STAY THE COURSE:
Preparation strategies leading towards the 2016 Olympic whitewater slalom events.

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After taking bronze at the 2015 World Championships, Michal Smolen is prepared for Rio.

Introduction

We have all heard the expression that you cannot fire a cannonball from a canoe. While this is an appropriate analogy for describing water's lack of stability when attempting to produce force, it does not fully describe the intricacies of developing the strength of Olympic slalom paddlers.

Prior to detailing the USA Canoe and Kayak National Team training, an abbreviated understanding of the sport is required. Whitewater slalom can be broken down into both individual and team categories. Individually, athletes can compete in the K1 (kayak) and C1 (canoe) disciplines while also electing to compete as a team in the C2 event (currently a male only category). All disciplines, regardless of gender, compete on the same whitewater course with gates strategically placed with the purpose of increasing race complexity. These gates can alternate direction, going from downstream (straight ahead) to upstream, requiring the athlete to work against the current with the goal of traveling through each gate

without touching it. Each touched or missed gate results in a time penalty, which is ultimately added to the athlete's finish time. Unblemished or a flawless run results in average times between 85-100 seconds based on the race category (e.g. canoe, kayak, or doubles), course length and difficulty. As the name of the game is to finish with the fastest time, each penalty can be a deathblow to a competitor, especially during a major international competition where fractions of second separate a gold medal from fourth place.

In addition to minimizing touches and missed gates, racing success is largely dependent on how well an athlete can read the ever-changing, unpredictable nature of water. This Zen-like relationship with the water allows the paddler to navigate the race course with economy, preventing unnecessary lines of action between gates that would otherwise lead to wasted energy. The ability to "become one with the water" develops through consistent practice over time, therefore coaches and paddlers alike must acknowledge that "in the boat" training is the priority.

Physical Development

Understanding that slalom athletes must allocate most of their practice time to the boat, a premium must be placed on dry-land training that maximizes training economy while serving to develop maximal force and rate of force development (RFD), also termed explosive strength, which is defined as the change in force divided by the change in time. In other words, we dedicated our weight-room sessions to increasing the athlete's strength and the ability to call upon that strength quickly.

Recall that a cannonball cannot successfully be launched from a cannon firing from a canoe. This analogy frames the limitations imposed on a paddler during competition. Newtonian physics reminds us that when the cannon imposes a force upon the cannonball, an equal and opposite force is placed back onto the cannon. If fired from dry land, the cannon would move very little as the ground provides enough support for the larger mass. However, in a boat, those reactionary forces would push the cannon-canoe tandem backward. This "action-reaction" ultimately renders the large force-producing cannon useless.

With regard to the slalom competitor, force is needed to accelerate the boat through and between gates as fast as possible. However, the unstable nature of water limits how much force can be applied to the paddle, thus preventing the athlete from utilizing their "maximal strength" each stroke.

Considering these sport-imposed limitations, the aim of weight training was to increase the athlete's ceiling and capacity for maximal strength in order to develop and enhance their "strength reserve" on the water. Additionally, this increased strength would promote greater rates of force development, which underpins an athlete's ability to accelerate. Furthermore, this explosive strength would allow the paddler with a greater ability to react and respond to the unpredictable nature of the water, especially when needing to redirect the boat. In short, if all paddlers enter the race with the same compromised opportunity to call upon their maximal strength, American slalom athletes would have a larger inventory of strength to pull from.

Exercise Selection

In order to concurrently develop the athletes' strength-reserve and RFD, an emphasis is placed on complex, multi-joint, free weight exercises. Specifically, the National team utilizes basic strength-training movements such as the back squat, front squat, overhead press, and bench press to ensure maximal force development. Moreover, weightlifting movements such as the power clean, power snatch, and their derivatives including the mid-thigh pull and countermovement shrug are executed to continue the refinement of maximal force output as well as RFD and power output.

In addition to the enhancement of a strength-reserve and elevated RFD, these exercises promote great mid-section/ trunk development as the overall load and speed of movement require tension and stabilization compared to single-joint movements and isolated mid-section exercises. As a result, the American slalom athletes are able to maintain an optimal posture in the boat, which is especially important during the bracing and acceleration phases of the paddle.

Periodization and Programming Tactics

The aforementioned exercises are blended together in a manner that allows the earlier pre-season improvements in muscle architecture to serve as the foundation for the exposure to and subsequent improvements in maximal strength. This heightened level of strength is then used to promote greater outputs in RFD and power.

This progression is carried out through careful programming that adheres to the basic tenants of periodization which can be defined as the strategic manipulation of an athlete's preparedness through the employment of sequenced training phases defined by cycles and stages of workload, harmonizing the relationship between training-induced fatigue and accommodation.

The programming model that has been used to physically develop USA Slalom National Team is termed Seamless Sequential Integration (SSI). The SSI model uses blocks of concentrated loads, which are typically 4-week cycles of training dedicated to a specific objective (e.g. maximal-strength or strength-speed). These blocks of training seamlessly merge together through the inclusion of functional overreaches, typically defined as a week of increased workload (volume). This brief exposure to higher volume maintains the work capacity and physical qualities developed through earlier phases of training while also setting up greater power outputs in future blocks of training through the reduction in training volume.

In addition to the blocks of dedicated training and functional overreaching, SSI emphasizes a fluid graduation between exercises used during specific blocks of training. For instance, the slalom athletes typically execute power cleans from mid-thigh alongside clean pulls during a maximal strength-speed block in order to improve the technical proficiency and RFD of the power clean which is prescribed during the subsequent speed-strength block of training.

The prescription of blocks and the exercises used to promote the objective within each training phase is largely based on the competition schedule as well as the interpretation of results provided through the team's performance-monitoring system.

Performance Monitoring

Over the past Olympic quadrennial, a battery of tests has been used to measure the physical preparedness of USA Canoe and Kayak paddlers. These objective assessments coincide with the slalom-specific tests (e.g. time trials) in order to guide the programming process and ensure maximal transfer of the training effect.

For example, an emphasis has been placed on creating strong athletes while minimizing the addition of unnecessary body mass, especially in the lower limbs. If left unchecked, the accumulation of mass would lead to a "sinking boat" resulting in more drag, which ultimately requires the athlete to expend more energy during the acceleration components of the race. Therefore, morphologoical characteristics (body composition and girth measures) were collected at the end of each mesocycle using the ISAK (International Society for the Advancement of Kinanthropometry) protocol. This monitoring tool ensured athletes were graduating through training blocks while maintaining the necessary body shape and size necessary for competitive success.

In addition to body composition, developments in strength were assessed through the isometric mid-thigh pull (iMTP). This test requires athletes to assume an "athletic stance", indicative of the 2nd pull position in the power clean. From here, the athletes aggressively pull against an immovable barbell while "pushing" through force plates. This test not only allows the coaching staff to determine a paddler's maximal strength without compromise (often resulting from a breakdown in lifting technique), but also provides the opportunity to track changes in RFD at key time points. For instance, 50ms and 200ms were tracked as they are similar to the "time to strike" and "time to pull" respectively. Collectively, these variables provided greater insight into the athlete's strength reserve and how quickly they can call upon that strength during competition.

Finally, paddlers took part in a series of static and countermovement push-ups in order to assess reactive ability and power output. Specifically, each testing session included 2 push-ups from both static and countermovement conditions at loads 0kg, 5kg, and 10kg, for a total of 12 efforts on a dual force plate. Results from this monitoring tool afforded clarity on each athlete's power profile while shedding light on their weakness. In order to better understand the type of training needed to be prescribed in upcoming blocks, a percent (%) fall-off was calculated between loads (0kg-5kg, 5kg-10kg, 0kg-10kg). Alongside the iMTP results, the percent fall off between push-up loads and/or condition (static and countermovement) was used to justify the prescription of maximal strength, strength-speed (moving heavy loads quickly), or speed-strength (moving light loads quickly).

Conclusion

The purpose of training is to bolster the likelihood of race-day readiness and competitive success. While no coach or program ideology can guarantee success, the exposure to consistent, well-designed practices can increase physical preparedness and self-confidence that goes alongside the belief training was executed in a properly directed manner.

Through our efforts emphasizing the development of strong and powerful paddlers, the USA Canoe and Kayak National Slalom Team has continued to showcase improvements during key international competitions leading up the 2016 Rio Olympics. Specifically, the United States has recently won 3 gold medals at the 2015 Pan American Games (men's K1, men's C1, and C2) followed by a bronze medal at the 2015 World Championships in the K1 event. These performance outcomes coupled with the monitoring data suggest that American slalom is trending toward a strong showing this summer.