Volume 1 No.4 **Rowing Biomechanics Newsletter** *April 2001*

News

☺ Three training camps were conducted on AIS facilities in Canberra during March 2001. 12 big boats and 56 athletes were tested. A new test protocol, which explores rowing power and technique under fatigue of 1800m race, was introduced.

☺ On April 5 and 12 AIS biomechanist Dr. Valery Kleshnev gave two presentation for AIS coaches and scientists titled "Rowing Biomechanics Developments: Three Years Review". More than 30 people attended the presentations and gave positive feedback.

Facts. Did You Know That…

✓ …longer Distance-Per-Stroke is more preferable for increasing of boat speed than higher Stroke Rate, especially in sculling. In Sydney Olympic Games six gold medals were won using longer DPS (W1x, M2x, W2x, M2x, LM2x, W4x) and three by means of higher SR (W2-, M2-, LM4-).

✓ …blade propulsive efficiency has highest values at the catch and finish of the drive. Slow blade insert into the water and "washing-out" at finish do not allow apply force at these parts of the drive and decrease propulsive efficiency of the blade;

✓ …footstretcher force is approximately 30% higher than handle force during on-water rowing, whilst they are nearly equal on ergos. This means that rowers receive relatively higher workload on legs and lower body on water and, vice-versa, arms and upper body are heavier loaded on ergos. This is true for any existing ergometers types (Concept-II, Row-Perfect, etc.);

Ideas. What if…

? …you used speed drills in rowing more extensively? Two sorts of drills are widely used in many sports: the first one emphasizes force application and the second one utilizes higher speed. Examples are: up-hill and downhill running, throwing a heavier and lighter discus, javelin, hammer, etc., swimming with water break and with dragging device. In rowing only the first type of drill is widely used: rowing by seats and with water break. It is not expensive to find 80-100m rope with 3-5m elastic part in it. A motorboat is not a problem either. Rowing in small boats with higher speed can improve technique when rowers move to bigger boats.

? …you predict of your current racing result without applying additional stress pressure on rowers? Also, would you like to know stroke rate and boat speed in different training zones more accurately? If the answer is "Yes", why don't you try "Progressive SR" test? The test consists of five-six 250-500m pieces with increasing SR (ex.: 20, 24, 28, 32, 36, 40), maximal force application and unlimited rest periods. You should take the time of each piece, count the number of strokes and then input the data into a simple computer program. The program automatically calculates your prognostic race speed and SR/DPS in different training zones.

Recent Developments

💻 A new software program was developed to meet requirements of the new biomechanical testing protocol with 1800m race. The problem was that the rowing course is not marked at all desired points (100, 300, 550, 850, 1050, 1300 and 1550m). The program calculates required distance from the boat speed sensor and automatically takes split times, average power and other biomechanical parameters for each rower during required sampling periods.

Contact Us:

✉ *Dr. Valery Kleshnev*
AIS/SSSM/Biomechanics
POBox 176, Belconnen, ACT, 2616,Australia
tel. (w) 02 6214 1659, (m) 0401 017 642
fax: 02 6214 1593
e-mail: kleshnevv@ausport.gov.au

Volume 1 No.5 **Rowing Biomechanics Newsletter** *May 2001*

News

☺ A training camp was conducted on AIS facilities in Canberra on May 7-11. Six boats and 18 athletes were tested. The average value of the power in a group of 12 female rowers and scullers was 238.6±17.9W over an 1800m race. The highest power over the race (265.6W) was measured in a double bow, stroke seat in LW4x was the second (259.8W) and stroke seat in W2x had the third score (251.2W).

😐 There were problems with the telemetry system during the training camp. Both transmitter and receiver failed due to unknown reason that delayed testing for one day.

Facts. Did You Know That…

✓ … even distribution of the boat speed during the race is not a common pattern and should not be a target for racers (1). In Sydney Olympic Games medal winners were 2.4% faster at the first 500m than their average speed for the whole race, 1.2-1.3% slower at the second and the third sections and 0.2% faster at the last one;

✓ …bend of the oar shaft could achieve up to 10 degrees at the point of maximal force application (our unpublished data). The shaft works as a spring and accumulates up to 25% of rower's power over the first 15-20cm of the drive. It is important to use this power at the end of the drive by means of maintaining blade depth and force application.

Ideas. What if…

? …you use imitation of cross-country skiing . (roller-blading with poles) as an out-of-water aerobic exercise? It is a well-known fact that cross-country skiers have the highest values of VO_{2max}. (2). Compared to usual rowers' aerobic drills (cycling and running), skiing imitation uses trunk and upper extremities muscles, which are very handy in rowing. It is one of a few exercises that use abdominal muscles in aerobic mode that can prevent rib fractures. Plus, it is much safer than cycling. Beautiful bicycle roads in Canberra and other Australian cities gives you a great opportunity to use this exercise;

? …you use "power strokes" more selectively. These drills with a water brake and "by seats" looks very similar because they both emphasize force application. However, their biomechanical structure is very different. Use drills with the brake to emphasize the first part of the drive because additional resistance significantly decreases boat speed during recovery phase and makes force application after catch more comfortable. Boat speed fluctuation here is higher than in normal rowing. Rowing "by seats" makes the second half of the drive harder because bigger passive mass of the boat decreases its acceleration, but in the same way it prevents deceleration during recovery and makes boat speed fluctuation lower than normal. Use rowing "by seats" or with additional weight (in singles) for drive finish improvement.

References

🕮 1. Kleshnev V. 2001.Racing strategy in Rowing during Sydney Olympics. Australian Rowing. 24(1), 20-23.

🕮 2. Strome S. et al. 1977. Assessment of maximal aerobic power in specifically trained athletes. Journal of applied physiology. 42(6), 833-837.

Recent Developments

💻 Significant progress was achieved in developing Windows-based software for data acquisition. Now it is working on the ergo, but on-water we still collect data under DOS and process it in new Windows software. The major problem is maintaining compatibility with old data formats and continuity of results.

Contact Us:

✉ *Dr. Valery Kleshnev*
AIS/SSSM/Biomechanics
POBox 176, Belconnen, ACT, 2616,Australia
tel. (w) 02 6214 1659, (m) 0401 017 642
fax: 02 6214 1593
e-mail: kleshnevv@ausport.gov.au

Volume 1 No.6 **Rowing Biomechanics Newsletter** *June 2001*

News

☺ Intensive testing of the National Team members was undertaken in June. From 29/05 until 27/06 total number of 64 athletes were tested in 13 boat types and 44 testing sessions.

After biomech. testing of LM2x in Penrith.

Facts. Did You Know That…

✓ …having "prognostic" times and an equation of dependence of the stroke rate on boat speed (1), "prognostic" stroke rates could be estimated for different boat types. Here they are (in Str./min):

W1x	M1x	W2-	M2-	W2x	M2x	M4-
35.2	37.3	36.2	38.3	37.0	39.0	40.0
LW2x	LM2x	LM4-	W4x	M4x	W8+	M8+
36.6	38.5	39.8	38.8	40.6	39.5	41.4

These rates could be used as targets in training or as average values for evaluation of races.

✓ …for different boat speeds you should adjust proportionally both stroke rate and distance-per-stroke. If the boat speed is in a range 80-120% of the "prognostic" speed, then for stroke rate simply take an average of the speed percentage and 100%. For example, if the boat speed is 94% then the stroke rate should be 97% of the "prognostic" from the above table. For lower speeds use square the root of their percentage.

✓ …our measurements showed that new "vortex" blades has a position of the center of pressure closer to the edge than normal blades. This makes them look like an oar with a longer outboard, though geometrically it is the same. Longer outboard decreases relative pressure on the blade at the same torque applied by the rower and makes the blades a bit more efficient.

Ideas. What if…

? …you reverse the direction of a pitch adjustment, when you use it for blade depth correction? For example, usually, you try to increase pitch if the rower puts the blade deeply. However, if the reason is a technical fault (non-horizontal pull), then you just help the rower to practice wrong technique! May be you should reverse the adjustment and decrease pitch for a while. This could make the rower very uncomfortable, but this would push him/her to change the technique in the right direction. After you see some positive changes, you can set up normal pitch again;

? …you use light rowing as a tool for technique improvement. Why do we even use a different word "paddling" for light rowing? Does that assume a different technique? However, swimming coach Gennadi Touretski widely uses light swimming in training of Olympic champions Popov and Klim. He says that maintenance of proper rhythm and movement structure at a low rate and force application is very important for the development of the efficient racing technique. Try to achieve proper stroke length and segment sequence, better muscle relaxation and "boat feeling" at light rowing. It is much harder to do during full pressure rowing, because strong muscle innervations partly block signals from proprioceptors (sensors that detect muscle stretching) and increase the muscle relaxation time.

References

📖 1. Kleshnev V., 2001. Racing Strategy in Rowing During Sydney Olympic Games. www.sportscoach-sci.com

Contact Us:

✉ *Dr. Valery Kleshnev*
AIS/SSSM/Biomechanics
POBox 176, Belconnen, ACT, 2616,Australia
tel. (w) 02 6214 1659, (m) 0401 017 642
fax: 02 6214 1593
e-mail: kleshnevv@ausport.gov.au

Volume 1 No.7 **Rowing Biomechanics Newsletter** July 2001

News

☺ Race analysis on mini-regatta of the National Team was conducted in Penrith on the 4th of July. Two sessions of biomech. testing on men's' eight were done the next day.

Biomech. testing of M8+ in Penrith on 05/07/2001

☺ Testing of M4- and M1x of Junior Team was conducted on lake Barrington in Tasmania on 18-19/07/2001.

Facts. Did You Know That…

✓ …the average difference in boat speed of the medallists during the Sydney Olympics was less than **1%**. It is interesting that the speed of 7th and 8th places in finals B was faster than the speed of 5th and 6th places in finals A.

Place	1	2	3	4	5	6
Speed to 1st (%)	100	99.61	99.30	98.76	97.90	97.17
Diff. from 1st (%)	0.00	0.39	0.70	1.24	2.10	2.83
Place	7	8	9	10	11	12
Speed to 1st (%)	98.53	98.16	97.35	97.17	97.14	94.91
Diff. from 1st (%)	1.47	1.84	2.65	2.83	2.86	5.09

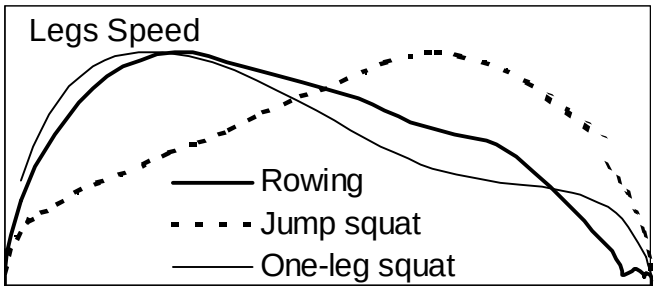
✓ … shape of force curve correlates with the blade propulsive efficiency (1). If we take the ratio of average to maximal force as a measure of the force curve profile, then increasing this parameter from 50% to 55% (towards more rectangular shape) could raise blade propulsive efficiency from 80% up to 83%. This is equates to a gain of about **1%** of boat speed or 3.5 sec on a 2000m race;

✓ …shorter drive time and lower rhythm (ratio of the drive time to the total cycle time) could cause decreasing of boat speed fluctuations and eliminate some energy losses (1). For example, shortening of the drive time from 1.0 down to 0.9 sec would reduce variation of boat speed by 3% and increase its average value by about **1%**.

Ideas. What if…

? …you use high-speed trunk drills on a more regular basis? Though, the trunk is not the most powerful body segment (the legs are), it connects legs with arms and plays a key role in drive action. Also, trunk back muscles are very slow by nature because in humans they are intended for posture maintenance and not for jumping and throwing like legs and arms. Using a quarter-slide drill with long and fast trunk work during warm-up could increase speed limit of trunk muscles and improve connection between the main body segments in full-length rowing;

? ...you think a bit more about similarity of out-of-water strength training parameters with on-water rowing. If we want to achieve a good transfer of the strength from the gym to the boat, then the most important rule is similarity of speed profile. Here is an example of typical legs speed profiles in rowing and in some strength exercises:



Obviously, one-leg squat, when you use the other leg for initial acceleration, looks much more similar to rowing than normal squat or jump-squat.

References

📖 1. Kleshnev V., 1998, Estimation of Biomechanical Parameters and Propulsive Efficiency in Rowing. Unpublished.

Contact Us:

✉ *Dr. Valery Kleshnev*
AIS/SSSM/Biomechanics
POBox 176, Belconnen, ACT, 2616,Australia
tel. (w) 02 6214 1659, (m) 0401 017 642
fax: 02 6214 1593
e-mail: kleshnevv@ausport.gov.au
www.ais.org.au/biomech/rownews

Volume 1 No.8 **Rowing Biomechanics Newsletter** *August 2001*

News

☺ Australians won three gold medals on the last World Championship in Lucerne. W4-, WL4x and W8+ showed outstanding performance. Well done! Congratulations to the athletes and coaches!

Facts. Did You Know That…

✓ …on the last nine Worlds and Olympics the percentages of the crews from different countries in **Finals A** in **all boat types** were (%):

	Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	
	Races	23	23	24	14	24	24	24	14	24	Average
1	GER	78	83	83	57	75	71	75	64	50	70.7
2	USA	57	43	50	50	67	58	54	64	54	55.3
3	AUS	43	52	54	71	33	50	42	71	29	49.6
4	ITA	35	48	50	36	42	50	46	43	58	45.2
5	GBR	48	35	42	21	54	46	38	29	50	40.2
6	FRA	30	39	29	29	38	33	33	21	33	31.8
7	CAN	35	30	29	57	29	17	33	21	17	29.9
8	DEN	30	35	42	36	29	29	25	14	17	28.5
9	NED	35	35	33	43	13	13	25	29	29	28.2
10	ROM	26	30	13	21	33	29	25	36	33	27.4

Here and below, for instance, 78% means 18 boats from a country in 23 Finals A.

✓ …percentages in **Finals A** in **Olympic boats** (%):

	Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	
	Races	14	14	14	14	14	14	14	14	14	Average
1	GER	79	93	86	57	86	64	71	64	79	75.4
2	AUS	29	50	43	71	36	50	64	71	29	49.2
3	USA	64	36	43	50	50	50	36	64	36	47.6
4	ITA	29	43	36	36	43	43	43	43	50	40.5
5	FRA	36	50	29	29	36	43	50	21	36	36.5
6	GBR	43	29	29	21	50	50	29	29	50	36.5
7	CAN	29	36	50	57	36	14	36	21	29	34.1
8	ROM	29	21	21	21	43	43	29	36	36	31.0
9	NED	36	29	43	43	7	14	36	29	21	28.6
10	DEN	14	36	36	36	36	43	21	14	14	27.8

✓ …percentages of **Medals** in **all boat types** (%):

	Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	
	Races	23	23	24	14	24	24	24	14	24	Average
1	GER	57	39	38	29	46	42	46	43	33	41.2
2	USA	35	26	29	29	25	38	42	21	17	29.0
3	ITA	26	30	33	7	21	38	21	29	33	26.5
4	AUS	13	17	17	43	21	21	29	36	13	23.2
5	GBR	17	22	25	14	33	17	21	21	21	21.3
6	FRA	13	13	21	29	21	17	8	21	21	18.2
7	ROM	13	26	4	14	29	17	13	21	21	17.6
8	CAN	30	9	17	43	17	13	17	7	4	17.3
9	NED	13	17	21	21	4	8	4	21	21	14.6
10	DEN	13	17	29	14	25	8	8	7	8	14.6

✓ … percentages of **Medals** in **Olympic boats** (%):

	Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	
	Races	14	14	14	14	14	14	14	14	14	Average
1	GER	64	64	43	29	57	50	50	43	57	50.8
2	AUS	14	21	21	43	14	21	50	36	7	25.4
3	USA	43	21	21	29	21	29	21	21	7	23.8
4	ROM	14	21	7	14	43	29	14	21	29	21.4
5	FRA	21	21	14	29	21	14	14	21	21	19.8
6	ITA	21	21	21	7	21	21	14	29	21	19.8
7	CAN	21	14	29	43	14	14	21	7	7	19.0
8	GBR	7	14	14	14	29	21	14	21	14	16.7
9	DEN	7	14	21	14	29	7	7	7	7	12.7
10	NED	7	7	29	21	0	7	7	21	7	11.9

✓ … percentages of **Gold Medals** in **all boats** (%):

	Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	
	Races	23	23	24	14	24	24	24	14	24	Average
1	GER	13	13	8	14	21	21	13	14	21	15.3
2	GBR	17	13	8	7	8	13	4	14	17	11.3
3	ITA	0	17	21	7	8	13	13	7	8	10.5
4	USA	4	9	21	0	17	8	25	0	0	9.3
5	ROM	9	9	0	14	4	4	8	21	8	8.7
6	AUS	4	0	8	14	8	8	4	0	13	6.7
7	FRA	13	4	0	0	8	4	0	14	8	5.8
8	CAN	17	4	8	7	4	4	4	0	0	5.5
9	DEN	0	9	8	7	8	4	8	0	0	5.0
10	SUI	0	0	4	14	4	4	4	0	0	3.4

✓ …percentage of **Gold Medals** in **Olympic boats**:

	Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	
	Races	14	14	14	14	14	14	14	14	14	Average
1	GER	21	21	14	14	29	21	21	14	36	21.4
2	GBR	7	7	7	7	7	14	7	14	14	9.5
3	ITA	0	21	21	7	7	7	7	7	7	9.5
4	ROM	7	0	0	14	7	7	14	21	14	9.5
5	CAN	14	7	14	7	7	7	7	0	0	7.1
6	USA	7	7	7	0	14	14	7	0	0	6.3
7	FRA	21	7	0	0	7	0	0	14	0	5.6
8	DEN	0	14	7	7	7	7	7	0	0	5.6
9	AUS	7	0	7	14	0	0	7	0	7	4.8
10	NZL	7	7	0	0	0	7	7	7	0	4.0

✓ …average ratios of the **Medals** to the number of crews in **Finals A** (%) are:

	1	2	3	4	5	6	7	8	9	
Medals	CHI	NOR	ROM	ITA	GER	CAN	IRL	FRA	CZE	17-AUS
Total	66.7	64.8	64.0	58.5	58.3	58.0	57.4	57.2	56.4	46.8
Gold	ROM	GBR	BLR	NZL	AUT	ITA	GER	SLO	IRL	16-AUS
Total	31.6	28.2	24.7	24.3	23.2	23.1	21.7	20.6	18.9	13.5
Medals	ROM	GER	YUG	NOR	UKR	CAN	FRA	NZL	AUS	10-USA
Olympic	69.2	67.4	66.7	64.3	57.1	55.8	54.3	52.9	51.6	50.0
Gold	ROM	NZL	GER	GBR	BLR	ITA	CAN	DEN	HUN	17-AUS
Olympic	30.8	29.4	28.4	26.1	23.5	23.5	20.9	20.0	20.0	9.7

Contact Us:

✉ *Dr. Valery Kleshnev*
AIS/Biomech., POBox 176, Belconnen, ACT, 2616
tel. 02 6214 1659, 0401 017 642, fax: 02 6214 1593
e-mail: kleshnevv@ausport.gov.au
www.ais.org.au/biomech/rownews

Volume 1 No.9 **Rowing Biomechanics Newsletter** *September 2001*

Facts. Did You Know That…

✓ …at the last World Championship in Lucerne the boat speed was faster than at the Sydney Olympics in all boat types. On average it was 1.39% faster in Finals A and winners were 1.52% faster. The biggest differences were achieved in LM4-, M8+, LW2x, W2-, M4x, W8+ and M4-, the lowest were in M2-, W1x, M2x and M1x.

% to Gold Times	OG 2000 Finals A	WC 2001 Finals A	Diff. 01-00 Finals A	OG 2000 1st place	WC 2001 1st place	Diff. 01-00 1st place
W1x	95.19%	96.03%	0.85%	96.40%	98.35%	1.95%
M1x	94.93%	95.83%	0.90%	95.87%	97.26%	1.39%
W2-	94.98%	96.78%	1.79%	95.82%	98.04%	2.21%
M2-	94.40%	95.14%	0.73%	95.17%	96.50%	1.33%
W2x	94.37%	95.82%	1.45%	95.80%	97.03%	1.22%
M2x	94.54%	95.42%	0.88%	96.12%	96.75%	0.63%
M4-	95.56%	97.02%	1.46%	96.56%	98.57%	2.01%
LW2x	94.53%	96.36%	1.83%	96.06%	97.70%	1.64%
LM2x	96.17%	97.62%	1.46%	97.18%	98.47%	1.29%
LM4-	95.40%	97.53%	2.13%	96.22%	98.43%	2.21%
W4x	95.07%	96.14%	1.07%	96.42%	98.14%	1.71%
M4x	95.33%	96.88%	1.56%	96.65%	97.98%	1.32%
W8+	95.13%	96.65%	1.53%	96.61%	97.34%	0.74%
M8+	95.05%	96.88%	1.83%	96.07%	97.72%	1.64%
Aver.	95.05%	96.44%	1.39%	96.21%	97.73%	1.52%

✓ …analysis of the boat speed in different placeholders confirms above results for Finals A (1-6 places). However, the boat speed in Finals B was faster at the Sydney Olympics. This fact, and our previous facts (RBN #7,2001), probably could be explained by significant differences in wind conditions of Finals A and B in Sydney.

Place	OG 2000	WC 2001 Olympic Boats	Diff. 2001 - 2000	WC 2001 All Boats	Margin from the 1st place (%)
1	96.21%	97.73%	1.52%	97.59%	0.00%
2	95.83%	97.33%	1.50%	97.18%	0.40%
3	95.53%	97.04%	1.51%	96.85%	0.74%
4	95.02%	96.45%	1.43%	96.41%	1.17%
5	94.19%	95.56%	1.37%	95.62%	1.97%
6	93.49%	94.50%	1.01%	94.71%	2.87%
7	94.79%	94.16%	-0.63%	94.27%	3.31%
8	94.44%	94.03%	-0.40%	93.94%	3.64%
9	93.66%	93.90%	0.24%	93.42%	4.16%
10	93.49%	93.47%	-0.02%	93.21%	4.38%
11	93.46%	92.78%	-0.68%	92.62%	4.96%
12	91.31%	92.17%	0.86%	92.23%	5.36%

Ideas. What if…

? …you use the most effective exercises for back pain prevention on a more regular basis? The major cause of back pain is irregular stress of the intervertebral disks when the spine bends under load. It is critical to maintain good condition of small muscles, which surround the disks and hold vertebrae together. Also, good balance of the front and back layers of the muscles is important. Usually, rowers have no problems with back layer, so development of the front intervertebral muscles must not be forgotten.

The most effective correction exercise against back pain is legs lifting on the bar. One-two sets of 10-15 reps. must be done strait after each rowing or ergo session, when the body is still warm. It is a good idea to construct the bars in the boat shed or not far from it.

This exercise also stretches the disks that improves their regeneration after workload by means of shape correction and increasing of blood circulation. The experience of a number of coaches and athletes in other sports with heavy spine loads (weightlifting, gymnastics) tells us that back pain is practically unavoidable unless the athletes always do correction exercises.

News

☺ Comprehensive biomechanical measurements were conducted in Canberra during September. 19 channels were measured from the single: two horizontal and two vertical oar angles, two orthogonal and two axial forces at the gate, two footstretcher forces, one handle and one blade forces, seat and trunk positions, boat and seat accelerations, boat speed, wind speed and direction. The purpose was modeling of the biomechanical rower-boat system.

Contact Us:

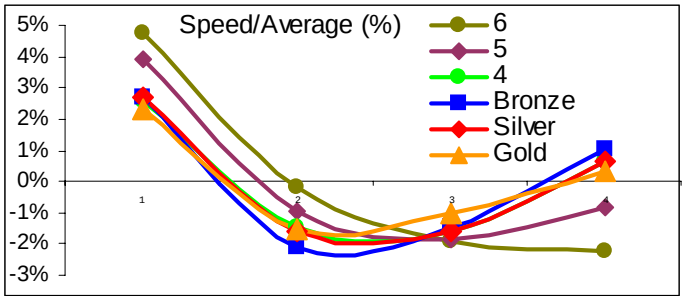
✉ *Dr. Valery Kleshnev*
AIS/SSSM/Biomechanics
POBox 176, Belconnen, ACT, 2616,Australia
tel. (w) 02 6214 1659, (m) 0401 017 642
fax: 02 6214 1593
e-mail: kleshnevv@ausport.gov.au
www.ais.org.au/biomech/rownews

Volume 1 No.10 **Rowing Biomechanics Newsletter** October 2001

Facts. Did You Know That…

✓ …the average race strategy on the last Worlds was similar to the Sydney Olympics (1): 3.2%, -1.3%, -1.6%, -0.1% from average speed. Winners were relatively slower over the first half of the race, but faster over the second one.

Relative boat speed in Finals A on the Worlds 2001.



✓ …Race tactics were also similar to the last Olympics. The most popular tactics were opposite: 1-4 and 4-1. The group with emphasis on the first half of the race (1-4, 2-4, 1-3) won 12 medals out of 48 cases (25%). The group with emphasis on the finish (4-1, 3-1, 4-2) won 40 medals out of 60 cases (67%).

Matrix of race tactics in Finals A at the Worlds 2001.
Columns – fastest section, rows – slowest one. n – number of crews in each tactic. Below – number of places in each tactic, e.g.: (2,2,…) means two gold, two silvers, etc.

1-4 n=23 2,2,0,2,8,9	**2-4** n=17 3,3,0,2,3,6	**3-4** n=6 3,1,1,0,0,1		32%
1-3 n=8 1,0,1,1,5,0	**2-3** n=4 0,0,0,1,1,2		**4-3** n=9 0,2,4,3,0,0	15%
1-2 n=6 0,2,3,0,1,0		**3-2** n=5 2,0,0,2,1,0	**4-2** n=16 3,2,6,2,1,2	19%
	2-1 n=6 1,1,0,2,1,1	**3-1** n=15 4,4,1,3,1,2	**4-1** n=29 5,7,8,6,2,1	35%
26%	19%	18%	38%	

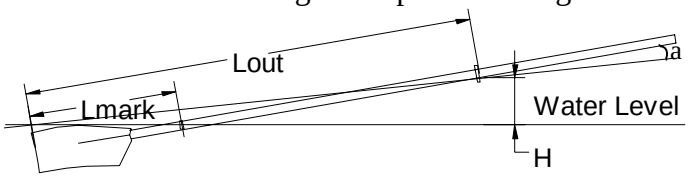
✓ …tactics with emphasis on the last section of the race were used more by American, French, Dutch and German crews. The British mainly used the first section to take over the race, Romanians preferred the third one and Australian finalists emphasized the second 500m piece (all gold medallists used 2-4 tactics). Italians didn't show clear preference.

Percentages of crews from different countries used tactics with emphasis on various race sections at the Worlds 2001.

Country	Crews in FA	Fastest section of the race 1	2	3	4
AUS	7	14%	57%		29%
FRA	8	13%	38%		50%
GBR	12	42%	8%	17%	33%
GER	12	25%	8%	25%	42%
ITA	14	21%	29%	14%	36%
NED	7	14%	29%	14%	43%
ROM	8	25%		50%	25%
USA	13	15%	23%	8%	54%

Ideas. What if…

? …you use markers on the oar shaft to indicate blade depth. Actually, this is not a new idea, but the following data will help you to connect the position of the marker (from the outer blade edge) with blade depth in degrees. Firstly, you need to measure the height of the gate from the water level (H). Then, take the marker position from the appropriate table at the desired depth angle (interpolate it if needed) and adjust it a little bit if your outboard is different from the indicated one. The good depth is 3-6 degrees.



Position of the marker for a sweep oar (m). Outboard 2.60m, add 0.7 cm for each cm if it's longer and vise versa.

Height (m)	Depth Angle (degrees) 3	4	5	6	7	8
0.15	1.08	1.27	1.41	1.53	1.62	1.70
0.20	0.94	1.11	1.26	1.37	1.47	1.56
0.25	0.83	0.99	1.13	1.25	1.35	1.43
0.30	0.74	0.90	1.03	1.15	1.24	1.33
0.35	0.66	0.82	0.94	1.06	1.15	1.24

Position of the marker for a scull (m). Outboard 2.00m, add 0.6 cm for each cm if it's longer and vise versa.

Height (m)	Depth Angle (degrees) 3	4	5	6	7	8
0.15	0.71	0.84	0.95	1.04	1.12	1.18
0.20	0.60	0.73	0.84	0.92	1.00	1.07
0.25	0.52	0.64	0.74	0.83	0.90	0.97
0.30	0.46	0.57	0.67	0.75	0.82	0.89
0.35	0.42	0.52	0.61	0.68	0.75	0.82

References

📖 1. Kleshnev V. 2001.Racing strategy in Rowing during Sydney Olympics. Australian Rowing. 24(1), 20-23.

Contact Us:

✉ © *Dr. Valery Kleshnev*
AIS/SSSM/Biomechanics
POBox 176, Belconnen, ACT, 2616,Australia
tel. (w) 02 6214 1659, (m) 0413 223 290
fax: 02 6214 1593
e-mail: kleshnevv@ausport.gov.au

Volume 1 No.11 **Rowing Biomechanics Newsletter** November 2001

Facts. Did You Know That…

✓ …more than 400 biomechanical sessions were done at the AIS during the last 3.5 years. All measured and valid data is stored in a database, which consists of more than 1800 boat-samples and 6000 rower-samples. Here is some analysis of the data.

✓ …this table allows you to assess the **catch angle**:

Catch Angle (deg)	Very Low (Less Than)	Low (Less Than)	Average	High (More Than)	Very High (More Than)
Men Scull	-60.0	-63.3	-66.5	-69.8	-73.1
M.Light Scull	-57.4	-60.9	-64.5	-68.0	-71.6
Men Sweep	-49.5	-53.1	-56.8	-60.4	-64.0
M.Light Sweep	-48.6	-51.4	-54.3	-57.2	-60.0
Women Scull	-55.3	-58.8	-62.2	-65.7	-69.1
W.Light Scull	-55.2	-58.3	-61.3	-64.4	-67.4
Women Sweep	-46.5	-50.0	-53.5	-57.0	-60.5

✓ …**release angle** can be evaluated using the table:

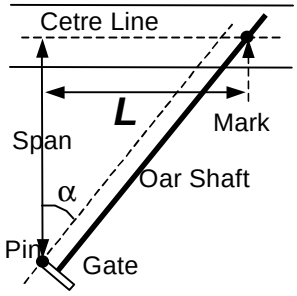
Release Angle (deg)	Very Low (Less Than)	Low (Less Than)	Average	High (More Than)	Very High (More Than)
Men Scull	36.5	40.1	43.8	47.5	51.1
M.Light Scull	37.7	40.2	42.6	45.0	47.5
Men Sweep	30.4	32.4	34.3	36.3	38.2
M.Light Sweep	30.0	31.8	33.6	35.5	37.3
Women Scull	37.4	40.2	43.0	45.8	48.7
W.Light Scull	36.4	39.6	42.8	46.1	49.3
Women Sweep	28.1	30.7	33.4	36.0	38.6

✓ …**total angle** can be assessed with the table:

Total Angle (deg)	Very Low (Less Than)	Low (Less Than)	Average	High (More Than)	Very High (More Than)
Men Scull	102.8	106.6	110.4	114.2	118.0
M.Light Scull	99.5	103.3	107.1	110.9	114.8
Men Sweep	84.4	87.8	91.2	94.6	98.0
M.Light Sweep	81.0	84.5	87.9	91.4	94.9
Women Scull	96.7	101.0	105.2	109.4	113.7
W.Light Scull	95.2	99.7	104.2	108.7	113.2
Women Sweep	80.0	83.5	86.9	90.4	93.8

Ideas. What if…

? …you set markers on the boat to check catch and release angles? All you need to know is the span (distance between pin and centre line of the boat). Then take the L value corresponding to the span and desired angle from the following tables. Put the mark on the center line of the boat at L cm from the pin projection. Stretch a rope between the mark and the center of the gate (approx. 4 cm. from the pin).



Finally, put the oar shaft along the rope and set markers somehow.

Position of the mark L(cm) for the catch angle.

Catch Angle	Span (cm) 78	79	80	81	82	83	84	85	86	87
-48	89.3	90.4	91.5	92.6	93.7	94.9	96.0	97.1	98.2	99.3
-50	95.5	96.7	97.9	99.1	100.3	101.5	102.7	103.9	105.1	106.3
-52	102.3	103.6	104.9	106.1	107.4	108.7	110.0	111.3	112.5	113.8
-54	109.7	111.1	112.5	113.8	115.2	116.6	118.0	119.3	120.7	122.1
-56	117.9	119.4	120.8	122.3	123.8	125.3	126.8	128.3	129.7	131.2
-58	126.9	128.5	130.1	131.7	133.3	134.9	136.5	138.1	139.7	141.3
-60	137.1	138.8	140.6	142.3	144.0	145.8	147.5	149.2	151.0	152.7
-62	148.6	150.5	152.3	154.2	156.1	158.0	159.9	161.7	163.6	165.5
-64	161.7	163.7	165.8	167.8	169.9	171.9	174.0	176.0	178.1	180.1
-66	176.8	179.1	181.3	183.6	185.8	188.0	190.3	192.5	194.8	197.0
-68	194.6	197.0	199.5	202.0	204.5	206.9	209.4	211.9	214.4	216.8
-70	215.7	218.4	221.2	223.9	226.7	229.4	232.2	234.9	237.7	240.4
-72	241.3	244.4	247.5	250.5	253.6	256.7	259.8	262.8	265.9	269.0

Position of the mark L (cm) for the release angle.

Rel. Angle	Span (cm) 78	79	80	81	82	83	84	85	86	87
28	37.9	38.5	39.0	39.5	40.1	40.6	41.1	41.7	42.2	42.7
30	41.6	42.1	42.7	43.3	43.9	44.5	45.0	45.6	46.2	46.8
32	45.3	46.0	46.6	47.2	47.8	48.5	49.1	49.7	50.3	51.0
34	49.3	50.0	50.6	51.3	52.0	52.7	53.3	54.0	54.7	55.4
36	53.4	54.2	54.9	55.6	56.3	57.1	57.8	58.5	59.2	60.0
38	57.8	58.6	59.4	60.1	60.9	61.7	62.5	63.3	64.0	64.8
40	62.4	63.2	64.1	64.9	65.7	66.6	67.4	68.3	69.1	69.9
42	67.3	68.2	69.1	70.0	70.9	71.8	72.7	73.6	74.5	75.4
44	72.4	73.4	74.4	75.3	76.3	77.3	78.2	79.2	80.2	81.1
46	78.0	79.0	80.1	81.1	82.1	83.2	84.2	85.2	86.3	87.3
48	84.0	85.1	86.2	87.3	88.4	89.5	90.6	91.7	92.8	93.9
50	90.4	91.6	92.8	94.0	95.2	96.3	97.5	98.7	99.9	101.1

? …you set the angle markers using pieces of 2-3 mm metal wire attached to the rigger? Bend them at desired angle. Our experience shows that touching of the wire at each stroke is a more efficient way of the angle stabilizing than watching the mark.

Contact Us:

✉ ©2001 Dr. Valery Kleshnev,
AIS/Biomechanics
POBox 176, Belconnen, ACT, 2616,Australia
tel. (w) 02 6214 1659, (m) 0413 223 290
fax: 02 6214 1593
e-mail: kleshnevv@ausport.gov.au

Volume 1 No.12 **Rowing Biomechanics Newsletter** December 2001

News

☺ Dear rowing coaches and rowers! This is the last Newsletter of the year 2001. I wish you a Merry Christmas and may all your dreams for the New Year 2002 become true!

Facts. Did You Know That…

✓ …the number of samples in the rowing biomechanics database in each rowers' category are the following:

Men Scull	M.Light Scull	Men Sweep	M.Light Sweep	Women Scull	W.Light Scull	Women Sweep
519	161	1628	808	489	739	1707

Here is an analysis of force parameters based on the database.

✓ …**Maximal force** applied to the oar handle can be evaluated using the table

Force Max.(N)	Very Low (Less than)	Low (Less than)	Average	High (More than)	Very High (More than)
Men Scull	593	680	766	853	940
M.Light Scull	579	636	692	749	805
Men Sweep	491	581	671	761	850
M.Light Sweep	467	528	590	652	714
Women Scull	394	471	547	624	701
W.Light Scull	355	416	477	538	599
Women Sweep	345	412	479	547	614

If you are not familiar with the Newton unit of force, then just put a dot in front of the last digit and you'll have the force in kilograms, eg.: 593 N ~ 59.3 kgF.

✓ …**Average force** applied to the oar handle during the drive phase can be evaluated using the table:

Force Aver.(N)	Very Low	Low	Average	High	Very High
Men Scull	308	356	405	454	502
M.Light Scull	284	322	360	398	435
Men Sweep	242	286	331	376	421
M.Light Sweep	224	259	294	329	364
Women Scull	194	240	286	332	378
W.Light Scull	189	221	253	285	317
Women Sweep	169	203	238	273	307

✓ …**Ratio of the average to maximal forces** can be evaluated using the table:

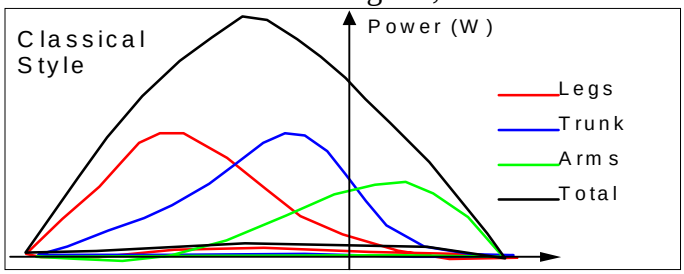
Aver / Max (%)	Very Low	Low	Average	High	Very High
Men Scull	43.9%	48.5%	53.1%	57.6%	62.2%
M.Light Scull	44.3%	48.2%	52.0%	55.8%	59.7%
Men Sweep	40.7%	45.2%	49.6%	54.1%	58.6%
M.Light Sweep	40.2%	45.0%	49.9%	54.7%	59.6%
Women Scull	44.4%	48.4%	52.5%	56.5%	60.5%
W.Light Scull	46.1%	49.7%	53.2%	56.7%	60.2%
Women Sweep	39.7%	44.8%	49.9%	55.0%	60.1%

Ratio of the average to maximal forces is an important parameter for evaluation of the force curve shape. If this parameter increases then the force curve becomes more rectangular. As we know from geometry, any rectangle has 100% of height-area ratio, and any triangle has 50%.

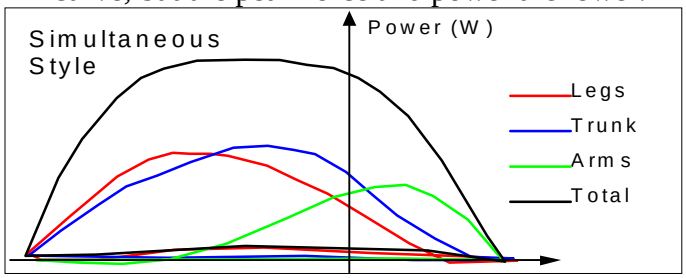
Ideas. What if…

? …you want to change a shape of your force curve? Then you need to know how segment sequence effects force application. The main rule is the following:

- A sequenced work of the legs and trunk (we also call it classical rowing style) produce higher maximal force and power, but the shape of the force curve is more triangular;



- Simultaneous work of the legs and trunk produce more rectangular shape of the force curve, but the peak force and power are lower.



80-85% of rowers use classical or similar rowing style and 15-20% are closer to simultaneous style.

References

📖 1. Kleshnev V., 2000, Power in Rowing. XVIII Symposium of ISBS, Proceedings, Hong-Kong, p. 96-99.

Contact Us:

✉ ©2001 Dr. Valery Kleshnev,
AIS/Biomechanics
POBox 176, Belconnen, ACT, 2616,Australia
tel. (w) 02 6214 1659, (m) 0413 223 290
fax: 02 6214 1593
e-mail: kleshnevv@ausport.gov.au