

SPORT-SPECIFIC CONDITIONING CONSULTANTS

'Sport-Specific Conditioning is our Focus, Performance is our Goal'

- PERFORMANCE NUTRITION - SPORT-SPECIFIC CONDITIONING - ATHLETE DEVELOPMENT - PERFORMANCE PSYCHOLOGY -

SPORT & EXERCISE SCIENCE

The Official Newsletter of Performance Training Systems Inc.

Vol. 1, No. 5

September 2010

Dear valued clients, partners, and training community,

The team at Performance Training Systems Inc. would like to continue thanking all of our newsletter recipients who responded via email and Facebook with their thoughts regarding our last issue; *Is there Doping in the CIS*. We encourage and welcome this feedback, and we are very confident by the interest our reader's have demonstrated in combating this reality, that performance enhancing drugs (PED's) are in Canadian sport. Performance Training Systems is committed to educating our clients and partners about the dangers of using PED's, and promoting Clean Sport values. Keeping sport clean, fair and fun is a responsibility we all share! The goal of this newsletter is to bring the 'Sport and Exercise Science' issues and concepts important to our clients and partners in a concise and educational format. Your feedback has suggested more sport-specific training program information, research reviews, and current topics.

In this Hockey issue we investigate training concepts that concentrate on Hockey performance, and injury prevention. We continue our look at Movement Screens – Part 2: The Forward Lunge, High Intensity Interval Training, the differences between elite and junior hockey players, hockey bioenergetics, and update you on PTS's 2010 Euro Summer Tour. Enjoy this issue, and let us know what you think!

High-Intensity Interval Training Improves the Lactate Threshold

Success in endurance-based sport can be affected by many factors; maximal aerobic capacity (VO_{2max}), economy of movement, and lactate threshold. When reviewing the literature, the lactate threshold, that is, the exercise intensity / workload, heart rate which results in lactate accumulation rate exceeding the metabolic rate. In other words, when the lactic acid concentrations, and muscle pH levels become so high they negatively impact performance. It is accepted, that the higher your lactate threshold, the greater your endurance capabilities. *Cont on pg 2...*

What's In This Issue:

- Welcome!
- PTS 2010 Euro Summer Tour
- Interval Training & The Lactate Threshold
- Movement Screens Part 2: The Forward Lunge
- Hockey Pre-Season: Specific Movement Assessment
- What factors differentiate between elite and junior hockey players?
- Bioenergetics for Hockey – A Time Motion Demand Assessment

CONTACT US

We want to hear from you! We want your suggestions. We want your feedback. Let us know what you think. Tell us at www.performancetrainingsystems.net

Performance Training Systems Inc. 2010 European Summer Tour

For 15 days this past August, PTS Founder and Director, Eric MacLean, M.ExiSci, CSCS, CEP, along with Performance Nutritionist Arwen Hodina, M.Sc. RD(c) toured parts of southern Germany, and northern Switzerland and Austria. In this, the 3rd successive summer tour, Eric & Arwen were able to meet with nutrition, sport science and athletic trainers in the German regions of Freiburg, Weil am Rhein, and Bavaria, and the in the Swiss city of Basel. The objectives of this tour were to increase the number and strength of amateur and professional contacts in these European regions, and to discuss and learn new strategies in athletic development. Following this trip, Performance Training Systems has now developed relationships with FC Freiburg (Bundesliga), PTSV Jahn (Athletics), ESV Freiburg (Soccer), and Weil - Friedlingen (Swiss Elite League Roller-Hockey).

One of the stand-out moments on this year's tour was a 3 hour observational tour of REHAB Basel, in Basel Switzerland. In this world class acquired spine and cranio-spinal injury rehabilitation clinic, PTS was exposed to techniques and methods in managing sport, and non-sport related spine and brain injuries. Performance Training Systems Inc is dedicated to providing our athletes with local as well as international opportunities. We take these annual trips in efforts of keeping current in the world of sport, and in efforts of providing our clients and athletes with international training and sporting opportunities. To find out how you can become involved in our European or international programs please contact us.



SPORT-SPECIFIC CONDITIONING CONSULTANTS

‘Sport-Specific Conditioning is our Focus, Performance is our Goal’

- PERFORMANCE NUTRITION - SPORT-SPECIFIC CONDITIONING - ATHLETE DEVELOPMENT- PERFORMANCE PSYCHOLOGY -



Eric MacLean, PTS Director, working with 15-16yr soccer players at ESV Freiburg, during PTS Euro Tour '10

Intervals and Lactate Threshold...

Recently researchers from Minnesota State University and the University of Wisconsin-Eau Claire examined the effects of integrating high-intensity interval training into the training practices of 20 physically active individuals. Subjects were randomly assigned into 1 of 2 treatments groups; 1 interval training session per week, or 2 interval sessions per week. All interval training was performed on a cycle ergometer at 110-120% of the subject's peak power (Watts) in a graded exercise test. All interval bouts were performed at a 1 to 7 work to rest ratio.

Post-training testing revealed both interval training interventions elevated the lactate threshold. It appears that there is a dose response, with the 2x per week training group resulting in a 3.9% greater increase in the %VO_{2max} that the lactate threshold occurs. Additionally, the 2 day per week intervention resulted in significantly greater increases in subject's work output at lactate threshold and overall peak work capacity.

Based upon this study it is clear that interval training can significantly elevate the lactate threshold and work capacity. It appears that 2 times per week results in a superior training response. While the results of this study clearly indicate that interval training is a powerful training tool it is important to note that further research is warranted in order to optimally integrate these training methods into the overall training plans utilized by athletes.

Pre-Season Conditioning: Hockey Specific Movement Analysis and Needs Assessment

For many Canadians, the days following the Civic long weekend mean 1 thing, and 1 thing only, the start of hockey season. For others, the hockey season never ended, rather, they were training in the off-season. Regardless of your training schedule, as a hockey player your season; training camp, or regular weekly pick-up game, is starting. With that, the smart and pro-active coach, parent or athlete, should focus on their, or their players physical preparation.

Hockey, like any sport, requires specific and focused training to provide optimal results and better performance. When developing a program for the competitive athlete, less focus should be placed on skill development, with an increased focus on injury prevention. A good place to start is to look at common hockey injuries.

The 3 main concerns related to common injuries on a specific hockey team are if the injuries are 1) contact or non-contact, 2) common to the athletes in the program, and 3) related to a common factor such as a previous training program. A movement analysis of hockey and of hockey players is important to determine how body positions and functional requirements impact the kinetic chain. Recognizing dysfunction is highly dependant on perspective.

Hockey players often have abnormal gait patterns that are compounded by restricted thoracic spine rotation, hip tightness, and a natural tendency to externally rotate their feet.

The likely cause of altered gait is from constant skating, mechanical compensations and restrictions that permit synergistic dominance, and turning off motor units (MU) within muscles that should operate as primary contributors to on-ice skills. By leaving these MU dormant, the athlete may still be successful, but will be limited and at an increased risk of injury.

The combination of altered gait patterns, the movement analysis, and injury research provides the starting point of the needs assessment. What follows is a brief overview of 3 specific needs that comprise the most essential requirements. If addressed with proper training and progression, attention to these areas should reduce the # of non-contact injuries, and enhance performance.

Specific Need #1: Thoracic spine rotation in spinal flexion

Adequate thoracic spine mobility may help alleviate lower back problems. If the thoracic spine is "locked up", the body will compensate through the lumbar spine. The lumbar region needs stability, which can be enhanced by maximizing range of motion (ROM). Currently it is popular to train thoracic movement through a variety of twists, lifts, chops and core rotational exercises. However it is important to ensure that the hockey player can rotate within spinal flexion.

Specific Need #2: Hip internal and external rotation in hip flexion

Quickness and reaction in many sports depend partly on ankle inversion and eversion. In hockey however, ankle movement is limited by the rigidity of the skate boot. Setting the blade on the ice, is therefore a function of hip rotation. Athletes could "muscle" through this restriction, but not efficiently and not without placing a high degree of torque on the knee. The hockey stance is in a position of hip flexion. A flexed hip changes the mobility and flexibility requirements of the hip joint and surrounding musculature when compared to upright standing. Further, the hip must be trained to accept internal and external rotation under tension. *Continued on pg 4...*

If you would like assistance in developing exercises or a training program for your hockey team, please contact us through our web page at www.performancetrainingsystems.net

Performance Training Systems is on the net.



SPORT-SPECIFIC CONDITIONING CONSULTANTS
 'Sport-Specific Conditioning is our Focus, Performance is our Goal'

- PERFORMANCE NUTRITION - SPORT-SPECIFIC CONDITIONING - ATHLETE DEVELOPMENT - PERFORMANCE PSYCHOLOGY -

Movement Screens: Part 2
The Forward Lunge

There was a time, a few years ago, that the author of this newsletter, Founder and Director of Performance Training Systems, Eric MacLean, contemplated and discussed PhD work. The following article reviews the concept of movement screens; individual or a series of standard movements that can be used to evaluate the biomechanical efficiency of an athlete's movement for the purpose of technique instruction and training progression. This concept is the focus of a previous colleagues', Matthew Kritz, PhD(c) research. This 2-part series will highlight the major findings of his work. The Body Squat and the Forward Lunge will be reviewed in this series, as they represent 2 essential components of a movement screen and should accompany any and all pre-training evaluation.

The concept of movement screens is based on the premise that optimal movement exists; that is, movement that occurs without pain or discomfort and involves proper joint alignment, muscle coordination, and posture. Next time you're at the gym, look around, how many people do you see training with free weights, and how many of them do you see using proper technique? Do you know what you are looking for? Do you know what proper movement technique is? Incorrect movement patterns directly lead to both acute and chronic joint and muscle pain, and are detrimental to training performance and competition, yet many recreational athletes do not know what to look for in assessing their movement.

Proper technique execution is the result of balanced contraction patterns between agonist and antagonist muscle groups, and balanced joint loading. When co-contracting muscle groups do not contract synergistically, *Continued middle.*

Dartfish Video Analysis
 Performance Training Systems uses Dartfish video analysis technology to screen and evaluate athletic movement. Contact us to book your evaluation, and watch how simple changes can enhance your speed, power, and athletic ability!

PERFORMANCE TRAINING SYSTEMS
We have your Training Needs Covered



DARTFISH 
 SEE. LEARN. SUCCEED.
www.performancetrainingsystems.net

Continued from left ... or do not move through proportionate ranges of motion (ROM), compensation forces are generated resulting in inefficient joint loading and compromised movement. The danger is that if these movements become habit, which is implied in the idea that movement is the product of 'schemes' (all movement is the result of programmed – frequency, amplitude and recruitment order – neurological muscle fibre contraction patterns), incorrect movement patterns will become the movement pattern of subconscious choice. Habitual incorrect movement will induce repetitive stress on the musculoskeletal and musculotendinous structures. Repeated exposure to improper joint loading will result in postural and joint strain, and leave the body at greater susceptibility to injury.

The forward lunge pattern is the most common lunge pattern exercise, exaggerates the movement that occurs in the lower body during the gait cycle. Given the relevance of the lunge pattern to sport, screening an athlete's ability to execute the lunge may have benefits. The following will attempt to review points of interest when teaching and evaluating the lunge movement.

Ankle Mobility

During the lunge, ankle mobility on both the lead and back legs is important for balance control. An inability to control ankle mobility has been identified as an injury mechanism. In or outward movement of the feet. *cont top right*

Dropping of the arch, lifting of the toes or heel are considered faulty. Any of these deviations from neutral are reported to increase force distribution across the knees and hip. It is believed that an increase in joint forces from poor biomechanical technique overstresses joint ligaments and tendons.

Knee Control

During the forward lunge, the knee of the front and back leg should be aligned with the hip and ankle during flexion and extension. The knee joint is a modified hinge joint made up of the tibiofemoral and patellofemoral joints, and is not designed to accommodate excessive mediolateral or anteroposterior movement. Proper lunge technique is to have the forward knee in a neutral position, aligned with the hip and ankle, not in a position of medio- or lateral rotation, or anterior relative to the ankle. When either of these movements occur it is thought to be the result of poor strength or activation of the rectus femoris, hamstrings, and hip adductor or abductor muscles. When the centre of mass appears to be moving forward (anterior) relative to the ankle, where the heel raises off the ground, there is less emphasis on hip mobility and increases patellofemoral shear force, and joint pain. There are many variables that have been associated with an inability to control knee alignment: weak or poor activation of the glutes, over or under developed quadriceps muscles, and poor mobility of the hips and ankles. A movement screen should include the lunge so that knee control can be checked and addressed as required.

Hip Mobility

The hip is a ball and socket joint capable of movement in all 3 planes, which functions to transmit forces between the lower body and the pelvis. During the forward lunge, mean hip ROM is reported to be 95+/-27° of flexion. Hip ROM can appear greater if pelvic and lumbar extension is allowed to take place. Forces at the hip joint are reported to be 1.25 and 1.31 times body weight during the down and upward phases of the movement. When an athlete performs a lunge the hips should remain parallel with the ground, there should be no mediolateral rotation or lateral dropping of the hip. The hips should appear stable.

Lumbar Stability

The trunk should remain vertical with the lumbar spine in a neutral position. Lunging with an external load an excessive lumbar extension has been reported to increase compression forces in the back. Load progression should be based on trunk and lumbar stability.

Head Position

There is no research directly investigating ideal head position, however, a neutral position keeps everything in the kinetic chain inline, so this is what is recommended. Kritz et al. Using the Body Weight Forward Lunge to Screen an Athlete's Lunge Pattern. *Strength & Conditioning Journal*. 2009. 31(6). 15-24.

SPORT-SPECIFIC CONDITIONING CONSULTANTS

'Sport-Specific Conditioning is our Focus, Performance is our Goal'

- PERFORMANCE NUTRITION - SPORT-SPECIFIC CONDITIONING - ATHLETE DEVELOPMENT - PERFORMANCE PSYCHOLOGY -

What Factors Differentiate Between Elite & Junior Elite Ice Hockey Players?

Recently researchers at the University of Technology in Trondheim, Norway, investigated the strength and endurance characteristics of 18 elite and 21 junior elite ice hockey players. Over a period of 3 weeks the players went through a battery of physiological tests to determine maximal strength (1RM for Bench Press and Back Squat), aerobic power (VO₂max), vertical jump performance (counter movement jump "CMJ"), weighted vertical jump (CMJ with 50kg weight), and sprint performances (10m & 40m).

The 'elite' players were +6.6yrs older, on average had body masses that were 11.1kg heavier, and exhibited significantly greater muscle strength than the junior elite players. When evaluating the strength differences, the elite group had greater absolute (200kg vs. 140.3kg), and relative compared to body weight (2.4 to 1.9) back squat strength, and had greater absolute upper body strength. Relative to body weight bench press strength was similar between groups.

The elite players displayed significantly higher measures of aerobic power, and higher CMJ. When looking at the force-time curve characteristics of the elite hockey players, it was noted that they generated significantly higher peak force values than the junior elite players. When looking at the sprint performances, the elite players were faster in 10m sprint times, while the 40m split times were not significantly different between groups.

Based upon the findings of this current study it appears that lower body strength and power play a major role in dictating the performance capacity of ice hockey players. This data suggests that strength and conditioning programs use methodologies that enhance lower body power. Overall, it seems the back squat and lower body plyometric exercises enhance physiological preparation for ice hockey.

Hoff, J et al. (2005). Strength and Endurance Differences Between Elite and Junior Elite Ice Hockey Players: The Importance of Allometric Scaling. *International Journal of Sport Medicine*, 26:537-541

Energetics: Ice Hockey

Time motion and physiological demands analysis indicates that a typical shift in a hockey game last 30-80 seconds, followed by 4-5 mins (including stoppage time) of active recovery.

Considering positional differences, defensemen play close to 50% of a game, while forwards play 35% of the time, with a work to rest ratio of 1:3.5 - 1:8. This data indicates that hockey is powered transitionally between aerobic and anaerobic energy pathways.

Montgomery, and Twist & Rhodes report that peak on-ice heart rates (HR) exceed 90% of max, and average above 85% of max. Given these high HR's, oxidative metabolism cannot fully satisfy a hockey players energy demands. Hockey athletes require highly developed anaerobic glycolytic and phosphagen energy pathways. Seliger et al., and Green et al., have found that the anaerobic metabolism accounts for 69%, oxidative metabolism 31%, ice hockey energy demands.

Peter Twist reports that there is a large amount of variation in energy system utilization per player, based on differences in intragame intensities, level of competition, playing time, position, and individual conditioning.

The ATP-PC, and the glycolytic energy system's ATP production peaks after 10-45 seconds, and provides energy for shifts lasting an average of 45 seconds. Shifts lasting longer than 45 seconds are characteristic of fatiguing musculature, and representative of an inverse performance relationship. As ATP production continues to rely on the glycolytic pathway, lactate and hydrogen ion concentration increase, contributing to increased fatigue and decreased performance.

The importance of a well developed aerobic system in ice hockey is demonstrated by a decreased recovery time between shifts *cont top right...*

Hockey assessment cont...

Specific Need #3:

Dynamic Scapular stability for shoulder mobility

The shoulder is a joint unlike any other. It is basically a ball (head of the humerus) being held against a plate (scapula) by a web of muscles tendons and ligaments. You cannot look at shoulder ROM without looking at scapula mobility. The scapula should elevate, depress, protract, retract, wing, tip, and rotate up or downward. When training the shoulder it must be approached by targeting scapulo-thoracic movements in a kinetic chain. That is using varies vectored resistance with scapula movements to train the scapula to move with the humerus.

PTS Fall Running Series

Are you running this fall? 5k, 10k, ½ or full? Need a boost to get across that line for a PB time? Let PTS help, and join our running series. Training programs, nutrition tips, and recovery advice. Email us today!

Continued from bottom left... and by reduced fatigue in the latter stages of a game.

Twist and Rhodes report that forwards require a higher recovery time and play less shifts that defensemen due to the tasks they perform; they cover more surface area, are required to change directions and generate increases in skating velocity more frequently than defensemen. While they report that defensemen engage in similar activities, with similar intensities, the difference in frequency of the demands, necessitates forwards play less shifts, and recover longer.

The training hockey player, coach or parent should consider the specific game and athletic profile when developing their pre-season conditioning plan.

Consider your level of play, positional and physical demands, and try to mimic those demands in your training program.

When attempting to train your energy systems, high intensity intervals, as discussed on page 1 of this issue, should be the strength of your program. Vary the work to rest intervals throughout the session and throughout the program so that you progressively place greater stress on your system. Do this well, and you'll be skating harder, and longer, and you'll be looking to score, not the for the bench.

If you would like more information on hockey training and pre-, or in-season conditioning please contact our Director of Athletic Conditioning at eric@performancetrainingsystems.net

If you would like more information on the physiological demands of ice hockey, you can download a full report from our web page at <http://www.performancetrainingsystems.net/Resources/Hockey%20Paper%20-%20Final.pdf>

PTS CONSULTING

PTS offers a unique consulting service utilizing social medias (Skype, Facebook, email) to deliver our training programs. Any training goals, any time of day, any where in the world, as your Performance Trainers, we are connected to you and your training.



PTS CONSULTING