

How to recognise and reduce asymmetric loads in gymnastics

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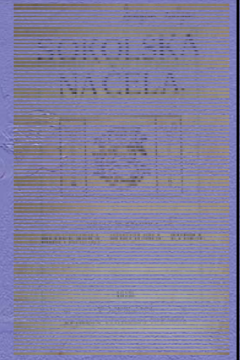
Why I became interested into symmetries?

Sokol is Slovenian past gymnastics club

In small booklet from 1919 Sokol meeting they wrote:

'We will work only on symmetric activities, however those sports which are asymmetric it will not be denied but not supported.'

Supported sports besides gymnastics:
swimming, rowing, skating, skiing, hiking



Definition of symmetry:

Symmetry is state of being symmetrical

Definition of symmetrical

If something is symmetrical, it has two halves which are exactly the same, except that one half is the mirror image of the other

(Collins Cobuild English Language Dictionary, 1988)

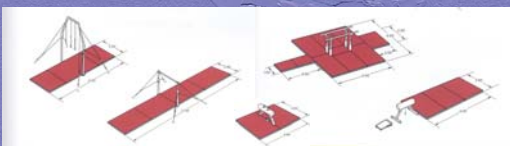
Gymnast activity can be described with two positions:

- Support position - contact with
 - apparatus
 - mats
 - methodical aids
 - coach
- Airborn position

FIG Rules have impact on symmetry.

Apparatus form design is by FIG norms symmetrical

With gymnast's position apparatus physical characteristics are not symmetric anymore.



COP (2013):

MAG, WAG : no words on symmetries

RG: 1.3.1 - Technical groups The asymmetric movements of 2 Clubs must be different in their shape or amplitude and in the work planes or direction; Throws or catches of 2 Clubs, simultaneous

[] Throw of 2 Clubs, asymmetric; Lack of precision in the workplanes of the clubs during asymmetric movements; 2.2.1. Right/ Left hand work (50% of the apparatus movements) Should be evenly distributed in the exercise; Lack of balance between Right/Left hand work; - No penalties

TRA, ACRO: no words on symmetries

AER: 2. Aerobic content - Complex AMP support asymmetric moves, use of symmetric and asymmetric moves, no deductions for asymmetries in load, No penalties

Lets analyze following exercises:




Count contacts with
Left hand, Both hands,
Right hand

Proportion between right/left/both hand ball manipulation

Category	Number	Time
Both	12	45.23
Left	10	11.35
Right	2	5.07

Lets analyze following exercises:




Count take off and landings for jumps and leaps,
Left leg, Both legs, Right leg

Frequency of loaded legs

Category	Left leg	Both legs	Right leg
Take off	4	3	2
Landing	4	5	3
Sum	8	8	5

Support time on left, both and right arm




Support time

Category	Support time
Left	10
Both	15
Right	8
Distorted	4

Other asymmetries found in different activities and its impact

Running (Čuk, Karacsony, 2004)



Change of velocity during approach - men-table (WC, Debrecen (HUN), 2002)

Step number	Trakler (Austria)	Trakler (Slovenia)	Trakler (Croatia)	Trakler (Hungary)	Trakler (Serbia)	Trakler (Czech Republic)	Trakler (Slovakia)	Trakler (Slovenia)	Trakler (Croatia)	Trakler (Hungary)	Trakler (Serbia)	Trakler (Czech Republic)	Trakler (Slovakia)
1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
3	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
4	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
5	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
6	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
7	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
8	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
9	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
10	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
11	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
12	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
13	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
14	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0

Data obtained with 3D kinematic analysis


Bricej, Dolenc, Bučar, Turšič, Čuk and Čoh, Sarajevo 2007

Velocity variability - gymnast #3


Velocity variability - gymnast #2

Russian gymnast

Unpublished measurements 2007



Landing (Marinšek, Ph.D. Thesis, 2011)



Exercise composition (Marinšek & Čuk, Biology of Sport, 2009)

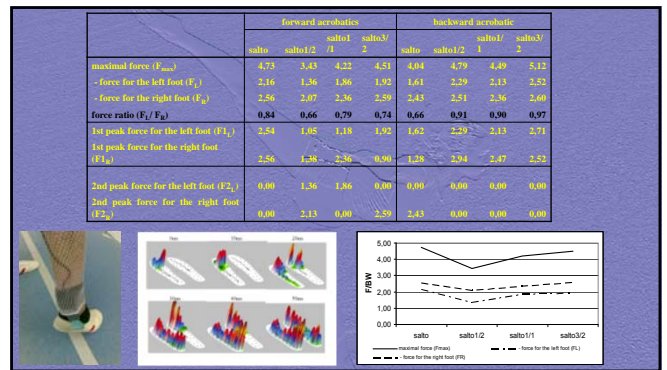
	number of somersaults	% of individual somersaults (N = 344)
Forward somersaults	171	49.7%
- without turns	85	24.7%
- with turns	86	25.0%
Backward somersaults	101	29.4%
- without turns	24	7.0%
- with turns	77	22.4%
Side and »arabiane« somersaults	72	20.9%
- side somersaults	22	6.4%
- »arabiane« somersaults	50	14.5%
Total	344	100.0%

Exercise execution

	Number of somersaults	% of individual somersaults (N = 344)
Feet together	164	47.7%
Feet apart (< than shoulder width)	151	43.9%
Feet wide apart (>than shoulder width)	25	7.3%
Support of the arm	4	1.1%
Total	344	100.0%

	f	f %
Somersaults without a mistake in landing	103	29.9%
Somersaults with mistakes in landing	241	70.1%
Total	344	100.0%

NUMBER OF TURNS LONGITUDINAL AXIS	SOMERSAULTS WITH MISTAKES				Number of mistakes (% of structure group)
	Small	Medium	Large	Fall	
Without turns	44	25		7	76 (88.5%)
% within the number of turns	57.9%	32.9%		9.2%	100.0%
% Within the somersaults with mistakes	28.8%	32.5%		70.0%	31.1%
1/2 (180°)	25	8			33 (66.0%)
% within the number of turns	75.8%	24.2%			100.0%
% within the somersault with mistake	16.6%	10.5%			13.7%
1/1 (360°)	28	17		1	46 (89.7%)
% within the number of turns	60.9%	37.0%		2.2%	100.0%
% within the somersault with mistake	18.5%	22.4%		10.0%	19.1%
3/2 (540°)	23	10		2	35 (66.3%)
% within the number of turns	65.7%	28.6%		5.7%	100.0%
% within the somersault with mistake	15.2%	13.2%		20.0%	14.5%
2/1 (720°)	30	13	3		46 (88.5%)
% within the number of turns	65.2%	28.3%	6.5%		100.0%
% within the somersault with mistake	19.6%	16.9%	75.0%		18.9%
5/2 (900°)	1	3	1		5 (100.0%)
% within the number of turns	20.0%	60.0%	20.0%		100.0%
% within the somersault with mistake	.7%	3.9%	25.0%		2.0%
Total	151	76	4	10	241 (70.1%)
% within the number of turns	62.7%	31.5%	1.7%	4.1%	100.0%



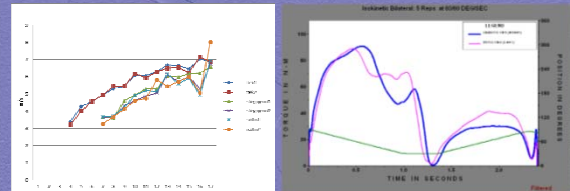
Competitive success (Čuk, Marinšek, Biology of Sport, 2013)

Step	R(uncorrected)	R_Square	Sig. t_Change
1	.503	.253	.000
2	.631	.398	.000
3	.679	.461	.002
4	.702	.493	.020
5	.718	.515	.045


	Standardized Coefficients	t	Sig.
(Constant)	Beta	5.094	.000
Diff. in vert. hips velocity in lowest position	.349	4.330	.000
Vert. velocity of leading hip at first contact	.233	2.749	.007
Diff. in ankle angle in lowest position	.214	2.546	.013
Knee angle change non leading leg	-.219	-2.791	.006
Diff. in knee angle in first contact	.170	2.032	.045



Motor abilities (unpublished control measurements 2012 and 2013)

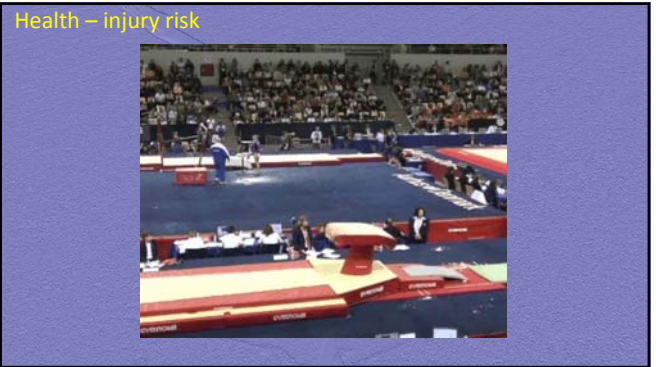


Morphologic characteristics, Čuk, Bučar Pajek, Pajek, Jakše, Peček, International Journal of Morphology, 2011



Variable	X	SD	Max	Min
Age (years)	23.40		30	17
Body height (cm)	168.08	6.25	185.50	157.40
Body weight (kg)	66.45	8.15	84.80	51.90

	LEFT Mean	St.Deviation	RIGHT Mean	St.Deviation	t	Sig.
Wrist diameter (cm)	6.04	0.35	6.08	0.37	-1.706	.096
Elbow diameter (cm)	6.79	0.41	6.86	0.43	-2.808	.008*
Knee diameter (cm)	8.79	0.54	8.78	0.54	.333	.741
Ankle diameter (cm)	6.94	0.59	6.90	0.65	1.397	.170
Circumference of thigh (cm)	54.07	2.84	54.02	2.85	-0.40	.526
Circumference of calf (cm)	35.50	1.87	35.55	1.88	-0.39	.736
Circumference of forearm (cm)	27.78	1.49	28.09	1.53	-3.069	.004*
Circumference of relaxed upper arm (cm)	33.15	2.12	33.26	2.30	-0.96	.376
Skinfold thickness of thigh - ventral (mm)	7.22	2.04	7.03	1.74	1.143	.260
Skinfold thickness of calf (mm)	5.01	1.31	4.88	1.27	1.261	.215
Skinfold thickness of biceps brachii (mm)	3.26	0.51	3.10	0.45	2.050	.047*
Skinfold thickness of triceps brachii (mm)	4.63	1.03	4.94	1.19	-3.407	.002*
Skinfold thickness of forearm - volar (mm)	3.40	0.72	3.43	0.69	-0.483	.632



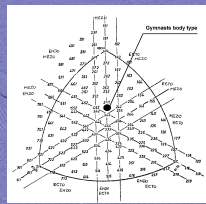
influence competition success



influence motor abilities (strength, force production)



influence morphologic characteristics



influence technical mastery



influence health status - avoid injuries



load plan, training and control should be in accordance with symmetry



Dr. Viktor Malozki, Professor Mihailo Krizanovic, Assistant Ranko Djordjevic, 1973

