Physical Training Considerations for Ice Hockey

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The sport of ice hockey has many of the same physical demands required by other power sports. The main differences for ice hockey reside in the playing surface, biomechanics of skating, and the substitution patterns. These differences require special attention for optimally preparing an athlete for the competitive season. In order to prepare a player for the season effectively, it is necessary to have a thorough understanding of the specific demands of the sport.

Energy System Considerations

The energy system demands of ice hockey are unique from many sports due to the substitution patterns seen during gameplay. The game is played at a fast pace and players substitute “on the fly” during gameplay. This is in contrast to many sports including American football and basketball, where substitutions take place only during stoppages in play. Recent data from the National Hockey League (NHL) reports that forwards average shifts about 45 s in length while resting 57 – 90 s between shifts (8). This results in about 6 – 8 shifts per period for a player. It is estimated that players spend about 23 s in some form of high-intensity activity (sprinting, striding, skirmishing, etc.) during each shift (8). When looking at adenosine triphosphate (ATP) supply from individual energy systems, the phosphagen system is the dominant system for short, high-intensity activity lasting 0 – 30 s (4). After 20 – 30 s, the glycolytic system becomes the dominant supplier, while the oxidative or aerobic system supplies ATP for long duration, low-intensity activity (4). Comparing this information to the time and intensity demands of the hockey player, it can be inferred that the phosphagen and glycolytic systems supply the majority of ATP during a shift. During rest between shifts, the oxidative system is relied upon for clearance of hydrogen ions accumulated during anaerobic glycolysis and regeneration of ATP and creatine phosphate.

Research on the repeated sprint ability of ice hockey players suggests that maximal oxygen uptake (VO₂max), as determined on a skating treadmill, is associated with reduced fatigue during an on-ice test mimicking a game situation shift (8). An athlete with a large aerobic base may recover faster and more efficiently between repeated, high-intensity efforts, allowing them to skate harder and longer on the ice. It has also been reported that high-intensity interval training may improve ice hockey performance and is more beneficial for power sport athletes than tradition endurance training (6). It is important to train all three energy systems in order to maximize on-ice performance. Training sessions for the energy systems should take place with a specific adaptation in mind to maximize the desired adaptation without causing interfering adaptations (e.g., aerobic capacity versus anaerobic capacity). Training can be varied by utilizing different modes (e.g., skating, cycling, running, rowing, slideboard work, etc.), work times, rest times, and volumes.
STRENGTH CONSIDERATIONS
Skating requires powerful legs, strong hips, and a stable torso to allow efficient transfer of force from the body to the ice. Performance differences between lower and higher level hockey players of the same age group are suggested to be primarily due to disparities in rate of force development (RFD) (9). This could be because athletes rarely have enough time to produce maximal force in most sports movements (5). In theory, an ice hockey player with a greater RFD will therefore be faster and more powerful than one with a lower RFD. This highlights the importance of training RFD for ice hockey athletes.

A properly designed strength training program can potentially improve RFD for hockey players (9). A strength training program performed with proper instruction can help to improve coordination and motor unit recruitment allowing the athlete to increase their RFD (9). Advanced athletes will require progressively more advanced strength training to continue reaping the benefits of their training (2). For these advanced ice hockey athletes, greater focus should be given to explosive training to increase power and RFD. Power and RFD can be trained with many methods, including weight training with submaximal weights (40 – 80% one repetition maximum), plyometrics, sprinting, and Olympic-style weightlifting. Advanced athletes with sufficient levels of maximal strength can shift more of their training to focus on maximizing RFD and speed.

INJURY REDUCTION
In order to prepare a hockey player, it is important to understand common injuries and causes of injury in ice hockey. Injuries during competition cannot be fully prevented as many injuries occur because of the inherent contact in ice hockey. Research shows that over half of all injuries during a game are caused by contact (1,10). Injuries to the knee, shoulder, head (including concussions), and face are commonly caused from contact. The most common injuries occurring in practices are non-contact soft tissue injuries including strains of the hip and pelvic muscles (1). From this research, coaches can deduce strategies to prevent common injuries.

It is unlikely that injuries occurring from contact can be entirely prevented by any specific training. Concussions in sports are an important issue but there is limited research on proper prevention protocols. Training the muscles of the head and neck is commonly recommended by strength and conditioning coaches and athletic trainers as a method of concussion reduction (3). A comprehensive neck training program could consist of dynamic and static movements including but not limited to training all planes of motion consisting of flexion, extension, lateral flexion, and rotation. Hip and pelvic strains may be reduced by strengthening the hip flexors, extensors, abductors, and adductors. Along with strengthening, it is necessary to ensure ice hockey players have adequate hip mobility for all exercises in the weight room and for on-ice skating demands. Ensuring that the hips are both strong and mobile will allow the ice hockey athlete to perform proper and efficient skating mechanics on the ice (1,10).

PERIODIZATION
Implementation of a training program should be organized into a periodized model. Using a periodization model will allow the coach to plan specific phases for off-season, pre-season, in-season, and post-season training. There are many periodization models to use when designing a training program including linear, undulated, or block periodization (11). Once a periodization model is chosen, the coach designs macrocycles and microcycles planned around energy system and strength requirements. Figure 1 outlines a sample periodization annual plan for collegiate ice hockey players. It should be noted that each phase has a specific focus for training. During certain times of the year, a particular physical quality receives the majority of the training.

CONCLUSION
Ice hockey is a unique, physically demanding sport that requires periodized training to maximize performance and reduce injuries. A training program for ice hockey should take these demands into account, while specifically training the phosphagen and glycolytic energy systems. While no training program can guarantee that the ice hockey player will completely avoid injury, a well-designed training program may help in reducing the frequency and severity of injuries, as well as ensure that they are not physically outmatched on the ice.
REFERENCES

ABOUT THE AUTHOR
Dan Meinz is the Director of Strength and Conditioning at Velocity Hockey Center in Eden Prairie, MN. He has trained hockey players at all levels from the National Hockey League (NHL) down to youth. Meinz has additional strength and conditioning experience at the University of Michigan; University of Minnesota; Minnesota State University, Mankato; and the Performance Center at the National Strength and Conditioning Association (NSCA) World Headquarters in Colorado Springs, CO. He received his Bachelor or Arts in Health Fitness from Gustavus Adolphus College and his Master of Arts in Exercise Physiology from Minnesota State University, Mankato in 2013. He is a Certified Strength and Conditioning Specialist® (CSCS®) and Member of the NSCA.
FIGURE 1. ICE HOCKEY ANNUAL PLAN

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Recovery, Work Capacity, Strength, Power, Speed, Maintenance.