

Periodized Strength Training for Sprint Kayaking/Canoeing

Michael Fekete, CSCS

Head Coach

Toronto Island Canoe Club, Toronto

HIGH PERFORMANCE SPRINT kayaking/canoeing requires a high level of relative strength, excellent local muscle endurance, and the ability of the muscles to perform in low pH environments. Excellent lactic acid clearance and proton- buffering capacity of the blood are also prerequisites for producing a consistently high level of mechanical power output.

Peak power generated by muscle action during acceleration can reach 928W in men, with subsequent stabilization at about 70 strokes per minute (1, 4). The energy needed for this output is generated by phosphagen and the fast glycolytic system. After the initial period of acceleration, extreme lactate values are maintained during the entire race (2, 3). They remain high and are maintained even when a metabolically more economic cruising speed requires an average power output of 350W anti 225W for men and women, respectively, at around 85% of $\dot{V}O_{2\max}$ for both sexes.

If we consider that a power is generated by the repetitive actions of the relatively small muscle groups of the upper body, we must acknowledge the fact that great demands are put on this musculature.

The ultimate goal of strength training and conditioning for sprint kayaking/canoeing is to elevate the athlete's overall capacity through a properly structured and periodized strength training program to a level where he or she can produce consistently high power output. This capacity is called speed endurance.

Theoretical considerations and practical experience confirm that in sprint flatwater kayaking/ canoeing:

1. Strength is the basic quality that provides the necessary foundation and influences the performance of others.

2. The best method for effectively structuring and manipulating strength training and conditioning in a goal oriented manner

is periodization. It allows for planned, optimal, and timely conversion/translation of gains achieved in one dimension of strength into qualities and further gains in another dimension.

3. The most effective strength training modality for optimal sequencing and integration of movements is free-weight training.

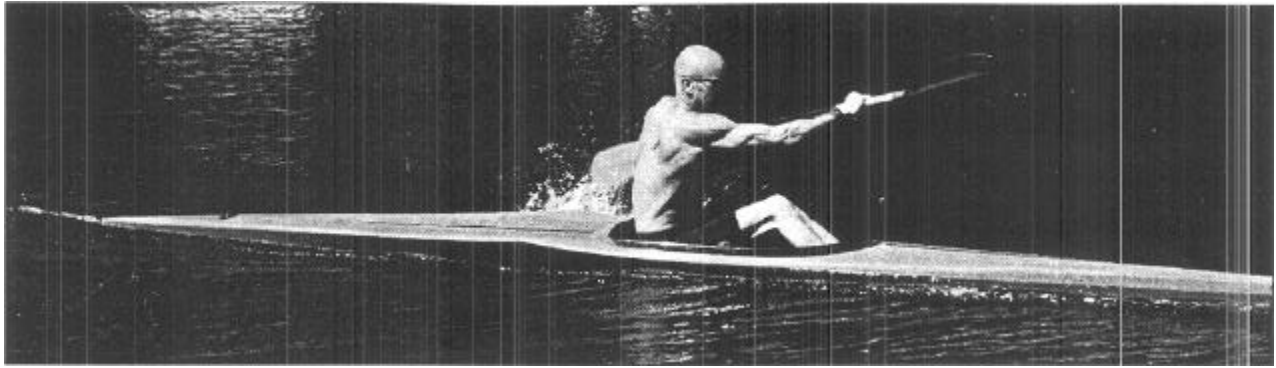
4. In order to maintain specific strength gains and high performance capacity, strength training and conditioning must be an integral part of the annual plan.

■ The Annual Plan

General Anatomical Preparation

The first mesocycle of our annual plan is called General Anatomical Preparation. Strength training during this preparatory period is mostly corrective/regenerative in character. Long-term injury prevention and planning for athletic

© 1998 National Strength & Conditioning Association



longevity will dominate this important period.

Overtraining during the competitive period may result in overuse and connective tissue fatigue. Postural restrictions and sustained postural habits may lead to joint degeneration, reduced flexibility and ROM, possible injuries, and ineffective breathing habits. On the basis of a comprehensive assessment, the strength and conditioning coach must address these problems by designing a plan that is highly corrective in nature.

Although every plan should reflect the individual needs of athletes, some general rules apply. When selecting exercises, it is best to choose the weight-bearing variety, standing good-mornings vs. sitting good-mornings, front squats vs. leg presses, etc.

Because of the sustained compressive forces acting on the rib cage (a result of a sustained sitting position), the intercostals and the diaphragm must be stretched and released (chest pullovers, dumbbell flies, etc.). The disproportion between pulling and pushing usually results in significant asymmetry between external and internal rotators. To restore dynamic joint stability, muscle balance must be reestablished.

Strength training in this mesocycle will consist of 3 to 4

workouts a week of medium volume, intensity, and density. Care must be taken to ensure that extensive and proper warm-ups are pursued before each workout. Exercises must be executed with slow and controlled movements in a technically correct manner in their full ROM.

Choose a resistance against which the particular exercise can be performed 8-12 times in a technically correct manner. Three sets for each exercise is considered optimal, with 3 minutes of active rest between sets. Stretch the prime movers between sets. Conclude each session with a comprehensive cooldown and stretching.

Progression should be conservative during this mesocycle. It is very important to develop a high level of body awareness, i.e., correct movement and correct posture. This period usually lasts 8 weeks and is very important for athletic longevity.

When this mesocycle is accomplished correctly, the results are increased bone mass and bone mineral density, increased muscle mass, improved muscle balance and ROM, increased tensile strength of tendons and ligaments, improved dynamic joint stability, and improved tissue mobility (connective, muscle, and nerve).

Maximization of Strength

The second mesocycle in our annual strength training and conditioning plan is called Maximization of Strength. This is when we attempt to improve the basic quality that provides a foundation and which will fundamentally influence the performance of others. This is the dimension on which all other dimensions will be built.

If properly converted in a timely manner, improvements in overall strength will always translate into improvements in relative and specific strength as well as power, muscle endurance, and speed endurance.

Strength training in this period will take 3 sessions a week and will be characterized by workouts of medium volume, complexity, and variety, and medium to medium-high intensity. Extensive warm-up and cooldown are very important.

This is the period when we gradually introduce 2 or 3 dynamic structural exercises such as hang cleans, power cleans, power snatches, etc. Because these exercises require not only a perfect neural coordination of participating muscle groups but also an optimal distribution (spreading) of force requirements over a large motor unit pool of various

prime movers, they should be undertaken right after the warm-up and before CNS and skeletal muscular fatigue sets in. The session should be continued with upper body exercises aimed at the prime movers involved in kayaking and canoeing.

These exercises should be relatively movement-specific, but not necessarily sport-specific. Exercises targeting the core muscles are performed at the end of each workout in order to avoid creating untimely fatigue in these important stabilizers.

For upper body exercises aimed at the prime movers, select a load against which the exercise can be performed 6 to 8 times in 3 sets. Three minutes of active rest (stretching the prime movers) is recommended between sets. Focus on technically correct execution.

Progression is very important during this period. As soon as more than 12 reps can be performed for each set, the weight should be increased by about 5- 10% so that the number of reps varies from 6 to 8. As the weights get heavier, it is best to do warm-up sets with lighter resistance before each exercise.

In order to be able to absorb the increased workload and consolidate results, reduce the training load in the 4th week to the level of the 2nd week and resume progression in the 5th week. Reduce the workload in the 8th week to the level of the 6th week and resume progression, and so on.

This period lasts 8-12 weeks and the results are: further anatomical corrections and increased bone mass, muscle mass, maximum strength, neuromuscular coordination, tensile strength of tendons and ligaments, muscle balance, and ROM, and better posture.

Specific Preparation

The third mesocycle is called Specific Preparation and will be characterized by constantly changing emphasis in the interrelation of its various components:

1. Volume will be medium at first; intensity will be gradually increased through faster movement execution, not through increased load.

2. Exercises will narrow down from a wider variety of relatively movement-specific exercises to sport-specific ones, which of course will decrease the variety.

3. As a result of increasing the number of repetitions and sets, executing the movements faster, and decreasing the length of rest periods, maximum strength gains are being decreased but will gradually be converted to gains in maximum muscle endurance in the first sub phase, then speed endurance in the second.

This mesocycle of Specific Preparation will last for about 8 weeks. Throughout the entire mesocycle, right after the warm-up, in order to slow down the inevitable erosion of gains in maximum and relative strength and power, do 2 sets of hang cleans. Of all the structural exercises, hang cleans are performed best in fast repetitions. Restrict the number of reps to 8-12 and the resistance to 60-80% of 1-RM. Both the intensity and density of structural exercises should be medium, with 3 minutes of active rest between sets.

During the first 4 weeks of this mesocycle (first sub phase), 3 workouts per week are recommended, each consisting of sport-specific exercises such as one-arm rowing, bent-over rowing, lateral shoulder raises, etc., performed at 60% of 1-RM. Movement execution is relatively fast:

- Fast concentric action accompanied by a total relaxation of the antagonist;
- No pause between the concentric and eccentric phases;
- The eccentric phase being almost a free fall with minimal eccentric action.

Compound sets-various exercises targeting the same prime movers but using slightly different angles and muscle recruitment patterns are used with very little rest (20-25 sec) between sets. Our goal is to progressively increase the number of reps and sets.

During this sub phase, instead of increasing resistance we progressively increase the number of reps and sets: it is common to use 4 to 6 sets of 60-80 reps. It is best to start with 1 set for each exercise of higher load (6- to 8-RM) prior to the ensuing sets of higher reps aimed at maximizing local muscle endurance. In fact, elite athletes should always reach OBLA (onset of blood lactate accumulation) with higher loads, and then continue with reduced loads. This protocol closely reflects the metabolic profile of the athletic activity.

The exercises aimed at the core muscles of the midsection should be left for last, which is not to say one should neglect them. The importance of strong back and abdominal stabilizers cannot be overestimated: They act as a powerful platform to guard against any loss of torque during the dynamic actions of prime movers.

It is very important to expose the core to the same training loads in order to ensure that the core muscles develop a high endurance capacity. We should never lose sight of the fact that this is the part of the body where propelling forces find their platform, where they cross and pass through, enhancing

and canceling out each other at each stroke.

A common mistake in strength training and conditioning for kayaking is to neglect the lower body through which the forces generated by the upper body and torso are transmitted to the boat. The inclusion of structural exercises such as power cleans and hang cleans will result in increased lower body strength.

In the second sub phase of this mesocycle of around 8 weeks, we turn from compound sets to circuit training. Movement execution becomes fast, then very fast, modeling and then exceeding the race tempo.

The target is to perform as many reps as possible within a certain time limit, which is progressively extended to reflect the duration of the race. The tempo of the workouts will be increased; for we gradually eliminate rest between stations and minimize rest between circuits.

The goal of this sub phase is to maximize speed endurance by training the working muscles to perform fast movements at a consistently high power output, and conditioning the relevant metabolic systems to provide the energy needed for this activity.

Partly because of the higher intensity of the workouts, and partly because this sub phase of strength training and conditioning usually coincides with the beginning of on-water training, we reduce the number of sessions to 2 per week. If interval training has already been introduced in the on-water workouts, we do circuit training after 'easy' days of continuous on-water workouts.

Concerning these changes in program design variables, the various systems will respond according to Roux's law of functional adaptation. They may remodel

Themselves the degree to which depends on the athlete's genetic potential and training status- to quantitative and qualitative changes in function. Adaptive changes may be reflected in

1. **Increased oxidative enzyme levels and increased activity of local oxidative enzymes (7);**
2. **Higher plasma lactate levels;**
3. **Increased proton buffering ability of the blood and muscles as well as increased ability of the muscles to function in a high proton and lactic acid environment;**
4. **Increased numbers of capillaries per fiber (8);**
5. **Conversion of fast twitch type IIb fibers to fast twitch type IIa fibers (10);**
6. **Optimization of sarcomere length for optimal force production (6);**
7. **Optimization of recruitment patterns and rate coding (9);**
8. **Increased ability of muscles to store glycogen;**
9. **Increased ability of the CNS to tolerate fatigue;**
10. **Enhanced organization of central command for muscle action (5)**

The Competitive Period

The fourth mesocycle of our annual strength and conditioning plan is called the Competitive Period. It is a common mistake to eliminate strength training in this phase. In order to attain high performance capacity, one should maintain existing strength, power, and muscle endurance status well into peaking for major competitions by performing two relatively low volume, low intensity, low density strength workouts a week and cease weight training only 6 to 7 days before a competition.

These workouts should consist of a warm-up, 2 to 3 sets of

dynamic structural exercises at 60% of I-RM, and 3 sets of 8-12 reps of 4 to 6 sport-specific exercises at 60% of I-RM. Active rest (stretch prime movers) between sets should be 3 minutes. Exercises aimed at the midsection (ab crunches, curl-ups, bent-knee twists, back hyperextensions, etc.) should be done last. These work-outs of medium volume and low to medium intensity will be characterized by relatively fast movement execution, slightly under competition tempo.

Apart from gross mistakes such as improper training load, wrong exercise selection, disregard for one's genetic potential or training status, and failing to observe recovery cycles, what are some common errors that may jeopardize the optimal organization and manipulation of a periodized strength training program for kayaking/canoeing?

■ Improper timing of conversion:

1. The strength base is not consolidated, which means more strength gains cannot be achieved without risking plateaus, injuries, or excessive gain in muscle mass.

2. The athlete stays longer than necessary with one dimension, long after it has ceased to provide adequate stimuli, risking plateaus and burnout.

■ Improper mode of conversion:

1. The athlete focuses,, only on the new dimension while neglecting to maintain improvements gained from the previous dimension. Being in a mesocycle that emphasizes muscle endurance doesn't mean we should completely disregard strength and power by neglecting dynamic, structural exercises that minimize such losses.

2. The athlete fails to reduce resistance when converting strength into maximum endurance

and tries to force a high number of reps and sets with heavier weights as used in the previous mesocycle. Smooth conversion requires that we reduce resistance when we aim for more sets and reps.

3. The athlete fails to speed up his or her movement execution when doing a high number of reps and sets.

■ Skipping the next logical dimension.

After maximizing strength, the athlete skips the sub phase aimed at gradually converting strength gains into muscle endurance, and instead moves to high-density circuit training characterized by no rest between sets and circuits, and very fast movement execution that promotes speed endurance.

■ Caveat

These errors may not only upset the discipline, consistency, coherence, integrity, and direction of our plan but may also lead to injuries, plateaus, and ill-timed peaks as well.

■ References

1. Armand, J-C. Monitoring the physiological aspects of high performance kayak-canoe training. MD thesis, Universite de Paris Ouest. 1983.
2. Cermak, J., I. Kuta, and J. Parizkova. Metabolic characteristics of top performance sprint canoeing and their changes during the annual training plan. -*J. Sports Med. Phys. Mtn.* 5:243-251. 1975.
3. Colli, R., P. Faceini, C. Schermi, E. Introint, and A. Monte. Dalla valutazione funzionale all'allenamento del Canoista [Functional evaluation of the metabolic aspects of sprint canoeing]. *SDS, Rivista di Cultura Sportiva*, 18: 2632. 1990.
4. Dal Monte, A., F. Piero, and R. Colli. Canoeing. In: *Endurance in Sport, The Encyclopaedia of Sports Medicine*. R.,J. Shephard and P-O Astrand, eds. Oxford: Blackwell Scientific Publ., 1992. pp. 555-562.
5. Desmedt, J.E., and E. Godaux. Voluntary motor commands in human ballistic contractions. *Ann. Neurol.* 5:415-421. 1979.
6. Herring, S.W., A.F. Grimm, and B.R. Grimm. Regulation of sarcomere number in skeletal muscle: A comparison of hypotheses. *Muscle & Nerve* 7:161-173. 1984.
7. Holloszy, J.O. Biochemical adaptations to exercise. *Exerc. Sport Sci. Rev.* 1:45-71. 1973.
8. Hoppeler, H., and S.L. Lindstedt. Malleability of skeletal muscle in overcoming limitations: Structural elements. *J. Experim. Biol.* 115:355-364. 1985.
9. Sale, D.G. Influence of exercise and training on motor unit activation. *Exerc. Sport Sci. Rev.* pp. 95-151. 1987.
10. Saltin, B., and P.D. Golinick. Skeletal muscle adaptability: Significance for metabolism and performance. In: *Handbook of Physiology. Skeletal Muscle*. L. Peachy, R. Adrian, and S.R. Gerzer, eds. Bethesda: American Physiological Society, 1983. pp. 555-631.



Michael Fekete has worked with various fitness clubs as a strength and conditioning specialist. He has won several triathlons over the years and in September he successfully defended his title as DiamondMan Quadriathlon Long-Distance Master World Champion.