous study of injuries in FIFA World Cup football.[30]

**Modification: Some of the originally proposed 14 categories were combined in order to avoid the previously described problem of having too few cases in some categories.[16]

***Modification: the category "other" was added, as the player's attention was sometimes directed elsewhere (e.g. coach/crowd//the pitch/ goal/ unknown etc.)

****Modification: the category "foul" included the awarding of a yellow or red card, in order to simplify the analysis.

The main reason for combining some categories was to avoid a problem identified in previous studies; namely, too many categories with small number of cases.

The variables "player's action with the ball", "player's movement intensity", "playing position" and the tackle parameters (included in the present study) were considered to fully describe a player's actions, role, and the contact mechanisms in the context of the present study. Therefore, the following original FIA variables,[16] were excluded:

- positioning
- player's role
- duel type
- ball winning situations
- player's movement direction
- tackling type
- type of incident risk action
- degree of individual ball control

Similarly, "ball possession", "attack type" and "degree of balance in the opponent's defence" (included in the present study) were thought to describe the team's actions and situations sufficiently for the context of the present study; thus, the following team-related original FIA variables,[16] were also excluded:

- Team action before injury incident
- Attack effectiveness

Additionally, the variable "localization on the field" [16] was excluded, as the main focus of the present study was on match circumstances, playing actions and tackle parameters, rather than the localization of the incident on the field. The playing actions included in the present study were also not always directly related to a specific location on the field (e.g. "attack type").

d) Added variables

The following variables, previously shown to be associated with injury incidence in the 2002, 2006 and 2010 men's FIFA World Cups were added to the analysis:

- Current score (team in focus of the incident losing, drawing or winning).[30]
- Match period (minutes 0-15, 16-30, 31-45+, 46-60, 61-75, 76-90+ or extra time.[1, 4, 7, 30]

e) Tackle analysis

A tackle was defined as any event that occurred during the normal course of the match and involved physical contact between two or more players while one or more of the players challenged for possession of the ball.[15, 17, 22, 25, 26]The contact injury risk incidents that involved a tackle were also analyzed using the tackle parameters proposed by Fuller et al.,[15] with the addition of one new category within the tackle action parameter (*):

- Tackle direction (front, side or behind)
- Tackle mode (on feet, sliding in, vertical jump)
- Tackle action (one-footed, two-footed, use of arm/hand, upper body contact, clash of heads, combination*)

* The new 'combination' category included tackles involving more than one simultaneous tackle action, as some tackle incidents were found to involve several simultaneous actions that had the potential to cause an injury.

Tackle parameters associated with contact injury risk incidents involving a tackle, that were identified by video analysis and which were also linked to a post-match reported injury, were compared with parameters associated with injury risk incidents involving a tackle, identified by video analysis that could not be linked with a post-match reported injury.

f) Statistical analysis

Ratios of the variable categories associated with contact injury risk incidents that were (a) linked with an injury and (b) not linked with an injury were calculated, in order to assess the injury predictive value of each variable category. Logistic multivariate regression models with robust estimate of variance were used to investigate the variables related to the contact injury risk incidents.Comparisons between groups were made by the chi-square test. The tackle parameters were not analysed in the same multivariate regression model with the other variables, as they formed a separate and predetermined group.[15] As there were only three tackle parameters, a multivariate regression analysis of them was not performed and comparisons between the categories of tackle parameters were made by the chi-square test.The level of significance was set at p-values <0.05. Intra-observer reliability was tested by reviewing and reanalysing 10% of the contact injury risk incidents (randomly chosen from the three tournaments and including a re-analysis of 23 different teams): a minimum of 3 weeks was allowed between the two assessments, in order to reduce potential learning bias. The agreement between the two sets of results was determined by the kappa statistic (κ). The level of agreement was defined as follows, poor:$\kappa=0.20$; fair:$\kappa=0.21$ to 0.40; moderate:$\kappa=0.41$ to 0.60; substantial: $\kappa=0.61$ to 0.80, and very good:$\kappa>0.80$.[34]

The STATA 12.1, StataCorp LP (College Station, TX, USA) statistical package was used for the analyses.

III. Results

The 192 matches resulted in 441 injuries being reported within the FIFA match-day injury surveillance system, of which 304 were contact injuries: in addition, 671 contact injury risk incidents were identified from the video recordings of these matches. One hundred and twenty-eight (42.1%) of the 304 reported contact injuries were linked with a corresponding contact injury risk incident. The intra-rater reliability for the video analysis of contact injury risk incidents was very good (κ=0.88-0.98) for all variables and tackle parameters.

From the FIA video analysis, two variables were identified as independent predictors of injury; attack type ($p<0.01$) and the involvement of foul play ($p<0.05$). Long attacks had the lowest ratio of contact injury risk incidents linked with injuries compared to other contact injury risk incidents. The involvement of foul play in the contact injury risk incidents was associated with a significantly smaller ratio of contact injury risk incidents linkable with injuries/other contact injury risk incidents, compared with the contact injury risk incidents not involving a foul. Table 1 summarizes the study results and the results of the regression analysis.

Table 1. The numbers of both the contact injury risk incidents that were not linkable with an injury and those that were linked with an injury, as well as their relative proportions for all the categories of each variable. Additionally, the results of the multivariate regression analysis, with the relative risk (OR*) for each category, as well as the significance of differences in the relative risks between the categories of each variable.

	Descriptive data		Results of multivariate regression analysis	
Variables and categories	Number of FIA contact injury risk incidents without linkable FIFA injuries (%)	Number of FIA contact injury risk incidents with linkable FIFA injuries (%)	OR* (95%CI)	p-value
All variables	543 (80.9)	128 (19.1)		
Ball possession				0.86
Defense	222 (80.7)	53 (19.3)	1 (Reference)	
Attack	321 (81.1)	75 (18.9)	1.05 (0.64-1.69)	
Attack type				0.01
Set play	69 (75.8)	22 (24.2)	1 (Reference)	
Breakdown attack	132 (76.7)	40 (23.3)	0.99 (0.50-1.94	
Long attacks, including a long pass	83 (72.2)	32 (27.8)	1.17 (0.57-2.40)	
Long attacks	259 (88.4)	34 (11.6)	0.42 (0.22-0.84)	
Current score				0.23
Losing	96 (79.3)	25 (20.7)	1 (Reference)	
Drawing	240 (77.7)	69 (22.3)	0.99 (0.56-1.75)	
Winning	207 (85.9)	34 (14.1)	0.64 (0.33-1.26)	
Degree of balance in opponents' defense				0.22
Good	280 (85.6)	47 (14.4)	1 (Reference)	
Average	180 (76.9)	54 (23.1)	1.35 (0.84-2.19)	
Poor	83 (75.5)	27 (24.5)	1.63 (0.91-2.93)	
Match period (time)				0.50
0-15 minutes	70 (76.9)	21 (23.1)	1 (Reference)	
16-30 minutes	84 (78.5)	23 (21.0)	0.79 (0.39-1.57)	
31-45 minutes	101 (82.8)	21 (17.2)	0.61 (0.3-1.27)	
46-60 minutes	92 (87.6)	13 (12.4)	0.48 (0.21-1.08)	
61-75 minutes	85 (79.4)	22 (20.6)	0.96 (0.46-1.98)	
76-90 minutes	99 (79.2)	26 (20.8)	0.87 (0.43-1.77)	
Extra time	12 (85.7)	2 (14.3)	0.54 (0.08-3.54)	

Player's position				0.73
Defender	173 (79.4)	45 (20.6)	1 (Reference)	
Midfielder	190 (79.8)	48 (20.2)	1.19 (0.71-1.99)	
Forward	142 (83.5)	28 (16.5)	0.87 (0.49-1.56)	
Goalkeeper	38 (84.4)	7 (15.6)	1.30 (0.13-13.31)	
Player's action with the ball				0.72
Dribbling	112 (83.6)	22 (16.4)	1 (Reference)	
Heading	46 (67.7)	22 (32.4)	1.54 (0.68-3.51)	
Deflecting the ball	199 (81.9)	44 (18.1)	1.04 (0.56-1.93)	
Kicking the ball	56 (86.2)	9 (13.8)	0.69 (0.28-1.7)	
Goalkeeper action	34 (85.0)	6 (15.0)	0.55 (0.04-7.66)	
No action with the ball	96 (79.3)	25 (20.7)	1.03 (0.46-2.31)	
Player's movement intensity				0.47
High intensity	456 (80.4)	111 (19.6)	1 (Reference)	
Low intensity	87 (83.6)	17 (16.4)	0.8 (0.44-1.47)	
Attention towards				0.41
Primary duelist	74 (87.1)	11 (12.9)	1 (Reference)	
The ball	435 (80.0)	109 (20.4)	1.68 (0.82-3.44)	
Team mate	24 (82.8)	5 (17.2)	2.11 (0.61-7.31)	
Other	10 (76.9)	3 (23.1)	2.53 (0.58-11.02)	
Involvement of a tackle				0.37
Yes	500 (80.8)	119 (19.2)	1 (Reference)	
No	43 (82.7)	9 (17.3)	1.52 (0.61-3.82)	
Involvement of foul play				0.02
No	194 (77.6)	56 (22.4)	1 (Reference)	
Yes	349 (82.9)	72 (17.1)	0.59 (0.38-0.93)	

a) Tackle analysis

Six hundred and nineteen of the 671 contact injury risk incidents involved a tackle and 119 (19.2%; 95%CI 16.1-22.3) of these incidents were linkable with an injury recorded in the injury surveillance. Figure 1 shows the percentages of contact injury risk incidents involving a tackle linkable with injuries (as defined in the FIFA post-match injury surveillance) for the tackle parameters direction, mode and action.

i. *Tackle direction*

Most (n=346) incidents resulted from tackles from the side, while 144 tackles came from the front and 129 tackles from behind. The differences in the proportions of contact injury risk incidents involving a tackle linkable with injuries compared with other contact injury risk incidents between the tackle direction categories (upper part of Figure 1), were not statistically significant (p=0.055).

ii. *Tackle mode*

The most common tackle mode in the incidents was on feet (n=328), followed by sliding in (n=176) and vertical jump (n=115). There were no statistically significant differences in the proportions of contact injury risk incidents involving a tackle linkable with injuries compared with other contact injury risk incidents-involving a tackle between the tackle mode categories (middle part of Figure 1).

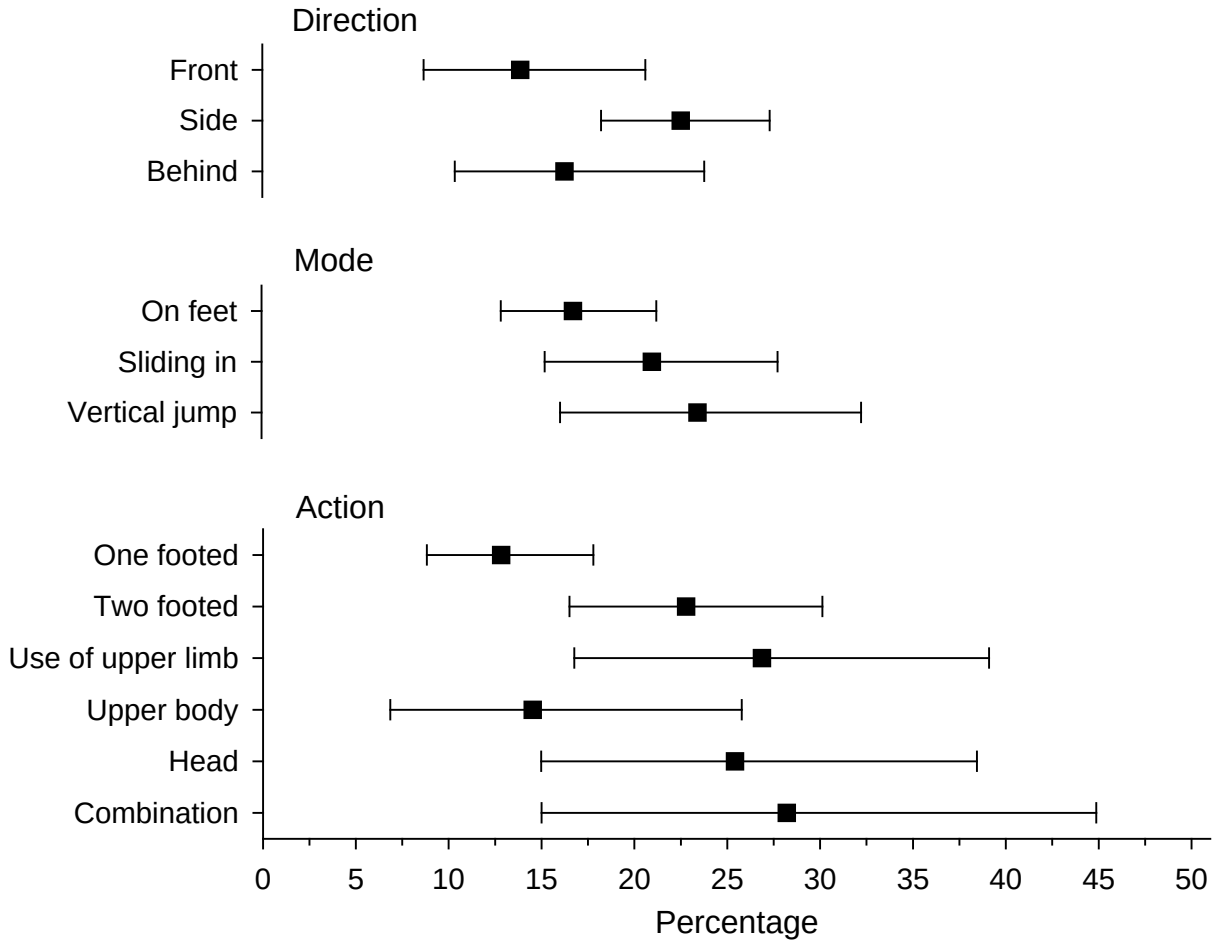

Figure 1 : The percentages and 95% confidence intervals of contact injury risk incidents involving a tackle that were linkable with injury for the different tackle parameters and categories.

iii. *Tackle action*

Most contact injury risk incidents involving a tackle, involved one footed tackle action (n=234), followed by two footed tackles (n=158), tackles involving use of the upper limb (n=67), tackles involving upper body contact (n=62) and tackles involving a clash of heads (n=59). Thirty-nine incidents involved a combination, and no dominant tackle action could be determined. Two-footed tackle actions, and tackle actions involving use of upper limb, a clash of heads or a combination of several tackle actions were more frequently associated with injuries than tackle actions involving upper body contact or one-footed tackle action. The differences in the proportions of contact injury risk incidents involving a tackle linkable with injuries compared to other contact injury risk incidents involving a tackle between the tackle action categories (lower part of Figure 1) were statistically significant (p=0.013).

IV. Discussion

The main finding of the present study was that there are major differences between the results obtained with the FIA methodology, the tackle analysis methodology and the injury surveillance system. In particular, the present study highlights some methodological issues concerning the definitions of some of the parameters used in the FIA methodology, which may be useful for developing new video-based epidemiological research methods for future studies of football injuries.

We were able to link only 42% of the contact injuries reported by team physicians with injury risk incidents, as defined in the FIA methodology and involving player-to-player contact. This questions whether the definition of an injury risk incident is appropriate for this type of epidemiological football injury study. In previous FIA studies, it was possible to link 34-54% of all reported injuries with injury risk incidents for both contact and non-contact injuries but with a tendency towards a higher identification percentage for contact injuries.[14, 18] In these FIA studies that combined medical data with video analysis of injury risk incidents, the injury definition used was based on time loss,[14, 16, 18] in contrast to the present study, which used a medical attention injury definition. The broader definition of injury used in the present study

may be a contributing factor for explaining the lower percentage of association achieved, as time-loss injuries are generally more serious and the circumstances of injury onset may be more visible in nature, and thus easier to detect and link to match events on video recordings. An investigation fo how injuries manifest themselves during matches could potentially provide useful information for a redefinition of what constitutes an injury risk incident. This view is supported by a previous study, which also found differences between the tackle mechanisms associated with injuries and those associated with FIA injury risk incidents.[26] These authors also questioned the validity of the current FIA injury risk definition.[26] A concern related to the low percentage of contact injuries recorded in the injury surveillance study that could be linked to contact injury risk incidents is that there may be one or more common but unknown factors linking these injuries that are not included in the FIA definition of an injury risk incident. It is thus difficult to consider the descriptive data obtained by these definitions as representing a general overview of playing actions and match circumstances leading to injuries. The present study considered all contact injuries as equal and did not differentiate between injuries of different types or different locations.

Injury risk incidents refer to situations in which the match is interrupted by the referee, a player is on the ground for more than 15 seconds, or the player appears to be in pain or receives medical treatment.[14, 16,18, 23, 29] However, these situations may have numerous other causes than an injury, such as player substitutions, off-sides or when a player is purely time-wasting. In the present study, some of these other situations were excluded, as only injury risk incidents resulting from contact between players were included in the analysis. It could also be questioned, whether apparent medical treatment (assessed on video recordings) should necessarily be associated with a risk of injury. A previous study by Fuller et al. indicated that most on-pitch medical attentions did not result in post-match physicians' reports, and that the majority of post-match physicians' reports were not associated with on pitch medical attention.[17]

Another concern with the FIA methodology is that the total frequencies of the variables and categories during a match are not assessed, making it impossible to draw conclusions with regards to the risk of injury associated with individual actions. Some factors, such as dribbling or a short pass may be present in most injury risk incidents, but they may also be the most common playing actions during a match; thus, an injury risk incident may result from only a small fraction of these actions. In the present study, the relative risk of injury associated with the variables was assessed by comparing the ratios of the number of contact injury risk incidents linked with contact injuries reported by team physicians to the number of contact injury risk incidents not linked with injuries for the categories of each variable. Using this approach, two variables were identified as independent predictors of injury; attack type and the involvement of foul play. Meaning merely, that the presence of some categories of the variables 'attack type' and 'foul play', during a contact injury risk incident, had an injury predictive value. Whether or not the variable itself has an injury predictive value remains unclear, as not all injuries could be linked with incidents and as the total frequencies of the variables were not recorded. However, the finding that the involvement of a foul in a contact injury risk incident was associated with a lower percentage of linkable injuries than when a foul was not involved seems somewhat counter-intuitive. A possible explanation for this result is that fouls usually result in the referee interrupting the game, which is one of the criteria for an FIA injury risk incident. In the present study most of the contact injury risk incidents involved a foul. However, player-to-player contact can cause injury irrespective of the involvement of a foul, and thus some non-foul contact situations, not fulfilling the criteria for a FIA injury risk incident, were almost certainly excluded. The results of the tackle analysis of the present study share similar limitations, as the included tackles were chosen from the cohort of identified contact injury risk incidents, and thus many other tackles (and possibly some injuries resulting from these tackles) were again most likely excluded.

The injury surveillance methodology may also present a source of bias, which could contribute to the discrepancies observed between the data obtained by the different methodologies. The injury surveillance reporting data consists of post-match injury reports, where all the players' complaints that required medical attention during, or immediately after, the match should have been recorded. For the researcher aiming at linking a post-match reported injury to an event on video material, the time (minute) of the injury reported on the injury form may constitute the best lead to identifying the corresponding match event. However, in post-match conditions, the reported time of injury may sometimes be an approximation, which complicates the video analyst's work in identifying the injury event. This could contribute to the low percentage of injury reports that were linked to an injury risk incident

The present study did not take into account the frequencies of the different criteria used in the injury risk incident definition. Thus, we cannot draw conclusions on whether some of the criteria, for example when a player is receiving on-pitch medical treatment, are more frequently linkable with a FIFA injury than others.

Importantly, only eight of the nineteen variables included in the original description of FIA [16], were included in the present study. Therefore, we cannot draw conclusions about the relevance of the other variables previously included in the FIA methodology.

What can we learn from the present study? The FIA video approach for investigating injury risk associated withplaying actions and match circumstancesrequires further development. The optimal method may be to focus on a few well-defined playing actions,in order to assess their total frequencies during matches, and to assess the injury risk associated with these actions. This approach was successfully applied by Fuller et al. in studies on tackle parameters in football [15, 17, 22] and rugby union.[40] They identified some tackle parameters having a greater propensity for causing injuries than others.[15, 40] They concluded that an assessment of injury causation factors should therefore, differentiate between initiating events with a high frequency of occurrence and a low propensity for injury and those events with a low frequency of occurrence and a high propensity for injury.[15, 40] Also Drawer et al. stated that an effective risk management strategy begins with an estimation and evaluation of the risks associated with the activity.[38] By comparing the number of contact injuries, based on post-match injury reports [2], and the number of injuries that was linked with the tackles identified on video recordings in one of the tournaments (2000 Olympics), included in the tackle analysis study by Fuller et al.[15], we find that 96% (98/102) of all the contact injuries were linkable with the tackles, further indicating that their methodology was suitable. However, we do not know how reliable the linking of a match event, identified by a researcher from video recordings, to an injury, reported by the team physician, really is. Fuller et al. identified 8572 tackles from 123 matches,[15] giving an average of roughly 70 tackles per match (or more than one tackle every two minutes).Thus, one player could potentially be involved in several tackles during the same match and within a short time frame. Considering this, the reliable linking of an injury to a specific tackle may be debatable, as it is based on the researcher's interpretation, especially when it comes to minimal and mild injuries.

V. Conclusions

In conclusion, the limitations discussed above make comparison of the results obtained by these three methodologies difficult to interpret and there is little evidence that the current definition of an injury risk incident, as defined in the FIA methodology, is adequate for linking match events with injuries. Future studies are needed that will provide more reliable methods for identifying injury causation events using video recordings: this is difficult, but it remains the most important factor. One potentially valuable methodological revision would be to include post-match reviews of video recordings of matches, in the presence of the injured player and/or the team physician who made the post-match medical assessment of the injured player, as these individuals are best suited to identify the injury events associated with an injury.

VI. Acknowledgments

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a) Contributorship statement

JR coordinated the study, conducted the statistical analysis together with HK, and drafted the manuscript. LL reviewed all the video recordings. JR, LL, LP, JK and MB participated in the study design, through revision and by partly writing the research plan, as well as approving the final manuscript. Author LP played a key role in the collection of injury data. JK, MB and LP participated in revision and writing of the research plan, the first draft, and the final manuscript. CF participated through revision and writing of the final version of the manuscript.

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New Tests for Early Screening of the So - Called Idiopathic Scoliosis

By Tomasz Karski & Karski Jacek
Vincent Pol University in Lublin, Poland

Introduction-

a) New tests for scoliosis

In the diagnosis of so-called idiopathic scoliosis we should use widely known old tests such as Adams & Meyer test, symmetry or asymmetry of waist test, but also new tests like – the side bending test for scoliosis (Lublin test), a test checking the habit of standing 'at ease'– on the right versus on the left leg, Dunkan Elly – test to discover the flexion contracture of hips making "anterior tilt of pelvis", pelvis rotation test (a new test since 2006), the adduction of hips test (similar to Ober test).This "adductions test" is deciding in new classification of scoliosis, explain character of scoliosis, place and character of curves, stiffness or flexibility of spine. All tests are presented below.

List of the old and new tests (Fig. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10) and clinical changes enabling an early discovery of scoliosis.

Keywords: so-called idiopathic scoliosis. examination's tests.

GJMR-H Classification: NLMC Code: WE 168

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New Tests for Early Screening of the So – Called Idiopathic Scoliosis

Tomasz Karski [α] & Karski Jacek [σ]

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I. Introduction

a) New tests for scoliosis

In the diagnosis of so-called idiopathic scoliosis we should use widely known old tests such as Adams & Meyer test, symmetry or asymmetry of waist test, but also new tests like – the side bending test for scoliosis (Lublin test), a test checking the habit of standing 'at ease'– on the right versus on the left leg, Dunkan Elly – test to discover the flexion contracture of hips making "anterior tilt of pelvis", pelvis rotation test (a new test since 2006), the adduction of hips test (similar to Ober test).This "adductions test" is deciding in new classification of scoliosis, explain character of scoliosis, place and character of curves, stiffness or flexibility of spine. All tests are presented below.

List of the old and new tests (Fig. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10) and clinical changes enabling an early discovery of scoliosis. The list of the new tests and symptoms (doctor's/examination questions and answers) are important to recognize an early stage of scoliosis: Test of adduction of both hips (in extension position of joints – like the Ober test). Important is also checking the flexion contracture of the hips and the external rotation contracture of the right hip. The are three models of movements of right / left hip and in consequence three groups and four types of scoliosis.

Below we describe tests using for early discovery of scoliosis (Figures 1 - 10):

1. Bending test for scoliosis - Adams/Meyer test. Flexion test performed with bent spine (and the whole of the body). When the shape is round it is good / proper, when stiff and in straight contracture – there is (it shows) the beginning of scoliosis.
2. Side bending test for scoliosis (bending to the left and to the right leg during standing in abduction), also called Karski or Lublin test, it is a modified Adams/Meyer test – more sensible as Adams test. A specially - in "C" II/A scoliosis and II/B group of scoliosis show very early beginning of deformity.
3. Rotation movements of the body test (new test since 2006).
4. Permanent standing 'at ease' test – checking the habit of standing – on the right versus on the left leg. The length of time (cumulative time) is deciding in children with scoliosis. The standing on the right leg is only one of causative influence in I epg and II/A & II/B epg groups.
5. The symmetry or asymmetry of the waist test (an old test, but still very important).
6. Presence of an illnesses (e.g. rickets). Rickets and general laxity of joints - increase oncoming of scoliosis.
7. Anatomical anomalies of the spine (spina biffida occulta, pectus infundibuliforme, rickets). If present, the proper development of the spine is endangered.
8. Body build type - asthenic and picnic (bad), athletic (good).
9. Willingness to participate in sports, if yes - good, if no - bad.

Additional causes of scoliosis and presented tests – connected with CNS (central nerve system) (Fig. 10)

A. Straight position / contracture of spine.
B. Anterior tilt of pelvis.
C. Laxity of joints

New rehabilitations exercises. Proper solution to the problem of scoliosis is an early prophylactics based on the new test for discovery of scoliosis and new exercises in context of the biomechanical etiology. The new rehabilitation exercises should remove the contracture in the pelvis, the hips and in the whole spine. The flexion - rotation exercises should be performed by very young children, already at 3 and 4. It is also important to change the standing, sitting and sleeping positions. The results of such treatment has proved beneficial in years 1985 (beginning of research about scoliosis problems) till 2014 (research with last observations). This matter is describing in details in third lecture / article.

Literature: see article about etiology of scoliosis and www.ortopedia.karski.lublin.pl

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Figures:

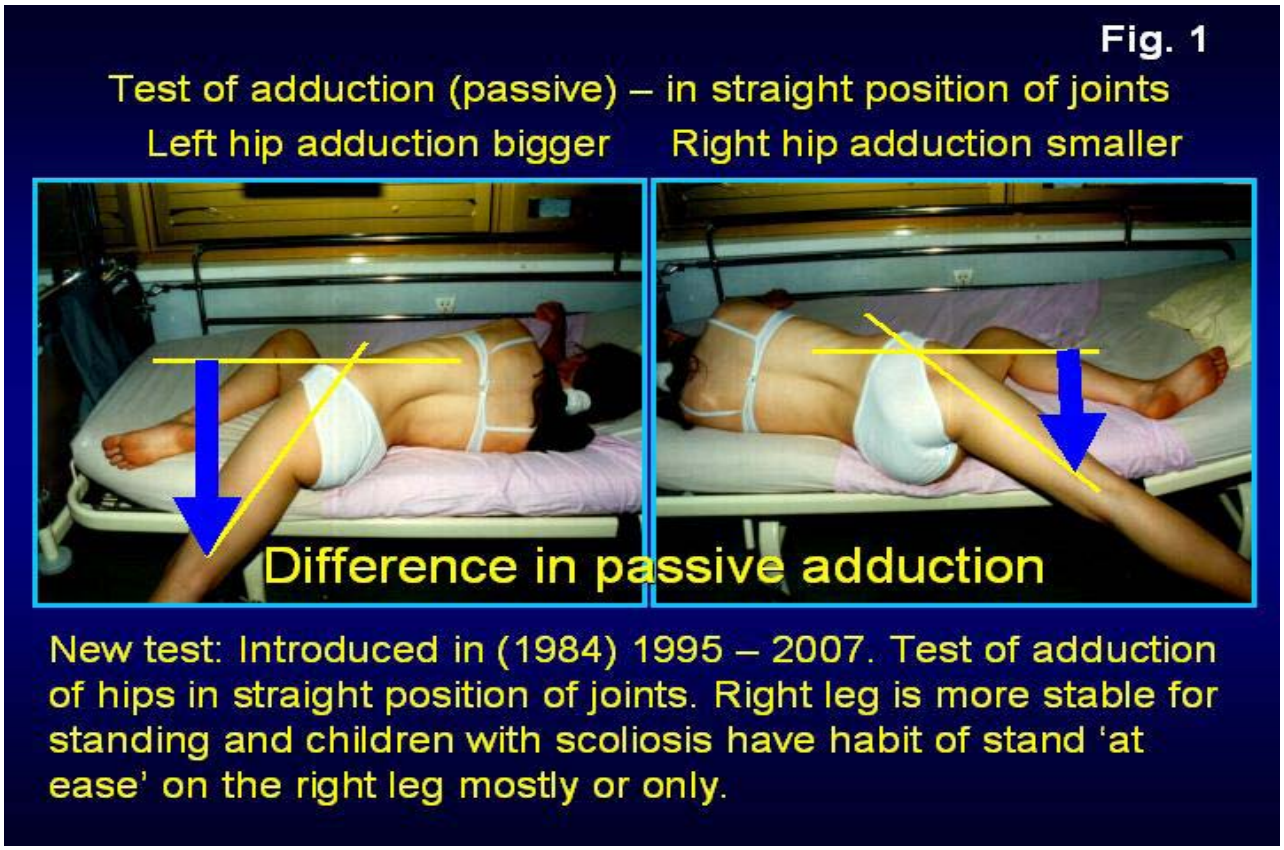

Figure 1 : Test of adduction of hips in straight position of joint

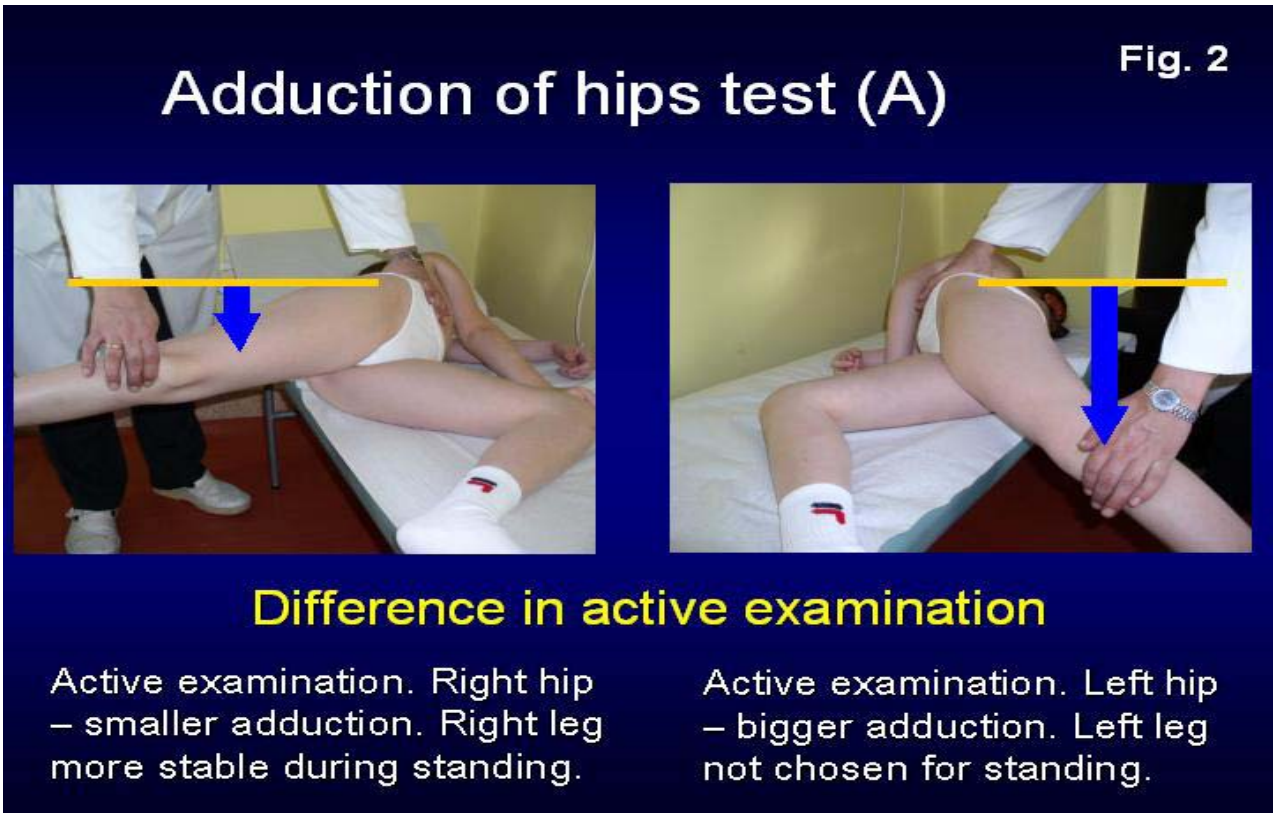

Figure 2 : Test of adduction of hips in straight position of joint

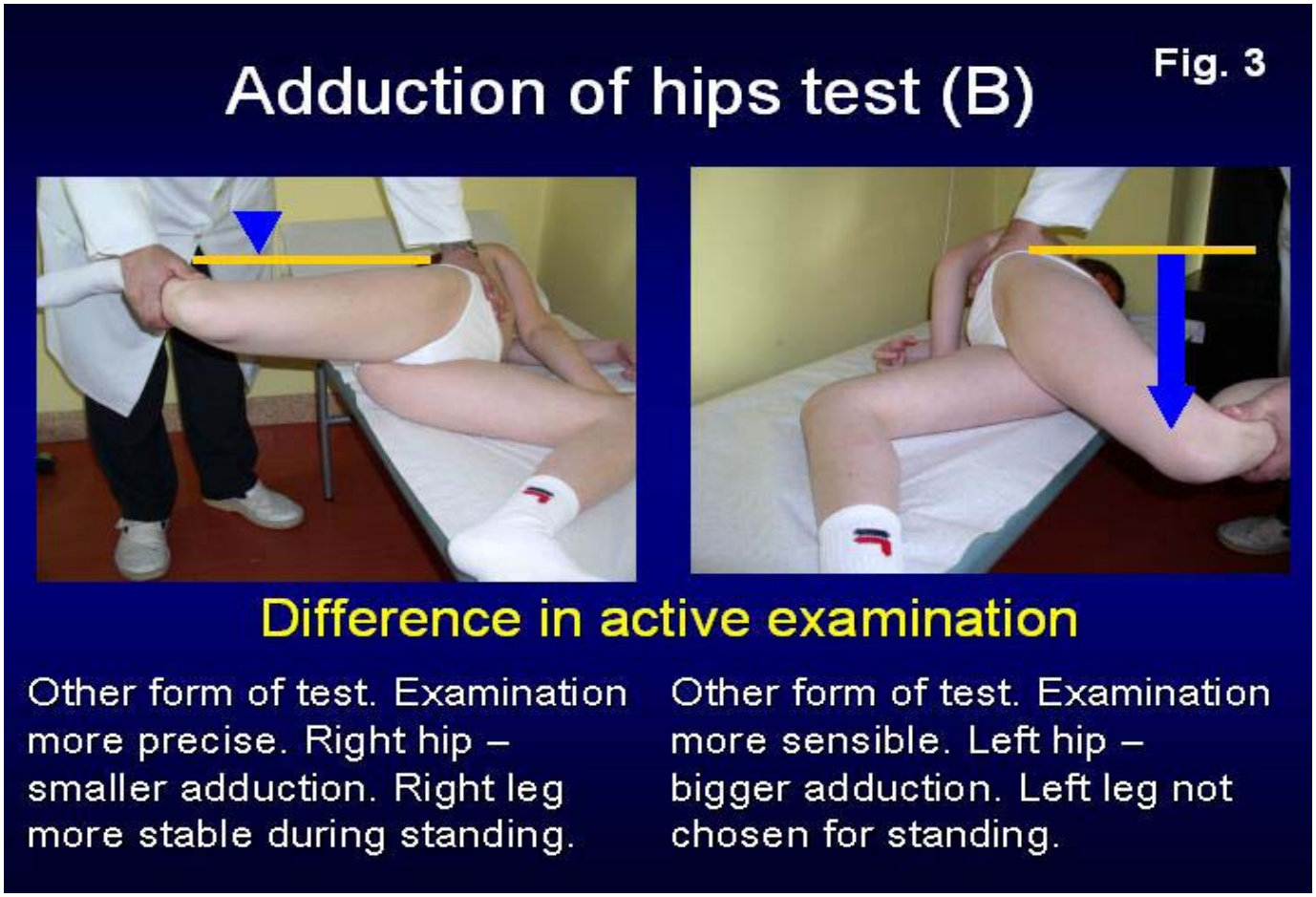

Figure 3 : Te st of adduction of hips in straight position of joint

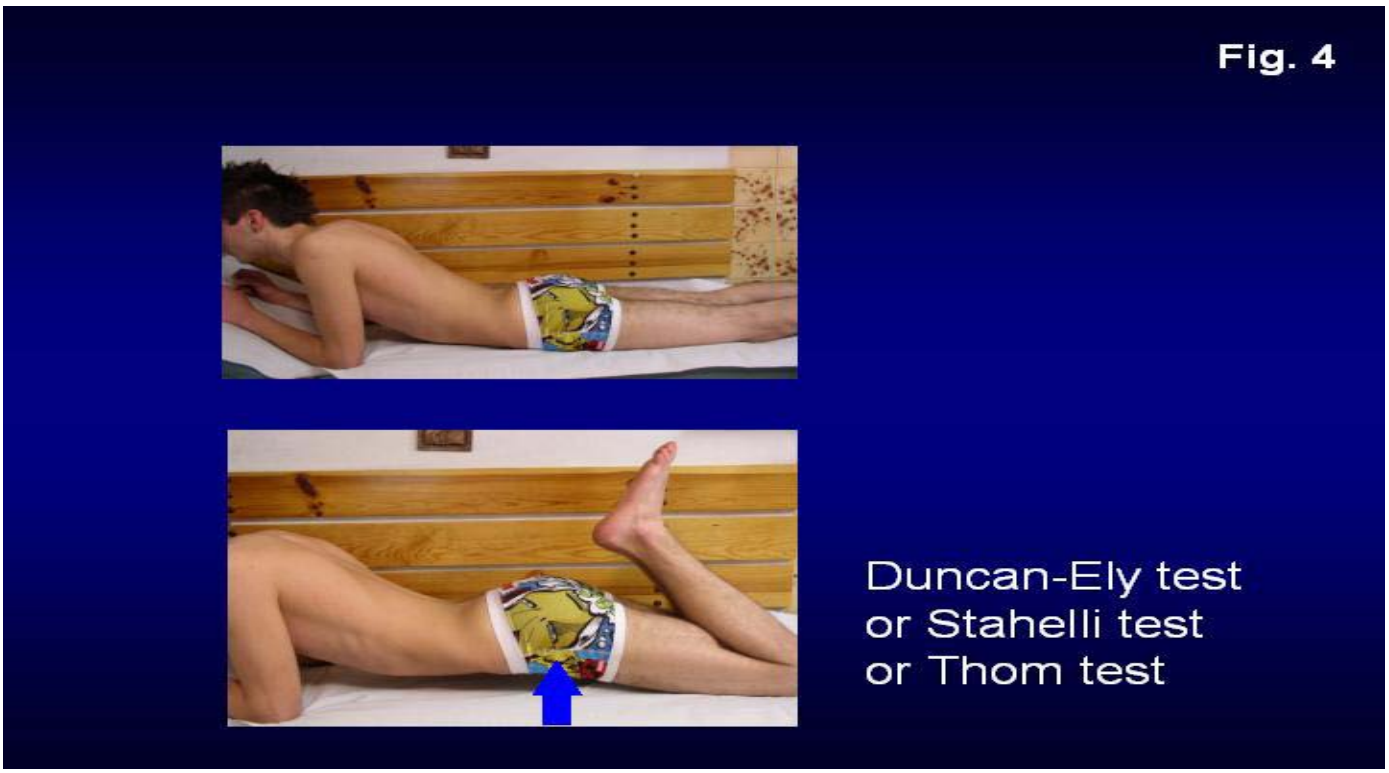

Figure 4 : Elly Duncan test or Staheli test or Thom test. Test for checking the „anterior tilt of pelvis" (flexion contracture of hips)

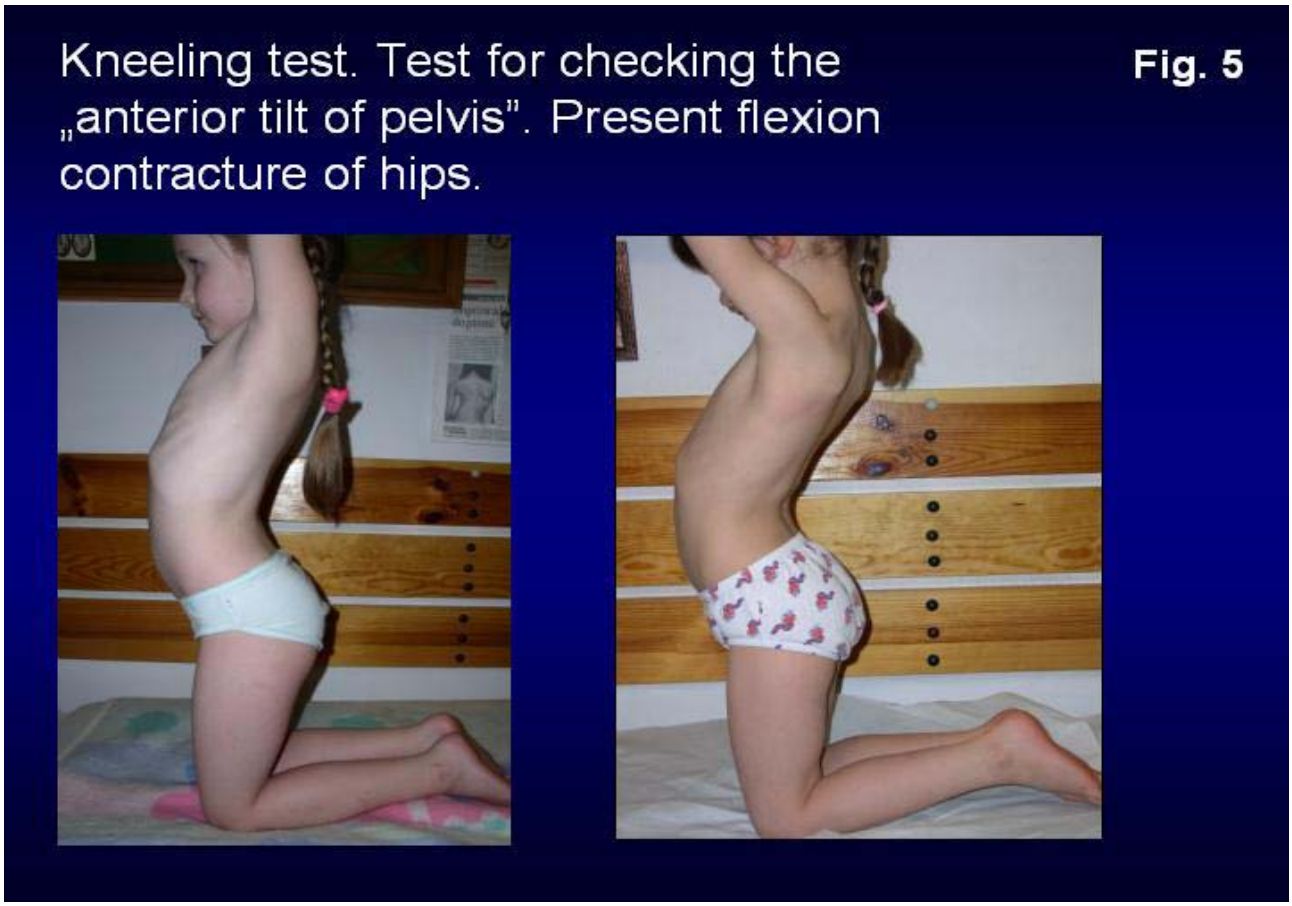

Figure 5 : Kneeling test. Test for checking the „anterior tilt of pelvis" (flexion contracture of hips)

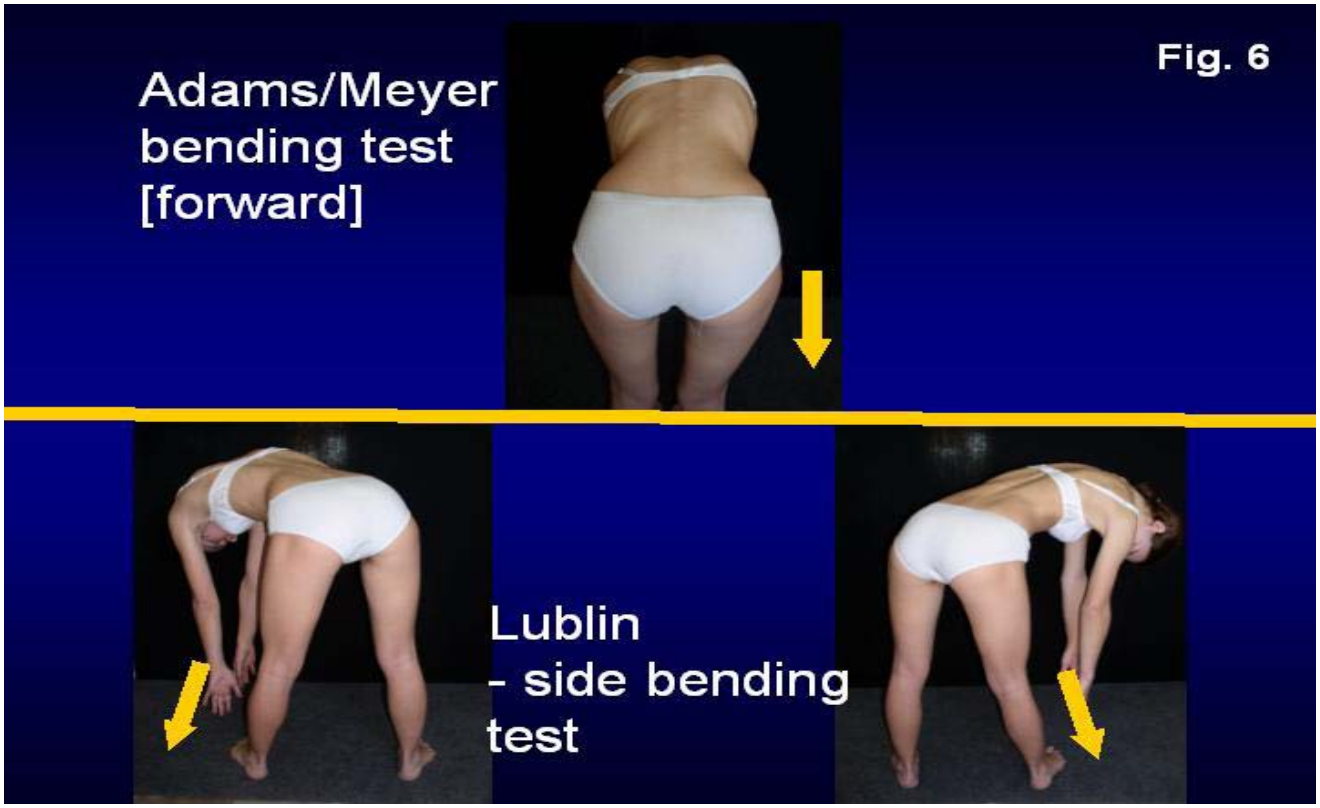

Figure 6 : Adams/Meyer bending test [forward] and Lublin – [side] bending test

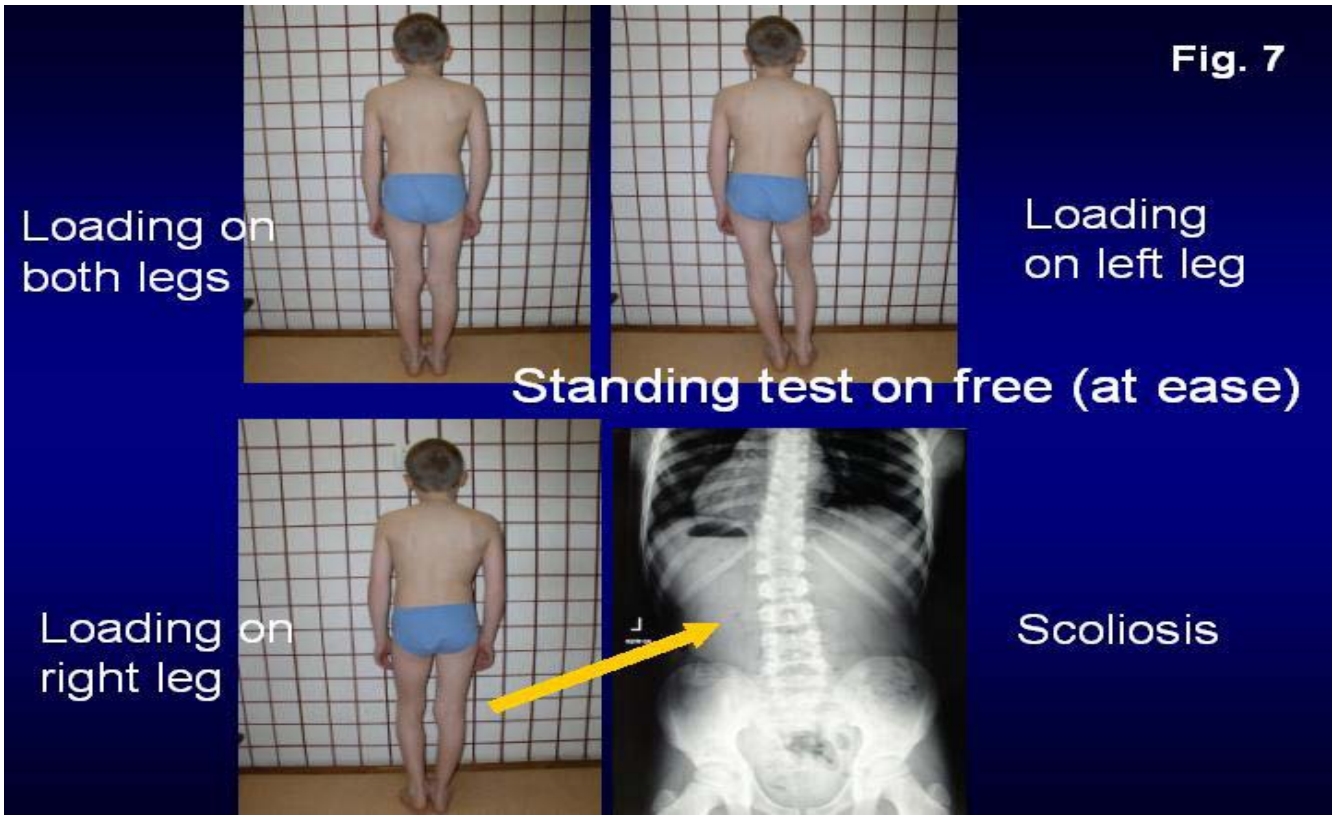

Figure 7 : Standing test on free (at ease)

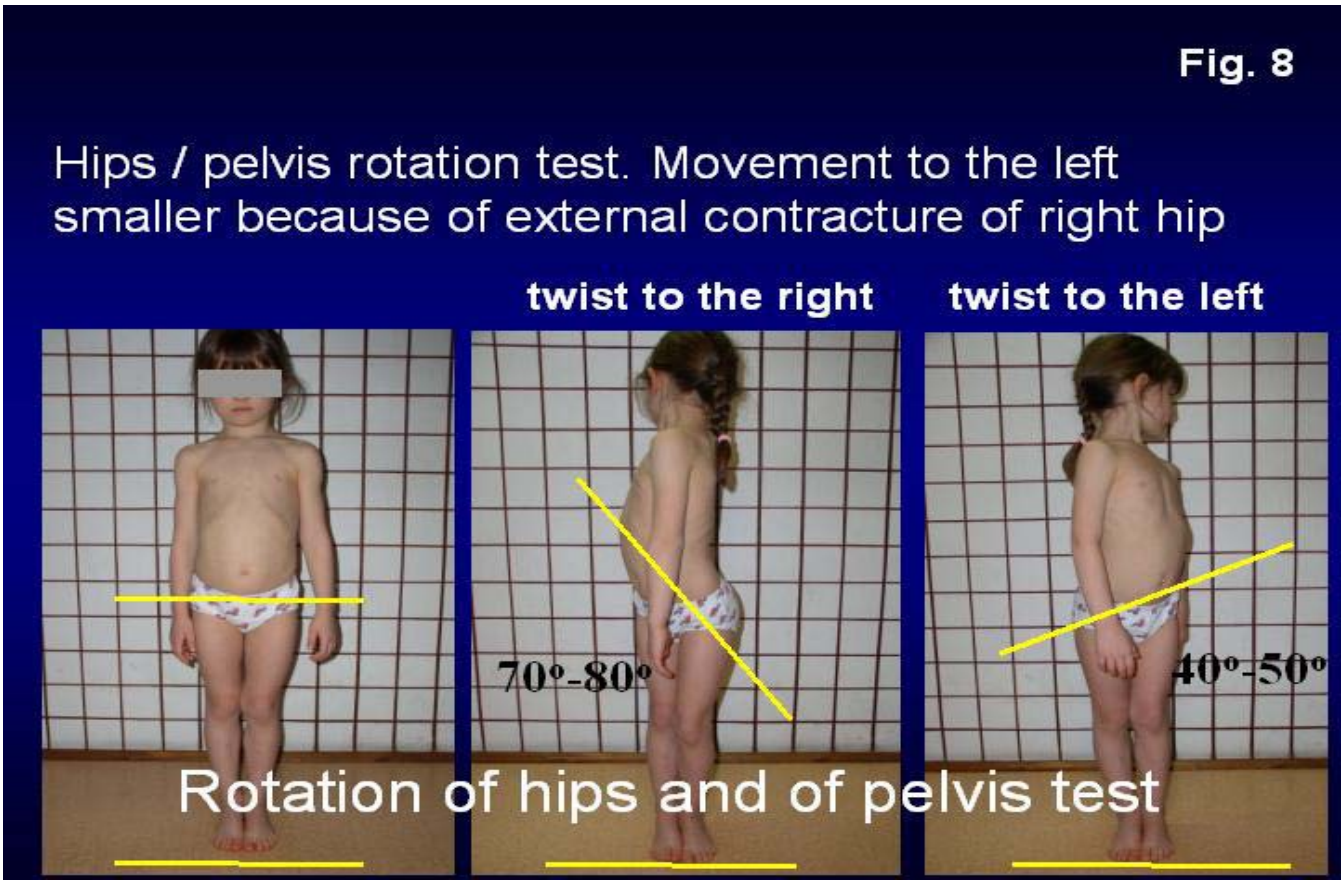

Figure 8 : Hip rotation test. Movement to the left smaller because of external contracture of right hip

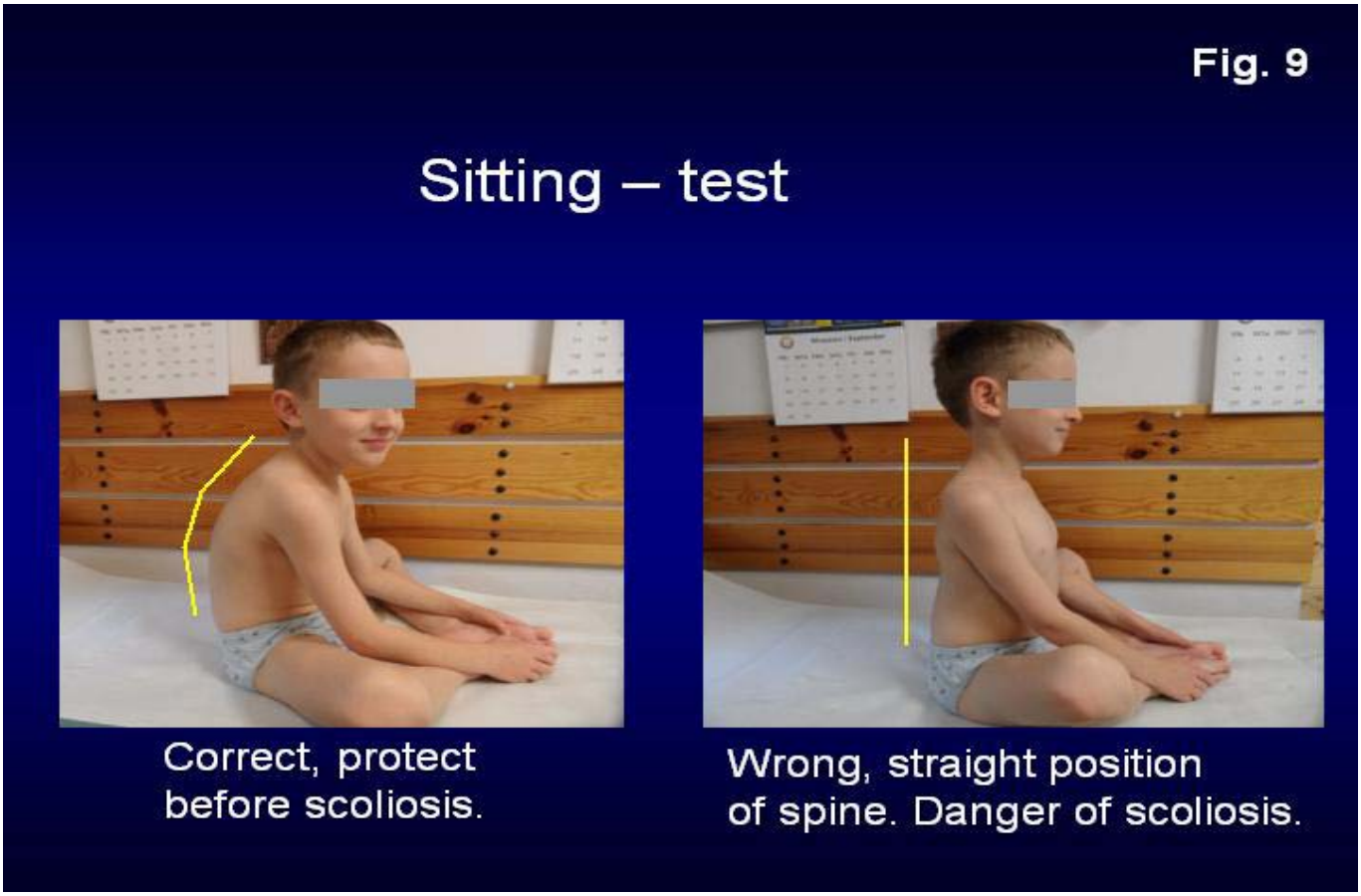

Figure 9 : Sitting – test. Straight sitting – wrong. Relax sitting – proper.

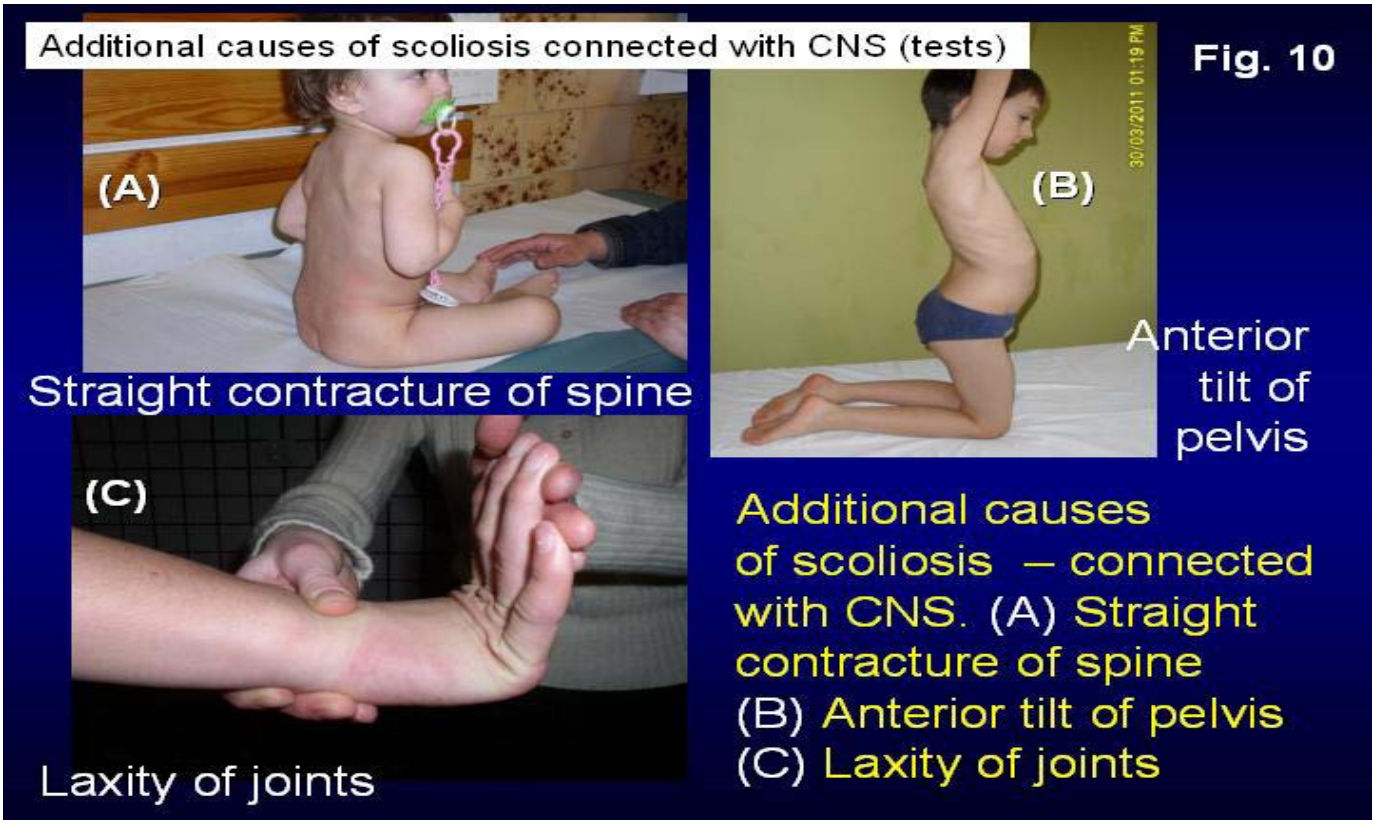

Figure 10 : Additional causes of scoliosis connected with CNS - tests (Central Nerve System)

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Difficult Tibial Nail Removal using the "Extended Trochanteric Osteotomy" Technique Prior to Total Knee Arthroplasty

By Aaron Schrayer, Di Lin Parks & and Russell Wagner
John Peter Smith Hospital, United States

Abstract- Osteoarthritis of the knee may occur in patients who have previously undergone tibial nailing, necessitating nail removal in order to perform total knee arthroplasty. Typically, the nail may be removed without a great deal of difficulty, either as a separate procedure or at the time of the arthroplasty. However, tibial nail removal may pose a significant challenge.

Extended trochanteric osteotomy is an exposure technique that provides optimal access to the femoral diaphysis.1 Creating a longitudinal window down the length of the femur exposes the intramedullary canal allowing for removal of well fixed components (such as fully coated press-fit stems) that are adherent to the bone. This technique has been well described in the literature with several variations of this procedure also now used quite universally.2 We report the use of a similar technique, extended tibial osteotomy, to remove an incarcerated tibial nail at the time of planned total knee arthroplasty. Our patient was informed that data concerning the case would be submitted for publication, and she consented.

GJMR-H Classification: *NLMC Code: WE 312*

Strictly as per the compliance and regulations of:

Difficult Tibial Nail Removal using the "Extended Trochanteric Osteotomy" Technique Prior to Total Knee Arthroplasty

Aaron Schrayer [α], Di Lin Parks [σ] & Russell Wagner [ρ]

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Extended trochanteric osteotomy is an exposure technique that provides optimal access to the femoral diaphysis.[1] Creating a longitudinal window down the length of the femur exposes the intramedullary canal allowing for removal of well fixed components (such as fully coated press-fit stems) that are adherent to the bone. This technique has been well described in the literature with several variations of this procedure also now used quite universally.[2] We report the use of a similar technique, extended tibial osteotomy, to remove an incarcerated tibial nail at the time of planned total knee arthroplasty. Our patient was informed that data concerning the case would be submitted for publication, and she consented.

I. Case Report

A sixty-three-year-old woman presented to the orthopaedic clinic for persistent right knee pain. Her orthopaedic history included a right tibial shaft fracture five years prior to presentation that was initially treated in a closed fashion. Seven months later, after having continued pain at the fracture site and trouble ambulating, a hypertrophic non-union was diagnosed, an intramedullary nail was placed, and the fracture healed. Subsequently, she had persistent, severe right medial knee pain requiring the use of a wheelchair to travel more than short distances. Physical examination was notable for BMI of 55, 10 to 90 degrees of motion, and palpable medial osteophytes; radiographs revealed complete loss of medial joint space (Figure 1).

Author α σ ρ: Investigation performed at the Department of Orthopaedics, John Peter Smith Hospital, Fort Worth, Texas. e-mail: rwagner@jpshealth.org

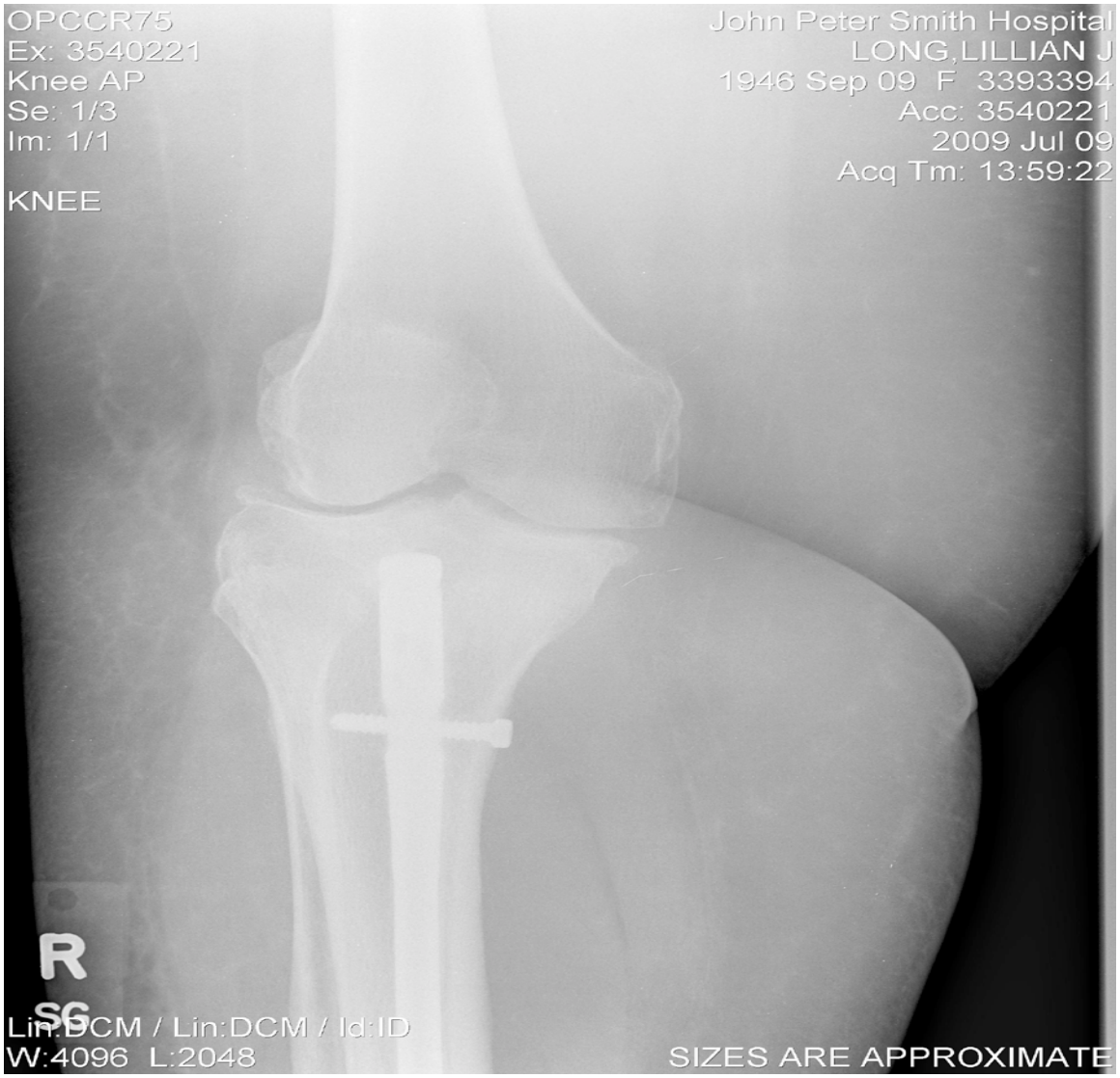

Figure 1 : (Pre op AP)

After a complete discussion of treatment alternatives, we planned to perform a right tibial intramedullary nail hardware removal along with a total knee arthroplasty. We began with the distal femoral and proximal tibial resections in order to facilitate insertion of the extraction bolt into the tibial nail. Removal of the intramedullary nail was then attempted using a slap hammer. Although we had very good fixation of the slap hammer onto the nail, the nail could only be extracted about 1cm after approximately an hour of hammering by all members of the operative team. When the nail was hammered in an antegrade manner in an attempt to loosen it, the proximal one-half of the tibia split into large medial and lateral displaced fragments, with the tubercle as a portion of the lateral fragment. Despite the fact that the proximal one-half of the nail was now completely exposed, further hammering did not "budge" the nail. At this point, we decided to perform an extended tibial osteotomy in order to gain access to the nail. An incision was made, continuous with the initial incision, extending down the medial face of the tibia to the ankle. The cortical window was elevated from the anterior crest of the tibia, attempting to leave as much soft tissue on this cortical window as possible. When the window was elevated, we found bone that had grown onto the nail and was larger than the diaphyseal diameter. We used a high speed bur to remove this bone and then were able to remove the nail. At this point, with the displaced bicondylar tibial plateau fracture extending to the mid tibia and the extended tibial osteotomy down to the ankle, we decided to perform a two-staged procedure, with plans for delayed total knee arthroplasty after the fracture and osteotomy had healed. Therefore, the tibial osteotomy cortical window was stabilized using two Luque cerclage wires and the proximal tibial plateau was stabilized with three 3.5mm lag screws. A Rush rod was placed to give overall alignment and to facilitate later rod removal. Although there was no evidence of infection, an antibiotic cement spacer was placed between the femur and the tibia to maintain collateral ligament length (Figure 2).

Figure 2 : (Post op AP with Rush rod)

At 4 months, the fracture and osteotomy appeared healed on radiographs and we performed primary total knee arthroplasty. Intraoperative exam and stress fluoroscopy images were consistent with healing of the fracture and osteotomy sites; consequently, the Rush rod was removed. She initially did well, but one month after the arthroplasty, she had increasing pain and clinical motion at the fracture site; therefore we returned to the operating room for plate fixation. The fracture then healed uneventfully. Fourteen months later, she had good pain relief and function, with 0-110 degrees of motion (Figures 3 and 4).

Figure 3 : (Post op AP with plate)

Figure 4 : (Post op lateral with plate)

II. Discussion

Tibial intramedullary nailing is a commonly performed procedure for tibial shaft fractures and nail removal is not uncommon. Anterior knee pain is generally the most common indication for nail removal with other common reasons being exchange nailing due to both delayed union and nonunion.[3,4] Complications may occur during nail removal. Though there is limited literature on problems encountered during tibial nail removal, one paper reported four cases of posterior tibial wall fracture upon removing the ACE titanium tibial nail while another described a case of a tibial shaft fracture upon removal of the Synthes Expert Tibial Nail.[5,6] Even though there are other possible complications that can occur, tibial fractures remain the most likely.

In revision hip literature, there is a growing trend toward performing an extended trochanteric osteotomy to remove well-fixed prostheses with the goal being to have a surgically controlled "window" rather than inadvertently causing significant boney damage.[2,7,8] In this patient, once the nail was partially removed, she would be unable to ambulate without removing the nail or cutting it off, which would make future nail removal even more difficult should it be necessary. Based on the senior author's (R.A.W.) use of extended trochanteric osteotomies in total hip procedures, creating a tibial window in a similar fashion seemed to be the best option.

Staged hardware removal with subsequent knee replacement may avoid the complication of prosthesis implantation in the presence of occult infection, but has the downside of two operative procedures. There is limited information on this topic. One study that compared short term outcomes of total hip replacement after complications of ORIF for hip fractures with a matched group of osteoarthritic patients showed that overall functional outcome at 1-year post-op was similar for both patient populations despite concerns of increased intraoperative difficulty and risk of fracture.[9]

Although performing the proximal tibial resection made insertion of the extraction bolt easier, it also forced us to go forward with a knee replacement or fusion in order for the patient to walk; therefore, in the future, we would plan nail removal prior to performing the boney cuts for total knee replacement, even if the arthroplasty is planned during the same procedure.

Recognizing possible "ongrowth" is vitally important to prevent complications like tibial fractures since forceful hammering is usually necessary for extraction of intramedullary tibial nails.[6] Titanium nails may be expected to have more ongrowth than steel nails. Creating a tibial window using the same technique as the extended trochanteric osteotomy allows for a controlled extraction of the intramedullary nail without causing unintended boney damage. We hope by this article to warn surgeons of this situation, which may become more common, and to provide a possible solution.

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Biomechanical Aetiology of the So-Called Idiopathic Scoliosis. New Classification (1995 – 2007) in Connection with "Model of Hips Movements"

By Karski Tomasz
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Introduction- The article describes the biomechanical aetiology of the so-called idiopathic scoliosis (1995 – 2007), known as an adolescent idiopathic scoliosis (AIS). The first lecture dealing with the issue was delivered in Hungary in 1995. The first publication was made in Germany in 1996 (Orthopädische Praxis).

Biomechanical development of scoliosis. The scoliosis appears as the secondary deformity originating in the asymmetry of hips' position and movement described by Prof. Hans Mau in articles about Syndrome of Contractures (Fig. 1, 2a, 2b, 3, 4a, 4b, 4c). Next - while walking and while standing 'at ease' on the right leg (T. Karski). The research proves that the right leg is the preferred one over the years for standing. This phenomenon is because of better stability of right leg in region of right hip during standing and this is because of smaller adduction in straight position of joint.

Keywords: *so-called idiopathic scoliosis, aetiology, biomechanics.*

GJMR-H Classification: *NLMC Code: WE 168*

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I. Introduction

The article describes the biomechanical aetiology of the so-called idiopathic scoliosis (1995 – 2007), known as an adolescent idiopathic scoliosis (AIS). The first lecture dealing with the issue was delivered in Hungary in 1995. The first publication was made in Germany in 1996 (Orthopädische Praxis).

Biomechanical development of scoliosis. The scoliosis appears as the secondary deformity originating in the asymmetry of hips' position and movement described by Prof. Hans Mau in articles about Syndrome of Contractures (Fig. 1, 2a, 2b, 3, 4a, 4b, 4c). Next - while walking and while standing 'at ease' on the right leg (T. Karski). The research proves that the right leg is the preferred one over the years for standing. This phenomenon is because of better stability of right leg in region of right hip during standing and this is because of smaller adduction in straight position of joint. Every type of scoliosis starts to develop at the time when the child starts to stand and walk. Depending of types of scoliosis is a special characterise of patho-morphology of deformity of spine and their various properties. To explain in details the biomechanical aetiology we must remember about the three asymmetries causing the development of scoliosis:

1. The asymmetry of the movement in the hips – adductions test (Fig. 5) – is the primary cause for development of scoliosis.
2. The asymmetry of the movement and in loading in pelvis and spine - left versus right side in gait. Gait – influences factor in I epg scoliosis and in III epg scoliosis.
3. The asymmetry of the time while standing 'at ease' on the left versus the right leg – more time on the right leg. Standing on the right leg - influences factor in II/A epg scoliosis and in II/B epg scoliosis.

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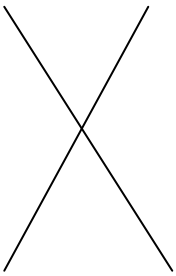
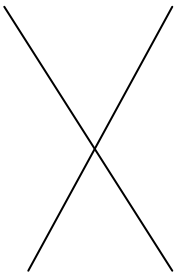
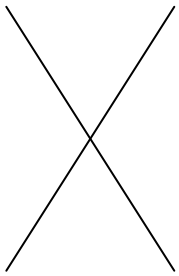
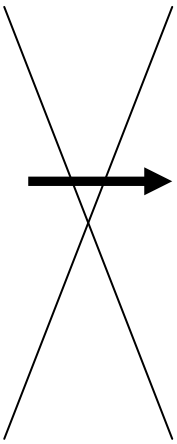
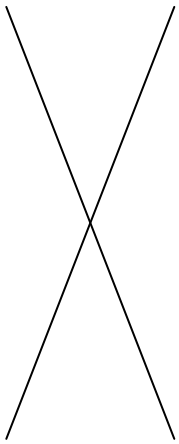
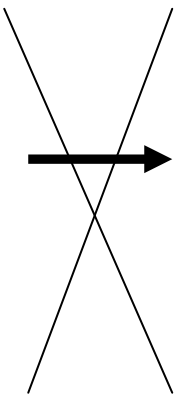
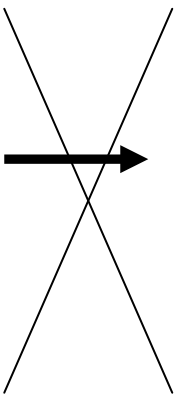
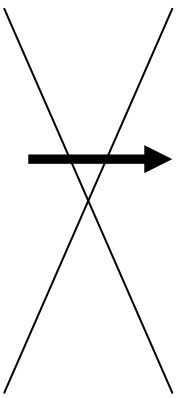
The asymmetry of movement of the hips is as mentioned above, is connected with "Seven Contractures Syndrome" described by Professor Hans Mau from Tübingen in Germany in 1960s (in German Siebenersyndrom) and then further explained (T. Karski) as a "Syndrome of Contractures and Deformities" (literature 1 – 15).

The consequential development of the spinal deformity is as follows:

1. Every type of scoliosis depends on the Model of Hips' Movement [MHM] (T. Karski 2006).
2. When the movement of hips is symmetrical – the is no pathological influence on spine during walking/gait and the is also symmetry of time standing on left / right leg. In such situation develop never so-called idiopathic scoliosis (Fig. 6, 7).
3. The asymmetry of the movement of hips in all cases of the so-called idiopathic scoliosis bases on the limited adduction, limited internal rotation and limited extension in the right hip. This phenomenon explain "the lest sided Syndrome of Contractures".
4. In gait, there is a limited movement of the right hip which is transmitted to pelvis and spine as a compensatory process and "enlarges" the movement in the spinal region. Consequently, there occurs a permanent distortion of the inter-vertebral joints, a rotation deformity and later stiffness of the spine. The asymmetry of the movement of hips in gait also causes a load asymmetry "with passing time" on both sides – left and right - and further, a gradual development of scoliosis.
5. The permanent standing 'at ease' on the right leg (the right hip is more stable [!]) starts and widens the curves – first, lumbar left convex and in II/B epg (see farther/next text) thoracic right convex curves.
6. The scoliosis "S" in I epg is connected with standing 'at ease' on the right leg and with gait.
7. The scoliosis "I" in III epg is connected only with gait. This type of scoliosis manifests itself as stiffness of spine. This deformity produces no curves or gibbous or a very slight one.
8. The following influences connected with gait and with standing on the right leg gives - three groups

and four types of scoliosis (see above): "S" double scoliosis - I etiopathological group (epg); causal gait and standing on right leg, lumbar left convex curve in "C" - II/A scoliosis sometimes with secondary thoracic right convex curve in "S" – II/B epg scoliosis; causal standing on right leg. In this subgroup ("S" – II/B epg scoliosis) not only standing 'at ease' on the right leg is the cause of scoliosis but also the laxity of joints (typical for minimal brain dysfunction [MBD]) and harmful exercises in former therapy - before the stay in our Department.

Asymmetry in the movements of hips (Tab. I). There are differences in the movement concerning the range of adduction, internal rotation and extension. Types of scoliosis in connection to "the model of hip movements" are presented the table below: Tab. I

Model of hips movements	**Causative influence**	**Type of "S" scoliosis – I epg**	**Type of "C" scoliosis – II/A epg**	**Type of "S" scoliosis – II/B epg**	**Type of "I" scoliosis – III epg**
Range of add. right hip -10 / -5 / 0 degree Range of add. left hip 30 / 40 / 50 degree	Gait and standing on the right leg 'at ease' (free) →	Scoliosis "S" I epg Two curves. Rigid spine. Gibbous in thorax right side. 3D. Progression.			
Range of add. right hip 20 / 30 degree Range of add. left hip 40 / 50 degree	Standing on the right leg 'at ease' (free) →		Scoliosis "C" II / A epg. Lumbar or Sacro – Lumbar or Lumbar – Thoracic left convex curve. Flexible spine. 2D. No progression or small.	Scoliosis "S" II / B epg. Lumbar left convex. Thoracic secondary right convex curve. Flexible spine. 2D or 3D. No progression or amall.	
Range of add. right hip -10 / -5 / 0 degree Range of add. left hip 0 / 10 / 20 degree	Gait →				Scoliosis "I" III epg No curves or slight. Rigid spine. 2D or 3D. Stable deformity. Not included till now to "scoliosis".

Material. In the years between 1985 and 2012, 1950 children with scoliosis were examined and 360 children constituted the control group. The material for the years 2012- 2014 is in research processing. The children from the control group were presented by parents as ones with the problem of scoliosis but there were without any visible spine deformity.

Classification [literature 1 - 15]

(Tab. I) When movement of hips (see model of movements), especial adduction in strait position of joint (this position is important in function - in standing and in gait) – is equal its mean symmetric of both sides - there is no scoliosis.

In new classification there are three groups and four types of scoliosis (Fig. 8, 9, 10, 11, 12, 13, 14).

I / "S" double scoliosis with stiff spine (3D - I epg), connected with gait and standing 'at ease' on the right leg;

IIA / IIB "C" and "S" scoliosis with flexible spine (II/A - 1D & II/B - 2D epg), connected only with standing 'at ease' on the right leg in "C" II/A epg and in "S" II/B epg additionally connected with laxity of joints and / or harmful previous exercises

III / "I" scoliosis (III epg – 2D) – stiff spine without curves and gibbous or with very slight ones. Connection with gait only.

Every type of scoliosis starts to develop at the age of 2 or 3.

II. Comment to the New Classification

I-st etiopathological group of scoliosis is "S" deformity in I epg. (Tab. I). This scoliosis can be diagnosed very early, at the age of 3 to 5. The authors observed that children aged 1 year who can walk and stand independently, stand mostly 'at ease' on the right leg (observation in Out – Patient Clinic) and it should be an alarming sign for doctors and parents indicating / showing the beginning of the developing of scoliosis. In the I epg group, the first clinical sign is the rotation deformity which should warm against future spinal deformity. In some cases of I epg group there is "lordo-scoliosis". The property of such scoliosis is: progression, especially after harmful exercises.

II-nd etiopathological group of scoliosis - "C" II/A epg deformity and "S" II/B epg deformity (2001). The scoliosis in II/A epg or II/B epg can be diagnosed at the age of 8 - 10 - 12 (Tab. I). The cause is the habit of permanent standing 'at ease' on the right leg for many years. Initially, it is the lateral physiological deviation, then fixed "C" left convex curve. In the development of the "S" II/B epg scoliosis there occurs additionally laxity of joints and / or harmful exercises (mentioned above). In some cases of II/B epg group we observe kypho (kifo) -scoliosis.

III-rd etiopathological group of scoliosis (2004) – scoliosis with little or no curvature (Tab. I). The cause is connected only with gait. In gait due to a restricted movement in the right hip, and a small movement in the left hip, a compensatory rotation movement in the spine is created. This compensatory movement makes, as mentioned above, a permanent distortion in the inter-vertebral joints which result in stiffness and rigidity of the whole spine. The stiffness of the spine can be observed in youth. However, nobody considered this to be scoliosis. These patients when adult often suffer from back pain.

The necessity of causal prophylaxis. The new classification clarifies the need for therapeutic approach to each etiopathological group of scoliosis and provides the possibility to introduce causative prophylaxis which is the theme of the next two lectures.

III. Conclusions

1. Last 39 years of Lublin observations confirmed the biomechanical aetiology of scoliosis.
2. There are three types and four groups of scoliosis connected with causative influence "standing on the right leg at ease" (treated as "standing") and with "walking" (gait).
3. There are following types of scoliosis: "S" scoliosis I epg, 3D. Causative influence: standing and gait, "C" scoliosis II/A epg, 1D. Causative influence: standing, "S" scoliosis II/B epg, 2D or mix. Causative influence: standing, plus laxity of joints and/or incorrect exercises in previous therapy, "I" scoliosis III epg, 2D or mix. Causative influence: gait.
4. Each type of scoliosis starts to develop in age of 2-3 years.
5. Both - the old tests (Adams & Meyer test) but also the new tests should be used for early screening. The new tests include: Lublin – "side bending test", checking for the habit of standing 'at ease' (right versus left leg), Ely Duncan test (or Thom or Staheli test), adduction of hips test (Ober test), and other (described in other article).
6. In the course of treatment and prophylaxis of spine the following should be introduced: stretching exercises, typical for karate, kung fu, taekwon-do, aiki-do, yoga. All these exercises prove be very beneficial for "mal position of body" and for scoliosis (described in other article).

Figures

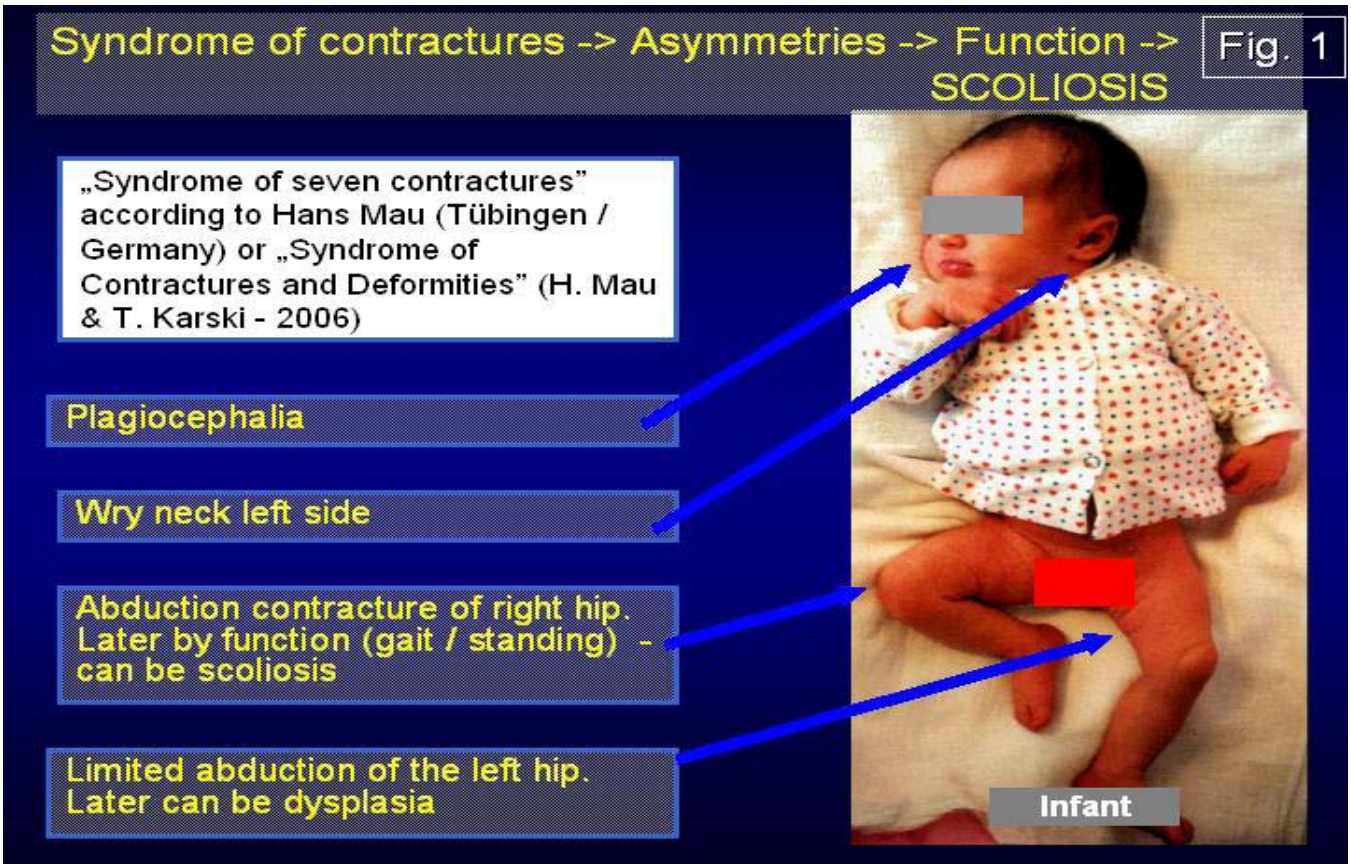


Figure 1 : Syndrome of contractures and deformities

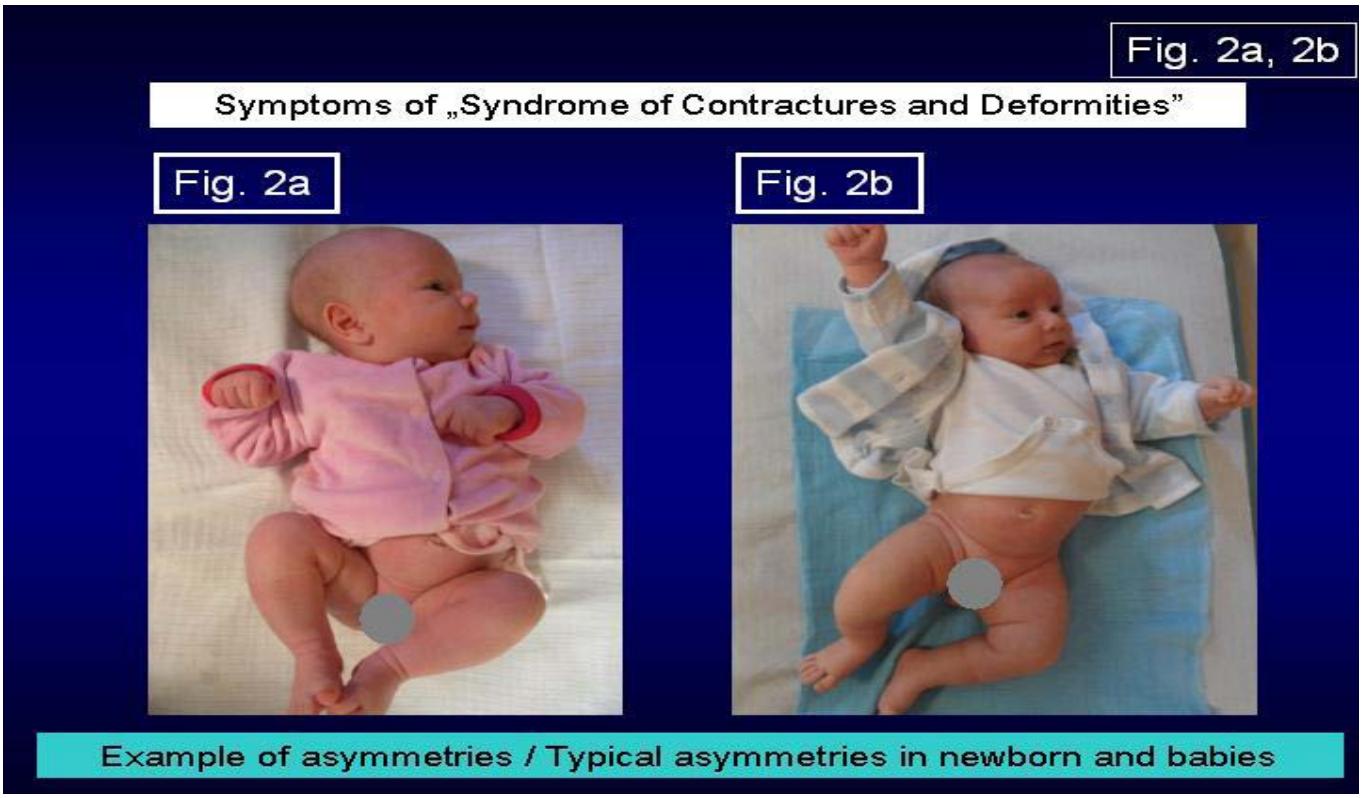


Figure 2a, 2b : Syndrome of contractures and deformities

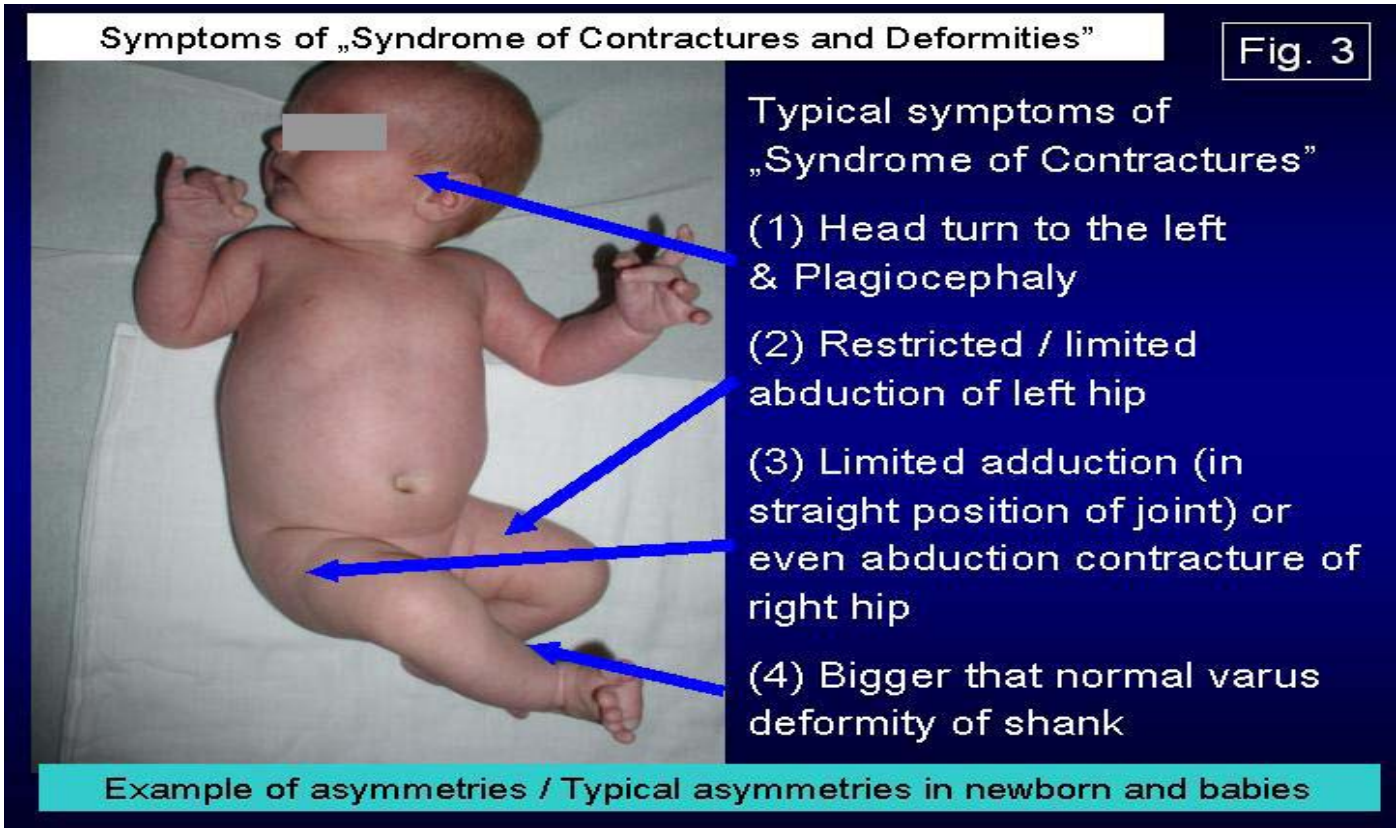


Figure 3 : Syndrome of contractures and deformities

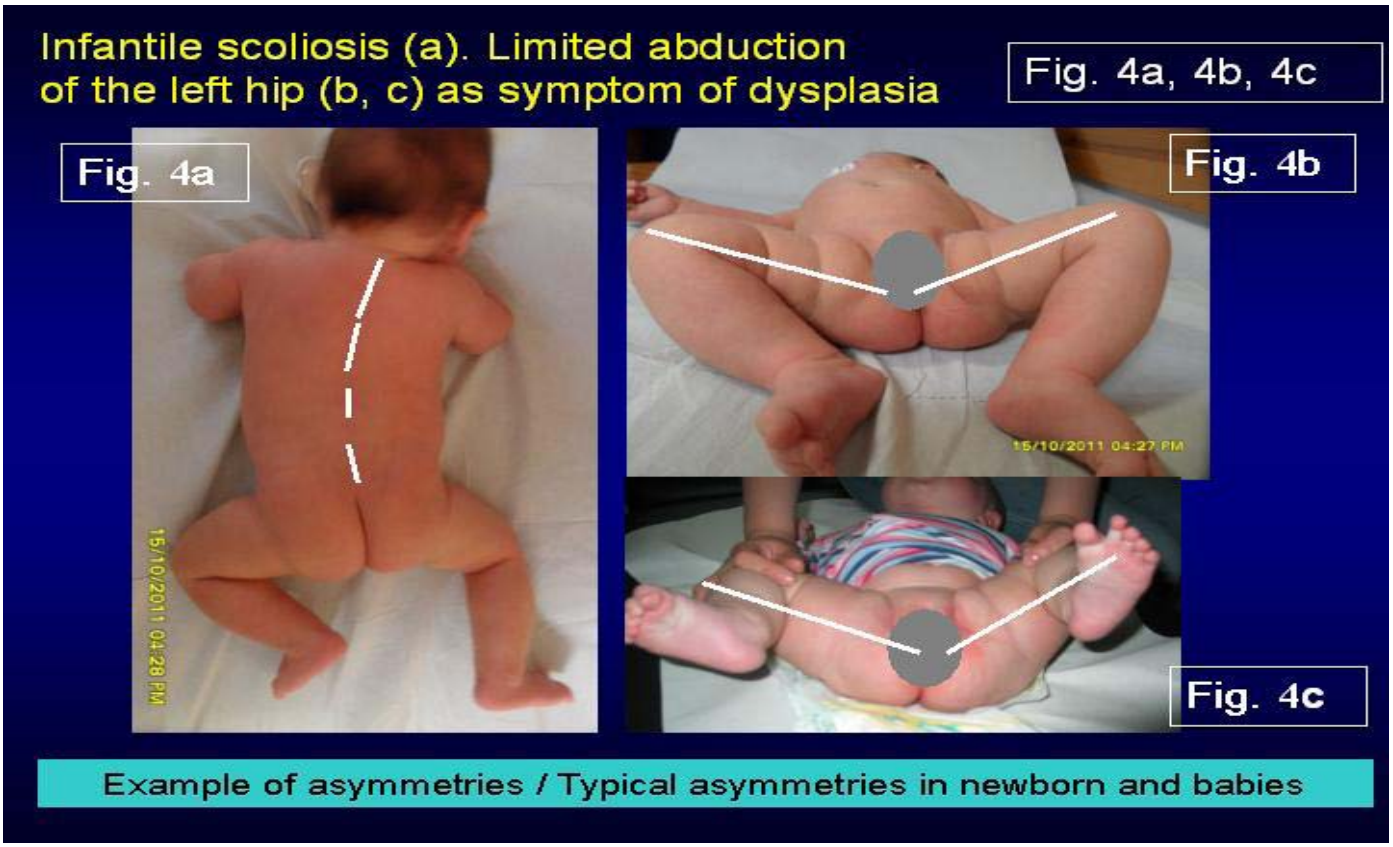


Figure 4a, 4b, 4c : Syndrome of contractures and deformities. Difference in abduction of hips. Smaller movement in left hip.

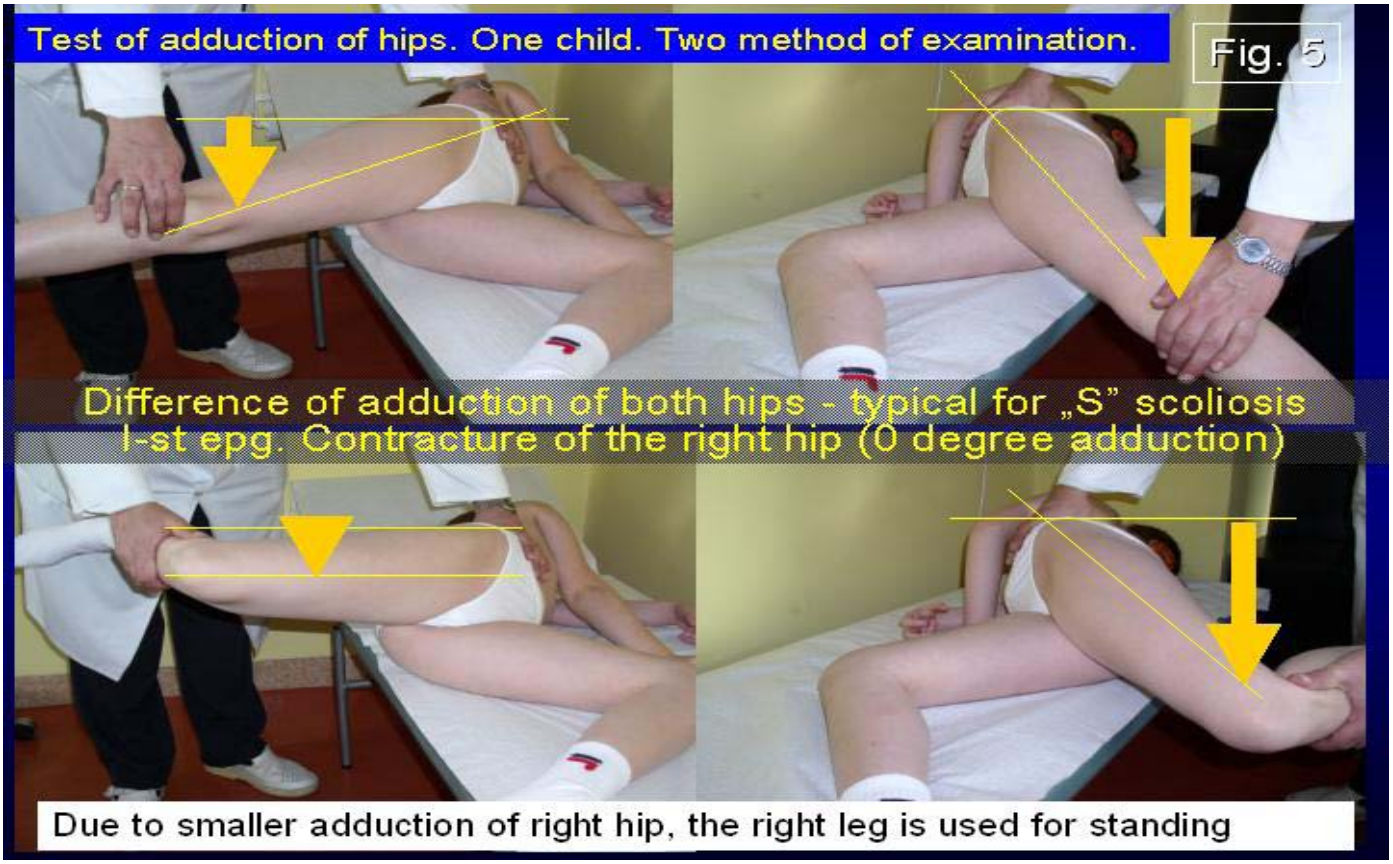


Figure 5 : Test to check the rage of adduction of hips in their extension position

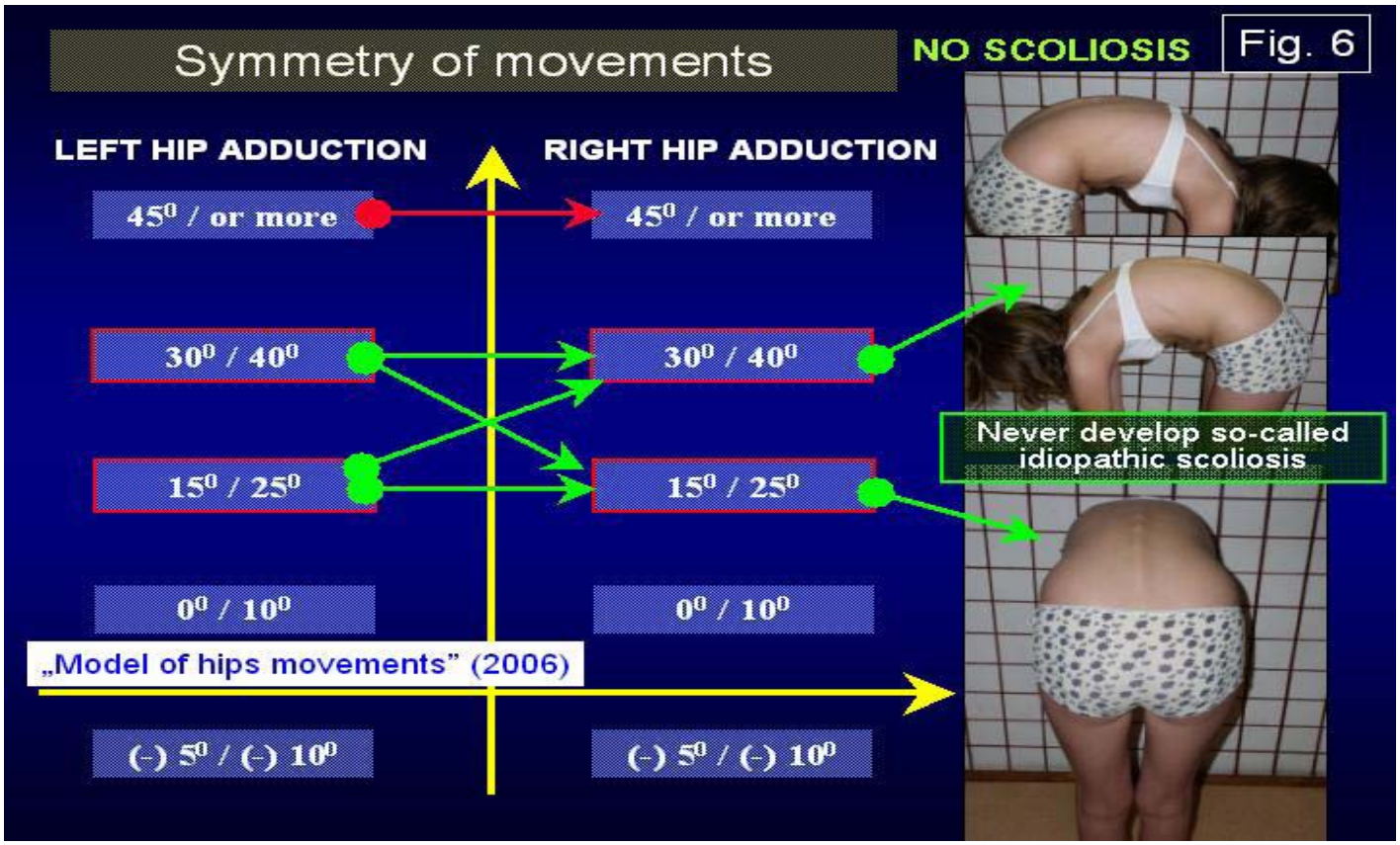


Figure 6 : Proper model of hips movement – healthy child, without spine deformity

Figure 7 : Example of a healthy child, without deformity

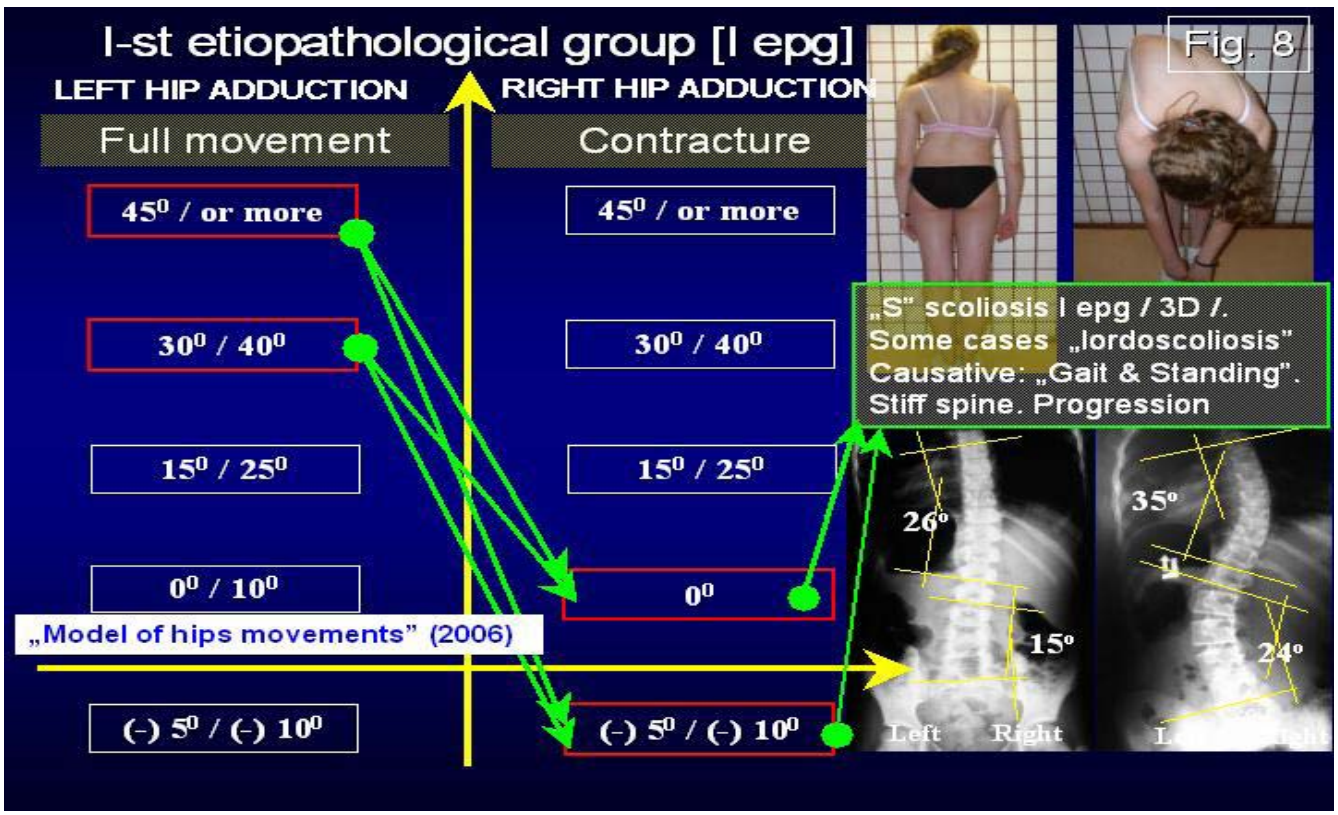


Figure 8 : „S" scoliosis in I epg (etiopathological group)

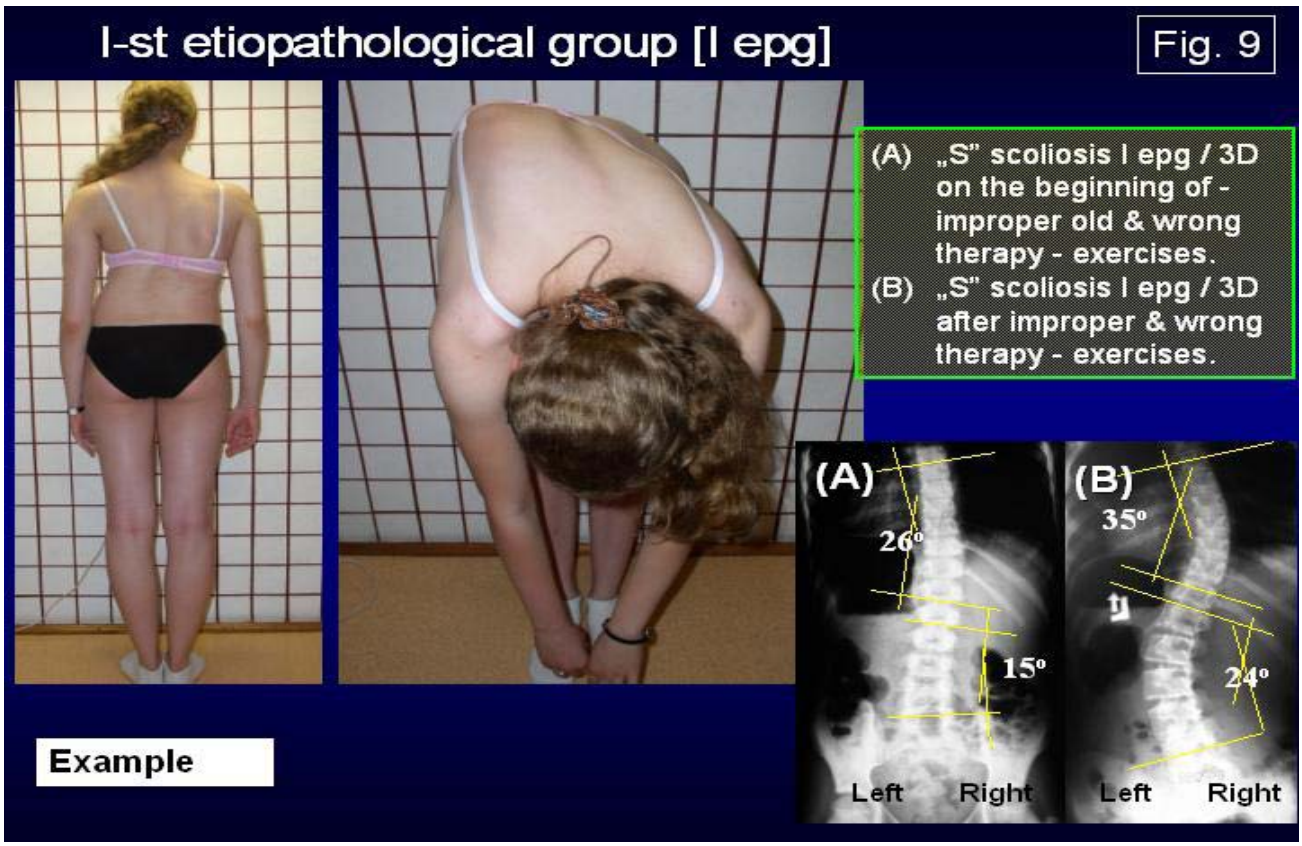


Figure 9 : Example of „S" scoliosis in I epg (etiopathological group) – before and after improper therapy (exercises)

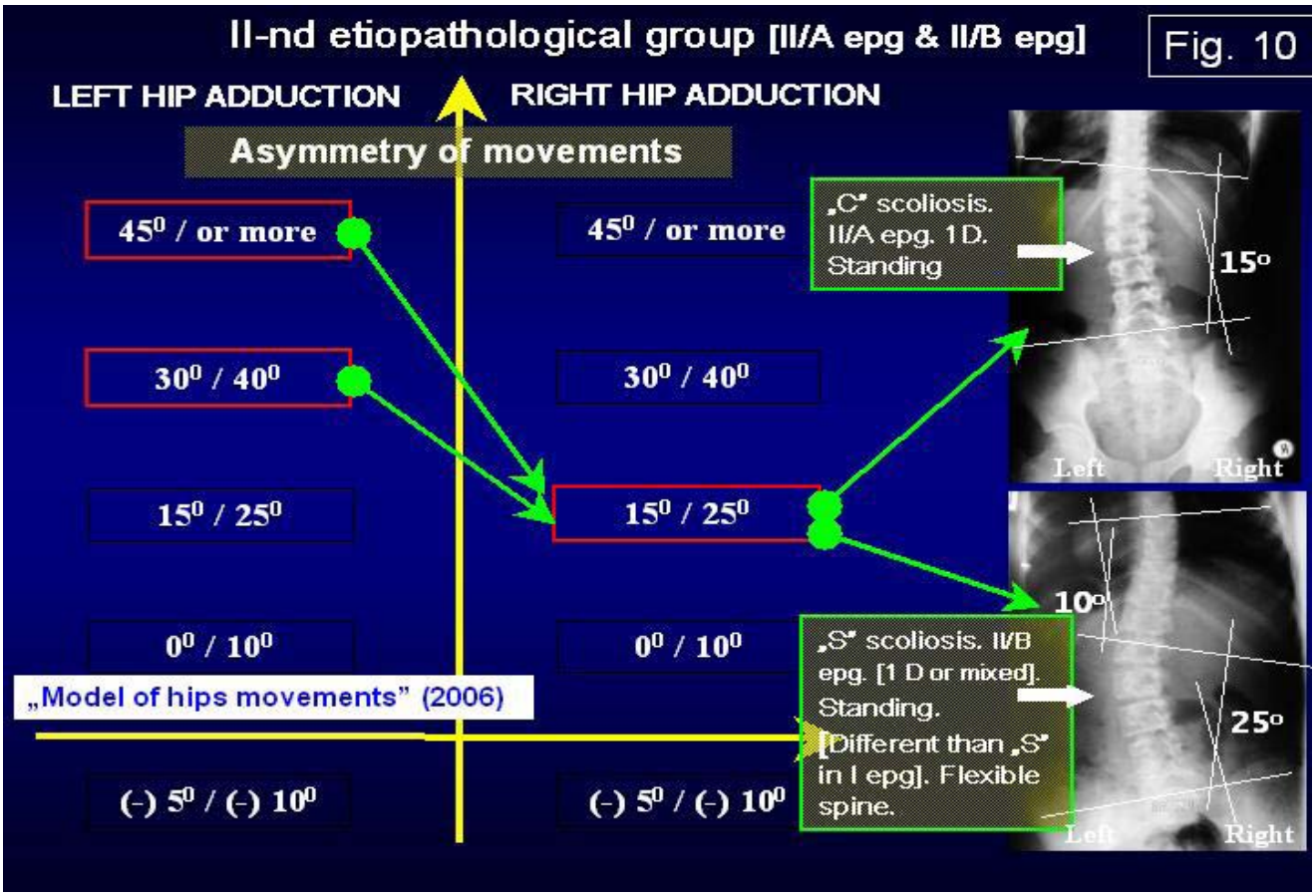


Figure 10 : "C" and "S" scoliosis in II/A epg and II/B epg

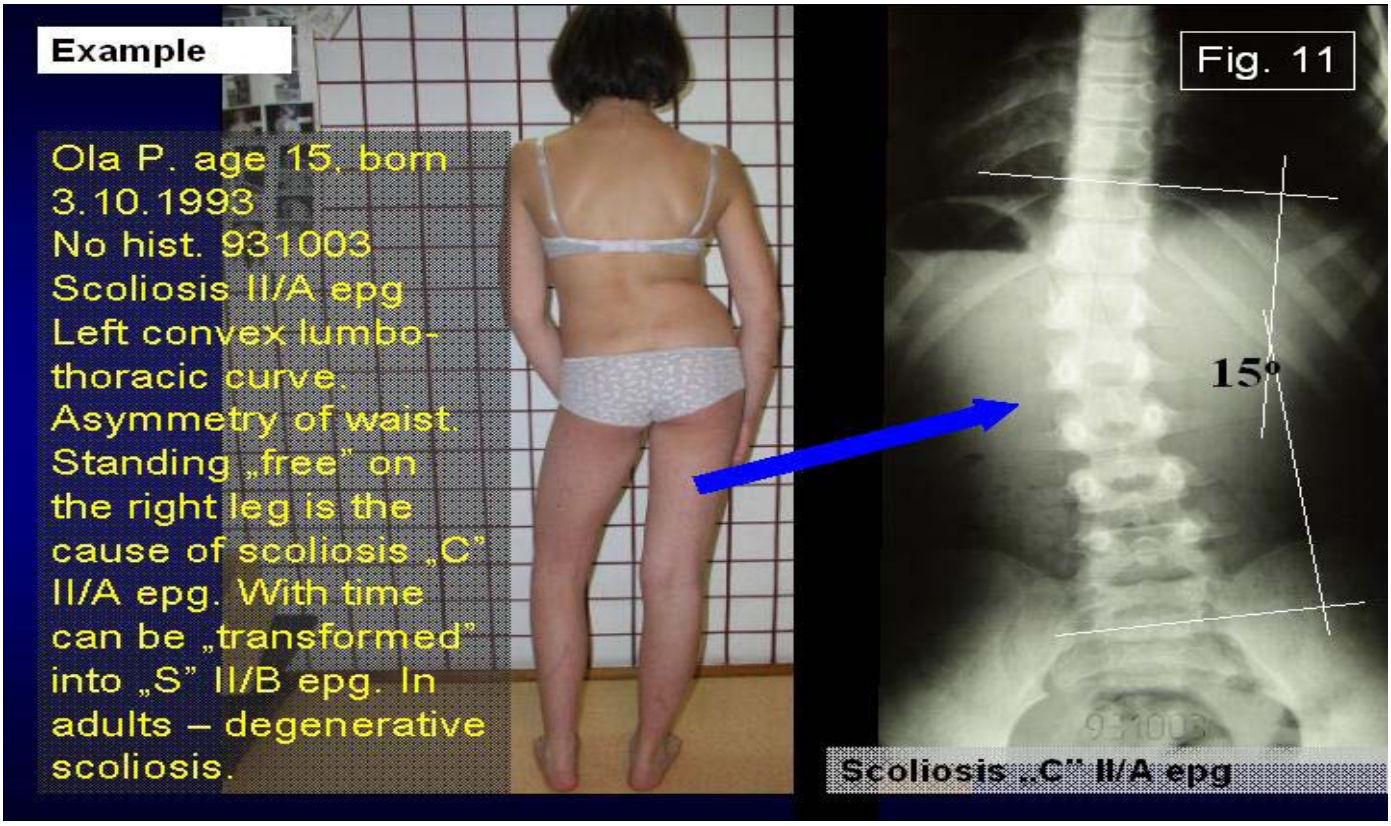


Figure 11 : Example of "C" scoliosis in II/A epg – standing 'at ease' on the right leg as causal influence for development of scoliosis

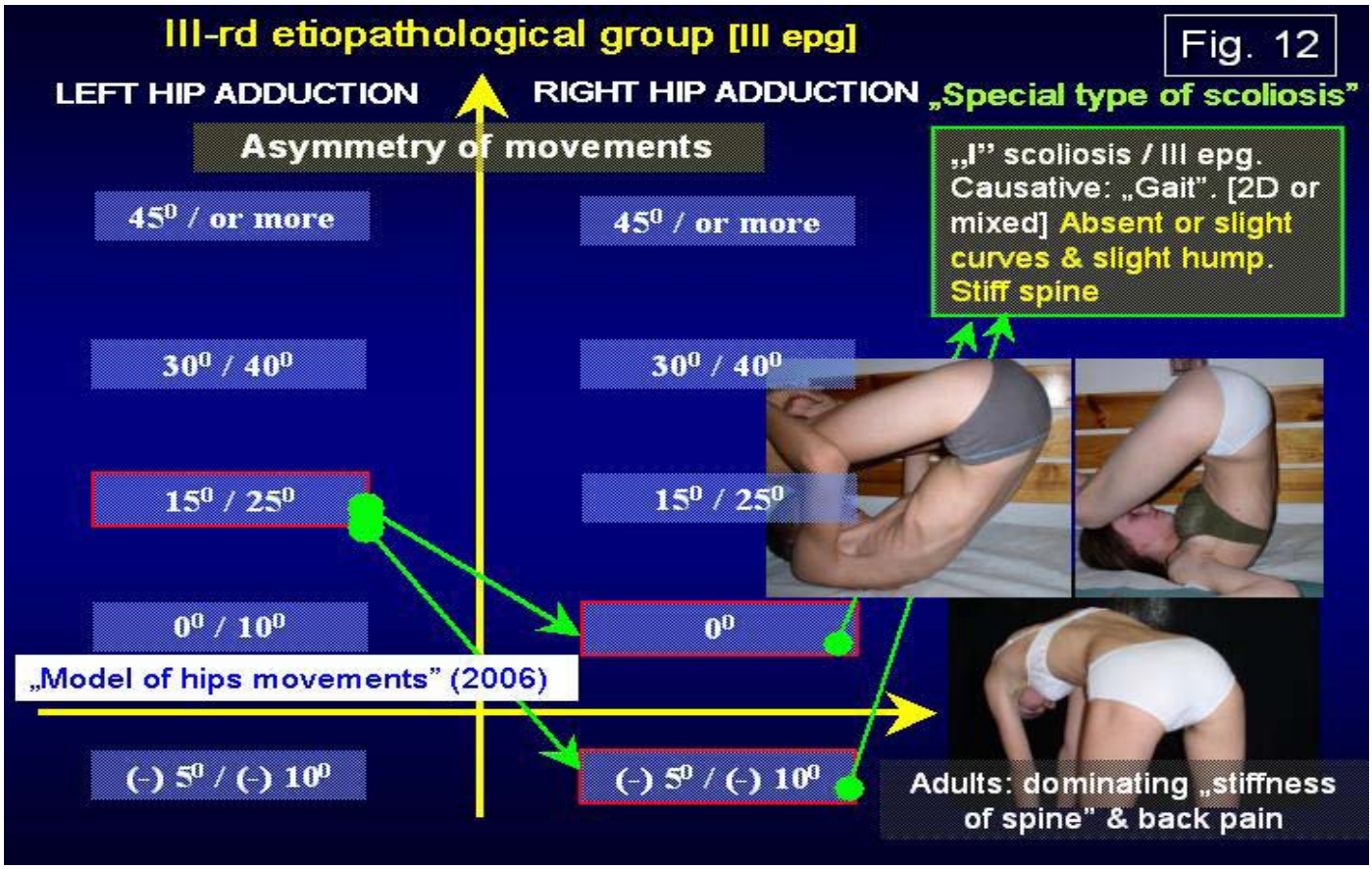


Figure 12 : "I" scoliosis in III epg

Figure 13 : Examples of "I" scoliosis. Stiff spine as a sign of spine deformity

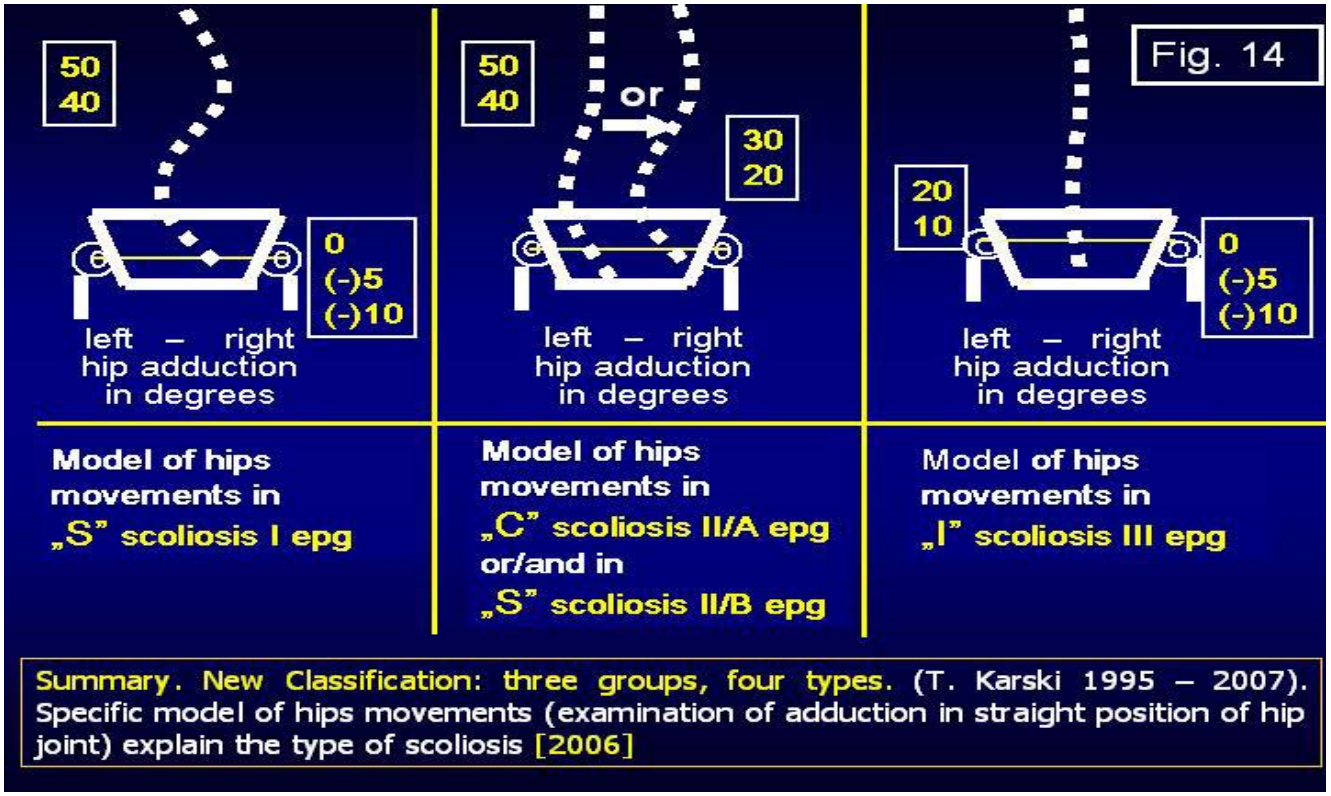


Figure 14 : Summary of new classification (T. Karski 1995 – 2007). Specific model of hips movements (examination of adduction in straight position of hip joint) and type of scoliosis [2006]

Tab. I Model of hips movement (T. Karski – 2006) and type of scoliosis

IV. Literature (Alphabetic)

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Significance of Anatomy in Recognizing Trauma with a Rare Case of Trauma with More than 75 Pellet Injuries

By Dr. Ashfaq ul Hassan, Dr. Rohul Afza & Dr. Zahida Rasool
SKIMS Medical College Bemina, India

Abstract- Blast and Pellet injuries are a modern nuisance. The increasing use of more destructive methods of damage infliction are on the rise and especially in more violent parts of the world are a cause of significant morbidity and mortality. The injuries can range from being simple or localized to more extensive multi system injuries. As such a proper assessment and proper management of the peleet injuries is a must and a judicious manner of managing these injuries should be managed. This Young patient had more than 75 pellet injuries after a blast. A thorough check up was conducted to look for injuries near vital structures and amazingly all vital structures were unaffected. The patient was monitored and discharged after a few days. The article deals with knowing the more important Anatomico surgical concepts involved in assessment of trauma in various regions of the body.

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I. Introduction

As the blast injuries are deliberately devised to inflict maximum damage, these injuries often occur in crowded places like markets and the range of people effected varies greatly as regards age, sex, number of people injured .We present a case of an young individual who received more than 75 pellet injuries that were scattered throughout the body. Most of the pellets were received on the right upper limb with a few in chest, abdomen and pelvis. The neck fortunately had pellets in safe areas .This was one rare case of trauma in which so many pellets were received by a single patient. In this patient the vitals were Normal. Neurological examination was normal as was Orthopaedic examination with evidence of bleeding from multiple sites on the body which was taken care of during the initial assessment. However there was no serious source of bleeding. Examination Investigations revealed:

Temp: 98.60F
BP: 126/78
RR: 12/Min
Pulse 82 bpm
HB: 11.7 gm/dl
WBC : 7200 / microlitre
Platelets : 2,80,000/microlitre (n 150000-400,000)
Sodium: 144meq/L (n 135-145)
Potassium : 4 meq/L(n 3.5-5)

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II. Discussion

Trauma in Kashmir valley has taken a toll. Many people have died, some have got lifelong disabilities and some are incapacitated. Neck: The area of the neck is especially Important as this area is unprotected by bone or dense muscular covering. The most significant neck injuries result from penetrating trauma, blunt neck trauma does occur and can be particularly difficult to manage because it often involves the airway, the first priority in trauma care. Fatality rates for penetrating neck trauma range up to 50% for rifle or shotgun blasts.

The neck is divided into a number of anatomic triangles. Two large triangles are important in discussing penetrating neck trauma. Penetrating wounds that enter through the sternocleidomastoid muscle or anterior triangle carry a high likelihood of significant vascular, airway, or esophageal injury. In contrast, wounds to the posterior triangle rarely involve the esophagus, airway, or major vascular structures, but, if directed inferiorly, intrathoracic injury can occur.

The boundaries of Anterior triangle of neck
Anterior: anterior median line of neck
Posterior: anterior border of sternomastoid
Base: base of mandible and a line joining angle of mandible to mastoid process.
Apex: manubrium sterni.
The subdivisions of Anterior triangle
Submental
Digastrics
Carotid and
Muscular triangle.
The boundaries of Digastric triangle
Anteroinferiorly: anterior belly of digastrics
Posteroinferiorly: posterior belly of digastrics stylohyoid.
Base: base of mandible and a line joining angle of mandible to mastoid process.
Roof : skin
Superficial facia: has platysma and cervical branch of facial nerve.
Deep fascia: splits to enclose submandibular gland.
Floor: mylohyoid, Hyoglossus and Middle constrictor

muscle.The anterior neck is further divided into three zones defined by horizontal planes

Zone I: It represents the base of the neck and thoracic outlet. Injuries here carry the highest mortality because of the risk of major vascular and intrathoracic injury.

Zone II: It represents the largest portion or midbody of the neck. Because of its relative size, Zone II injuries are most common but carry the lowest mortality. Significant injury is generally apparent, and exposure of vital structures is readily accomplished.

Zone III : It is the part of the neck above the angle of the mandible. The risk of injury to the distal carotid artery, salivary glands, and pharynx is greatest in this zone, and exposure can be particularly difficult.

III. Thorax

The life threatening injuries incurred in penetrating trauma are distinctly different from those of blunt injuries. Penetrating thoracic injuries (e.g., stab wounds, gunshot wounds, and impalement on a foreign body) primarily injure the peripheral lung, producing both a hemothorax and pneumothorax. More than 80% of all penetrating chest wounds cause a hemothorax, and nearly all cause a pneumothorax. The Penetrating injuries that enter or traverse the mediastinum must also be evaluated for potential cardiac, great vessel, or esophageal injury. Hemodynamically unstable patients with mediastinal entering or traversing wounds should be considered to have exsanguinating thoracic hemorrhage, pericardial tamponade, or tension pneumothorax. Hypovolemia from intrathoracic hemorrhage is second only to rib fractures as a sequel of thoracic trauma.

Penetrating injuries resulting in direct cardiac injury and pericardial tamponade can rapidly compromise cardiac function.

IV. The Abdomen

Is the third most commonly injured body region. Abdominal injuries can be particularly challenging, because it is often difficult to assess intra-abdominal pathology in the multiple-injured victim. Blunt trauma continues to be the most common mechanism of injury to the abdomen.

Abdomen is divided into nine regions by:

- Two vertical planes: right and left lateral planes. Passing from midinguinal point and crossing tip of ninth costal cartilage (mid-clavicular lines)
- Two horizontal planes:

1. Subcostal plane: passes through lower border of 10th costal cartilage and near upper border of body of L3.
2. Transpyloric plane: can be used instead of subcostal plane. Passes through tip of ninth costal cartilage and lower border of L1.
3. Transtubercular plane: passes through tubercles of iliac crest and body of L5 vertebra near upper border.

The nine regions of abdomen

- Upper:

1. Right hypochondrium
2. left epigastriumhypochondrium
3. Epigastrium

- Middle:

1. Right lumbar
2. Left lumbar
3. Umbilical

- Lower:

1. Left iliac
2. Right Iliac
3. Hypogastrium.

Stomach: It lies obliquely in upper and left part of abdomen, occupying epigastric, umbilical and left hypochondriac region. Most full-thickness gastric injury is due to penetrating trauma. Gastric rupture secondary to blunt trauma is rare . If vomitus or gastric aspirate is bloody, an injury to the stomach should be suspected. However, it is not unusual for small amounts of blood to be found in the gastric aspirate, even though laparotomy reveals no grossly apparent lesion.

Duodenum: The position of duodenum: Duodenum lies above the level of umbilicus against L1-3 vertebrae, extending ½ inch to right and 01 inch to left of median plane. The length of duodenum and its different parts Duodenum is a 10 inch long, curved around the head of the pancreas in form of C. Approximately three fourths of duodenal injuries result from penetrating trauma, and one fourth are from blunt injuries. Penetrating injuries are usually readily diagnosed at operation, but the insidious nature of many blunt duodenal injuries makes the initial diagnosis difficult.

In addition to maintaining a high index of suspicion in patients with appropriate injury mechanism, a serum amylase level should be initially obtained and if elevated, repeated at 6-hour intervals in patients with blunt abdominal trauma. The radiologic signs of duodenal injury on the initial plain abdominal or upright chest radiograph are subtle, showing only mild scoliosis, obliteration of the right psoas muscle, or retroperitoneal air that is difficult to distinguish from the overlying transverse colon.

Pancreas: Pancreatic trauma is relatively uncommon, accounting for less than 10% of all abdominal injuries. Although the pancreas is relatively protected in the retroperitoneum, the increasing frequency of large-caliber, high-velocity civilian gunshot wounds contribute to an increasing incidence of pancreatic injury. Because the pancreas is surrounded by major abdominal organs and blood vessels, associated injuries are common.

Liver and biliary tree: Liver. The liver is the most commonly injured organ following penetrating trauma and the second most commonly injured organ following blunt trauma. Fortunately, the injury is often minor and easily managed. When the liver is the only organ injured, half the lacerations are nonbleeding and do not require suture. In most lacerations that are bleeding, the source is within the substance of the liver, and control can be obtained by direct ligation. With deeper lacerations, bleeding may initially be so significant as to prevent adequate exposure. Under these conditions, the next maneuver is that of inflow occlusion (Pringle maneuver).

Porta Hepatis: It is a deep transverse fissure, 05 cm long, on the inferior surface of right lobe of liver, between quadrate lobe below and front and caudate lobe above. Through it vessels, nerves and ducts pass to and from liver Isolated penetrating or blunt injuries to the porta hepatis are uncommon. Unless there are associated injuries to the aorta and inferior vena cava (which take priority) noted at laparotomy, an immediate Pringle maneuver frequently allows isolation of the structures in the porta hepatis and determination of whether the injury involves the portal vein, hepatic arteries, or common bile duct. Repair of vascular injuries takes precedence over biliary structures. Injuries to the portal vein have a high mortality rate. The portal vein supplies 80% of the total hepatic blood flow and 50% of the oxygen delivery.

Gallbladder: injury to this organ has been reported to occur after both penetrating and blunt trauma. Cholecystectomy is the procedure of choice for severe contusion, avulsion, or perforating injuries to the gallbladder.

Spleen: The spleen lies obliquely along the long axis of 10th rib. It lies mainly in left hypochondrium but the posterior end extends into epigastrium. It is directed downwards, forwards and laterally.

The spleen is the most commonly injured intra-abdominal organ. Splenic injury must therefore be suspected in any patient with blunt abdominal trauma, particularly if associated with left lower rib fractures. The diagnosis is often suspected on physical examination but is generally confirmed by abdominal CT scan or exploratory celiotomy for hemoperitoneum.

Colon: The colon is second only to the small bowel in frequency of abdominal organs injured from gunshot wounds, and third (liver, small bowel) following abdominal stab wounds. Gunshot wounds to the abdomen generally require exploratory laparotomy.

Kidneys: Penetrating injury to the kidney may be secondary to a gunshot. Parenchymal injury caused by a low-velocity weapon is usually not life threatening and is generally easily treated with débridement and primary repair of the kidney with dependent drainage. High-velocity bullet wounds are different. Many nephrectomies and partial nephrectomies are performed in patients with high-velocity penetrating injury because of inability to control hemorrhage and accurately define the extent of the injury.

V. Conclusion

It can be safely concluded that the proper knowledge of Anatomy is important for first recognizing the injuries especially be pellets or blasts. The perfect knowledge of Anatomy is helpful in management as well. As such a surgeon or a trauma orthopedic surgeon should be well aware of the important anatomic relations in the neck, thorax and abdomen.

Figure 1 : Pellet Injuries in Limbs, Neck, Thorax and Abdomen

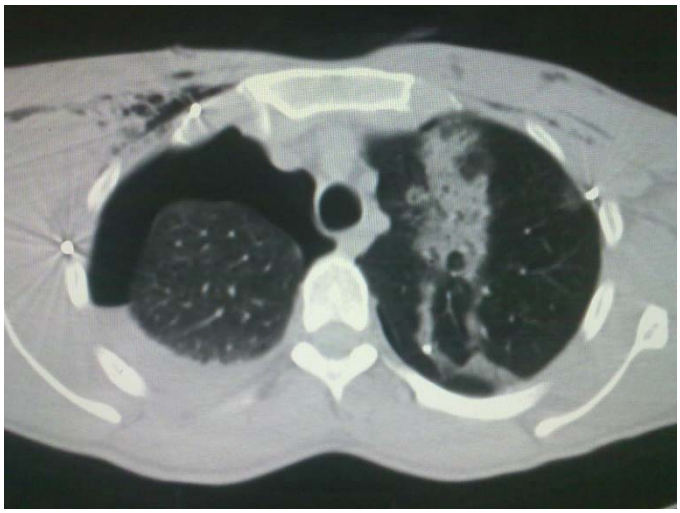

Figure 2 : Pellet Injuries in Lungs

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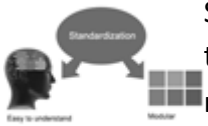

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Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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