Ultimate Hockey Training

Transforming Effort Into Ability

Kevin Neeld

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Table of Contents

Acknowledgements

A project of this magnitude would not have been possible without the help of others. From the development of training philosophies and methodologies to editing, revising, and producing the final product, I am indebted in gratitude to everyone whose support was influential in the creation of *Ultimate Hockey Training*.

I have been fortunate to be able to call some of the world's most influential and forward-thinking coaches in athletic development my mentors. In this light, I owe a special thank you to Michael Boyle and Eric Cressey, whose teachings continue to be foundational in my understanding of human movement and performance enhancement and therefore for many of the ideas in this book, and whose continued support and guidance has been invaluable.

I've also benefited greatly from the incredible minds of Chris Boyko (Amherst College), Brijesh Patel (Quinnipiac University), Mike Potenza (San Jose Sharks), Sean Skahan (Anaheim Ducks), Jim Snider (University of Wisconsin), Darryl Nelson (US NTDP), and Rob McLean (Colorado Avalanche), each of whom I consider both a mentor and a friend.

The publishing of this book was made possible by the collective wisdom of David Kavanaugh and Thomas Reale, who provided relentless support throughout the process.

The assistance of Jared Beach, David Lasnier, Matt Siniscalchi, and Karl Kurtz, my team at Endeavor Sports Performance, was integral in providing me with both the time to write and comments to improve the quality of the work. I also owe Karl Kurtz a special thank you for his tireless work on ensuring that the images and graphics associated with *Ultimate Hockey Training* accurately portray the intended experience.

Lastly, I offer my most sincere thank you to my loving girlfriend and best friend Emily Lewis, for being a source of interminable inspiration. I couldn't imagine life without you.

Understanding The Process

When I started my hockey career I was fat, slow, and impressively mediocre. I was fortunate to train under and play for some great coaches. I was also fortunate to come across a few people (coaches, teammates, family, and friends) that truly believed in me and convinced me to believe in myself. My career ended with me being the only Captain, but one of many leaders that took the University of Delaware to the Final 4, the second best finish in school history (at that time). What's amazing about my story is how un-amazing it really is. Every year thousands of players recreate themselves by focusing on a specific goal and working tirelessly to achieve it.

If you're a player and you're reading this, I commend you for being proactive about your development. Your attitude will undoubtedly lead you to success throughout other aspects of your life. It's important to me that you know that you are capable of anything you truly dedicate yourself to. Genetics plays a role in maximal limitations, but if you approach your training (and every life situation) with a success orientation and ferocious tenacity, and surround yourself with people that do the same, you will find yourself achieving levels of excellence you only dreamed possible.

If you're a coach and you're reading this, I urge you to be the type that encourages every player you come in contact with, regardless of their ability at the time you meet them. I've worked with players that were small town standouts and rapidly become international stars; I've worked with players that were told they would never have a career in hockey that went on to sign professional contracts; and I've worked with players that were deemed unfit for elite college hockey who went on to make NCAA Division I rosters. Anything is possible for any player. I'd rather be the one coach that tells them they can, instead of one of many coaches that tells them (verbally or otherwise) they can't.

The Endeavor Difference

At this time, I currently work as the Director of Athletic Development at Endeavor Sports Performance in New Jersey. I'm fortunate to work with hundreds of hockey players throughout the year from the youth to professional levels. Endeavor is a unique training environment in that we're a "private" training facility, meaning we see players for a wide range of times (from a few weeks to a few years) depending on the situation. I'm fortunate in that I work out of a 12,000 square foot facility and have outstanding resources I can use to train my players, including, but not limited to a skating treadmill, 25-yard track, slideboards, medicine balls, BOSU balls, trap bars, sleds, cable columns, Olympic platforms. I also have complete control over what goes into our hockey training programs.

As I continue to gain experience in this industry it becomes increasingly evident that programs are highly dependent upon each strength and conditioning coach's (or, as I like to think of us, athletic development coaches) situation and environment. Intuitively I think I've always known that, but it didn't stop me from instantly judging a program that I thought was subpar. I write programs the way I do and have developed my hockey development philosophy based on the athletes I see in my situation. Your situation will undoubtedly be different. You may:

1) Not have access to the same equipment or space
2) Work with athletes with a better training background, which typically aren't as reliant on progressions, but need a greater focus on variety
3) Have guaranteed access to your athletes year-round
4) Need to answer to a management team that requires you do design your programs in certain ways to meet their needs.

You get the picture. As you read through this book, I encourage you to keep these differences in mind. Where appropriate, I'll do my best to describe how I may do things differently in different situations. Ultimately, I'd like you to examine your own situation, consider the information and training concepts I discuss throughout the book, and implement the strategies that you feel will give you the best chance for success.

*Throughout the book, I will refer to an individual hockey player as "he". This is not to undermine the incredible growth and success of female hockey, only to be consistent grammatically.

The Hockey Training Revolution

We're in the middle of a revolution. Sports training, or strength and conditioning, originated from applying body-building and powerlifting concepts to athletes. Football was the first sport to truly embrace the benefits of a strength and conditioning program, and as a result, many so-called sport-specific training programs today are heavily influenced by football-specific strategies. Secondary to this influence, many professionals in the strength and conditioning industry were former football players and, consequently, were primarily familiar with the training strategies they experienced as athletes.

As I have the opportunity to work with more and more elite level hockey players, it becomes increasingly clear that the hockey development industry is in a transitional period. The number of strength and conditioning coaches, like myself, that come from a playing and/or coaching background continues to grow. This growth parallels the increasing awareness of the individual needs, not just of specific sporting populations, but also of specific individuals within a sport. The outcome is a more intelligent, effective training approach from an industry that doesn't just understand the game of hockey from an educational stand-point, but has personally endured the arduous nature of the sport.

A well-designed training program, when combined with dedication and effort, has the ability to completely transform a player, sometimes in as little as one off-season. This can help players that lack the rapid skill acquisition and creativity that we associate with super stars that compete at the highest levels because of their superior physical development. Naturally, there is a "gift" aspect of physical development as well, but training can improve any player's physical capacity and therefore allow them to compete at levels they may not have had a shot at otherwise. Interestingly, there seems to be a growth in the number of exceptional talents that also possess admirable work ethic. These players are exactly what hockey needs. They are actively expanding the possibilities of hockey performance and largely responsible for the improved popularity of the sport worldwide.

The purpose of this book is to present the training techniques and progressions that most effectively create high performing, injury-resistant hockey players. In the ensuing chapters you'll discover everything from the functional framework from which hockey performance is built to how the nervous system functions to control speed, strength, and power to specific program design strategies hockey players should use throughout the year.

Hockey training is only now starting to break free from the foundational sports training influences of bodybuilding, powerlifting, and football. The information in this book will help you become an authority and leader in the movement toward advanced development hockey training.

Lifelong Hockey Development

One of the most common questions hockey players, parents, and coaches ask is:

"How young is too young to start training?"

The answer surprises most people. There is a preconceived idea that hockey players shouldn't start training until they're 13. Once he turns 13, THEN he can start lifting. This mythical age requirement has persisted for decades, as if the first day as a teenager holds some magical marker of development.

Does this make sense though? It is commonly acknowledged that hockey players develop at different rates. Some players will hit growth spurts when they're 11 years old, others at 17. Some develop motor skills and general coordination at 7 years old, others at 14. An absolute age just doesn't seem to be the best marker of physical readiness to train.

The research in this area says children can start doing some form of resistance training at the age of 6!

While reading this research, it was surprising to learn that fractured growth plates and stunted growth is completely unsupported. It's one of those long-standing myths that people have come to accept as true, but really isn't backed by anything except speculative theory. It's certainly scary when you think about how many people have steered away from training because of this "theory".

For the average young player, six may still seem too young to start training, and probably is, but consider this:

While running, ground reaction forces (which matches the amount of force a person puts into the ground) can exceed 3 times a person's body weight.

This means that forces in excess of three times the child's body weight need to be absorbed with every running stride! Forces at the ankle, knee, and hip joint can be even higher. The truth is that all movement is a form of resistance training. While the impact forces will be lower in a primarily horizontal movement like skating, it's still likely that a well-structured resistance training program will put LESS stress on the body than a youth game of hockey (and injury rates in lifting are actually lower than in most youth sports).

In reality, the appropriate age for a hockey player to start training has more to do with social maturity than physical maturity. If a player is mature enough to follow instructions and grasp the importance of proper movement patterns, he is probably physically and mentally able to train.

Younger players tend to perform better in a one-on-one setting or in very small group training environment (4 or less). Larger groups can be more distracting, as players are more inclined to goof off rather than maintain focus on proper technique cues from the athletic development coach. With that said, this is the most difficult age to get players in isolated settings, and for good reason. Michael Boyle, one of the world's leading experts in hockey player development, has been outspoken about not applying adult values to kids. It is difficult to structure a training program for young players that doesn't cross this boundary, while maintaining the dedication, focus, and structure required to excel in a hockey training program. To avoid misinterpretation, structure in youth hockey or with youth hockey players is purposeful. This is a necessary aspect of human development, as well as an essential aspect of hockey player development. Instead, the focus with younger players should be on having fun and developing leadership and teamwork skills, more so than emphasizing strength and speed improvements.

As mentioned previously, age guidelines are somewhat arbitrary because of differences in psychological and physical maturity. With that said, youth hockey programs still break down teams by ages and birth years, so providing general guidelines based on these ages seems appropriate. Ultimately, it's up to the coaches, players, parents, and athletic development coaches to decide what is best for the athletes' situation. The following section includes basic guidelines as to what players at specific ages should be focusing on in order to maximize their long-term development.

Hockey Development Model

Age Group: U-12

Development Guidelines

1) Participate in 2-3 different sports with distinct off-seasons
2) Emphasis should be on having fun with friends, developing leadership and teamwork skills
3) Incorporate other outdoor activities into daily lifestyle (e.g. riding a bike, rollerblading, hiking, playing tag, run the bases, capture the flag, etc.)

Off-Ice Training Guidelines

Off-ice hockey training programs, if present at all, should be limited to 1-2 sessions per week for ~30 minutes. It is appropriate to introduce basic 5-10 minute dynamic warm-ups at this stage that consist of movements like shuffles, cariocas, butt kickers, high knees, skips, back pedaling, and jogging.

The “training” should be based on small area games designed to emphasize a variety of movement patterns and strategies. The goal of the training is to improve the “movement library” of the players by creating an environment that causes the players to have to both proactively and reactively move in multiple directions (forward, backward, lateral, and diagonal) using a variety of transitional strategies. At this age, the players’ nervous systems are highly adaptive and will soak up new movement patterns like a sponge. This gives them a solid athletic foundation to build from in the future and minimizes the risk of early overuse/under-recovery injuries that a “strictly hockey” focus leads to. The possibilities are limitless, but running mini 3-on-3 soccer, flag football, or ultimate Frisbee tournaments fit the above requirements well.

Age Group: 13-16

Development Guidelines

1) Continue to participate in 2 different sports with distinct off-seasons
2) Emphasis should be on developing overall athleticism, with an increased emphasis on sport-specific skills
3) Appropriate to introduce a comprehensive hockey training program

Off-Ice Training Guidelines

Hockey training programs should consist of 1-2 sessions per week in-season, and 2-4 sessions per week in the off-season. The initial emphasis should be on learning efficient movement patterns and proper lifting technique. This includes teaching things like acceleration technique, lower body and hip positioning in transitional movement patterns, and hip initiated rotational movement. As players begin to master technique in basic patterns and lifting movements (e.g. squats, deadlifts, reverse lunges, back leg raised split squats, push-ups, rowing, chin-ups, front planks, side planks, glute bridges, and belly presses), it's appropriate to move on to more advanced progressions of single leg lifts and Olympic lift variations.

Age Group: 17+

Development Guidelines

1) Specialization in only hockey is okay
2) Emphasis on maximizing sport-specific skill through increased practice time dedicated to on-ice skill improvement
3) Advanced level year-round hockey training program

Off-Ice Training Guidelines

At this point, players are ready for year-round hockey training programs that truly begin to push them toward their maximal athletic capacity. Programs should consist of 2 sessions per week in-season, and 4 sessions per week in the off-season. If the above progression is followed, players will already possess technical mastery in most movements and lifts. This will allow the training to have an increased emphasis on maximal power, strength, and conditioning.

The astute reader will notice that, after a longwinded discussion on the limitations of the generic recommendation that players should not train until they're 13, the model above introduces training around a similar time. The major difference between the typical recommendation and the development model listed above is that the former is based on a fabricated fear of injury, while the latter is based on typical psychological and physical readiness. As mentioned previously, the absolute age a hockey player should begin to train is highly dependant upon the individual's maturity and the environment in which he is able to start training (e.g. A 12 year old should not start lifting on his own).

The goal of training is to maximize athleticism to allow players to fulfill their potential and compete at the highest level possible. If regimented training is introduced too early, many players will burn out from the over-commitment, and never realize their full potential. If training is introduced too late, players may miss an opportunity to create sound training habits and movement patterns, thus leading to a rush to add strength and power to a shaky foundation. The key is to introduce training slowly and only progress when the athlete has demonstrated the technical mastery, as well as the physical and psychological maturity necessary to succeed at the next level.

Furthermore, the two most common mistakes today's hockey players make are specializing in only hockey at a young age and playing hockey year-round. It may seem counterintuitive that these are "mistakes", but these two trends in hockey development have led to an epidemic of burnout and injuries that are in fact easily prevented. Both early specialization and year-round playing accelerate the rate at which players develop overuse/under-recovery injuries. Evidence exists in thousands of players between the ages of 12-18 that are suffering from chronic groin and/or hip flexor strains. These specific injuries were few and far between a decade ago. Essentially the trend has been to replace preparation time with competition time. In order to correct this trend, a push toward increasing preparation time and creating distinct off-seasons from hockey must occur. The development models above provide a good starting place.

Discovering Hockey Function

Every second of every shift in every period counts. Many games are won or lost buy a single goal, which can often result from a single mistake made by a single player. Mental breakdowns are undesirable, but physical breakdowns are unacceptable. If every player dedicates the appropriate time and energy to his training, physical breakdowns should not be a concern.

Hockey necessitates a unique set of physical demands. At times, efficiency is a main priority in the interest of longevity. Using unnecessary energy will result in lower performance levels toward the end of a shift, which could be costly. At other times, efficiency takes a back seat to an absolute task outcome. When a player dives to block a shot from going into an empty net, the efficiency at which his neuromuscular system propels him forward is less important than his effectiveness in blocking the shot. In all scenarios, it is of paramount importance that the hockey player's body is working in synergy, and not fighting against self-imposed limitations.

Human movement, and therefore hockey performance, can be understood by utilizing three functional concepts:

1) Joint-By-Joint Approach to Training
2) Anatomy Trains
3) Task Demands

The main purpose of outlining these three "functional frameworks" is to demonstrate the importance of removing isolated physical limitations in order to maximize integrated performance. An impairment in thoracic rotation, an example commonly used throughout this chapter, will cause limitations not just in spine and shoulder function, but will affect every joint and muscle throughout the body and the movement strategies used to accomplish a given task.

Let's explore each one of these functional concepts in more detail.

The Joint-By-Joint Approach

The "Joint-By-Joint Approach" (hereon referred to as JBJA), was developed and popularized by world-renowned hockey strength and conditioning coach Michael Boyle and physical therapist Gray Cook. Starting from the ground-up, the JBJA describes how the body has joints alternating in emphasis regarding whether they typically need to be trained for improved mobility or improved stability. The chart below presents specific details on which joints need mobility (or range of motion; ROM) and which need stability.

Mobility	Stability
Ankle Joint	Knee Joint
Hip Joint	Lumbar Region
Thoracic Region	Scapulothoracic Joint
Glenohumeral Joint	Elbow Joint

If you read the chart from left to right, you'll notice that these joints alternate from the ground up: Ankle -> Knee -> Hip -> Lumbar (Low Back) -> Thoracic (Upper Back) -> Scapulothoracic (Shoulder Blades) -> Glenohumeral (Shoulder Joint) -> Elbow. It's important to understand that this is just a theoretical framework to understand human movement, not an absolute prescription for training. For example, it's possible to have a hypermobile glenomueral joint (e.g. excessive range of motion through the shoulder), which could increase a hockey player's risk of injury. The JBJA serves two major purposes:

1) It brings awareness to the idea that every joint has specific mobility AND stability needs in order to function properly
2) It demonstrates how limitations in one area can cause compensations in others

Every joint falls somewhere on a mobility-stability continuum. As an example, consider the lumbar region. Each segment of the lumbar spine has about 2-4° of rotation range of motion for a total of about 13° of total rotational capacity. In contrast, the thoracic spine has in excess of 70° of rotation ROM, and each hip has about 30-50° in both internal and external rotation. From this viewpoint, it's obvious that we should be emphasizing rotation through the hips and thoracic spine and not through the lumbar spine. Failure to do so could result in excessive rotation through the lumbar spine, which can cause a number of disc and spinal bone issues. This fits well into the Mobility-Stability Table above.

This information has been misinterpreted by some to indicate that athletes should not rotate through the lumbar spine at all. While it is important not to emphasize or force rotation past end range of lumbar complex, using the allowable motion through that region is absolutely essential to efficient movement. The key is to stay within the confines of the joint and to use the neuromuscular system to control the movement. Referring back to the continuum, note that joints that require a high level of mobility, such as the glenohumeral or shoulder joint, necessitate a requisite level of stability. When stability is comprised, excess forces tend to be absorbed by the joint and surrounding ligaments. As a result, these structures can become damaged. Ligament damage (overstretching or tearing) increases joint laxity, which by definition improves mobility. However, this mobility comes at the expense of necessary structural stability and increases the risk of subsequent injury to that joint.

To expand on the latter point, if a joint in the mobility column has sub-optimal mobility, another joint will need to “fill in the gap” by providing additional range of motion. This compensatory movement usually occurs at the next joint up. As previously alluded to, a lack of rotation through the hips can lead to excessive rotation through the lumbar spine, which is one source of back pain in hockey players. Following this idea, refer back to the table and take notice that mobility restrictions in the left column lead to compensatory movements (and probable soft-tissue damage and injury) to the joints in the right column.

Anatomy Trains

In 2001, Thomas Myers authored the book Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists. For everyone working in the athletic development industry, this is a must-read. Myers brilliantly outlines seven anatomical networks within the body (Superficial Back Line, Superficial Front Line, Lateral Line, Spiral Line, Arm Lines, Functional Lines, and Deep Front Line), explaining their role in both posture and movement. Contrary to the isolation approach used to teach introductory anatomy classes in most educational systems, Anatomy Trains highlights the interconnectedness of muscles through a soft-tissue network referred to as fascia. Myers emphasizes that one should not think of the body as having muscles that connect to bones to produce isolated movements, but as an interconnected fascial network with muscles in fascial sacs. A simple way to picture this is to think of someone wearing a wetsuit. If he was to reach across his body, the wetsuit would stretch in some locations and shorten or bunch in others. This is a crude demonstration of how stresses are relayed across fascial networks during movement.

The Anatomy Trains approach demonstrates how any performance goal, whether static or dynamic, is dependent upon the cohesive performance of functional units of muscle and the surrounding tissue. It also provides theoretical evidence for direct anatomical connections between seemingly remote muscles. As an example, Myers asks that his readers stand up and attempt to touch their toes in a typical "hamstring stretch" movement. After noting how far they could reach, he has them roll the bottom of each one of their feet on a tennis ball, a method used to release tension in the fascial system (more on this later). After rolling for one minute on each foot, he asks them to attempt to touch their toes again. Remarkably, people tend to stretch considerably further. The idea is that the tension release occurring in the plantar fascia on the underside of the foot releases tension throughout the entire "Superficial Back Line", which extends up the backside of the body through the hamstrings, spinal erectors, and ultimately around the scalp to the eyebrow ridge on the front of the head.

In this framework, tension in the foot could manifest in pain or functional limitations anywhere along the backside of the body. The other "lines" or myofascial meridians present a similar interconnectedness and consequent interdependence of remote muscles.

Task Demands

In contrast, or more appropriately, in harmony with the idea of direct anatomical connections between joints and muscles through the fascial system, there is also a functional connectedness between muscles and joints based on task demands. This concept is theoretically simple, but has profound implications. Imagine that a right-handed defenseman is just inside the blue line, directly inline with the net, facing his partner in anticipation of a one-timer pass. If the shooter's stick is cocked back fully, he will need to rotate roughly 180° to follow through with his stick in a direction to put the shot on net. For the purposes of this example, let's assume that his feet do not move. This means that he'll need to find 180° of rotation through his arms, shoulders, spine, hips, knees, and ankles. If this player has a significant limitation in thoracic rotation, he'll need to compensate for that by increasing the amount of rotation in another area of his body. As discussed in the JBJA, the adjacent joint or joint complex is the most likely culprit, but rarely the only party involved. In this example, he'll likely look to his left hip for more internal rotation ROM as the pelvis will need to rotate more on top of the femur to allow the torso above it to achieve the task goal. If the hip reaches end range, he may need to steal more rotation through his left knee.

In the above task example, a limitation in thoracic rotation ROM, may lead to excessive rotation at the left knee. The left knee is linked to the thoracic spine through a functional task demand. This is merely one example illustrating how interconnected and interdependent our joints and muscles are throughout our bodies. There are countless other examples within the game of hockey.

Unlocking Functional Movement With Self-Myofascial Release

The repetitive nature of hockey guarantees that at one time or another every player will suffer from some subjective feeling of muscular tightness. Typically, the first thing a player will do when he feels tight is stretch. Stretching may or may not be a desirable option depending on the cause of the tightness. As a few examples, let's consider muscular deficiencies, sub-threshold injuries, and myofascial restrictions.

Muscular Deficiency

A common deficiency that many hockey players face is a lack of strength and/or poor activation patterns of the psoas major, a hip flexor that has the best ability to flex the hip past 90°. If the psoas provides insufficient force, or adequate force at the wrong time, other hip flexors will have to take on the extra load to compensate. Two likely culprits are the tensor fascia lata (TFL, the thick chunk of meat you can grab toward the outer top portion of your thigh when you lift your leg) and the rectus femoris (one of the four quadriceps muscles that also functions as a hip flexor). Because the TFL and rectus femoris are required to perform this extra work while they are already in a shortened position at the hip, it is likely they will feel tight afterwards. Stretching could help alleviate the feeling of tightness, but if the psoas deficiency isn't addressed, you'll keep stretching/tightening yourself in circles. This example highlights the importance of addressing the causes of these problems, not just the symptoms.

Sub-Threshold Injury

Everyone suffers bumps, bruises, aches, and pains throughout the course of lives. Some of these injuries will necessitate medical attention, while others may be "sub-threshold". Sub-threshold refers to an injury that isn't severe enough to require medical attention, and, at least theoretically, should resolve on its own. Consider an athlete with a very slight medial meniscus tear (cartilage on the inner aspect of the knee). This player's body may naturally compensate for this injury by shifting weight off of the damaged meniscus while in static postures and during dynamic movements. As a result, the soft-tissue structures that cross the lateral aspect of the knee and function to prevent genu varum (an inward collapse of the knee), such as the IT Band, may begin to feel tight. Stretching, if effective, could alleviate the tightness, increase the load to the medial meniscus and ultimately increase the severity of the injury.

Myofascial Restriction

All structures within the body (namely bone, muscle, ligaments, and tendons) are wrapped and interconnected by a tissue known as fascia. Fascia serves multiple purposes, including relaying tension to adjacent structures, and circulating fluid and nutrients to other soft-tissue structures. Because fascia responds to the mechanical forces and neurological inputs placed across it, it is also capable of experiencing changes in length and stiffness. This is likely one of the reasons why some players just don't respond to stretching. Many times, the subjective tightness has to do with a myofascial restriction, which is best addressed through soft-tissue manipulation.

It's extremely important that hockey players take an active role in addressing both their soft-tissue length (commonly thought of as stretching) and soft-tissue quality (soft-tissue manipulation).

Soft-Tissue Manipulation Made Simple

When presenting this idea to players, parents, and coaches, most are unfamiliar with soft-tissue manipulation. To illustrate how it works, consider the following analogy:

Your muscles have elastic properties similar to a rubber band. Imagine taking a rubber band and stretching it a bit, then letting it return back to it's normal resting length. Get a feel for the length at which the rubber band starts to generate a resistance to stretching. Now think about tying a knot in the rubber band. Stretch it from both sides again. You'll notice now that the length at which it starts to generate resistance to stretching is shorter than it was previously. You'll also notice that the more you stretch it, the tighter the knot gets and the thinner and weaker the areas on both sides of the knot get. Furthermore, if you attempted to stretch the band now to the same maximal length achieved by the band before the knot was tied, you'll find that the band will tear.

This example illustrates what many players do when they stretch muscles without addressing soft-tissue quality. If you simply untie the knot in the rubber band (the analogy for soft-tissue manipulation), the overall length of the band will increase and it will elongate much more effectively and efficiently. Similarly, getting soft-tissue work done or performing self-myofascial release (SMR) using various implements as described below will improve the length and extensibility of the muscle without stretching it in the traditional sense. It can also cause players to respond better to stretching as the body stops guarding the area and allows the tissue to extend.

Professional Soft-Tissue Work

As a player's playing age increases, it becomes increasing vital that the player seek out a quality Active Release

Technique (A.R.T.) or Graston practitioner to get regular work done. “Regular” will be up to the practitioner’s determination, but in general players should start looking into this type of therapy in high school and go for regular maintenance visits at least once per month. This is truly the secret behind long-term injury-free excellence on the ice. In many cases, massage therapists will avoid the hip musculature for liability reasons, and therefore aren’t of much use for the purposes of focused tissue restoration (although the relaxation that comes from a good massage is still a major benefit!). As is the case with specialists in all professions, all manual therapists are not created equally. It is worth asking around for a recommendation from other players that have had successful treatment. If the manual therapist is also a chiropractor or physical therapist, he or she can usually bill through insurance, which cuts down on out of pocket expenses. In addition to getting professional work done, players should perform self-myofascial release work on a regular basis.

Self-Myofascial Release

Self-myofascial release refers to a player performing soft-tissue manipulation on himself. To accomplish this, a variety of implements need to be used, ranging in density and surface area or how focused the stress is. Certain implements lend themselves better to certain areas of the body depending on the size and shape of the soft-tissue structure(s) to be manipulated. To give you a basic idea of differences in density and surface area, we’ll use a scale from 1-4 to denote differences in the implement, with 1 being the least dense or least focal and 4 being the most dense and most focal.

Implement	Density	Surface Area
Basic Foam Roller	1	1
PB Elite Foam Roller	3	1
PVC Pipe	4	2
3kg Med Ball	2	2
4kg Med Ball	3	2
Tennis Ball	2	3
Lacrosse Ball	4	3
Golf Ball	4	4

Denser and more focused implements are able to reach deeper tissues. The above table provides built-in progressions as a player's body adapts to this type of stimulus.

SMR Implement Progressions

1) Basic Foam Roller -> PB Elite Foam Roller -> PVC Pipe
2) 3kg Med Ball -> 4kg Med Ball (based on Perform Better's Med Balls)
3) Tennis Ball -> Lacrosse Ball -> Golf Ball

With all of these implements, the goal is to use them to "iron" out knots or trigger points along the length of a specific muscle or muscle group. The best results will typically occur while through a full range of motion for each area, followed by troubleshooting specific areas of tightness. As a general rule, aim to perform 10-12 rolls or around 20-30s of rolling for each area.

Because SMR is meant to help provide more efficient and effective extensibility of your muscles and surrounding structures, it is best to perform this work prior to your training, practices, and games. As is often the case, if the player feels tight and restricted following training, practices, and games, it would be a good idea to roll again following the particular activity. The list below presents the areas that most hockey players should focus on for their SMR work.

Once a player becomes proficient in each of these techniques, he can focus the majority of his SMR time on the techniques that most directly address his areas of individual tightness, while only hitting the other ones sporadically for maintenance.

Self-Myofascial Release Circuit

Foam Roll/PVC

1) Hip Flexor (TFL)
2) Front Thigh (With Knee Flexed 90°)
3) Front/Outside Thigh (Lateral Quad)
4) Outside Thigh (IT Band)
5) Inner Thigh (Hip Flexed 90°)
6) Butt (With Foot Crossed)
7) Lower Back (Along Each Side of Spine)
8) Inner Shoulder Blade (Rhomboids)
9) Outside Shoulder Blade/Lats

Demonstrating SMR of the outside thigh using a foam roller.

Med Ball

1) Chest (Thumb Up)
2) Outer Back Thigh (High Lateral Hamstrings)
3) Inner Back Thigh (High Adductors)

Demonstrating SMR of the outer back thigh using a medicine ball.

Lacrosse/Tennis Ball

1) Bottom Foot
2) Outer Back Lower Leg
3) Posterior Shoulder

Demonstrating SMR of the outer back lower leg using a lacrosse ball.

Innovative Dynamic Warm-Ups

It's time for a paradigm shift. Like too many other aspects of hockey training, the traditional "jog and stretch" warm-up persists today amongst many organizations strictly because it was what players did in the past. The major goals of a dynamic warm-up are to minimize injury risk and improve subsequent performance. The traditional warm-up falls short in accomplishing both of these tasks.

Jogging has long been used as the initial part of a warm-up because it provides the following benefits:

1) Increased heart rate
2) Increased circulatory rate
3) Increased respiratory rate
4) Increased body temperature

It's senseless to argue against these benefits, as these are all necessary and desired responses to a well-formed dynamic warm-up. With that said, jogging does not take any joint through a full range of motion and therefore does not reinforce neuromuscular control or soft-tissue extensibility through these ranges. Additionally, static stretching follows the warm-up jog the majority of the time. Essentially this set-up capitalizes on the heat-induced improvement in soft-tissue extensibility to give the allusion of an increased effectiveness of stretching. Unfortunately, this static stretching period also provides adequate time for your heart, circulatory and breathing rate to return to resting levels. Basically, the major benefits of the jog dissipate. This practice also places static stretching immediately before the main training activity. If the program is well-designed, this main activity will likely be a maximal intensity sprint or power exercise. There is substantial evidence that static stretching actually decreases performance if done immediately prior to speed and power efforts (more on this later). Moreover, there is NO evidence that static stretching has any effect on preventing injuries in subsequent activities; in fact, it may actually increase injury risk (Shrier, 1999; Witvrouw et al, 2004)!

In comparison, a well-designed dynamic warm-up will offer the following benefits:

1) Increased central nervous system excitability
2) Increased neural drive to working muscles and activation of “dormant” muscles
3) Increased neuromuscular control and coordination
4) Increased soft-tissue extensibility through a full ROM, especially of specific overly stiff muscles
5) Increased heart rate
6) Increased circulatory rate
7) Increased respiratory rate
8) Increased body temperature

Ultimately, the dynamic warm-up effectively accomplishes the purposes of the warm-up, to minimize injury risk and improve performance.

Coming back to the Joint-By-Joint Approach, the dynamic warm-up can be used to mobilize joints that typically need improved range of motion. More specifically, dynamic warm-ups should include multiplanar (e.g. movements that integrate front-back, side-side, and rotational motion) mobility exercises for the ankle, hip, thoracic spine, and glenohumeral joint, while emphasizing control of the foot, knee, lumbar spine, scapulae, and elbows. One limitation of joint mobility work is that the improvements in muscle extensibility and movement quality are short-term. Traditionally, dynamic warm-ups were designed so that all mobility work was performed together, and all activation work was performed after.

Strength and Conditioning Coach Nick Tumminello was the first to point out that it made more sense to pair a mobility exercise with an activation exercise to immediately reinforce the improved mobility with neural control. This is a fantastic idea and should be implemented whenever practical. Realistically, gains in mobility will not disappear within a minute or two. Occasionally for facility design reasons, it is easier to do a couple mobility exercises, usually for the same joint, in a row before moving on to an activation exercise. Still, it is important to come back to this mobility-activation pair concept. After going through a mobility-activation exercise for the major joints and controlling muscle groups within the body, it is beneficial to progress into more traditional dynamic warm-up exercises like shuffles, cariocas, butt kickers, high knees, skips, back pedaling, and jogging.

The following pages present three examples of dynamic warm-ups for hockey players.

Dynamic Warm-Up 1

Exercise	Reps/Distance
3-Way Ankle Mobilization (Toes on Wall)	(3x5)/side
Penguin Walk	25 yards
Quad Mobilization	8/side
Reverse Lunge w/ Rotation	8/side
Diagonal Hip Rock -> Step	6/side
Lateral Lunge w/ Instep Touch	8/side
Side Lying Diagonal Arm Arc	8/side
Side Lying Bow and Arrow	(5x5s)/side
Yoga Push-Up	8
Inverted Reach	8/side
Windmills	10/side
Side Shuffle	25 yards/side
Long Stride Carioca	25 yards/side
Butt Kickers	25 yards
Back Pedal	25 yards
¾ Speed Jog	25 yards/side
Side-to-Side Hops	20
Front-to-Back Hops	20

Dynamic Warm-Up 2

Exercise	Reps/Distance
Ankle Rock	8/side
3-Way Ankle Mobilization	(3x5)/side
Active Lateral Leg Swing	10/side
3-Way 1-Leg SLDL Rotations	(3x4)/side
3-Way Bowler SLDL	(3x4)/side
½ Kneeling Hip Flexor/Pec Mobilization	8/side
Super Dog	8/side
Lateral Kneeling Hamstring Mobilization	8/side
Rotational Lateral Squat	8/side
Arm Scissors	20
3-Way Split Squat Hold	(3x10s)/side
Side Shuffle	25 yards/side
Long Stride Carioca	25 yards/side
Butt Kickers	25 yards
Back Pedal	25 yards
¾ Speed Jog	25 yards/side
Side-to-Side Hops	20
Front-to-Back Hops	20

Dynamic Warm-Up 3

Exercise	Reps/Distance
3-Way Ankle Mobilization (Toes on Wall)	(3x5)/side
3-Way Opposite Leg Reach	(3x5)/side
Spiderman Lunge w/ Rotation	8/side
Diagonal Split Squat w/ Pec Mobilization	8/side
Reach, Roll, and Lift	8/side
Wide Stance Quadruped Rocking	8/side
Squat to Reach	8/side
Quad Stretch into Inverted Reach	8/side
Knee Hug w/ > 90° Hold	8/side
X-Pattern Arm Circles	20
Side Shuffle	25 yards/side
Long Stride Carioca	25 yards/side
Butt Kickers	25 yards
Back Pedal	25 yards
¾ Speed Jog	2 x 25 yards
Side-to-Side Hops	20
Front-to-Back Hops	20

Hockey players should perform some sort of dynamic warm-up before every practice, game, and training session. The warm-ups above tend to take about 20 minutes to go through the first time. Once the exercises become familiar to the athlete, these warm-ups will take around 10-12 minutes. During off-season training, advanced players may be following a four sessions per week training program that is divided into a lower body/upper body split. As a result, the question may arise as to whether they should be performing unique warm-ups more focused on their lower body some days and on their upper body others. Athletes will benefit most from warm-ups with a full body emphasis. The body adapts based on the frequency and intensity of the stimuli it is provided. Performing full body warm-ups four days per week consistently reinforces the desired mobility and stability necessary to maximize performance and minimize injury risk.

References:

1) Shrier, I. (1999). Stretching Before Exercise Does Not Reduce the Risk of Local Muscle Injury: A Critical Review of the Clinical and Basic Science Literature. *Clinical Journal of Sports Medicine*, 9, 221-227.
2) Witvrouw, E., Mahieu, N., Danneels, L., & McNair, P. (2004). Stretching and Injury Prevention: An Obscure Relationship. *Sports Medicine*, 34(7), 443-449.

Breakaway Hockey Speed

The first step toward training to develop game changing speed is to understand what factors contribute to speed. Whether on feet or skates, speed can be defined as:

Speed = Stride Length x Stride Frequency

Stride length is a combination of how far the striding leg pushes and how far the ensuing glide is with the stance leg before taking the next stride. As an example, think of pushing with your right leg and gliding on your left. Your stride length is the distance you travel from that single push alone before taking your next stride with the left leg.

Stride frequency is how quickly each foot turns over. To demonstrate a slow stride frequency, think of standing on the goal line and pushing with your right leg to glide on your left all the way to the blue line. Once you reach the blue line you'd push with your left leg and glide to the far blue line. Skating in this way, you'd have an incredibly slow stride frequency because you spent so much time on your glide leg before taking the next stride.

Improving either stride length OR stride frequency will help a hockey player become a faster skater. However, improving both will lead to larger improvements in skating speed than either quality alone.

Increasing stride length can be accomplished in two ways:

1) Getting down lower while skating
2) Increasing propulsive force

Let's address these one at a time.

How To Increase Stride Length

Almost all hockey players, especially younger players, stand up too tall while they skate. Having said that, lower is not always better. To help explain, take a look at the pictures below.

The set of pictures above demonstrates a tall skating stance. Note how short the stride length is.

This set of pictures demonstrates an optimal skating stance. Note how much longer the stride length is than the pictures above. A lot of coaches tell players to bend their knees further; in science terms this is known as increasing knee flexion. Telling players to bend their knees more is a pretty good coaching cue, but it's important to realize that increased knee bend also necessitates an increased bend at the hips; in science terms this is known as increasing hip flexion. Look at the two sets of pictures above again; do you see how both the knees AND hips are more flexed in the "optimal" skating position compared to the "tall" skating position?

As mentioned earlier, lower is not always better. Take a look at the pictures below to see why getting *extremely* low won't help a player skate faster.

Demonstrating Extreme Knee Flexion

Demonstrating Extreme Hip Flexion

As ridiculous as these pictures look, they demonstrate the point:

There is an optimal skating depth for each player based on his individual build and joint range of motion.

The second way to increase stride length is to increase the amount of propulsive force, or stride power, put into each stride. More simply, the harder the player pushes, the further he goes. Making a change to the skating stance can automatically lead to improved stride power.

The other major way to drastically improve stride power is to develop incredible strength in the hips and legs. Only recently have ice hockey players started to realize the incredible value of strength training for on-ice speed improvements. Skating requires single-leg stability (on the glide leg). In order to improve single leg stability, off-ice training should include single-leg exercises to help improve the strength of the muscles on the outside of the hip. When players develop the requisite strength to perform single-leg exercises correctly, the majority of their lower body strength work should be based around single-leg exercises (more on this later).

How To Increase Stride Frequency

While skating, the legs switch back and forth from a “stride leg” to a “glide leg”. Ultimately, stride frequency is limited by the rate at which a player can recover his stride leg back under his body.

In other words, the faster the stride leg recovers from the fully extended position to back under the body, the faster the next stride can be taken with the other leg. A common question may be, “Wouldn’t the speed at which the stride leg pushes back also affect stride frequency?” Absolutely! In most cases, hockey players do not have a problem pushing off quickly. No one sets off to race for a puck pushing at half speed, yet hockey players are rarely taught to focus on recovering their stride leg as quickly as possible.

While some resistance-band work to help reinforce a rapid stride leg return may be justified, it is far from necessary. Most players can make substantial improvements simply by consciously thinking about recovering their stride leg as quickly as possible. In other words, improving stride frequency is more cueing and practice oriented than training oriented. After consistent practice, the body will naturally recover the stride leg quickly without conscious effort.

<u>An Optimal Skating Stride Strategy?</u>

After discussing how to improve stride length and stride frequency, it is important to address a common mis-conception many coaches and player express:

“Long, powerful strides are more effective than short, choppy strides.”

In general there are two types of skaters: Those with long powerful strides and those with short choppy strides. Unfortunately, more often than not, the players with short, choppy strides are encourage to develop long, powerful strides when in fact their current stride pattern is serving them just fine. At every level, players with short choppy strides are usually some of the faster players on the ice. This leads to the question, *“Are long powerful strides more effective (e.g. generate more speed) than short choppy strides?”*

Interestingly, anecdotal evidence has repeatedly shown that both skating techniques can be equally effective. In other words, players can be fast while using both strategies. In fact, research supports that a wide range of postures and stride strategies can be used to generate maximal skating speeds (Allinger & Van Den Bogert, 1997).

At first, this may seem counterintuitive, but consider that long powerful strides result in a relatively lower stride frequency. Contrarily, short choppy strides result in a relatively higher stride frequency. Think of it like this:

Long Powerful Strides*:*

Stride Length x Stride Frequency = Speed

Short Choppy Strides:

Stride Length x **Stride Frequency** = Speed

Two different skating strategies lead to the same result.

At this point you may be wondering how this fits in with the “almost all hockey players stand up too tall while skating” comment made earlier. Remember that there is an "optimal" skating position for each individual. Most skaters with naturally short choppy strides are naturally tighter than skaters with long powerful strides and have a slightly higher optimal skating position. Understanding the player's body will go a long way in maximizing skating speed through proper technique.

Developing Proper Skating Technique

Regardless of skating proficiency (quality/appropriateness of skating technique), every player can get faster. However, many hockey players waste incredible amounts of energy in movements that do not actually help them get anywhere.

Absolute maximum skating speed will be heavily dependent on your skating technique efficiency.

Let's consider an analogy originally proposed by world-renowned Strength Coach Eric Cressey:

> Think of a player's skating technique as a glass, and his current level of speed as water in that glass. Imagine the glass if half full. By finding his optimal skating depth, increasing his stride power through effective resistance training exercises, and increasing his stride leg recovery rate, the player can fill his glass to the top with water (maximize his speed at his current skating technique).
>
> Note that he has only maximized his speed at his *current skating technique*. Essentially he's filled a small glass. Perfecting his skating technique will give him a bigger glass, which he can then fill with more water. In other words:
>
> Hockey players miss out on incredible speed gains by having sub-optimal skating technique.

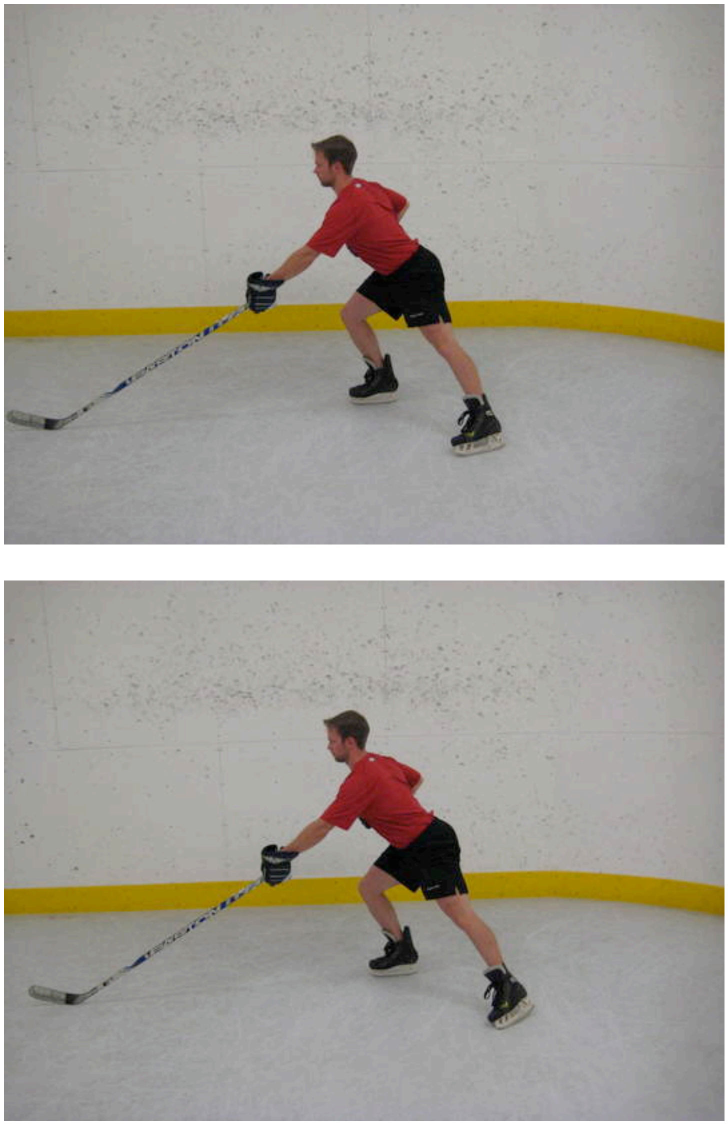
Perfecting skating technique takes years of practice. Players that spend time working with a power skating coach make faster progress than players that do it on their own. Having said that, many players make common errors that are relatively simple to fix:

1) **Poor stride angle.** While skating forward, the stride leg should push backward at a 45° angle. If the push is angled too much in a straight back direction, part of the skate blade loses contact with the ice, which means the power being put into the stride is not transferred into the ice.
2) **Poor arm swing.** While striding with the right leg, the right arm should drive straight forward (or *slightly* toward the midline of the body) as if reaching in front of the body, and the left elbow should drive straight back with the arm bent so that the hand ends up next to the top of the abdomen. Swinging the arms side to side will carry momentum sideways, resulting in a waste of energy attempting to prevent sideways movement.

Demonstrating proper arm swing

3) **Failure to push with toes.** Whether skating forward or backward, in a straight line or crossing over, every stride should finish with a push off the toe. This is an incredibly strong motion. Almost every-one can stand on one foot and use their “calves” to lift their heel off the ground, demonstrating the

strength of this muscle group. A lot of power can be added to the stride simply by implementing this simple toe push to the end of all strides.



Demonstrating an incomplete (top) and complete (bottom) skating toe push.

An up-close demonstration of an incomplete (top) and complete (bottom) skating toe push.

Three Secrets To Becoming A Better Skater

Having had the opportunity to work under and with some of the best power skating coaches in the country led to the realization that one of the most unique aspects of power skating that is severely underutilized is low speed edge work. Too many "power skating experts" have players that lack great edge control practicing high-speed, high-skill skating drills. Just like the old adage, "you can't run if you can't stand," you can't skate fast if you can't skate

The key to becoming a better skater is to focus intently on these three things:

1) **Become comfortable on each edge.** The skate has an inside edge and outside edge. Players need to feel comfortable on both, skating forwards and backwards, on one skate and on two. Spend time on the ice practicing inside and outside edge holds (making large "C" patterns on the ice while holding an edge) going both forward and backward. Gradually progress into making tighter "C's" by leaning further on the edges.
2) **Get to know the rocker.** The skate blade is shaped in a front-to-back arch pattern. This means that only a portion of the skate blade is on the ice while skating. It's important to learn how to center the body over the skates and feel comfortable with the difference in this "centered position" between forward and backward skating. Practice doing skate swivels going in a forward and backward direction. A forward swivel involves starting with a deep knee bend with the feet together. Point the toes out push through the heels with both feet in a "V" pattern so that the legs are extended out to the sides, then pull the heels back in together to make a big oval-shaped pattern. A backward swivel involves the exact same movement except that the body needs to be centered more over the balls of the feet than the heels, and the movement is initiated by pointing the heels out.
3) **Eliminate the comfort zone!** This is the number one mistake hockey players make while doing power

skating drills. Boundaries need to be tested. Do no be afraid to fall. While accelerating, lean forward. When turning, lean into turns/crossovers to turn tighter and pick up speed. Progress comes from pushing the body to its limits, and re-establishing new comfort zones each time. Taking an occasional spill will show the exact limit to an individual's edge control, and ultimately help define the comfort zone limit while skating at extreme angles.

Once these skills are mastered at low speeds, THEN progress to practicing these skills at higher speeds.

Game-Ready Speed

Any time spent training to improve speed must be functional. Functional simply means that any off-ice speed training should improve on-ice speed in ways that improve individual game performance.

To help illustrate this point, consider two players. Player A beats Player B in a three-lap race around the rink EVERY time. Player B beats Player A in a "suicide" (goal line -> blue line -> back to goal line -> red line -> back to goal line -> far blue line -> back to goal line -> far goal line -> back to goal line).

Which of these two races is more hockey functional?

The answer is the "suicide." Hockey is characterized by rapid accelerations, decelerations, and direction changes. Almost NEVER will a hockey player skate at a continuous speed during a game.

To develop functional hockey speed, there needs to be an understanding of all three types of hockey speed:

1) Linear Speed
2) Curvilinear Speed
3) Transitional Speed

Linear speed is speed in straight-line movements and can be broken down into acceleration (speeding up) and maximum speed. An argument can be made that maximum speed isn't nearly as important as a rapid rate of acceleration. Who cares if you can skate 30 mph if it takes you 6 seconds to build up to that speed?

Hockey rarely allows enough time or space for a player to skate in a straight line at maximum speed. The only consistent exceptions are when a forward (usually the off-side winger) springs loose looking for a breakaway pass or during back-checking.

Curvilinear speed includes any skating, forward or backward, that involves turning or crossing over. Curvilinear speed is almost always acceleratory (not max speed), and doesn't require a large off-ice training emphasis. The best way to improve curvilinear speed is through linear off-ice speed training and on-ice skating technique training. In other words, this aspect of skating necessitates that the player is proficient on his edges. Without that skating ability, off-ice speed improvements will not translate onto the ice.

Transitional speed is the most important aspect of functional hockey speed and coincidently the most overlooked in off-ice hockey training programs. Transitional speed includes any movement that involves a direction change. Think about a typical shift. Defensemen and centers spend a lot of time alternating between the corner and the front of the net in the defensive zone, constantly changing direction. Forwards are in a state of constant movement in the offensive zone, weaving in and out of defenders, cycling the puck, and alternating between gliding and rapid bursts of speed.

If the game of hockey is broken down into its basics, it becomes apparent that transitional speed encompasses EVERY skating motion in the offensive and defensive zones once play has been established (e.g. not the initial rush).

All of these movements involve quickly changing between forward, backward, lateral, and diagonal patterns. Naturally, this requires a high level of skating ability, but the ankle, knee, hip and torso can be easily trained off the ice to help you improve your transitional speed on the ice.

Unfortunately this aspect of speed, despite its clear importance to successful on-ice performance, is usually overlooked in hockey training programs. While many people perform standard "agility drills", few teach the footwork and transitional movement patterns that will really help translate to the ice.

Off-Ice Linear Speed Training

Off-ice linear speed training is the key to developing first step quickness and explosive starts on the ice. Despite common belief, traditional "quick feet drills" off the ice do not translate to quicker feet on the ice. Ladder drills may be appropriate for some football players and other athletes that require fine footwork, but aren't necessary for hockey players. These drills generally lead to players standing up tall and looking down at their feet while trying to wrap their minds around complex footwork. Needless to say, standing up tall, while looking at the ice is the fastest way to get rocked by an opponent. Even if a concussion-inflicting hit is avoided, the majority of the small-range-of-motion quick feet drills performed on agility ladders won't carryover to the unique large-range-of-motion footwork performed while skating.

In order to emphasize explosive starts during off-ice speed training, it's important that the athlete is well rested before starting each speed training drill. Everyone is different, so it's hard to make a generic rest interval recommendation. Take the necessary time. Speed training should be conducted under the motto, "Explosive; not tired!" Too often speed training is mistaken as conditioning and players don't get faster; they just get tired. If the athlete needs fifteen seconds to catch his breath, he should take it. If he needs two minutes to catch his breath, he should take it.

There are two different aspects of linear speed training:

1) Acceleration Emphasis
2) Maximum Speed Emphasis

Acceleration emphasis speed drills include every drill that isn't performed at maximum speed. It generally takes players about 20-25 yards to reach max speed, so any distances less than this should be used to improve acceleration; distances greater than 20-25 yards can be considered maximum speed drills.

There are endless possibilities when picking distances to performing speed drills. Research correlating off-ice sprinting speed with on-ice skating speed has shown that 30-yard sprints are the best predictor of on-ice speed. To keep things simple, sprint work should be performed using three distances: 10, 20, and 30 yards.

With the understanding that all speed work should be performed at maximal effort, it is important to keep the total volume of speed work relatively low (e.g. no more than around 150-200 total yards). As an example, a linear speed training session may include 6 x 10 yard sprints and 4 x 30 yard sprints. The total yardage for this session would be 180 yards, which is toward the higher end.

A quick word on sprint technique

Although mastering running form is not as vital for a hockey player as it is for athletes in other sports, some attention to proper form is necessary. While starting, maintain a forward lean and think of jumping or exploding out of the start. The first ten yards or so are characterized by a unique stride, with one knee driving up while the other leg drives straight back.

Proper alignment during sprinting

While accelerating, there should be a natural transition into a normal cyclical running stride. Once the transition is made into the cyclical running stride, strive to drive the knees forward, and have each foot strike occur directly beneath the body with the toes pulled toward the shin. The arms should be pumping the whole time. The elbows should be bent to a loose 90° and cycle straight forward and back from the level of the pants pocket to the level of the shoulder.

The biggest mistake most hockey players make is that they stand straight up at the start of their sprints. Think of leaning forward and driving the legs straight back while accelerating from a starting position. It is okay to fall forward. Remember-get out of that dreaded comfort zone!

Linear speed and acceleration drills begin from a variety of starting positions, including:

1) **Push-Up Start.** Starting in a push-up position helps emphasize leaning forward at the start of the sprints.
2) **Side Lunge Start.** Side lunge starts emphasize a strong lateral/rotational push off of one leg at the start, a movement that is very functional for hockey players.
3) **Side Tall Kneeling Start.** This is a more dynamic variation to the side lunge start.
4) **Side Standing Start.** A progression from the previous two lateral starts emphasizing a strong lateral/rotational push-off. This is the start most commonly used by wingers breaking out of the defensive zone.
5) **Backward Start.** Start facing the opposite direction from the intended sprint destination. This start mimics the footwork involved in pivoting from backward to forward skating.
6) **2-Point Start.** A traditional sprint start with both feet on the ground. Focus on staying on the balls of the feet and leaning forward.
7) **Falling Start.** A more dynamic variation of the 2-point start, emphasizing a strong backward push on the first stride.
8) **Flying Start.** Flying starts involve jogging a specified distance before transitioning into an all out spring. Because acceleration in hockey rarely occurs from a completely stationary position, this is a good way to

teach linear speed changes. A 20-yard forward jogging start is a good distance to use.

Using distances of 10, 20, and 30 yards, the majority of these starting positions have a heavy acceleration emphasis. As mentioned earlier, hockey players RARELY reach full speed while skating in straight line without having to change direction.

Most offensive- and defensive-zone battles for possession are won by the player with the quickest first few steps. That is why there's such a greater emphasis on acceleration than true maximum speed training. Having said that, maximum speed training is still important. Flying starts are a great way to reach top speed quickly and maintain it over a good distance (e.g. Jogging 20 yards, sprinting 30 yards).

Off-Ice Transitional Speed Training

Transitional speed training takes the starting positions described above and makes them more dynamic. For example, instead of a side standing start, you could use a shuffle-to-sprint, simply defined as a transition from a lateral shuffle into a forward sprint.

Transitional movement starts include:

1) **Shuffle.** There are four main ways to start a transitional speed drill with a shuffle. Shuffle sideways while facing forward and transition into a forward sprint. Shuffle sideways while facing backward and do a 180 turn into a forward sprint. Shuffle sideways and open up into a forward sprint. Shuffle back 5 yards and transition laterally into a forward sprint. Naturally, all of these movements can be transitioned into a back pedal as well.

2) **Back Pedal.** Back pedal 5-10 yards in one direction, then transition laterally to sprint a given distance in the opposite direction. You can also modify this by transitioning to sprint in a lateral direction.
3) **Back Sprint.** Sprint 5-10 yards in one direction, then transition laterally to sprint a given distance in the opposite direction. This can also be modified by transitioning to a sprint in a lateral direction.

Perfecting transitional movement technique has a clear carryover to on-ice movements. During any shuffle movement, focus on staying low and keeping your eyes level; in other words, don't bob up and down. When transitioning from lateral movements, focus on staying low and loading the hips. Hockey players tend to stand up too tall. Remember that acceleration is most rapid and efficient while in a leaning position. Standing up too tall guarantees that time and energy are wasted getting back into a good acceleratory position. Why waste time and energy to be slower?

When transitioning back toward the direction from which they just came, players tend to stand up tall and allow their hips to sway past their feet. When the hips move outside of the feet, and therefore outside of the base of support, the athlete becomes less stable and has an increased risk of rolling his ankle. During this type of transition, the athlete will also want to push off the inside of his foot and through his toes as in a forward stride. When using a transitional movement that involves a crossover step, make sure the back leg drives fully under the front leg and push through the toes, just like during a crossover stride.

Staying low and keeping the hips inside the outside foot allows the athlete to load his hips and make a more explosive transition. Make sure that the head ALWAYS turns to look towards the intended destination before the transition. Players should think of transitioning "eyes first".

This is a terrific habit to get into off the ice because it will help build awareness of on-ice surroundings (e.g. know where opponents are, find open ice, etc.).

Demonstrating a faulty transitional movement pattern. Because the inside foot is outside of the hips, no propulsive force can be created by that leg.

Demonstrating a proper transitional movement pattern. Note how the inside foot is slightly inside of the same side hip and shoulder.

Speed Training Program Design

Our hockey players generally perform 2-4 speed drills per week, 1-2 per training session. Many players are surprised at how little time the speed training aspect of their training session takes. We rarely spend more than 15 minutes of our training sessions on speed training (about 7.5 minutes per drill). Remember that the goal is to improve maximal acceleratory rate or maximal speed. If too much time is spent on speed training, mental focus and physical intensity will drop, and it is unlikely any real improvements will be made.

The speed training emphasis can be broken down in a number of ways, but two great ways are:

Speed Training Breakdown 1

Day 1

1) Linear Speed Drill: Acceleration Emphasis
2) Transitional Speed Drill: Acceleration Emphasis

Day 2

1) Linear Speed Drill: Max Speed Emphasis
2) Transitional Speed Drill: Acceleration Emphasis

Speed Training Breakdown 2

Day 1

1) Linear Speed Drill: Acceleration Emphasis
2) Transitional Speed Drill: Max Speed Emphasis

Day 2

1) Linear Speed Drill: Acceleration Emphasis
2) Transitional Speed Drill: Acceleration Emphasis

Notice that in both scenarios, there are two linear and two transitional speed drills, and three acceleration emphasis and one max speed emphasis speed drills per week.

Linear Speed Training Drills

1) 10-Yard Sprint (Push-Up Start): 8x
2) 10-Yard Sprint (Side Lunge Start, Side Tall Kneeling Start, Side Standing Start, 2-Point Start, Falling Start): 4x/side
3) 20-Yard Sprint (Push-Up Start): 4-6x
4) 20-Yard Sprint: (Side Lunge Start, Side Tall Kneeling Start, Side Standing Start, 2-Point Start, Falling Start): 2-3x/side

5) 30-Yard Sprint (Push-Up Start, 20-Yard Flying Start): 4x
6) 30-Yard Sprint: (Side Lunge Start, Side Tall Kneeling Start, Side Standing Start, 2-Point Start, Falling Start): 2x/side

Basic Transitional Speed Training Drills

1) Lateral 5-Yard Shuffle (Facing Forward) to Forward Sprint*
2) Lateral 5-Yard Shuffle (Facing Backward) to Forward Sprint*
3) 5-Yard Forward Shuffle to Forward Sprint*
4) 5-Yard Backward Shuffle to Forward Sprint*
5) 5-Yard Movement Series 1 (Shuffle-Shuffle-Sprint)
6) 5-Yard Movement Series 2 (Shuffle-Shuffle-Back Pedal)
7) 5-Yard Movement Series 3 (Shuffle-Sprint-Back Pedal)
8) 5-Yard Movement Series 4 (Shuffle-Back Pedal-Sprint)
9) 5-10-5: Shuffle Only: 3-4x/side
10) 5-10-5: Forward Sprints/Lateral Transitions: 3-4x/side
11) 2.5-5-2.5: Crossover Start Emphasis: 4-5x/side
12) Lateral Bound -> Forward Sprint*
13) Back Run -> Forward Sprint*
14) Lateral Run -> Forward Sprint*
15) Back Pedal -> Forward Sprint*
16) Lateral Back Pedal -> Forward Sprint*
17) Forward Back Pedal -> Forward Sprint*

*Reps depend on distance. See linear speed drills above for general repetition recommendations for specific sprint distances.

Advanced Transitional Speed Training Drills

Once the basic transitional speed training drills are completed, there needs to be a progression to more challenging variations. The key here is to emphasize multiple transitions and different movement patterns within a given drill. Creativity is the only limit here. A few examples to use toward the end of the off-season are:

1) 5-Yard Forward Sprint -> 5-Yard Forward Shuffle -> 10-Yard Forward Sprint
2) 5-Yard Back Shuffle -> 5-Yard Forward Back Pedal -> 10-Yard Forward Sprint
3) 5-Yard Forward Sprint -> 5-Yard Backward Back Pedal -> 10-Yard Forward Sprint

Concluding Thoughts

Speed training for hockey doesn't need to be complicated to be effective. Following the recommendations in this chapter will drastically enhance on-ice speed through effective off-ice training. Remember that every repetition needs to be performed at maximal intensity. Speed training should be the first thing done after a dynamic warm-up (before power training, strength training, core training, and conditioning). Take as much rest as needed between repetitions.

Remember: "Explosive! Not tired."

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Creating Strength And Power Through Neural Manipulation

Most people in the hockey world that do not have an educational background in exercise science or kinesiology are surprised to learn about how the central nervous system controls every aspect of performance. In order to fully understand how to best train hockey players for improved, power, strength, reactivity, coordination, and conditioning, it is necessary to delve into some of the basics of the nervous system. While the nervous system is incredibly complex, it can be simplified into a couple key points that everyone can understand.

There are two foundational neural concepts that control all force output:

1) Motor Unit Recruitment
2) Rate Coding

Motor Unit Recruitment

The central nervous system (CNS) is comprised of the brain and spinal cord and is the driving and controlling force behind all movement. First, it is important to understand that the CNS does not recruit muscle fibers, it recruits motor units (MUs). A motor unit is a motor neuron and all the muscle fibers it innervates. All motor neurons are located in the ventral horn (front) of the spinal cord. The axons from these extend out and divide to connect to individual muscle fibers. When a motor unit is recruited, all of the muscle fibers that are innervated by that particular motor neuron produce force. This means that, unless a motor unit consists of a motor neuron connected to one muscle fiber (this has never been documented in humans), it is impossible to recruit individual muscle fibers. The force level at which an MU is recruited is known as the “recruitment threshold”. Importantly, the recruitment threshold of a MU, and therefore of muscle, depends not only on the amount of force needed, but also on the velocity at which the force is generated, which is referred to as rate of force development (ROFD). More on ROFD in a bit.

The amount of force a muscle can exert depends on both the number of MUs within that muscle and the number of muscle fibers that each MU is driving. This latter characteristic is known as a MU’s innervation ratio. Larger muscles that are responsible for greater amounts of force production tend to have more MUs and MUs with higher innervation ratios. This allows greater force production from the recruitment of a single MU, which contrasts muscles that require more fine control and therefore would not benefit from large increases in force production. As an example, a small hand muscle may have around 100 MUs, each connecting to 100 muscle fibers. A larger muscle in the lower leg may have around 550 MUs, each innervating 2,000 muscle fibers (Feinstein et al, 1955). The small hand muscle gives the CNS greater control by allowing it to increase force in smaller increments, whereas the larger lower leg muscle gives the CNS the ability to rapidly create high amounts of force for high velocity activities like skating.

Motor units within (intramuscular compartmentalization) and between muscles (inter-muscular compartmentalization) are grouped based on their ability to assist in specific tasks. This simply means that different parts within a muscle can team up with different parts within other muscles to accomplish a common goal. This is another great example of the integrated nature of human movement.

Within each task group, MUs are recruited from small to large based on the size of the cell body of the neuron, which correlates with the force production ability of that MU. In other words, smaller units have a lower recruitment threshold and are always recruited before larger ones; derecruitment occurs in the reverse order. This is known as Henneman's size principle (Henneman, 1957), and demonstrates that larger MUs cannot be recruited unless the smaller units have already been recruited and stay active.

Relevant to training, this means that low intensity exercises lead to adaptations in lower threshold units (e.g. small MUs), whereas higher intensity exercises lead to adaptations in both low and high threshold units.

Rate Coding

Once a MU becomes active, it can increase the force it produces by increasing the rate at which it discharges until it reaches a maximum discharge rate. In addition to the rate of MU discharges, the timing of the discharges can have a significant influence on the force output. For instance, when a MU discharges twice within an exceptionally short period of time (e.g. <20ms), force production is roughly 20% greater compared to if it had been discharging at a constant rate (Binder-MacLeod & Barrish, 1992). These "doublet" discharges are one strategy the nervous system uses to rapidly increase force output. Specific training strategies can be used to increase the number of doublets at the beginning of a contraction (more on this later).

The Balancing Act

In general, the nervous system balances excitation (+) and inhibition (-) to achieve a desired result. Increased excitability of cells in the motor cortex (brain) and motor neurons in the spinal cord has been documented following training (Griffin & Cafarelli, 2007; Aagaard et al., 2002). If a neuron becomes more excitable, any given signal will result in a larger response. This may be a bit confusing. This example using arbitrary units (AUs) will help clear up any confusion. Imagine there are 5 AUs that reach a motor neuron in the spinal cord. The motor neuron then processes these 5 AUs and sends 5 AUs to the muscle. After a few months of training, the excitability of this motor neuron increases. Now for the same 5AUs reaching the motor neuron from descending pathways (from the motor cortex), 8AUs are sent to the muscle. More AUs to the muscle means more force production.

Other possible adaptations involve decreased inhibition from various other players within the central and peripheral nervous system, including (for the fellow science enthusiasts) Renshaw cells, golgi tendon organs (muscle tension receptors), cutaneous and other receptors, and descending influences from supraspinal areas (think brain). The idea of increased force production due to decreased inhibition is somewhat similar to the above example, except a few more characters were added. If 5AUs leave the motor cortex on its way to the motor neuron, it's possible that only 3AUs reach the motor neuron, due to some form of inhibition. Decreased inhibition following training may result in 4AUs reaching the motor neuron. More AUs to the motor neuron typically means more AUs to the muscle.

Building on this concept of balanced excitation and inhibition, force expression is also determined by the balance of force production from antagonistic, or opposing muscles. This idea is pretty straight forward. If an athlete wants to perform a biceps curl, he would want maximal activation of his biceps and minimal activation of his triceps, since triceps activity would somewhat cancel out biceps force production. Turning to another arbitrary unit example: If your biceps are producing 15 AUs to flex the elbow, and the triceps are producing 5 AUs, the net effect will be 10 AUs of elbow flexion force. If the triceps activity were cut down to 2 AUs, the net effect will be 13 AUs of elbow flexion force, meaning a greater amount of elbow flexion force will be expressed.

Implications for Strength Training

An understanding of how the CNS drives movement becomes unimportant if there is uncertainty as to how it can be manipulated through training. Luckily, it is well documented that resistance training can have a significant effect on the CNS. Specifically, resistance training can lead to strength improvements through:

1) Increase in CNS excitability (as mentioned above)
2) Increase in CNS' ability to activate muscle fibers (Knight & Kamen, 2001)
3) Increase in MU discharge rate (Knight & Kamen, 2001)
4) Decreased antagonist activity (Carolan & Cafarelli, 1992)

Taken as a whole, these changes indicate that the CNS is better able to send signals to the muscle that lead to high levels of force production. Factor in that muscle fiber growth also increases the force producing ability of a MU, it is clear how the neuromuscular system can be manipulated through training to improve a hockey player's strength and power capacity.

There are other considerations regarding how to manipulate training to capitalize on an understanding of the CNS. In general, smaller muscles, such as those in the hand, tend to recruit all their MUs by about 50% of their maximal force in that movement. In contrast, larger muscles such as the biceps brachii continue to recruit MUs until around 80-90% of their maximal force (Masakado, 1994). Below these "maximal recruitment" forces, the nervous system can use strategies involving both recruitment/derecruitment and increasing/decreasing discharge rate to alter force outputs. Once maximal recruitment is reached, discharge rate becomes the sole neural strategy for controlling MU force. It’s important to note that because smaller MUs encompass less muscle mass, the initial recruitment of these MUs produces relatively small amounts of force; in contrast, the later recruited motor unit produce larger amount of force per stimulus.

The implication is that force production increases exponentially as recruitment proceeds through the order to the higher threshold MUs, and that if the intention is to improve maximal strength and power capacity, it is important to make an effort to incorporate these higher threshold units. Taking a look back at the previous paragraph reveals an easy solution to this problem.

In order to improve maximal strength, a hockey player needs to periodically train with loads around 90%+ of his 1-repetition max (1-RM) for that exercise. This will help ensure both maximal recruitment and maximal discharge rate of the involved musculature, and therefore expand the player’s maximum strength capacity.

A question that often arises is whether or not these high threshold MUs are recruited during lower intensity work once fatigue starts to set in. In other words, do the high threshold MUs kick in when the lower threshold MUs can no longer handle the workload? The answer is: probably not. As fatigue sets in, there is evidence that the motor cortex in the brain is unable to maximally activate the working MUs (Sogaard et al, 2006). As a result, it is likely that this inability will prevent the activation of high threshold MUs during a higher repetition activity. This highlights the importance of high intensity training for hockey players; it’s the most effective way to improve the capacity of the MUs that drive powerful movement on the ice!

Power vs. Rate of Force Development

Power = (Force x Distance)/Time

From a neural standpoint, maximizing power comes down to maximizing rate of force development (ROFD). There are two primary differences between power and ROFD:

1) Power requires movement, whereas ROFD can involve applying force against an immovable object, such as driving your shoulder into an opponent while battling for a puck in the corner
2) Power is an external expression or outcome, whereas ROFD is an internal factor whose expression and can still be limited by antagonist activity (as discussed above)

Implications for Power Training

A primary goal of all strength and power training should be to maximize and improve ROFD. Speed of movement is one of the most important factors related to strength and power gains. Actually, *intended* speed of movement is one of the most important factors. As previously mentioned, maximal strength training should be done above 90% 1-RM. Having said that, lifting a load at that intensity, regardless of the intension, will not allow for the load to be moved quickly. Fortunately, the actual movement speed does not matter. The intended movement speed does.

Not only does maximizing the intended concentric (positive) phase of the lift maximize intramuscular tension, it also leads to unique neural adaptations. According to a study done by Van Cutsem et al. (1998), maximizing intended contraction speeds leads to:

1) Increased rate of force development
2) Increased doublet firing
3) Decreased motor unit recruitment threshold

This is true of dynamic and isometric contractions (Aagaard et al., 2002; Gabriel et al., 2001; Maffiuletti & Martin, 2001). The fact that these adaptations occur with isometric contractions, which involves producing force without a change in the total muscle length, is further evidence that the actual movement speed is not as important as the intended movement speed.

Decreasing the recruitment threshold may have positive implications on maximal force production due to a maximal firing rate ceiling effect. If a high threshold unit is recruited late in the contraction, it only has a small amount of time to increase its firing rate, and therefore increase force production. If the high threshold unit is recruited sooner in the contraction, as it would be when the player thinks about moving the weight as quickly as possible, it has more time to increasing its firing rate and increase the amount of force produced.

The major application of these principles is to always attempt to perform the concentric (positive) phase of the exercise as quickly as possible. To give a few examples, think of performing the following movements as quickly as possible:

1) Standing up from the bottom of a squat
2) Pushing the bar away from the chest in a bench press
3) Pulling the chest up to a bar during a chin-up

Performing the concentric phase, referred to as the "positive" phase, of the exercise with the intention of maximizing movement speed will help ensure maximal MU recruitment and ROFD, ultimately leading to better gains in strength and power.

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The Case For Unilateral Training

One heavily debated argument has divided the hockey training industry:

"Should hockey players squat?"

For reasons to be discussed, this question can really be extended to, "Should hockey players perform bilateral lifts?" Bilateral lifts refer to exercises where two limbs are working in unison. This includes lower body exercises like squats, front squats, deadlifts, and stiff-legged deadlifts, and upper body exercises like standing shoulder press, bench press, and barbell rows. While these lifts are deeply rooted in strength and conditioning history, the associated benefits and risks have recently been called into question.

Michael Boyle was the first coach in the hockey training industry to implicate that single-leg lower body lifts may be a safer, more effective way to improve strength in hockey players. The initial, and most commonly used argument for single-leg training is that most movements in the game of hockey are made off of one leg or involve one leg moving in isolation of the other. Boiled down, the idea was that you play hockey on one leg, so you should train on one leg. Otherwise it's not "functional".

Lost in this rationale is the difference between static and dynamic stability/balance. In other words, the challenge to maintain single-leg stability (e.g. balance) is different when standing still than when moving. This is why hockey players can easily glide on one leg, but have a hard time standing on one leg for any appreciable amount of time. This also explains why hockey players with incredible balance on the ice may not be able to perform a one-leg squat.

This “functional” argument is supplemented with several others. Specifically, compared to bilateral training, single-leg training:

1) Requires greater force production from more muscles
2) Decreases spinal loading
3) Increases the proprioceptive and sensory demand of the exercise
4) Reinforces the neural circuitry common to most athletic movements

Differences in Force Production

As soon as one leg is lifted off the ground, the demand on the lateral hip stabilizers increases. These muscles must contract strongly to prevent the hips and torso from dropping down toward the side of the lifted leg. This simple movement will affect all the major muscles that connect to the hip, but will really accentuate the role of the hip abductors (gluteus medius and gluteus minimus) and external rotators (gluteus maximus, obturator internus, obturator externus, gemelli inferior, gemelli superior, and piriformis) in creating hip stability.

While the “functional” argument may be limited from a balance standpoint, the fact is that hockey players still need appropriate single-leg stability. Every time a player strides with one leg, the other leg and hip need to remain stable in order to give the stride leg a solid base to push from. In fact, in the first few strides, as much as 85% of the time is spent in single-leg support (Marino, 1979). Any accessory movement of the other leg and hip will result in a loss of power expression from the stride leg and could increase the player’s risk of injury. Single-leg exercises help strengthen the lateral hip stabilizers and reinforce stability patterns that will translate to more explosive movement on the ice.

Long-Term Implications of Spinal Loading

Spinal loading in itself is not bad. In fact, weight training can increase the amount of bone mass in the vertebrae, which ultimately makes them stronger and more resistant to fracture. Unfortunately, a different picture is painted over the long haul. Keeping with the idea that the goal is to create hockey players that experience success over a long career (not have a good year and then spend their last 70 years with back pain), it is important to look at the long-term implications of the repetitive heavy spinal loading that is common in lifting programs, such as:

1) Increased incidence of spondylosis (Aggrawal et al., 1979)
2) Decrease in intervertebral disc height (Granhed & Morelli, 1988)
3) Lumbar spine degeneration (Videman et al., 1995)

If single-leg exercises require less of an external load, then using them in place of traditional double-leg exercises could decrease the total compressive load to the spine. The risk may be reduced even within a single training session because single-leg exercises tend to give the spinal column more degrees of freedom, or movement direction options than double-leg training, and therefore make it less likely to be forced into an injurious position.

Neural Implications of Unilateral Training

One of the biggest knocks on single-leg training is that it tends to require less of an external load, which many infer to mean a less intense stimulus to the muscle. This raises an important question:

“Is external load completely indicative of internal stress to the muscle?”

The simple answer is probably not. The longwinded answer involves a discussion on a neural phenomenon known as the bilateral deficit. The bilateral deficit refers to the fact that the sum of individual extremity force production is greater than bilateral force production (Obtsuki, 1983; Schantz et al., 1989). In other words, if an athlete performs a one-legged knee extension with his left leg only, then his right leg only, and added these two forces together, the sum would be greater than if he performed a knee extension with both legs together.

Bilateral Deficit: Leg A + Leg B > Both Legs

Interestingly, this deficit can be as high as 20% during slow contractions (Howard & Enoka, 1991; Koh et al, 1993), and as high as 45% during rapid contractions (Koh et al, 1993; Vandervoot et al, 1984). This strength deficit becomes increasingly relevant when we consider that most movements in hockey are performed at maximal velocity.

While the bilateral deficit is thought of as a neural phenomenon, it is likely less of a phenomenon than a long-term adaptation to the movements humans perform most regularly. Consider the movement legs perform during walking, running, and skating patterns. In all three cases, as one leg goes through an extension pattern, the other is going through a flexion pattern. Similarly, as one arms drives forward, the other drives back. This pattern of opposite or dissociated inter-limb movement, which has been grooved since birth (even in crawling), predominates in almost all daily activities and hockey-related movements.

The bilateral deficit provides one of the strongest arguments for unilateral training. Hockey players have an opportunity to use their training to reinforce and strengthen the neural patterns that most directly replicate those that they need on the ice. Unilateral lifts also decrease the base of support of the athlete, which necessitates greater proprioceptive input and sensory feedback to maintain balance.

The proposition here is not to abandon all bilateral lifts. Squat, deadlift, bench press, shoulder press, chin-up, and row variations all have their place in a hockey training program. Traditionally these lifts have been used to create the foundation of the training program:

In light of understanding neural contributions to hockey performance, this foundation can be inverted to improve the safety and effectiveness of the training program:

This may be a profound transition to make, but have confidence in knowing that these suggestions are not being made blindly; there is sufficient evidence to support the switch. Interestingly, many players will have 1-RM Reverse Lunge and Back Leg Raised Split Squat numbers comparable to their 1-RM Front Squat. This observation can be explained by the bilateral deficit and/or the idea that core stability (the ability for the core to generate sufficient stiffness to maintain stability) is the limiting factor in bilateral exercises. Either way, more effective training stimuli result from building a program around unilateral lifts.

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Strength And Power Training For Hockey

Speed – Strength Continuum

In consideration of strength and power training, it is important to note that hockey requires a range of low load, high velocity movements and high load, low velocity movements. An example of a low load, high velocity movement is taking a quick snap shot, whereas an example of a high load, low velocity movement would be the aforementioned battling against an opponent in the corner. My colleague Eric Cressey describes these requirements as occurring along an Absolute Speed – Absolute Strength continuum. Essentially this continuum looks like this:

Absolute Speed <-> Speed-Strength <->
Strength-Speed <-> Absolute Strength

This continuum explains why certain hockey players respond so well to specific types of training. For instance, young hockey players tend to notice drastic performance improvements from strength training because they have spent so much time doing training on the other end of the continuum. This continuum can also be used to categorize different aspects of a training program:

Absolute Speed: The majority of off- and on-ice speed training

Speed-Strength: Lighter Olympic Lifts, Med Ball Throws

Strength-Speed: Heavy Olympic Lifts, Medium Intensity/High Velocity Lifting

Absolute Strength: The majority of off-ice strength training

While the continuum provides a great framework to understand athletic ability, these qualities need to be re-arranged to form a pyramid to better exemplify each quality's emphasis in a training program.

Speed and power are derivatives of strength, meaning for any given strength level is there a maximal amount of speed and power that can be derived from it. Returning to Cressey's glass of water analogy, speed and power can be thought of as the "water" within the "glass" of maximum strength. In other words, by training to increase maximum strength, the capacity to adapt in other markers of athleticism is expanded. The pyramid better illustrates how absolute strength creates the foundation that other aspects of athleticism are built upon. In consideration of this pyramid, one of the primary goals of a hockey training program should be to improve the player's maximal strength and the rate at which he/she can apply that strength.

Power Training for Hockey

In hockey terms, the goal of plyometric training is to become more "explosive". Depending on the emphasis of the training, this can relate to skating faster, hitting harder, and/or adding some power behind shots. Power training can be broken down into two major categories:

1) Lower Body Plyometrics
2) Full Body Exercises

Lower Body Plyometrics

When a muscle undergoes a quick stretch before it contracts, it is able to produce more force than it would have had the pre-stretch not occurred. This is a result of both a neural reflex loop known as the stretch-shortening cycle and the natural mechanical properties of the muscle (e.g. the elasticity in the myosin heads that form the cross bridges). The primary goal of lower body plyometric training is to improve this elastic power output through the hip and lower body musculature.

A great example of how this is applied on the ice is when a player stops hard and changes direction. As the player begins to stop, he will flex at the knees and hip to load the hip and lower body musculature. The energy from this loading is released as the player quickly explodes out in the opposite direction. In contrast, if the player were to stop and pause before transitioning in the opposite direction, the stored elastic energy would be lost and it would require a greater effort from the player's neuromuscular system to generate the same starting power.

When implementing plyometric training, it is important to emphasize proper landing technique first. If an athlete cannot land with proper technique, it is unlikely he will be able to efficiently generate power from that position. In general a proper landing should involve:

1) Landing with the foot/feet flat
2) Simultaneous bending of the ankle, knee, and hip in a "butt back" position that replicates sitting in a chair
3) Keeping the hip, knee, and foot of each leg in a straight line, so that the knee does not collapse inward
4) Maintaining a "chest and eyes up" posture

Demonstrating proper jump landing technique with the feet, knees, and hips in a straight line, the hips back, and the chest and eyes up.

This landing technique creates a stable foundation for the player to move from, ensures muscular loading and therefore reduces uncontrolled impact stress to the joints, and ultimately minimizes the risk of injury. To reinforce mastery of landing technique, plyometric training should follow a three-stage progression:

1) **Discontinuous.** The player sticks the landing and resets before the next jump.
2) **Rebound.** The player lands, loads, and immediately rebounds out to the next jump. After sticking the landing of the second jump, the player resets before performing the next repetition.
3) **Continuous.** The player jumps, lands, and immed-iately rebounds out to the next jump, per-forming all the reps for a given set continuously.

The initial stage in this progression ensures that landing technique is mastered before moving on to advanced versions. Because each jump in this phase is initiated with a quick loading movement, the athlete is still training to improve elastic power. The second stage provides a controlled environment to monitor how a player lands in preparation for another explosive movement. The goal is to load the legs and hips, but minimize the time on the ground before the next jump. Lastly, the progression to continuous jumping allows the player to capitalize on proper technique in repetitive explosive patterns.

As with speed training, adequate rest needs to be given between each set. It is impossible to improve maximal power without adequate time for recovery!

Plyometric Exercise Progressions

There are seemingly countless lower body plyometric exercises to choose from, but keep things as simple as possible. While this type of training is extremely important, it encompasses only a small amount of the total training time. Consider breaking plyometric training down into linear and lateral/diagonal movements. Performing lower body plyometrics twice per week, which is sufficient for most players, allows for one day of linear exercises and on day of lateral/diagonal exercises. Linear and lateral/diagonal categories can be further subdivided into vertical and horizontal emphases. Because hockey is primarily a horizontal sport, jumps with a vertical emphasis should be used sparingly. The exception is with injured players who suffer from hip flexor and/or abdominal injuries. With these players, the stress across the anterior abdominal wall during exercises like broad jumps causes pain, whereas vertical jumps can be performed pain free.

Players should perform two simultaneous progressions:

1) Horizontal Linear Double-Leg:

   Phase 1: Discontinuous Broad Jump: 3 x 6
   Phase 2: Broad Jump w/ Rebound: 3 x (4x2)
   Phase 3: Continuous Broad Jump: 3 x 6

2) Horizontal Lateral/Diagonal Single-Leg

   Phase 1: Discontinuous Lateral Bound: 3 x 5/side
   Phase 2: Lateral Bound w/ Rebound: 3 x (3x2)/side
   Phase 3: Continuous Lateral Bound: 3 x 6/side

Each phase lasts about 3 weeks depending on the progress of the player. These progressions should carry players straight through the off-season. Once players enter the season, plyometric training should be substantially reduced because of the amount of time they spend on the ice, but the same progression ideas apply. This is also a great time to incorporate more box jumps, which minimize landing stresses.

Note that the total volume of plyometric work is extremely low. The highest volume reached in this approach is 24 jumps on the horizontal linear double leg day and 36 jumps on the horizontal lateral/diagonal single-leg day, for a total of 60 jumps in any given week. Remember that the purpose of this training is to improve and reinforce maximal power output. As volume increases, effort and capacity tend to decrease.

Full Body Power Training

The goal of full body power training is to teach the body to rapidly generate force through the hips and lower body musculature and transfer it through the core and to the upper body. This power comes into play anytime a player gives or withstands a hit or shoots. Full body power training can be further broken down into two main applications:

1) Olympic Lifts and Variations
2) Medicine Ball Throws

As with any exercise, Olympic lifts and medicine ball throws are just tools. The created training stimulus depends highly on how these tools are used. If players are performing Olympic lifts with extremely light loads (~30%) it is likely the exercise will create a low load, high velocity stimulus that more closely replicates that of medicine ball throws. While there are many different applications for both Olympic lifts and medicine ball throws, they generally satisfy different training requirements in regards to the previously described Speed-Strength Continuum. While the emphasis in both types of exercises is on rapid movement, Olympic lifts can be loaded heavily and will generally be performed at a lower velocity relative to medicine ball throws. Olympic lifts also tend to have a more vertical emphasis, whereas medicine ball throws lend themselves well to rotational movements, which have a more direct benefit to shooting power.

Full Body Power Progressions

There are a number of Olympic lifting variations and progressions to follow. Hockey players should start all of our Olympic lifts from the “hang” position, where the bar or dumbbell is just above the knees. As the position of the load approaches the floor, the lift tends to put a greater emphasis on the lower body. It also pulls the player further down than a good hockey stance and into a position that most players cannot get into while maintaining a neutral lumbar spine.

Because the lower body musculature receives such a large amount of training volume from plyometrics and speed work, the lower body should be slightly de-emphasized during these lifts. Naturally, the lower body and hip musculature is still heavily involved, but the higher the position of the load, the more the emphasis is on the upper body. With this in mind, these full body power exercises should be performed on upper body training days in the off-season and as the only power exercise on training days closest to games in-season.

Six Olympic lift variations that players should perform are:

1) 1-Arm DB Hang Snatch
2) DB Push Press
3) 1-Arm DB Push Press
4) Hang Clean
5) Kettlebell Swing
6) 1-Arm Kettlebell Swing

All six of these exercises are relatively easy to learn, so players can start making progress without spending undue time on learning technique. While mastering technique is important, the goal of training is improve a physical ability that will translate to on ice performance. The sooner the athlete can start loading the exercises and improving capacity, the faster they start to make progress. If similar improvement in capacity can be made with two exercises, but one takes substantially longer to teach than other, the athlete is ultimately wasting valuable development time by using the more technically complex exercise.

Keep the repetitions for these lifts under 5 to emphasize maximal neural output. The exception is with kettlebell swings, which is a great exercise to improve power endurance while transitioning from the off-season to the pre-season. The unilateral variations (1-Arm DB Hang Snatch, 1-Arm DB Push Press, and 1-Arm Kettlebell Swing) tie in a greater component of core stabilization as the core functions to maintain neutral alignment in the presence of an asymmetrical load.

Medicine ball throws can be performed from a side-standing or front-standing position and include scoops (underhand) against a wall, shotputs against a wall, and slams against the floor. Scoops place the greatest emphasis on hip and core power generation, whereas shotputs and slams tie in a greater degree of upper body power generation. As a result, players should initiate their med ball training with scoops and progress to the other variations. This allows the athlete to teach his body to generate maximal power and velocity through his hips and core without having to worry about relying too heavily on his upper body.

Side Standing Med Ball Scoop

Side Standing Med Ball Shotput

Once players have mastered these movements, they can progress to initiating each throw with a partner toss. By initiating the throw with a partner toss, the player is forced to rapidly decelerate the incoming ball and quickly transition back to a powerful movement. Essentially it increases the deceleration load to the player.

Medicine ball throws should be performed for 3-4 sets of either 5-6 reps/side or 8-10 reps for bilateral movements (e.g. overhead slams and underhand scoops). In the off-season, a greater emphasis should be placed on rotational scoop and shotput patterns to help players improve rotational power capacity. As the season gets underway and players undergo substantial rotational forces through-out the week on the ice, these rotational patterns should be deemphasized to help de-load the stress to the involved musculature.

Strength Training for Hockey

As discussed previously, absolute or maximum strength lays the foundation for all other aspects of athleticism. The larger the base of maximum strength, the greater the potential for power and speed. With that said, strength training for hockey is not as simple as mimicking the programs of the insanely strong (e.g. powerlifters). While certain training principles, such as performing lifts above 90% 1-RM can be taken from powerlifting, hockey training programs need to account for the specific needs of the sport.

Unbalanced Programming to Restore Balance

A reoccurring theme throughout this book is the importance of creating and maintaining strength and stiffness balance across joints. With few exceptions, most hockey players present with common imbalances, which are discussed in more detail in the next chapter. Briefly, players will be overdeveloped and tight through their upper body and hips, and underdeveloped and weak through their upper backs, and glutes. These adaptations result from a combination of playing hockey, sitting too long, and, in some cases, a training program excessively geared towards improving mirror appeal. In order to combat these imbalances, it is necessary to design an unbalanced training program.

To understand how to go about this, it is necessary to understand how to design a balanced program. A balanced training program will have an equivalent (or near-equivalent) amount of upper body pushing (bench press and overhead pressing variations) and pulling exercises (rowing and chin-up variations), and an equivalent amount of lower body pushing (squat variations) and pulling exercises (deadlift variations).

As an example, a balanced full body program may look like:

A1) Back Leg Raised Split Squat: 3 x 6/side

A2) Low Pulley Row: 3 x 6

A3) Stability Ball Front Plank: 3 x 20s

B1) Trap Bar Deadlift: 3 x 6

B2) Dumbbell Chest Press: 3 x 6

B3) ½ Kneeling Belly Press IsoHold: 3 x 15s/side

In this example, the volume of upper body pulling (Low Pulley Row) and pushing (Dumbbell Chest Press) is identical, as is the volume of lower body pushing (Back Leg Raised Split Squat) and pulling (Trap Bar Deadlift). This is an oversimplified version of a program, but it serves our purposes here. In contract, an unbalanced program may look like:

A1) Back Leg Raised Split Squat: 5 x 6/side

A2) Low Pulley Row: 2 x 6

A3) Stability Ball Front Plank: 3 x 20s

B1) Trap Bar Deadlift: 3 x 6

B2) Dumbbell Chest Press: 5 x 6

B3) ½ Kneeling Belly Press IsoHold: 3 x 15s/side

Notice how the volume of pushing (for both lower and upper body exercises) is substantially higher than that of the pulling exercises. This type of program will exacerbate the existing structural imbalances and ultimately lead to an increased risk of injury. In fact, most hockey strength programs, at least at first, should have a greater emphasis on upper body and lower body pulling exercises to restore balance across the shoulders and hips. Using a more complex programming example, this may look like:

A1) Back Leg Raised Split Squat: 4 x 6/side

A2) Low Pulley Row: 4 x 6

A3) Lateral MiniBand Walk: 3 x 8/side

B1) Trap Bar Deadlift: 3 x 6

B2) Dumbbell Chest Press: 3 x 6

B3) ½ Kneeling Belly Press IsoHold: 3 x 15s/side

C1) Slideboard Hamstring Curl: 3 x 8

C2) Chin-Up (Underhand Grip): 2 x Failure (>6)

C3) Stability Ball Front Plank: 3 x 20s

Notice how the volume of upper and lower body pulling is significantly higher than upper and lower body pushing. The breakdown looks like:

Lower Body Pushing:
Back-Leg Raised Split Squat x 24 reps

Lower Body Pulling:
Trap Bar Deadlift x 18 reps
Slideboard Hamstring Curl x 24 reps

Upper Body Pushing:
Dumbbell Chest Press x 18 reps

Upper Body Pulling:
Low Pulley Row x 24 reps
Chin-Up x >12 reps

It is not necessary to calculate ratios for every program, but for the purposes of illustrating this point, ratios of lower and upper body pulling/pushing are:

LB Pulling/Pushing: 42/24 = 1.75x more pulling

UB Pulling/Pushing: 36/18 = 2.0x more pulling

Within this context, a program does not need to be balanced (or strategically imbalanced) within every training session. More importantly, a program should be balanced within each microcycle, or mini training cycle. In most cases, microcycles last a week. Extending the idea of unbalance programming to restore balance across a weeks worth of training, a program may have four strength training sessions following a lower/upper split (e.g. Two lower body days and two upper body days). A simple approach would be to have one session for both lower and upper body be completely balanced with pushing and pulling volume, and have one slightly imbalanced toward pulling exercises.

Cycling In Focused Eccentrics

The previous chapters on neural aspects of training provide clues as to how to frame the tempo, or speed of movement, of strength training exercises. Tempo is broken down into eccentric (muscle lengthening, lowering or “negative” phase), isometric (muscle not changing length, “transition” phase), and concentric (muscle shortening, raising or “positive” phase) phases. Tempo recommendations are pretty straightforward:

1) **Concentric:** Always perform this phase as quickly as possible to maximize MU recruitment and rate of force development
2) **Isometric:** No pause, but controlled motion through the transition
3) **Eccentric:** Controlled pace, unless specifically dictated otherwise

If tempo changes are prescribed in a program, they should affect only the eccentric phase, and be used sparingly. While there is some transfer, strength gains are somewhat specific to the type of contraction used during training (e.g. concentric vs. isometric vs. eccentric). In the case of most traditional lifts, the amount of load used will be limited by the concentric strength of the player. As an example, a hockey player usually will not squat a weight that he could not push back up (concentric failure). With that in mind, one strategy of improving maximal strength is to overload the eccentric phase and get assistance through the concentric phase. This is most easily accomplished during upper body exercises like chin-ups and bench pressing, but can be applied to squat variations. In this case the player would descend down until the bar hits safety pins in a squat rack, at which point they can let the bar stay there, have spotters return it to the rack, and then start the next rep. This will allow the player to improve his maximum eccentric strength without being limited by his maximum concentric strength.

Another application of focused eccentric phases is in improving the total time under tension of a set. It is commonly accepted that muscular hypertrophy (increases in muscle size) results from sets that last between 30-70 seconds. At the pace that most players lift, even a set of 10-12 reps is completed within 15s. Lengthening the eccentric phase will increase the time under tension, which will create a more hypertrophic effect. This strategy should be used for no more than one exercise from each movement pattern per week. Eccentric contractions are extremely damaging to the muscle and result in substantial muscular soreness. If every movement pattern is hammered with lengthened eccentric phases, the player will be sore and immobile! An example of how to cycle lengthened eccentric phases through the week is presented below.

Day 1: Dumbbell 1-Leg Squat: 4 x 6/side (5s negative)

Day 2: Chin-Up: 4 x 6 (4s negative)

Day 3: Slideboard Hamstring Curl: 3 x 8 (3s negative)

Day 4: Incline Dumbbell Chest Press: 3 x 6 (5s negative)

Cluster Sets for Maximal Strength Improvements

This is a maximal strength trick straight from the power-lifting community. A cluster set refers to performing a specified number of reps, pausing for 10-20 seconds, then performing a specified number of reps again.

There are several ways to implement cluster sets, but a few highly effective choices are:

(2x4): 2 sets of 4 reps separated by 10-20 seconds

(4x2): 4 sets of 2 reps separated by 10-20 seconds

(4x1): 4 sets of 1 rep separated by 10-20 seconds

In each of these cases, each cluster (e.g. a cluster of 4 sets of 2 reps) counts as one set. Players should perform 3-4 cluster sets for a given exercise.

The concept behind clusters is pretty simple. By providing a brief break (or several brief breaks depending on the design of the cluster) in the middle of the set the player can do more repetitions at a given weight than he could without that break. For example, if a player can bench press 205lbs for eight reps. Using a cluster format, he may be able to do 230lbs for (2x4), or maybe 245lbs for (4x2). In each case, eight reps are performed for each set. However, by altering the cluster parameters, the load used can be substantially increased. This strategy is especially effective at improving a player's maximal strength. As with focused eccentrics, cluster sets should be used sparingly (e.g. 1-2 exercises per week), as they induce high levels of central fatigue and are more time consuming than traditional sets.

Programming Considerations

Several books have been written on the complexities of strength training program design, and there are literally endless possibilities. Attempting to detail every possible set and rep scheme would be both confusing and counter-productive, but program design does not need to create headaches. Set up programs using 4-week cycles, with each week having a slightly different emphasis.

Week 1: Introductory Emphasis

Week 2: Volume/Hypertrophy Emphasis

Week 3: Strength Emphasis

Week 4: Deload Emphasis

Week 1 is meant to introduce the player to any new exercises he will be performing, and to get an idea of where his strength is at those exercises. Week 2 bumps the volume up to create a greater hypertrophic stimulus. In Week 3, the volume drops at or slightly below that of Week 1, but the intensity of the lift is increased substantially. In Week 4, both volume and intensity are decreased to provide a window of recovery for the player. With novice lifters who do not need this recovery window, simply return to the volume of Week 1, but continue to push the intensity.

For every training session, choose 1-2 lifts that are a primary focus. For those lifts, program 3-6 sets of anywhere from 1-8 reps, depending on the focus of that training phase. For the secondary lifts, program 2-3 sets of 6-10 reps. The following examples will help make these ideas more concrete.

Day 1: Lower Body

A1) Dumbbell Reverse Lunge
Week 1: 4 x 6/side
Week 2: 4 x 8/side
Week 3: 4 x 5/side
Week 4: 3 x 6/side

A2) Lateral MiniBand Walk
Week 1: 3 x 10/side
Week 2: 3 x 10/side
Week 3: 3 x 10/side
Week 4: 2 x 10/side

B1) Dumbbell 1-Arm 1-Leg SLDL
Week 1: 3 x 8/side
Week 2: 3 x 10/side
Week 3: 3 x 6/side
Week 4: 2 x 6/side

B2) Front Plank/Side Plank
Week 1: 3 x 20s/each
Week 2: 3 x 20s/each
Week 3: 3 x 20s/each
Week 4: 2 x 30s/each

C1) Slideboard Hamstring Curl (3s negative)
Week 1: 3 x Failure
Week 2: 3 x Failure
Week 3: 3 x Failure
Week 4: 2 x Failure

C2) Standing Tight Rotation
Week 1: 3 x 15s
Week 2: 3 x 15s
Week 3: 3 x 20s
Week 4: 2 x 20s

Day 2: Upper Body

A1) Dumbbell Chest Press
Week 1: 4 x 6
Week 2: 4 x 8
Week 3: 4 x 5
Week 4: 3 x 6

A2) Lying Dumbbell Internal Rotation
Week 1: 3 x 8/side
Week 2: 3 x 8/side
Week 3: 3 x 8/side
Week 4: 3 x 8/side

B1) Low Pulley Row
Week 1: 4 x 8
Week 2: 4 x 6 (4s negative)
Week 3: 4 x 6
Week 4: 3 x 8

B2) ½ Kneeling Belly Press
Week 1: IsoHold: 3 x 15s/side
Week 2: IsoHold: 3 x 20s/side
Week 3: Dynamic: 3 x 8/side
Week 4: Dynamic: 3 x 10/side

C1) Weighted Chin-Up (Neutral Grip)
Week 1: 3 x 6
Week 2: 3 x 8
Week 3: 3 x 4
Week 4: 2 x 6

C2) Wall 1-Arm Stability Ball Holds
Week 1: 3 x 15s/side
Week 2: 3 x 15s/side
Week 3: 3 x 15s/side
Week 4: 2 x 15s/side

These examples are slightly modified excerpts of an off-season training program. Notice that in each case the week-to-week variations in the primary and secondary lifts follow the scheme described above. From here, increasing the overall emphasis on hypertrophy or maximum strength becomes pretty simple. Just shift the volume or time under tension upward to maximize the hypertrophic effect and downward with a concomitant increase in the overall intensity to maximize the maximum strength effect.

For example, instead of a primary lift using a scheme like this:

Week 1: 4 x 6
Week 2: 4 x 8
Week 3: 4 x 4
Week 4: 3 x 6

A more hypertrophy-oriented scheme may look like:

Week 1: 4 x 8
Week 2: 4 x 10
Week 3: 4 x 6
Week 4: 3 x 8

And a more maximum strength oriented scheme may look like:

Week 1: 4 x 4
Week 2: 4 x 6
Week 3: 4 x 2
Week 4: 3 x 4

Again, this is an oversimplified view of program design, but it provides a template by which other strategies (paired sets for the same muscle groups/movements, focused eccentrics, cluster sets, etc.) can be integrated.

Exercise Progressions

The case has already been made for unilateral training. Most players can jump right into single-leg training with a little coaching, but upper body training tends to be more effective if you start with bilateral and progress to unilateral. As with other progressions in this book, these are not set in stone. Some players may have a more difficult time with a squat pattern than a split squat pattern, despite the split squat technically coming later in the progression. These progressions are meant to provide a framework to help guide athletes with minimal training background to advanced training strategies.

Lower Body Pushing Emphasis
Squat
Split Squat
Back Leg Raised Split Squat
Single-Leg Squat

Single Leg Squat using the platform as a depth indicator

Lower Body Pulling Emphasis
Pull Throughs/Stiff-Legged Deadlift/Stability Ball Hamstring Curl
Trap Bar Deadlift/Slideboard Hamstring Curl
Straight Bar Deadlift/Slideboard Hamstring Curl with 1-Leg Negative
Reverse Lunge/Step-Up/1-Leg Stability Ball Hamstring Curl
1-Leg Stiff-Legged Deadlift/1-Leg Deadlift/1-Leg Slideboard Hamstring Curl

*Reverse Lunges and Step-Ups are really hybrid exercises, but placing them in this category emphasizes pulling through the front leg instead of driving off the back leg.

Trap Bar Deadlift

Dumbbell Reverse Lunge

Upper Body Pushing Emphasis
Incline Push-Up
Push-up
Dumbbell Chest Press/Bench Press/Overhead Press
Alternate Arm Dumbbell Chest Press/Alternate Arm Overhead Press
1-Arm Cable Chest Press/1-Arm Overhead Press
Horizontal/Incline 1-Arm Rotational Cable Chest Press

Alternate Dumbbell Chest Press

Upper Body Pulling Emphasis
Lat Pulldown/Low Pulley Row/Inverted Row
Chin-Up Holds/Chin-Up Negatives Only
Chin-Ups/Alternate Low Pulley Row
1-Arm Row/Standing 1-Arm Cable Row

Standing 1-Arm Cable Row

With most lower body exercises, the athlete can use dumbbell, back squat grip, and front squat grip variations. Using dumbbells lowers the center of gravity, making it the easiest variation for players learning new movements. From here, progress to front squat grip movements, then back squat grip movements. After players become proficient in all three, it is just a matter of rotating which one the player uses in order to minimize spinal loading. With squats and squat variations, it is helpful to identify the depth players should squat to using a box (back and front squats) or stacked weight plates (single-leg squats). This will ensure consistency from rep to rep and set to set, while accounting for individual differences in hip ROM.

With upper body movements, the goal is to progress toward movements with a “dissociation” emphasis. Because a player’s arms will act largely independent of one another during hockey, it is helpful to reinforce this separation during training. As with unilateral lifts for the lower body, this does not necessitate that the training neglects strength improvements. Dissociated upper body movements like Alternate Arm Dumbbell Chest Press and Standing 1-Arm Cable Row can still be loaded extremely heavily.

Simply changing the grip can create several variations to upper body pulling exercises. For example, chin-ups can be done with an underhand, overhand, neutral, or mixed grip (one overhand, one underhand). With rotating handles, it is possible to perform variations with all of these grips and with a rotational grip from overhand to underhand. In contrast, upper body pressing movements should only be performed with a neutral grip (palms facing each other). This minimizes the amount of glenohumeral (shoulder) internal rotation and consequent risk of various impingement symptoms. During horizontal pressing movements, players should focus on keeping their elbows within 45° of their sides (e.g. keep your elbows in tight) to decrease the stress to the anterior shoulder capsule at the bottom position.

The next chapter will dive into the remaining major aspect of strength training for hockey.

Functional Core Training

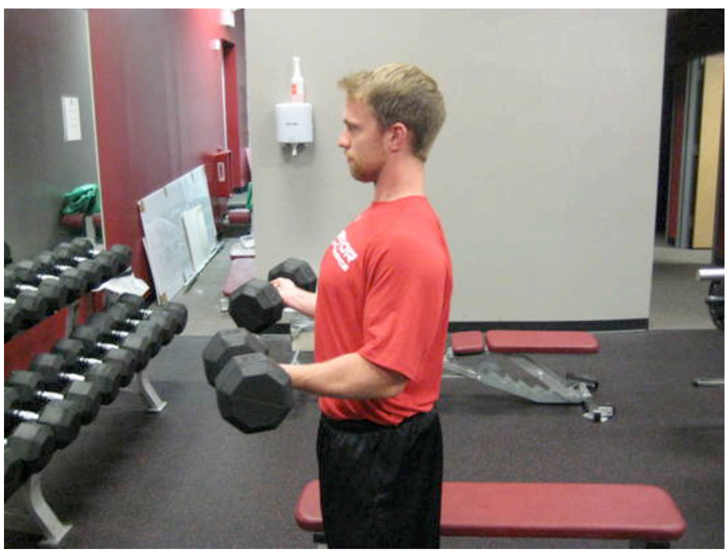
The word “functional” is used to describe a wide variety of training practices (too wide!). Most people picture images of unstable surface training with people standing on stability balls, balancing on a BOSU on one leg, and all sorts of other circus-like exercises. Unfortunately the term functional has been bastardized into eliciting thoughts of these gimmicks that are the antithesis of functional. To reorient us, functional core training refers to using the core for its anatomically designed functions with special regard to its role in creating and controlling movement on the ice.

The archaic nature of the core training programs of most hockey players is truly amazing. Despite the vast improvements in the understanding of the core in the last decade, most players continue to do the same mindless exercises (e.g. sit-ups, crunches, bicycles, leg throw downs, Russian twists, and Supermans). To be fair, the problem is not that players are ignoring current evidence on more effective core training; it is that the information has not yet reached them. Take a closer look at a few of these exercises.

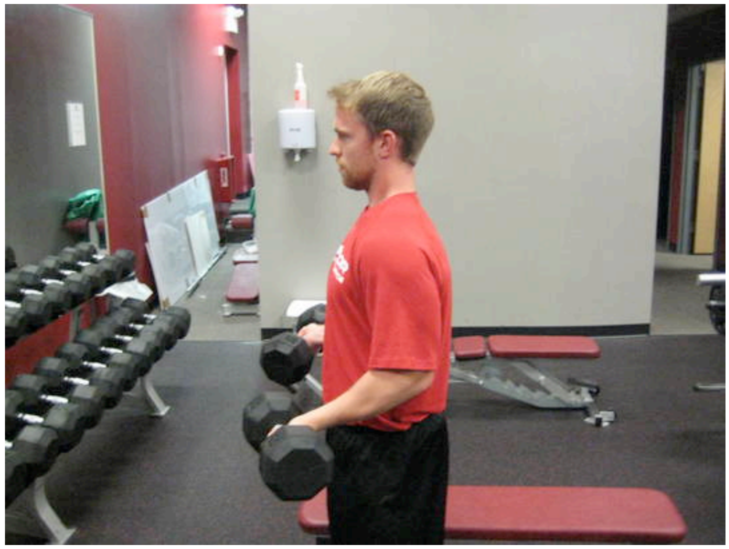
Sit-Ups. Sit-ups usually involve someone or something holding the player’s feet down. Anytime the feet are locked in place, the hip flexors are going to kick in and start pulling hard. Since the feet are locked, the hip flexors aren’t going to flex the thigh toward the pelvis, but instead will pull the pelvis toward the thigh.

This may be confusing at first because most anatomy classes teach that each muscle has a distinct origin and insertion, and the muscle serves to pull the insertion point toward the origin. This is not the case. Assuming an individual’s muscles have two attachment points (a drastic oversimplification, but it will do for this purposes), when a muscle attempts to shorten, it does so by pulling the two attachments toward each other. Typically one end is more stable than the other, allowing it to remain relatively stationary as the muscle pulls the other attachment toward it. As an illustration of this concept, think of the biceps brachii function in a biceps curl, where it moves the forearm toward the humerus (upper arm), versus during the chin-up, when it pulls the humerus toward the forearm. As another biceps example, many times as people lower the weight during a biceps curl, they'll get the weight about half way down and then the elbow angle won't change, but the shoulder blades will anteriorly tilt to get the weight through this part of the ROM.

This is because the biceps brachii attaches to the coracoid process (short head) and the tubercle of the glenoid cavity (long head) of the scapula. When the forceful pull of the biceps on the anterior scapula exceeds the ability of the scapular depressors (e.g. lower trapezius) to maintain scapular stability, the scapula will anteriorly tilt, allowing the weight to be lowered without the elbow angle changing.



Dumbbell Biceps Curl with proper alignment



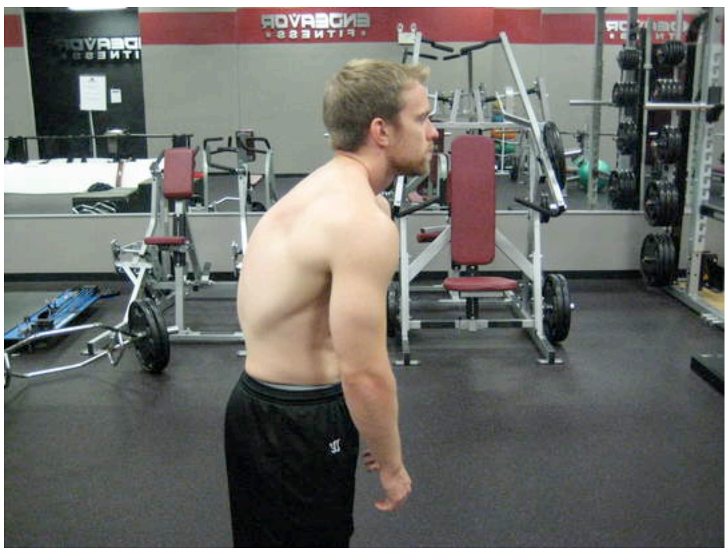
Dumbbell Biceps Curl demonstrating anterior scapular tilt and forward movement of shoulder

The strong pull of the hip flexors during a sit-up creates two main problems. The first problem is that the exercise is largely negating the musculature intended to produce the movement. While the rectus abdominis (the “6-pack” muscle) and internal and external obliques are contracting, their collective force production is minimal compared to that of the hip flexors. The second problem is that the psoas major attaches to the lower spine (transverse processes of T12-L5). Essentially this means that there will be a strong pull on they athlete’s lower back while performing sit-ups. This will be a running theme with many traditional core exercises. It is no mystery why players that perform these movements with high volumes on a regular basis have low back pain.

Crunches with Side-Lying Variation. While crunches may be lesser of an evil than sit-ups, they still should not be included in hockey training programs. Despite this commonly held belief, the hip flexors are still producing force during crunches, even with the hips and knees bent to 90°. On a related note, because most people are more concerned with the *quantity* of repetitions opposed to the *quality* of the repetitions, the pelvis rarely maintains a stable position. As the hip flexors pull hard, and the pelvis tilts anteriorly, a significant amount of stress is placed on the lumbar spine. Even if the exercise is performed perfectly, it still should not be used consistently in programming.

Coupled with a lifestyle characterized by hours of sitting, chronic shortening of the rectus abdominis through training can result in this muscle becoming somewhat permanently shortened, which can result in a depressed rib cage (Sahrmann, 2001). A depressed rib cage will have a negative influence on breathing due to an altered diaphragm position, and a decreased ability for the rib cage to expand and contract. It can also lead to an increased kyphotic (hunchback) curve of the thoracic spine. An increased thoracic kyphosis can lead to a forward head posture, which correlates with headaches, but has even more relevant implications for hockey players. The increased kyphosis tends to drive the shoulder blades laterally along the rib cage. This puts the glenohumeral joint in an exposed position that significantly increases the likelihood of a shoulder separation (acromioclavicular joint) or dislocation (glenohumeral joint), especially if a player is hit from the side or falls on an outstretched arm.

Normal spinal alignment



An exaggerated example of thoracic kyphosis. Note the forward head posture, and compromised position of the shoulder.

The side-lying variation (knees bent and together twisted to the side) is commonly recommended to target the obliques. Unfortunately this variation puts the lumbar spine in a rotated position. Crunching in this position leads to lumbar flexion. Dr. Stuart McGill, the world expert on mechanisms of low back pain, has shown us through his research that repeated lumbar flexion and rotation is a primary mechanism for a slipped disc (McGill, 2002). This is also the problem with the ab ladder sit-ups with mid-position twist. The hip flexors are pulling hard on the lumbar spine while it is in flexion and then forceful rotation is added. This is not exactly what we're looking for out of these exercises. While crunches do work the rectus abdominis and the internal oblique (if performed the correct way by tucking the chin, pulling the navel in toward the spine, and crunching up one vertebrae at a time), the potential negative side effects necessitate considering if it is the *best* way to train this musculature.

Bicycles and Leg Throw Downs. Bicycles involve the athlete lying on his back and repetitively and rapidly extending one hip and knee as he flexes the other hip and knee. Conceptually, this exercise isn't horrible. However, the way it is typically performed makes it a poor way to train the core for reasons already discussed. The hip flexors do the majority of the work, the pelvis moves into an anteriorly tilted position, and lumbar stability is compromised.

Leg throw downs are another poor exercise for a similar reason. Most players do not possess the core strength to perform this exercise correctly. In fact, in many cases the player will not be able to use their musculature to prevent anterior pelvic tilt at all, as evidenced by the forceful pulling of the lumbar spine above the ground with each throw. The rectus abdominis and external oblique, which are primarily responsible for preventing anterior pelvic tilt, are not strong enough to resist the movement, so the pelvis rapidly tilts anteriorly, pulling the lumbar spine off the floor. When the hips are in maximal anterior tilt, then it is possible that the hip flexors will release a bit to leg the hips angle change. This allows the legs to reach the floor, and the hip flexors to gain some momentum as they pull the legs off the floor and back up to the starting position.

Supermans. Supermans produces similar problems as the previously discussed exercises, but in a different direction. Since almost all hockey players have tight hip flexors, lying on their stomach will result in a downward pull of the lumbar vertebrae, pulling the lumbar spine into hyperextension. This means we have sub-optimal spinal alignment before the exercise is even started. Since the rest of the movement basically involves hyperextending the torso and simultaneously hyperextending the hips, the lumbar spine is stuck in the middle, moving into extreme hyperextension. Performing an alternate superman (lifting the right arm and left leg) adds a rotational force to a hyperextending lumbar spine, which isn't any better. Furthermore, extension of the hip past a neutral position should primarily be performed by the gluteus maximus. Most players have visibly lax glutes during this exercise, instead choosing to pull with their hamstrings. This re-inforces a poor movement pattern that could have significant implications in other movements. Most importantly, very few people actually have weak lower back musculature that necessitates special attention (Kendall et al, 2005). In fact, many players will have overdeveloped lumbar erectors as a result of poor core control and/or maintaining a rounded over posture for prolonged periods of time.

After further analyzing these exercises, it is easy to understand that the emphasis is on the wrong musculature and on the wrong movement strategies. Equally as importantly, these traditional exercises exacerbate the negative adaptations that result from a modern culture of prolonged sitting, such as tight hip flexors, increased thoracic kyphosis, and a forward head posture. Michael Boyle accurately refers to this as "cementing dysfunction." Again, this is clearly not the purpose of training. This brings about two important necessities regarding core training: The need to identify the definition and function of the core.

Defining Core Function

The core consists of all the muscles that attach to the hips and spine. This definition is quite broad, or more encompassing, in comparison to the traditional surface level abdominal muscle definition. The reason for this broadened definition is highlighted by an improved understanding of the core's collective function. The core serves three major purposes:

1) Create a stable platform for extremity (leg and arm) movement (Kibler et al, 2006)
2) Create stiffness for efficient force transfer between the lower and upper extremities (Geraci & Brown, 2005)
3) Control pelvic tilt and rotation (Sahrmann, 2001)

As a quick side note, some readers may not think of core training as anything but a means to an end: a six-pack. It is worth pointing out that possessing an aesthetically pleasing midsection is primarily a function of body fat. In other words, regardless of how strong a player's core is, he won't have a six-pack unless his body fat levels are around 10%. Conveniently, this is the hallmark most elite level hockey organizations want their players anyway, so it makes sense to encourage players to optimize their diets for performance and aesthetic reasons.

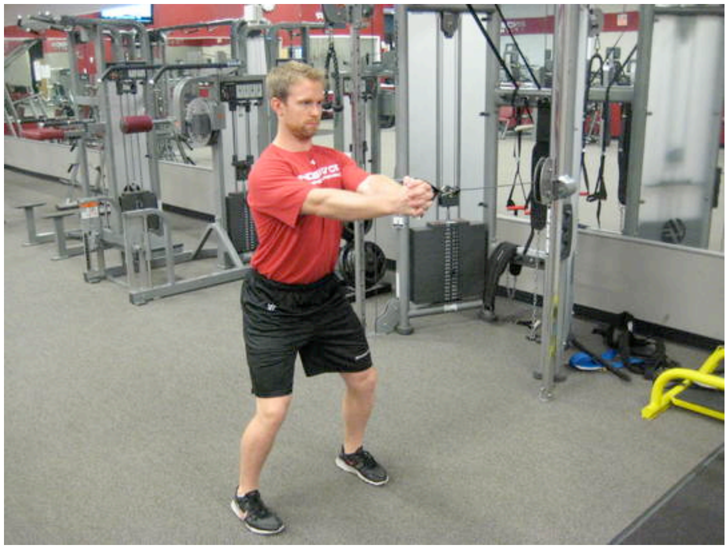
Understanding the definition and true purpose of the core allows for more effective core training progressions. When deciding on core training exercises, it is important to keep a few things in mind:

1) Direction of the stress
2) Position of the hips, spine, scapulae, and head
3) Load and volume of the exercise
4) Predictability of the movement

Direction of Stress

Core exercises can be divided into linear, rotational, and diagonal "stressors" based on the direction of the load. For example, front planks, side planks, and glute bridges have a linear orientation; standing belly presses and plank rotations have a rotational orientation; and chop and lift variations have a diagonal orientation. Because hockey creates a wide variety of multi-directional stressors across the core musculature, it is necessary to incorporate exercises with all of these movement directions.

Side plank



Standing Belly Press IsoHold

Standing Cable Chop

Body Position

Naturally, body position will change depending on the exercise; the goal is to ensure that no joint is in poor alignment. For example, during plank variations, the hips should be fully extended, the spine in a neural curve, and the head in proper alignment with the rest of the body (ears in-line with the acromioclavicular joint). During glute bridges, the hips should be fully extended and the lumbar spine should not hyperextend. During almost all core exercises, the hips should be centered within the base of support provided by the feet. If proper alignment is lost, the exercise should be terminated.

Load and Volume

There is some debate as to whether core strength is more or less important than core endurance. This debate exists largely in regards to the general population, but has been extended to athletes. In consideration of the demands of hockey, both core strength and endurance are important. As a result, core training program design should reflect this by incorporating heavier loaded exercises for lower volumes (e.g. slideboard rollout for 3 sets of 8) and lighter loaded exercises for higher volumes (e.g. standing belly press for 3 sets of 30s/side).

Predictability of the Movement

During a game, movement on the ice can be described as both proactive and reactive. In other words, there are times when players are consciously making decisions about what they want to do, and others when they are moving reflexively without much thought. The idea of reactive core stabilization spawned from hearing physical therapists Gray Cook and Michael Reinold speak about the importance of training the sensoriomotor systems to detect movement/ stress and generate an appropriate force response.

The application of this principle has revolutionized core training programs to include more perturbation-based exercises. A perturbation, by definition, is a challenge to stability. Perturbations can be both internally and externally driven. For example, while performing a side plank, moving the top leg into flexion and extension will create a challenge to stability. Because leg movement is dictated by the person doing the exercise, this is an example of an intern-ally driven perturbation.

Side Plank with Active Hip Flexion/Extension

In contrast, if a player were holding a side plank and a partner manually attempted to rotate or laterally deviate the player's hips or shoulders, he would have to react to the unpredictable stimulus. This is an example of an external perturbation.

Side Plank with Perturbation

Certain external perturbations can be applied with either a stiffness or completely reactive emphasis. To distinguish between the two, imagine performing a split squat isohold (knee right above the ground) while holding a stability ball with your arms locked out overhead.

The "perturbator" can cue the athlete to get tight and not move at all while really cranking on the ball in a variety of movements (push, pull, rotate, diagonally shift, etc.). In contrast, the perturbator can also cue the athlete to maintain a stable position, but relax as much as possible and just react to the perturbation as quickly as possible. On the ice, the difference between these two variations manifests between reacting to an unexpected stimulus while already in a battle, such as fighting for a puck in the corner, compared to reacting to a completely unexpected stimulus where the player may be a bit more lax. External perturbations are a more advanced progression of core training, and should not be added to any exercise that cannot be performed with perfect form, but can provide a highly hockey-specific core training stimulus when used correctly.

Overhead Stability Ball Split Squat IsoHold with Perturbation

Core Training Progressions

Before getting to the “sexier” advanced core training exercises, it’s necessary to build a solid foundation of functional stability and movement patterns. The progressions below provide a solid framework from which to base core training programs.

General Core Progressions

All core training should start with a stability emphasis. This provides a controlled environment to reinforce proper joint alignment, posture, and stabilization strategies. These stability-driven exercises can be progressed by increasing the time, load, adding a perturbation, and/or by moving to a more intense variation. During training phases with a heavy core training emphasis (e.g. Early Off-season), do three sets of all core training exercises, and progress between rep ranges of 8-15 per set or 15s-30s holds, depending on the exercise.

Examples of progressions are presented below. Of course, every player will progress at different rates. Sometimes it will take players several weeks to be able to progress to a more advanced exercise. This is one of the reasons that most training programs are more accurately just training templates. Frequent changes need to be made to accommodate individual players.

Example 1: ½ Kneeling Belly Press
Week 1: IsoHold: 3 x 15s/side
Week 2: IsoHold: 3 x 20s/side
Week 3: Dynamic: 3 x 10/side
Week 4: Dynamic: 3 x 12/side

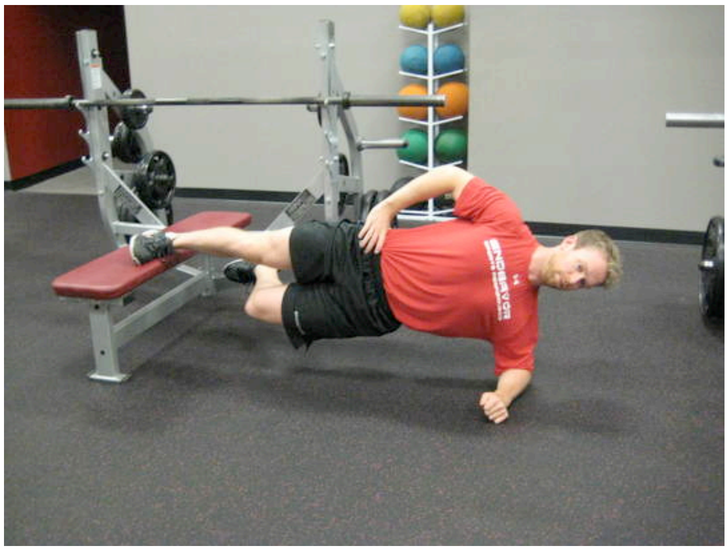
Example 2: Stability Ball Front Plank
Week 1: 3 x 20s
Week 2: 3 x 30s
Week 3: w/ Mini Rollouts: 3 x 10
Week 4: w/ Mini Rollouts: 3 x 12

As the athlete progresses to other phases, the repetition/duration schemes stay similar, but he may only do two sets instead of three to account for increased training volume of other aspects of his program (e.g. power training). The progressions below provide a guideline of how to move from basic to more advanced exercises. It is not necessary to use every exercise in this progression as many of the exercises parallel each other in both training stimulus and difficulty, and some players may find certain exercises more difficult than others. The important thing is to consider what type of stress the exercise places on the body. The multitude of exercises is presented in the interest of variety.

Linear Anterior Core Emphasis
Front Plank
1-Leg Front Plank
Front Plank March
Stability Ball Front Plank
Stability Ball Front Plank w/ Mini Rollout/Slideboard Alternate Arm Body Saw
Slideboard Body Saw
Slideboard Push-Up with 1-Arm Reach
Stability Ball Rollout
Bar/Ab Wheel/Slideboard Rollout
Overhead Stability Ball Pertubation
Squat Hold with Overhead Stability Ball Pertubation
Split Squat Hold with Overhead Stability Ball Pertubation
Front Plank with Pertubation
Stability Front Plank with Pertubation

Stability Ball Front Plank

Linear Lateral Core Emphasis
Side Plank/1-Arm Dumbbell Hold
1-Leg Side Plank/1-Arm Dumbbell Farmer's Walk
Side Plank March/Side PLank w/ Active Hip Flexion/Extension
1-Leg Standing 1-Arm Dumbbell Hold
Feet Elevated Side Plank
2-Way Bunkie Side Plank
2-Way Bunkie Side Plank with Active Hip Flexion/Extension
Side Plank with Pertubation
Feet Elevated Side Plank with Pertubation



Bunkie Side Plank (1-Way)

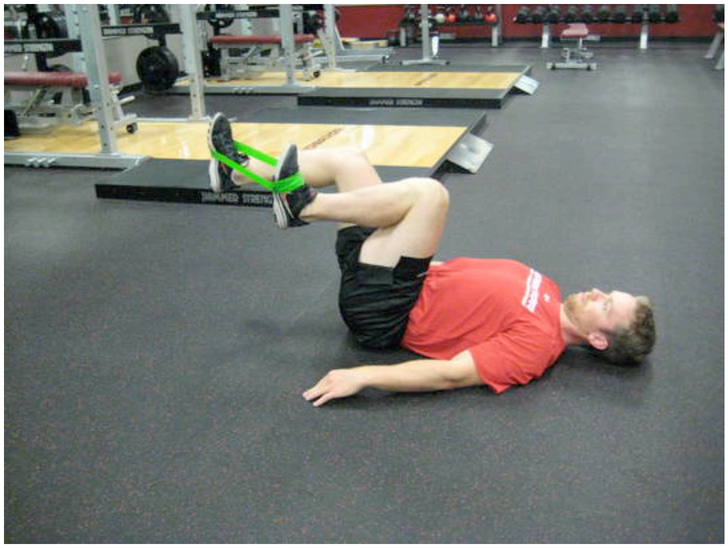
Rotational Core Emphasis
1/2 Kneeling Belly Press IsoHold
1/2 Kneeling Belly Press IsoHold
1/2 Kneeling Belly Press
Tall Kneeling Belly Press IsoHold
1/2 Kneeling Belly Press/Stability Ball Tight Rotation
Standing Belly Press IsoHold/Standing Tight Rotation
Standing Belly Press/Rotational Planks/Med Ball Tight Rotation
1-Leg Standing Belly Press IsoHold
1-Leg Standing Belly Press
Standing Belly Press IsoHold with Pertubation
Split Stance Belly Press IsoHold with Pertubation
1-Leg Standing Belly Press IsoHold with Pertubation

1-Leg Standing Belly Press IsoHold

Diagonal Core Emphasis
1/2 Kneeling Cable Chop/Lift
Tall Kneeling Cable Chop/Lift/Stability Ball Front Plank with Diagonal Reach
Standing Cable Chop/Lift/Standing Diagonal Tight Rotation
Split Stance Cable Chop/Lift/Med Ball Standing Diagonal Tight Rotation

Tall Kneeling Cable Lift

Anterior Hip Emphasis
Lying Psoas Lift
Band-Resisted Lying Psoas Lift
Seated Psoas Lift
Band-Resisted Seated Psoas Lift
Standing Psoas Lift
Band-Resisted Standing Psoas Lift



Band-Resisted Lying Psoas Lift

Posterior Hip Emphasis
Glute Bridge IsoHold/Super Dog IsoHold/Wall March IsoHold
Glute Bridge/Super Dog/Dynamic Wall March
1-Leg Glute Bridge IsoHold/Quadruped Hip Extension IsoHold
1-Leg Glute Bridge/Alternating Wall March/Quadruped Hip Extension
Glute Bridge March/Bird Dog IsoHold
Bird Dog

1-Leg Glute Bridge IsoHold

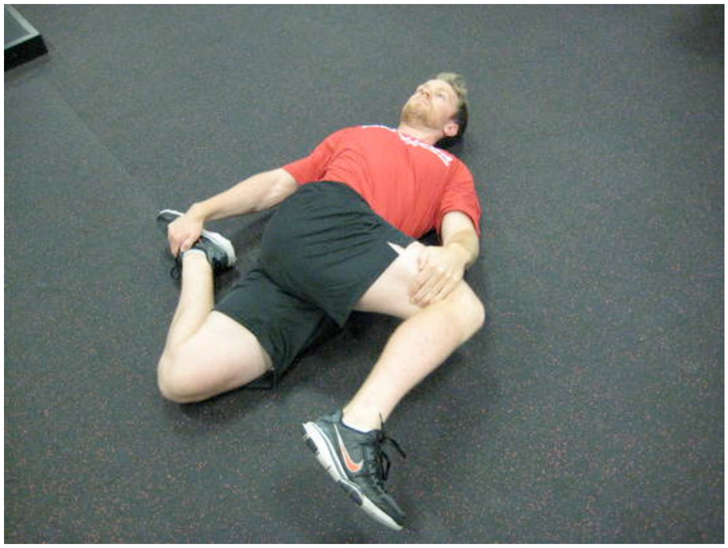
Lateral Hip Emphasis
Lateral MiniBand Walk/Backward Monster Walk (Knees)
Lateral MiniBand Walk/Backward Monster Walk (Ankles)
Lateral MiniBand Walk/Backward Monster Walk (Ankles; Speed Emphasis)
2-Way Skater/2-Way Goalie

Lateral MiniBand Walk

Medial Hip Emphasis
Lateral Slideboard Lunge/6-Way Med Ball Crush
Band-Resisted Lateral Slideboard Lunge
Diagonal Slideboard Lunge
Band-Resisted Diagonal Slideboard Lunge
Band-Resisted Rapid Stride Recovery

Diagonal Slideboard Lunge

Diaphragm Emphasis
Lying Belly Breathing
Prone Belly Breathing
Brettzel Breathing



Brettzel Breathing

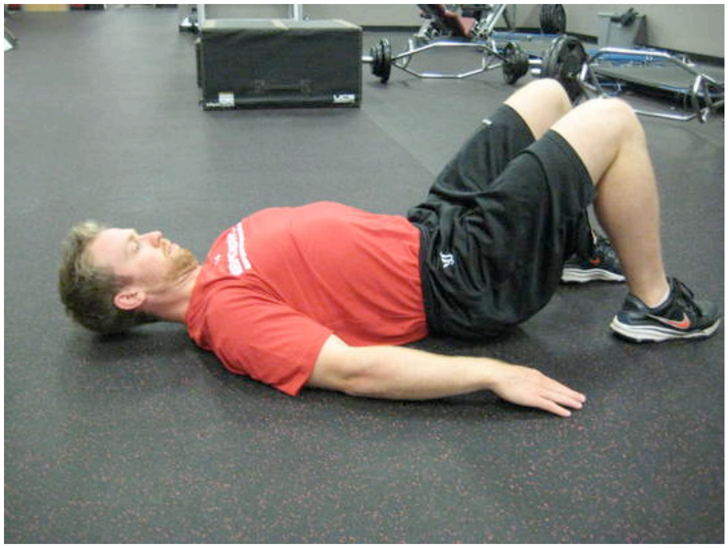
Scapulae Musculature Emphasis
Prone Y, T, W Holds
Scap Push-Ups on Forearms/Alternate Arm Scap Wall Slide
Dynamic Y, T, W's
Scap Push-Up/Yoga Push-Up/Scap Wall Slide/Quadruped 1-Arm Reach
Hips Flexed Dynamic Y->W's, Standing Dynamic Blackburns
Inverted Scap Row/Scap Push-Up into Yoga Push-Up/Reach, Roll, Lift
Hips Flexed Dynamic Blackburns

Dynamic Y->W

Rotator Cuff Emphasis
No Money Drill/Lying Internal Rotation
Side Lying Ext. Rotation/Band-Resisted No Money Drill/Prone Int. Rotation
1/2 Kneeling Cable Ext. Rotation/1/2 Kneeling Cable Int. Rotation
1-Arm Stability Ball Wall Hold
1-Arm Stability Wall Hold with Pertubation
1-Arm Med Ball Front Plank
1-Arm Med Ball Front Plank with Pertubation

1-Arm Stability Ball Wall Hold

Anterior Neck Emphasis
Wall Chin Tucks
Lying Chin Tucks
Quadruped Chin Tuck



Lying Chin Tuck

Re-evaluating "Neutral"

During exercises like cable belly press holds, cable overhead holds, and stability ball perturbations, it is common to reinforce a "neural" posture, meaning the cable handle or ball is held inline with the midline of the body. Initially, this strategy is the most beneficial, as it allows the player to learn proper alignment. However, once a player is familiar with this position, this strategy is limited in that hockey players need to react to anti-stabilization stimuli in a wide variety of positions. One way to help bridge the gap between always being "neutral" and the demands of on-ice competition is to have them move in a different direction for each set. For example, the first set the player would line up the resistance with his midline; the second set he'd line up the resistance at a 45° angle to his right, and the second set he'd line up the resistance at a 45° angle to his left.

This allows the improvements in stabilization to be extended through a wider range of motion and reinforces the multiplanar role of the core.

Seasonal Considerations

The seasonal considerations for core training are not nearly as complex as other aspects of training (e.g. strength, speed, and conditioning). As long as players are performing the exercises with proper technique, and do not have any glaring imbalances, the most important thing is to include a wide variety of patterns. During the season, back off some of the exercises with a rotational emphasis, as players are going through rotational patterns several hundred times per week on the ice. Similarly, during the early off-season, place a greater emphasis on rotational core training in the direction that opposes the player's forehand shot. For example, have a player perform one set of side standing med ball scoops on his shooting side and three sets on his non-shooting side. The goal here is to help restore balanced strength and stiffness across the involved musculature.

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A New Look At Hockey Conditioning

Conditioning can make or break a player. The previous chapters have outlined the importance of strength and power in hockey training programs. In reality, none of that matters if a player does not have the stamina to maintain a high level of performance shift after shift. Unfortunately, the overwhelming majority of hockey players have been going out their conditioning in completely the wrong way. Conditioning is at the forefront of the hockey training revolution.

Tradition has passed down the idea that hockey players needed to build an aerobic base before moving on to more intense bouts of interval-based conditioning. This concept was transferred to hockey from old school periodization models and continues to be perpetrated by the coaches that cling to the “that’s what I did as a player, so that’s what you need to do” mentality. The proponents of aerobic training for hockey players tend to emphasize the documented benefits, but neglect the documented deleterious effects.

Aerobic training does lead to a number of positive adaptations that ultimately improve the body’s ability to deliver oxygen to working muscles. These benefits include increased:

1) Blood volume
2) Red blood cell number (these cells carry oxygen)
3) Density of capillaries in muscle
4) Size and density of mitochondria in muscle (oxygen processing components of muscle cell)
5) Left ventricular size (this chamber pumps blood to the rest of the body)
6) Stroke volume

7) Ability to store muscle glycogen (energy stores within the muscle)
8) VO_2 Max (aerobic capacity)

At first glance, this appears to be an impressive list of physiological adaptations that would absolutely benefit hockey players. As with any aspect of training, it is important to weigh the desired and undesired adaptations to aerobic training if it is going to earn a justified place in the training program. While the list of deleterious effects may not be as long as the list of benefits, the impact of these adaptations is tremendous. Aerobic training leads to:

1) A transition of MUs toward exhibiting “slow twitch” characteristics
2) A blunted stretch-reflex response
3) High volumes of repetitive movements through partial ranges of motion

What do “twitches” have to do with hockey?

Muscle fibers have typically been viewed as either slow-twitch (Type I), fast twitch (Type IIb) or intermediate (Type IIa). Other names have been used, but generally these three categories persist. In general, these categories exhibit the following characteristics:

Characteristic	Type I	Type IIa	Type IIb
Motor Neuron Size	Small	Medium	Large
Force Output	Low	Medium	High
Contraction Speed	Slow	Fast	Fastest
Time to Peak Tension	Slow	Fast	Fastest
Relaxation Time	Slow	Fast	Fastest
Oxidative Capacity	High	Medium	Low
Glycolytic Capacity	Low	Medium	High
Glycogen Content	Low	High	High
Capillary Density	High	High	Low
Mitochondrial Volume	High	Medium	Low
Fatigability	Low	Medium	High

Type I,IIa, and IIb fibers are referred to as “slow twitch” or “fast twitch” based on their contraction speed, which is depicted by both the time to peak tension and relaxation time above. The faster a fiber (or more specifically, a MU) can generate tension and relax, the faster the tension “twitch”. According to the table, Type I fibers are well adept at producing low levels of force over extended periods of time, which is essential for holding various postures and activities like extensive distance running. On the other end of the spectrum, Type IIb fibers create high levels of force, but are highly fatigable. These are the fibers players rely on for quick bursts of speed on the ice. Naturally, Type IIa fibers exhibit characteristics in the middle of these two extremes.

While separating MU and muscle fiber characteristics into categories provides an easy way to understand differential properties of muscle fibers, it is likely that muscle fibers are not divided into categories as much as fall on a continuum ranging from exhibiting extreme slow twitch properties to extreme fast twitch properties. Coming back to aerobic training, a transition toward a greater proportion of Type I fibers would lead to a profoundly negative impact on a player's ability to generate explosive power, which would inhibit his ability to skate fast, accept and give high velocity hits, and shoot hard. This is accentuated by the fact that prolonged aerobic training can lead to a blunted stretch reflex response, which is a neural reflex designed to rapidly create high levels of force (Avela & Komi, 1998). In other words, prolonged aerobic work trains hockey players to sustain impressively mediocre performances for extended periods of time.

In consideration of the aforementioned discussion, the bright light of aerobic training benefits is beginning to dim. Repetitive, low-medium speed partial ROM movements is a great way to set the body up for strains related to overuse and a general lack of preparation for the high velocity full ROM movements of the hip and knees on the ice. From a training standpoint, finding a way to capitalize on the positive benefits of aerobic training, while minimizing the deleterious effects would provide a viable alternative to condition for hockey. Luckily, such a conditioning strategy exists.

Interval Training Introduction

High intensity interval training (HIIT) has gained popularity over the last several years as the research-supported benefits become impossible to ignore. There are two groundbreaking studies that create the foundation for replacing steady-state aerobic training for HIIT.

Take a look at what these studies found:

Study 1: The "Tabata" Study

Six weeks of training for 60 minutes/day for 5 days/week at 70% VO2max resulted in a significantly smaller increase in VO2max (the marker of aerobic capacity) and smaller increase in anaerobic power (what matters for hockey player) than an interval training program involving 7-8 sets of 20s of all out effort followed by 10s of rest.

In other words, *6 hours of training per week produced worse results than 20 minutes (5 days of the interval training totals 20 minutes) of training, even in measures of aerobic capacity!* This, by the way, comes from a study that is over a decade old (Tabata et al., 1996).

<u>Study 2: The Gibala Study</u>

When comparing two weeks of training with either 4-6 30s bouts of all out cycling followed by 4 minutes of recovery (total work: 2-3 minutes; total time including rest: 18-27 minutes) and 90-120 minutes of cycling at 65% max, there were NO DIFFERENCES in:

1) Performance improvements (e.g. similar significant reductions in times to complete a cycling task);
2) Increases in muscle oxidative capacity; or
3) Increases in muscle buffering capacity and glycogen (energy) content.

The authors of this study also noted that the sprint-interval training required 90% less training time than the endurance training. 90%! (Gibala et al, 2006)

The big picture here is that interval training trumps aerobic training, even in measures of aerobic capacity, and takes a mere fraction of the time to perform. This understanding creates a foundation for training hockey players, but is not the whole picture. It is important to understand that fatigue on the ice is multifaceted. In order to create hockey-specific conditioning programs, it is imperative that we consider EVERY aspect of fatigue. This is where things start to get fun.

Fatigue Mechanisms

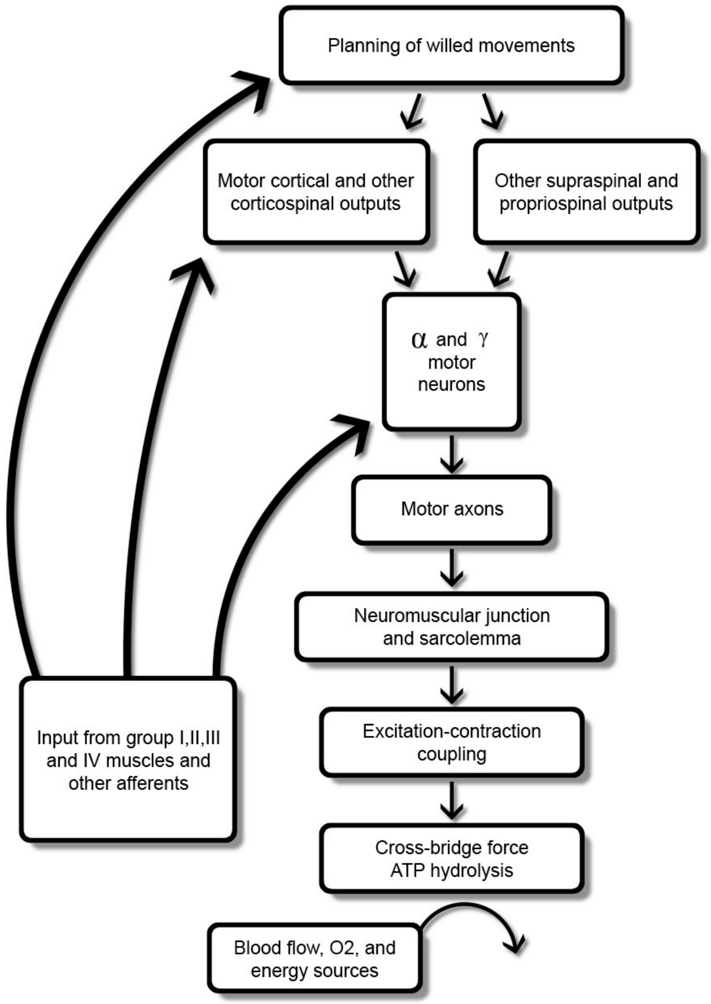
Fatigue is a complex phenomenon. Think of fatigue as an underlying factor of any activity or accumulation of previous activities that causes:

1) A decrease in performance
2) An inability to perform a given task

These performance decrements are brought about by three primary points of fatigue:

1) Respiratory fatigue
2) Localized muscular fatigue
3) Neural fatigue

Anecdotally, when players think of fatigue they most readily acknowledge the first two of these factors. Performance is generally limited by a “burning” or “heaviness” of the legs, or an inability to catch one’s breath. While there are some definite differences in the pathways through which these fatigue mechanisms interact, it is important to note that these three factors are heavily inter-related. For example, if the leg and hip musculature become fatigued locally, less force will be put into each stride. As a result, the player will need to exert a greater amount of effort into each stride, which will result in an increase in both respiratory and neural fatigue. The interdependence of these factors is highlighted in the graph below.



The process of generating voluntary muscle contraction. The complexity of this diagram illustrates the multiple levels at which fatigue can influence force production. In this representation, respiratory fatigue is represented by "blood flow, O2 & energy sources", and the localized muscular fatigue is represented by the chain starting at "neuromuscular junction & sarcolemma". All other components in this model are nervous system oriented. (Adapted from Gandevia, S. Spinal and supraspinal factors in human muscle fatigue. *Physiological Reviews*, 81, 1725-1789, 2001).

Respiratory Fatigue

Hockey is primarily an anaerobic sport, meaning the velocity and intensity at which players move during a shift is too high for the aerobic system to adequately provide fuel. As a result of this anaerobic energy production, the body builds up an "oxygen debt", meaning a lack of oxygen to the working muscles and other body systems will become a performance-limiting factor. Naturally, the body can only sustain these activities for so long before the body needs to replenish this oxygen debt. Respiratory fatigue can be viewed in light of both the lungs ability to take in oxygen, and the heart and circulatory system's ability to deliver this oxygen to the rest of the body. The importance of the lungs in taking in adequate oxygen through complete inhalation and removing respiratory byproducts through complete exhalation highlights the importance of the diaphragm.

The diaphragm is a flat muscle that lines the lower rib cage/upper abdomen area. During proper inhalation the diaphragm contracts, depressing and expanding the rib cage, which provides more room for the lungs to expand. Proper diaphragm function can result in as much as a 30% increase in lung expansion. This has significant implications on hockey performance.

Localized Muscular Fatigue

Localized muscular fatigue is a feeling every hockey player is familiar with. Simply, localized muscular fatigue is an inability for specific muscles to produce task-dependent force requirements. This can be brought about by an inability of muscle fibers to contract, insufficient energy delivery, and reductions in neural drive (discussed later). Muscle contractions and energy delivery, and therefore their implications on fatigue, differ between static and dynamic contractions. Dynamic contractions tend to utilize a greater amount of the body's high intensity energy stores (e.g. Adenosine Triphosphate and Phosphocreatine), and produce a greater amount of metabolic byproducts (e.g. H+ ions), which inhibits localized force production. In comparison, static contractions have a component of occluded blood flow, whereby the intramuscular pressure resulting from the contraction exceeds systolic blood pressure and shuts off the exchange of nutrients between the muscle and blood. This means that fuel cannot be delivered to the working muscle and that byproducts cannot be removed from the muscle. Bigland-Ritchie at al. (1995) provide a great resource on the differential mechanisms of fatigue that may spark the interest of those with an academic background in exercise science.

On the ice, the hip and upper leg muscles are the typical culprits, but the shoulders and back extensors are also affected. Fatigue in the hips, legs, and back extensors is caused by the need to maintain a deep “hockey stance” throughout prolonged periods of time, and alternate these periods of static holds with high velocity dynamic efforts. This is especially true for forwards in the offensive zone, and defenseman, centers, and goaltenders in the defensive zone. While players will stand straight up throughout a shift, more active shifts require players to maintain a knee and hip flexed position, even while gliding, which heavily loads the hips, legs, and back extensors.

Neural Fatigue

Neural fatigue can be divided into supraspinal (brain), spinal, and peripheral components. Supraspinal fatigue is evident by an increased relative muscle activation to produce a given force. This comes back to the example above. Basically, as fatigue sets in, the CNS will need to activate muscles to a greater extent to get the same force output, meaning the CNS will be active at a higher proportion of its maximal capacity. In the interest of longevity (e.g. endurance), the goal on the ice is to use the minimum amount of muscular activation and energy resources to achieve a desired task. Fatigue-related increases in “CNS effort” are unavoidable, so the preparation goal becomes to maximize CNS capacity so that on-ice tasks can be accomplished at a lower relative CNS intensity.

Spinal fatigue refers to changes that affect the excitability and inhibition of motor neurons within the spinal cord. One of the major fatigue-related changes is a decrease in Ia-afferent excitation. Ia afferents are muscle stretch receptors that serve to increase the activation signal to the stretched muscle. This is the neural loop responsible for the stretch reflex, and is an efficient way for the body to naturally improve force production from working muscles. On the ice, players take advantage of the stretch reflex at the end of every stride, as the rapidly stretched adductors and hip flexors produce high amounts of force to return the stride leg beneath the body. Players also use the stretch reflex anytime they stop and change direction or wind up to take a shot. The quick stretch of the hip and leg musculature is what allows players to “spring” out in another direction. As a result, a decrease in the excitatory drive from these Ia afferents will lead to decrements in a player’s ability to move explosively and can result in an increase risk of injury to the adductors, hip flexors, and abdominal musculature.

Lastly, fatigue is associated with changes in the ability for the signals from the CNS to reach the muscle (neuro-muscular propagation) and the speed at which they do so (conduction velocity). As with the above neural components of fatigue, these changes will alter the ability for players to move explosively, and can affect the timing and coordination of muscle contraction.

Conditioning Considerations

Despite the complexities of the underlying scientific mechanisms of fatigue, applying these concepts to hockey conditioning protocols is relatively simple. However, the discussion on these mechanisms reinforces that there is more to conditioning hockey players than just improving their lung capacity. When designing a hockey conditioning program, it is necessary to consider:

1) Work-to-rest intervals of the game
2) Body positions and movement patterns
3) Velocity of movements
4) Intensity of movements
5) Emphasized cause of fatigue (respiratory, localized muscular endurance, or neural)

All of these factors need to be trained in concert to best train players off the ice for on-ice competition. Depending on the level of competition, the average shift lasts about 30-45 seconds. Within that shift, there is usually a stoppage, and periods of both maximal and minimal intensity efforts. In other words, rolling three lines for 45s shifts doesn't necessarily mean that hockey players need to condition using 45s intervals with a 1:3 work-to-rest ratio (WRR). In fact, at most levels it is rare for players to roll through 45s shifts line after line without a stoppage. Players often receive more rest than is commonly acknowledged, and this should be accounted for in their conditioning programs.

During a shift, players need to maintain a good "hockey stance" which involves keeping the hips and knees flexed and the chest and eyes up without flexing at the lumbar spine (lower back) or becoming overly kyphotic at the thoracic spine. Movement occurs at both high velocities and high intensities. While players do perform lower velocity/intensity movements, it is important that players prepare for the maximum requirements of on-ice demands, which will necessarily also prepare them for less strenuous play. Regarding the cause of fatigue, the major take home from the differential fatigue mechanism discussion is that hockey conditioning programs need to account for both static and dynamic fatigue, meaning including training based around prolonged holds in specific postures in addition to the more traditional conditioning modalities.

Choosing a Modality

There are about a half-dozen different conditioning methods that are well-suited for hockey players depending on the time of season. These include:

1) Running (Shuttle Runs)
2) Slideboarding
3) Sled Work
4) Circuit Training
5) IsoHold Progressions
6) Biking

The time of season really dictates which of these conditioning modalities is most appropriate. During the off-season, conditioning should be built around shuttle runs and slideboard work. As the off-season progresses, conditioning should include more sled work and isohold progressions to improve the player's work capacity and ability to maintain a good hockey stance for prolonged periods of time. In preparation for training camps and to tie in a conditioning emphasis to in-season strength training, it is appropriate to use more circuits. Biking is mostly an in-season conditioning option, as it is safe, low-impact, and unloads the lateral and medial hip muscles, which are heavily worked on the ice. AirDyne bikes are preferable to typical stationary bikes because they incorporate an arm action, which serves to help players maintain a more upright torso and make their biking more of a full body effort.

Year-Round Conditioning Progressions

As previously discussed, the time of season will dictate the nature of the conditioning, both in terms of the modalities used and the program design itself.

During the off-season, conditioning should be broken down into three main phases:

1) Phase 1 (8-12 weeks out from pre-season): Traditional Interval Training
2) Phase 2 (4-8 weeks out from pre-season): Heart Rate Accommodating Interval Training
3) Phase 3 (0-4 weeks out from pre-season): Chaos Interval Training

Traditional Interval Training

During Phase 1, conditioning is not a main priority of training. The goal here is to introduce conditioning to the players and start building a foundation to build upon in the future. At this time, it is appropriate to condition twice per week using traditional interval training. Traditional simply means using set WRR intervals within a session. For hockey, intervals with a WRR of 1:3 are a great place to start. Conditioning should be performed either using strictly shuttle runs (having the players run back and forth between cones ~25 yards apart, emphasizing quick transitions and a fast-paced jog in between) or shuttle runs and slide-boarding.

If teams have successful seasons, especially at the elite levels, they may not have much of a break from the end of the season before the beginning of their off-season training. In these situations, it is important to minimize the stress to the medial and lateral hip musculature, which needs time to recover from the season. As a result, slideboarding would not be the best choice for the first several weeks of of-season training. If, however, players were able to take 4-12 weeks away from hockey-related activities, it is a good idea to reintroduce lateral movement patterns via slideboarding.

During this phase, players should use a short work interval for one session (emphasizing explosive movement) and a longer work interval for the next (emphasizing good movement mechanics). For example, a week of conditioning might look like:

Day 1: Slideboard: 8 x :30/1:30

Day 2: Shuttle Runs: 10 x :15/:45

This set-up begins to prepare players for the more intense demands of future conditioning.

Heart Rate Accommodating Intervals

More recently, heart rate monitoring has received attention as a way to dictate WRR intervals. From a physiological perspective, this makes a lot of sense. In order to ensure full recovery between each interval, the player is told not to begin their next interval until a pre-determined minimum heart rate is reached. This highly physiologically meaningful strategy loses validity when the demands of hockey are reconsidered. The game of hockey never waits for a player's heart rate to recover to a certain point. When the game proceeds, the player must be ready. With that in mind, heart rate-driven intervals are not as appropriate as time-driven intervals.

It is possible to combine concepts of heart rate and time-based intervals. During a conditioning session, a player's heart rate will not elevate as high during the beginning intervals as it will during the latter intervals. As a result, the player will not need as much time to recover from the initial intervals as he will the latter. During Phase 2, make two major changes to the conditioning sessions:

1) Alternate work durations between short and long time periods
2) Alter the WRR intervals from 1:1 through 1:3.

On one conditioning day, shorten our WRR to 1:2 and operate within this range with a short (<15s) and long (>15s) work interval. On another day, divide a conditioning session into thirds, and make each third progress from a WRR of 1:1 to 1:2 to 1:3. This increases the conditioning stress, but does not lose the specificity of the intervals relevant to the game. Introducing a 10-20 lb weight vest at this time will begin to mimic the external loading and breathing obstruction of hockey equipment.

In Phase 2, continue to use shuttle runs once per week and slideboarding once per week, but add an "isohold conditioning" component to the end of one of the days. The exact set-up depends upon how many days per week the players are training. Check out the examples below:

2-Day/Week Program

Day 1: Slideboard 6 x (:10/:20, :30/1:00)

Day 2: Split Squat IsoHolds: 3 x 30s/side; Shuttle Run: 2 x (:10/:10, :20/:40), 2 x (:10/:20, :20/:40), 2 x (:10/:20, :20/:60)

3-Day/Week Program

Day 1: Slideboard: 6 x (:10/:20, :30/1:00)

Day 2: Split Squat IsoHolds: 3 x 30s/side

Day 3: Shuttle Runs: 2 x (:10/:10, :20/:40), 2 x (:10/:20, :20/:40), 2 x (:10/:20, :20/:60)

4-Day/Week Program

Day 1: Slideboard: 6 x (:10/:20, :30/1:00)

Day 3: Split Squat IsoHolds: 3 x 30s/side

Day 4: Shuttle Runs: 2 x (:10/:10, :20/:40), 2 x (:10/:20, :20/:40), 2 x (:10/:20, :20/:60)

In these examples, split squat isoholds are performed at the end of the “strength training” portion of the training session. The intervals are read such that everything in the parentheses is performed as a circuit. For example, the shuttle runs would be performed as 2 sets of 10s on, 10s off, 20s on, 40s off, then 2 sets of 10s on, 20s off, 20s on, 40s off, followed by 2 sets of 10s on, 20s off, 20s on, 60s off.

Chaos Intervals

In the final phase of off-season conditioning, increase the total conditioning volume, and transition into “chaos intervals”. Chaos intervals involve progressing through work intervals of varying durations with varying WRR intervals. These are about as game-specific as it gets, as they reflect the predictably unpredictable nature of real competition. In this phase, continue doing shuttle runs once and slideboarding once per week, but progress the isoholds into a more dynamic variation. Instead of holding a position for a prolonged period, alternate periods of holds with explosive movements, which more directly mimics the demands of the game and increases the cardiorespiratory demand of the exercise. It is ideal to use lateral movements during this phase, to increase the stress to the lateral and medial hip muscles in preparation for the increased skating demand that the pre-season brings. It is hard to accommodate this if players are only training twice per week, as something will get left out (in this case, the isoholds -> dynamic movement).

2-Day/Week Program

Day 1: Slideboard: 5 x (:15/:15, :30/:60, :10/:30, :45/:90)

Day 2: Shuttle Runs: 5 x (:5/:10, :20/:40, :10/:30, :30/1:30)

3-Day/Week Program

Day 1: Slideboard: 5 x (:15/:15, :30/:60, :10/:30, :45/:90)

Day 2: Split Squat IsoHolds -> Slideboard: 4 x 3x(10s+5)/side

Day 3: Shuttle Runs: 5 x (:5/:10, :20/:40, :10/:30, :30/1:30)

4-Day/Week Program

Day 1: Slideboard: 5 x (:15/:15, :30/:60, :10/:30, :45/:90)

Day 2: Upper Body Circuit: 3x through 4 exercises

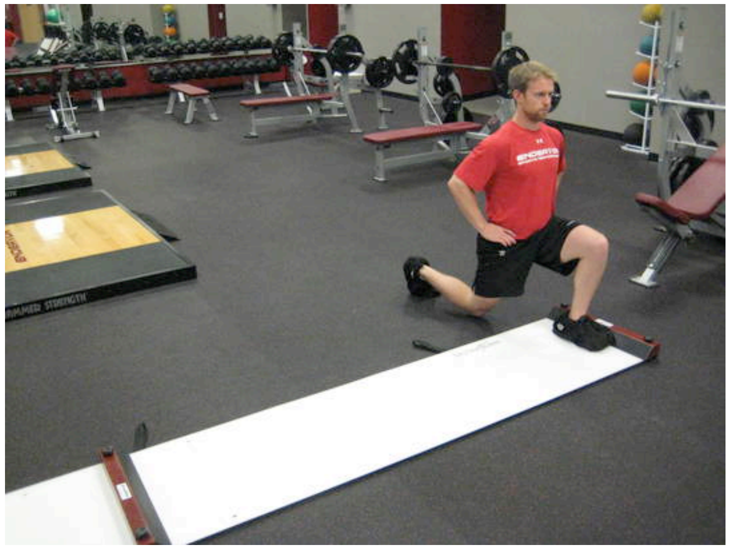
Day 3: Split Squat IsoHolds -> Slideboard: 4 x 3x(10s+5)/side

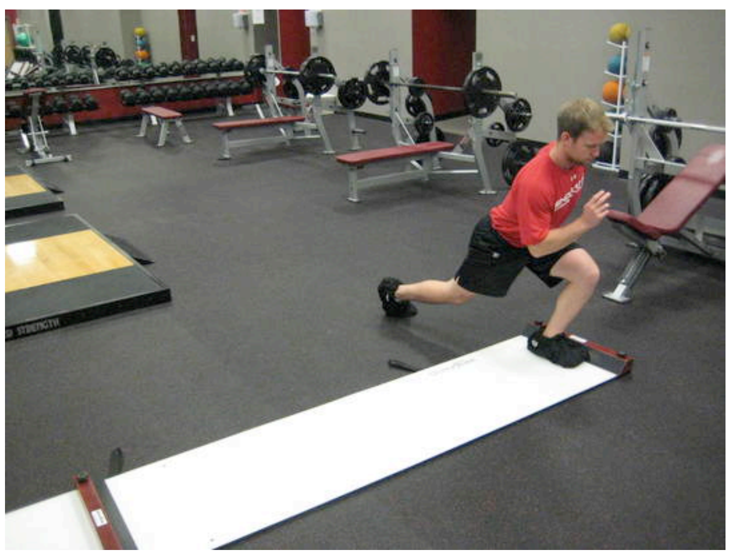
Day 4: Shuttle Runs: 5 x (:5/:10, :20/:40, :10/:30, :30/1:30)

These examples follow the same guidelines as before. In the case of the 4-day per week program, finish the session with an upper body and core training circuit to introduce strength training with a greater conditioning emphasis. An example of a circuit is:

1) Rotational Incline Cable Press: 3 x 6/side
2) Stability Ball Rollout: 3 x 8
3) Chin-Up (Underhand Grip): 3 x Failure
4) Overhead Med Ball Slam: 3 x 10

The players would perform one set of each exercise and then return to the top of the order, going through three times in total. The split squat isoholds -> slideboard involves the player holding a 10s split squat position with his front foot on the inside edge of a slideboard. After 10s, the player explodes out of this position laterally and slide-boards back and forth five times, finishing on the opposing side, where he immediately descends into a split squat with the opposite leg forward. He repeats this process until he performs three 10s holds on each side.





Split Squat IsoHold into Slideboard

As the pre-season gets underway and players start to skate a lot more, their conditioning needs change. Around this time, the frequency of training tends to decrease to 2-3 sessions per week, and the demand on the "skating muscles" is a lot higher. Because the on-ice conditioning volume increases, the emphasis of the off-ice training changes toward improving "work capacity", which means doing as much work in as little time as possible. This augments both local and global muscular endurance, while continuing to create a cardiorespiratory conditioning effect. Work capacity circuit possibilities are endless, but a good starting place is to pick an exercise from every major movement pattern and build a circuit around those by alternating between lower body, upper body, and core exercises:

1) Lower Body Squatting Pattern
2) Upper Body Pulling Pattern
3) Core Rotational Pattern
4) Lower Body Deadlifting Pattern
5) Upper Body Pressing Pattern
6) Core Linear Pattern

This template ensures the players are hitting all the major muscle groups and movement patterns and, therefore following a balanced program.

As the season gets underway, the emphasis on off-ice conditioning diminishes. At this point, sufficient practice time has been dedicated to build a solid base of on-ice conditioning. Off-ice conditioning really only needs to be performed by players that do not receive sufficient practice and/or playing time to develop and maintain their on-ice conditioning. This may include players that skate three times or less, players with coaches that run extremely low intensity practices (not many), elite level players that do not receive much ice time during games, and players reconditioning following an injury.

There are a couple ways to approach in-season conditioning. In general, the conditioning should unload the medial and lateral hip muscles and minimize impact stresses to the body. Bike conditioning lends itself to these goals. Keep things simple here and use more generic work intervals and WRR. A couple examples would be 10 x :20/:40 and 8 x :30/1:00. With that said, in certain situations (such as reconditioning a player from an injury) it may be appropriate to follow similar progressions as during the off-season.

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The Truth About Stretching

Imagine hearing that the most common part of every hockey player's training program IMPAIRED performance? In other words, the one thing that all players do, and just about every coach recommends is actually making them worse!

This is the disastrous and one-sided picture that has been painted on static stretching recently. There has been a slew of research documenting the deleterious effects of static stretching on a variety of aspects of performance, including measures of balance, agility, strength, power, and speed. The outcomes of these studies typically show paralleled or decreased performance when compared to no warm-up at all, and inferior performance compared to a dynamic warm-up. Furthermore, the long-standing claim that stretching prior to activity reduces injury risk has been challenged (see Shrier, 1999; Witvrouw et al, 2004).

While these studies have caused a reevaluation of if, how and when to use static stretching, the strength and conditioning industry largely over-reacted to their results. Decreases in performance following static stretching are thought to result largely due to a decrease in musculotendinous stiffness (MTS; Witvrouw et al, 2004, Fletcher & Anness, 2007). Ryan et al. (2008) documented the changes in MTS following different static stretching protocols for the plantarflexors (calves) and found that stiffness returned to baseline levels within 10 minutes following two minutes of static stretching, and within 20 minutes for static stretching durations of four and eight minutes. It is important to keep in mind that the majority of the performance decrements observed in the anti-stretching research studies were assessed IMMEDIATELY after prolonged periods of static stretching. It is rare that a hockey player will hold a stretch for a minute or two, and then IMMEDIATELY jump into a competition-driven maximum effort movement. More typically, the player will hold an on-ice stretch for 10-15 seconds, which isn't sufficient time to lead to a decrease in performance, and/or perform a dynamic warm-up after the static stretch, which negates any negative effects of static stretching. The reality is that the application of static stretching in hockey negates any application of these research results to the sport.

Stiffness vs. Shortness

To completely understand the implications of this research, it is important to distinguish between tissue stiffness and shortness. Consider two muscles that have the same length, but different stiffness qualities. Both muscles will have the ability to shorten and extend to the same absolute lengths. In other words, they'll have the same total range of motion. The difference is that the stiffer muscle will require more force to achieve the fully lengthened positions.

Michael Boyle provides a great example of this by comparing a green and black miniband. Both bands start at the same length, and can lengthen the same amount, but the black band requires that the athlete pulls a lot harder to stretch it fully. Now compare two muscles with the same stiffness, but different lengths. In this case, both will stretch using the same amount of force, but the shorter muscle cannot stretch as far.

Boyle provides another insightful illustration of the implications of stiffness using two minibands. If the end of a green band is tied to the end of a black band, and then both ends are pulled, the green band will stretch more readily than the black band. As a result, the green band will undergo a greater change in length than the black band. If the stretching continued, the green band would eventually begin to tear. This is exactly what happens within the body. In Diagnosis and Treatments of Movement Impairments Syndromes, Shirley Sahrmann discusses how the body will move in the path of least resistance. Tying this in with Thomas Myer's Anatomy Trains concept, it becomes easy to identify how excessive relative stiffness in some tissues can cause tearing in others. For example, there are fascial connections between the rectus abdominis and the adductor longus. If the rectus abdominis is overly stiff (as it commonly is in players that sit too much and/or do all their core work in the form of crunches and sit-ups!), this will put excessive tension across the adductor longus, which, not coincidentally, is the most commonly strained "groin" muscle in hockey players. This just further highlights the importance of addressing stiffness imbalances within the body to both maximize performance and minimize injury risk.

Hockey players will often report feeling "tight" or "stiff", and tend to use both words interchangeably to describe tissues that may either be stiff or short. However, addressing the cause of these feelings necessitates that we understand if we're dealing with tissue shortness (muscle cannot achieve the ROM) or stiffness (muscle requires greater force to achieve the ROM). This will come into play as we discuss the short- and long-term implications of stretching.

The Truth About Stretching

Over the long haul, stretching may not be doing what was originally thought. Improvements in ROM following stretching are related to viscoelastic properties of the muscle, meaning the stretch maximizes the elasticity of the muscle in its current structural form (Herbert, 1988). As a consequence, these improvements are short-term because the actual structure of the muscle is not being affected. A parallel school of thought is that stretching improves ROM by improving stretch tolerance, or the ability to deal with the discomfort of end range motion (Law et al, 2009). This raises questions about the function and effectiveness of current static stretching practices.

In the big picture, it is important to consider the postures/ positions that hockey players are in the majority of the day, as this in itself is a form of stretching. For example, if a player sleeps on his side with his knees up for eight hours, this is the equivalent of an 8-hour signal telling the body to lengthen the glutes and shorten the hip flexors. Similarly, if a player sits in a chair or car for prolonged periods of time, the body is signaled to lengthen the glutes and thoracic spine extensors, and shorten the hip flexors, pecs, and cervical extensors. Coincidentally, these are the same adaptations that frequently occur as a result of playing hockey.

The take home message is that tissue length and stiffness adaptations occur in response to the duration tissues are held in certain positions, the volume of movement they undergo through a certain ROM, and the intensity of the stress placed across them. Because the goal is to restore and maintain balance across the major joints in the body (notably the hips and shoulders in hockey players), it is necessary to account for all types of stressors, which means “stretching” recommendations will also include a lifestyle/posture component.

Implications and Applications

The time course of changes in MTS and adaptations in stretch tolerance are highly relevant to training hockey players, but have different implications for short- and long-term effects of stretching. Knowing the “return to baseline” time course of MTS, provides an understanding of the relative time frame to capitalize on improvements in ROM. For example, most hockey players have tight hip flexors, which will limit their ability to extend their hip, both in terms of ROM and motor control (muscle activation patterns). If a player performs a 30s ½ Kneeling Hip Flexor Stretch on each side, he will have about ten minutes to perform an active movement that takes advantage of less restricted hip extension (e.g. a Reverse Lunge) before hip flexor stiffness returns to baseline levels. He may have a slightly longer window since moving through static stretches will likely result in a moderate increase in body temperature, which improves tissue extensibility, but the 10-minute mark provides a good rule of thumb. Static stretching can be used to gain short-term improvements in ROM, which is immediately followed by an exercise to “rewire” the nervous system to integrate this ROM into functional movement.

A second short-term application of static stretching is to restore the muscle to its resting length following activity. Whether it’s training, practicing or playing a game, certain muscle groups will become stiff and lose ROM as a result of the activity. These ROM deficits are still present up to 96 hours later (Jamurtas et al, 2005). This is especially true if the activity involves repeated eccentric contractions, such as the adductors and hip flexors experience from skating (Reinold et al, 2008). Taking a few minutes after these activities to go through a specific stretching routine can help restore the tissue to its resting length, and minimize the risk of semi-permanent shortening as a result of the accumulated stress. In simpler terms, certain tissues will be short after a practice. If they aren’t re-lengthened, they’ll be short entering the next training session, practice or game. From this already shortened position, the additional activity will lead to a further shortening. These shortening stresses accumulate and eventually lead to a length and/or stiffness imbalance across a joint, which is a primary risk factor for injury. This affects all players, but especially those at the more elite levels that train, practice, or play at least once a day.

To capitalize on these short-term alterations in muscle stiffness and stretch tolerance, stretches should be held for 30 seconds; holding a stretch longer than that does not appear to have any additional benefit (Bandy et al, 1997). Unfortunately this strategy does very little for stimulating an actual increase in the length of the muscle, which is achieved by adding muscle units called sarcomeres in series with existing units. There are two primary methods for stimulating increases in muscle length:

1) Prolonged stretches (Caiozzo et al, 2002)
2) Tension in a lengthened position (Aquino et al, 2010)

The application of these strategies is relatively simple, but practically unpleasant. Accumulating stretches of moderate discomfort for 15+ minutes per day is one effective strategy for increasing muscle length. This can be done in a single 15-minute bout or in three 5-minute bouts. Because this induces muscle damage, which necessitates recovery time, it's best not to use this strategy on back-to-back days. The second strategy involves contracting the working muscle while it's in a lengthened position. A great way to capitalize on this is to move into a stretch position for a certain muscle group, and then try to re-shorten the muscle against a resistance. As an example, imagine an athlete performing a pec stretch against a doorframe. After shifting into a good stretch, the athlete could pull his arm into the doorframe as hard as he could. The two best applications of this strategy for hockey players are holding push-ups and/or split squats in the bottom position and driving up against resistance. Start with intervals of 30s and progress up to two-minutes before adding more of a load.

Lastly, hockey players need to understand that short bouts of stretching cannot undo a day, week, or lifetime of bad posture. It's a time game. Proper postural alignment needs to be reinforced until it becomes a part of their natural lifestyle. A detailed postural analysis is beyond the scope of this book, but here are a few key things to look for:

1) Toes Pointed Out

   Short or excessively stiff soleus (calf) and/or hip external rotators

2) Hips Flexed/Excessive Lumbar Lordosis

   Short or excessively stiff hip flexors and/or lumbar erectors

3) Excessive Thoracic Kyphosis/Winged Scapula/Foreword Shoulders

   Loss of thoracic extensibility and/or short or excessively stiff pec minor, pec major, and/or lats

4) Foreword Head Posture

   Related to excessive thoracic kyphosis and/or short or excessively stiff cervical extensors

These issues can be addressed through training by focusing on decreasing the stiffness of overly stiff areas and increasing the stiffness in antagonistic areas. For example, a player with a hips flexed or excessive lordotic lumbar curve posture should focus on decreasing the stiffness of his hip flexors and increasing the stiffness of his glutes. Most importantly, the player will need to make a conscious effort to change his posture throughout the day by not slouching, and standing up at least once per hour and walking around or doing some quick stretches for his hip flexors.

Stretching for Hockey

The pictures below illustrate the most effective stretches for hockey players. In general, it's best to stretch hockey-specific problem areas (as mentioned above) 2-3 times per week or after most training sessions, practices, and games. To address a specific shortness, stretching should be performed 4-5 times per week for two weeks, at which point the issue should be re-examined. It's not necessary to go through the same stretching routine every time. In fact, utilizing different stretches for the same muscle group will provide a slightly different lengthening stress to the tissue, which will ensure you aren't neglecting any areas.

Upper Body: Anterior Emphasis
135° Pecs Stretch
90° Pecs Stretch
45° Pecs Stretch
Biceps Forearm Stretch
Prone Pushup Stretch

135° Pecs Stretch. Pull your arm back as you lean into the stretch. Keep your chest up and shoulder down.

90° Pecs Stretch. Pull your arm back as you lean into the stretch. Keep your chest up and shoulder down.

45° Pecs Stretch. Pull your arm back as you lean into the stretch. Keep your chest up and shoulder down.

Biceps/Forearm Stretch. Contract your triceps to further straighten your elbow.

Prone Press Up Stretch. Keep your chin tucked and arch up smoothly through your entire spine.

Upper Body: Posterior Emphasis
135° Cross-Body Lat Stretch
90° Cross-Body Shoulder Stretch
Sleeper Stretch
Split Stance Triceps Stretch
Lateral Traps Stretch
Diagonal Levator Scap Stretch
Bilateral Neck Stretch

135° Cross-Body Lat Stretch. Lean down and away from your raised arm.

90° Cross-Body Shoulder Stretch. Lean away from your raised arm.

Sleeper Stretch. Keep your shoulder blade packed back and gently push down on your hand to internally rotate your shoulder.

Split Stance Triceps Stretch. Actively reach down your back as you pull your elbow and lean your body to the side.

Lateral Traps Stretch. Keep your chin tucked back and gently pull your head to the side.

Diagonal Levator Scap Stretch. Keep your chin tucked back, rotate your head 45° and gently pull your chin toward your chest.

Bilateral Neck Stretch. Keep your chin tucked back and use both hands to gently pull your chin toward your chest.

Lower Body: Anterior Emphasis
1/2 Kneeling Hip Flexors Stretch
1/2 Kneeling Hip Flexors Stretch with Internal Rotation
Rectus Femoris Stretch
Rectus Femoris Stretch with Internal Rotation

½ Kneeling Hip Flexors Stretch. Sit up tall, squeeze your butt on your back leg and tilt your hips backward.

½ Kneeling Hip Flexors Stretch with Internal Rotation. With your back foot turned out, sit up tall, squeeze your butt on your back leg and tilt your hips backward.

Rectus Femoris Stretch. Sit up tall, squeeze your butt on your back leg and tilt your hips backward.

Rectus Femoris Stretch with Internal Rotation. With your back foot turned out, sit up tall, squeeze your butt on your back leg and tilt your hips backward.

Lower Body: Posterior Emphasis
Bent Knee Calves Stretch
Straight Knee Calves Stretch
Standing Cross-Body Hamstrings Stretch
Standing Hamstrings Stretch
Standing Outside-Body Hamstrings Stretch
Lying 90°/ 90° Stretch
Lying Cross-Body Glutes Stretch
Lying 90°/ 90° Knee Hug Stretch
Lying Knee-to-Knee Stretch

Bent Knee Calves Stretch. Keep your heel on the ground as you drive your knee down toward the floor.

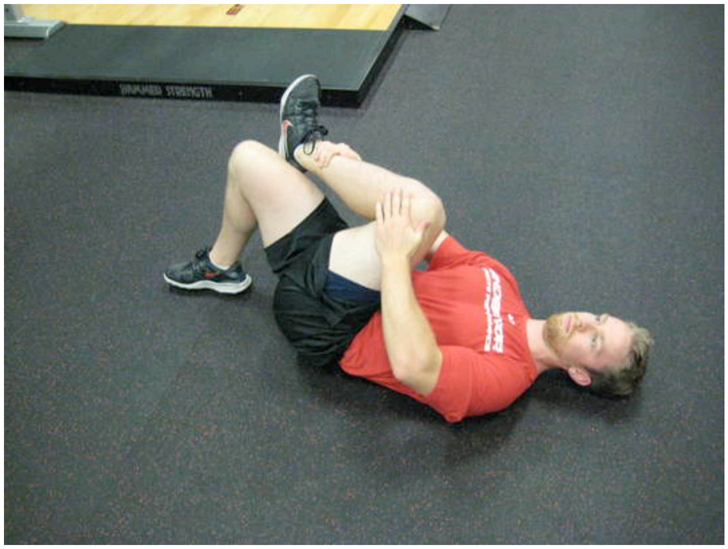
Straight Knee Calves Stretch. Keep your heel on the ground as you shift your hips forward.

Standing Cross-Body Hamstrings Stretch. Rotate your hips forward and inward. Keep your back flat and chin tucked.

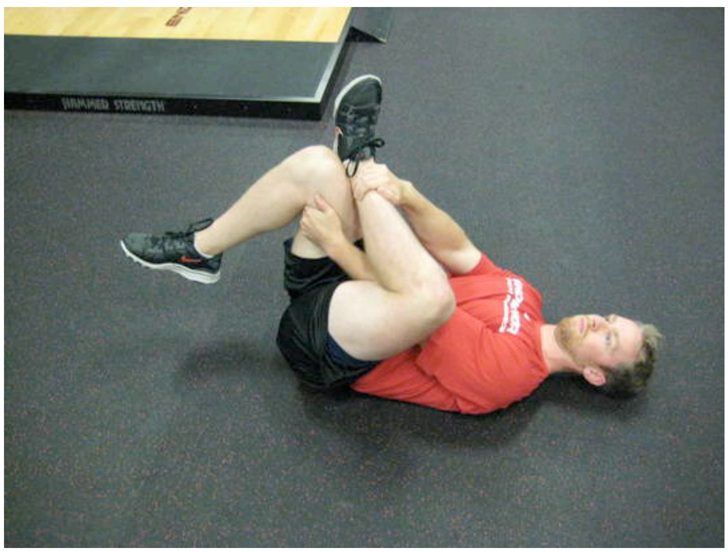
Standing Hamstrings Stretch. Rotate your hips forward. Keep your back flat and chin tucked.

Standing Outside-Body Hamstrings Stretch. Rotate your hips forward and outward. Keep your back flat and chin tucked.

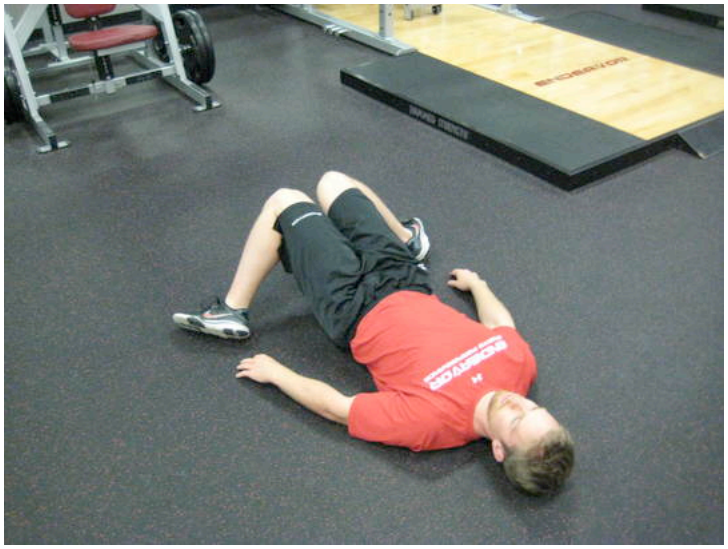
Lying 90°/90° Stretch. Maintain a slight arch in your lower back as you gently push your knee away from you.



Lying Cross-Body Glutes Stretch. Maintain a slight arch in your lower back as you gently pull your knee across toward your opposite shoulder.

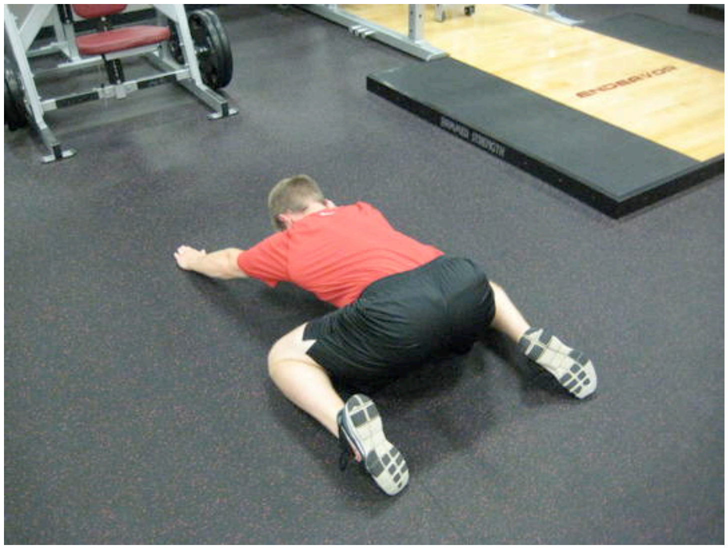


Lying 90°/90° Knee Hug Stretch. Maintain a slight arch in your lower back as you gently pull your knee in toward your chest.

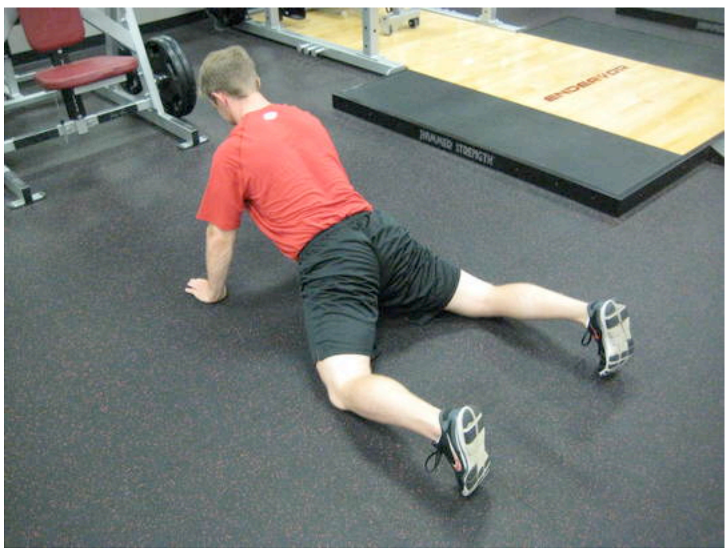


Lying Knee-to-Knee Stretch. Maintain a slight arch in your lower back as you gently pull your knees toward one another.

Lower Body: Medial Emphasis
Wide Stance Quadruped Rocking Stretch
Lateral Kneeling Quadruped Rocking Stretch
Lateral Kneeling Quadruped Rocking Stretch with External Rotation
Lateral Squat Stretch



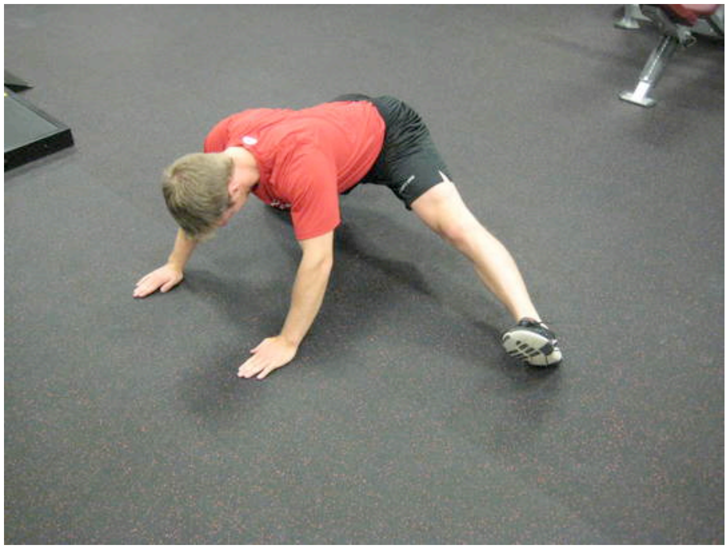
Wide Stance Quadruped Rocking Stretch (Back). Maintain a flat back as you push your hips back toward your heels.



Wide Stance Quadruped Rocking Stretch (Forward). Maintain a flat back as you shift your hips forward toward the floor.

Lateral Kneeling Quadruped Rocking Stretch (Back). Maintain a flat back as you push your hips back toward your heels.

Lateral Kneeling Quadruped Rocking Stretch (Forward). Maintain a flat back as you shift your hips forward toward the floor.



Lateral Kneeling Quadruped Rocking Stretch with External Rotation. Maintain a flat back as you push your hips back toward your heels.

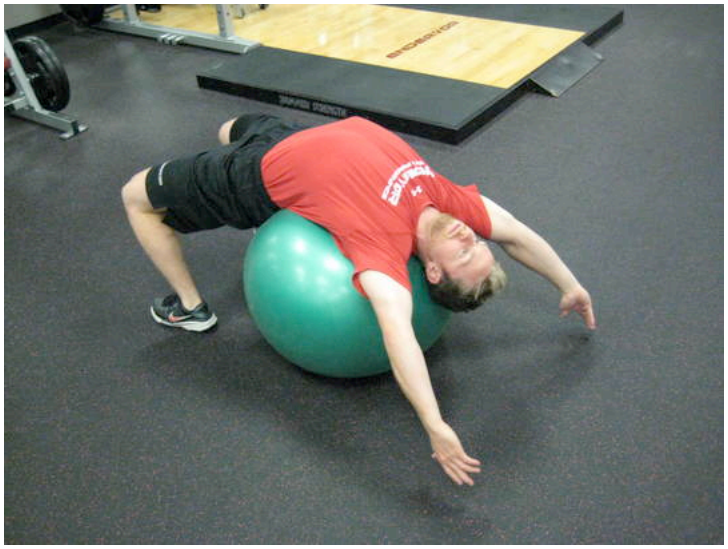
Lateral Squat Stretch. Maintain a flat back as you sit back and down to feel a stretch in your straightened leg.

Combo Stretches
1/2 Kneeling Hip Flexors and Opposite Pecs Stretch
Wall Triceps/Lats/Lateral Hip Stretch
Lateral Squat with Toe Touch Stretch
Stability Ball "Y" Stretch
Brettzel Stretch
Brettzel 2.0 Stretch

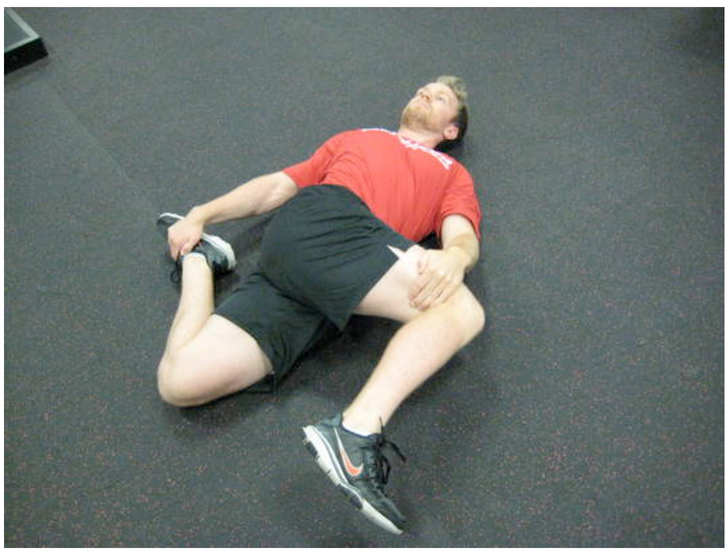
½ Kneeling Hip Flexors and Opposite Pecs Stretch. Sit up tall, squeeze your butt on your back leg and use the foam roller to actively drive a stretch to your opposite side chest.

Wall Triceps/Lats/Lateral Hip Stretch. Actively reach down your back as you lean into the wall to feel a stretch from your triceps down through the side of your hip.

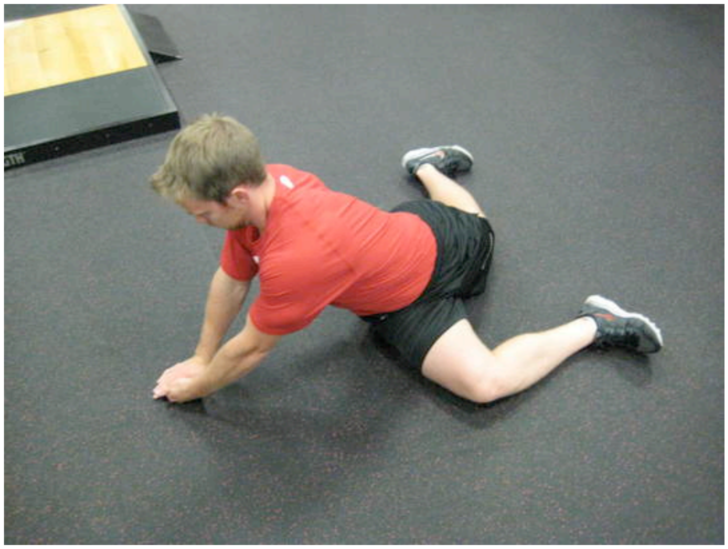
Lateral Squat with Toe Touch Stretch. Maintain a flat back as you sit back and down and reach across toward your opposite foot to feel a stretch in your straightened leg and through your spine.

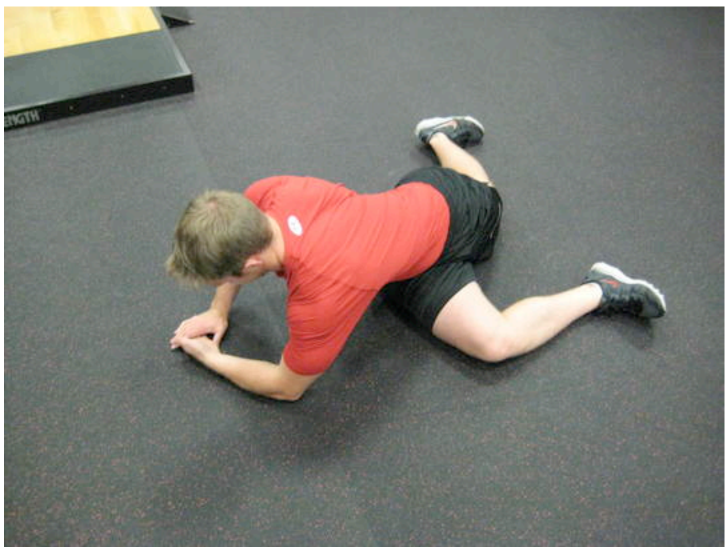


Stability Ball "Y" Stretch. Keep your chin tucked back as you reach your arms overhead in a "Y" pattern to feel a stretch through your abdominals, chest and lats.



Brettzel Stretch. Keep your chin tucked as you pull your bottom leg back and your top shoulder down toward the floor.





Brettzel 2.0 Stretch. Keep your chin tucked back and slowly move from your hands down to your forearms.

Following a practice, this is a great routine to start with. Hold each stretch for 30s.

1) Lying Cross-Body Glutes Stretch
2) 1/2 Kneeling Hip Flexor Stretch with Internal Rotation
3) Rectus Femoris Stretch with Internal Rotation
4) Wide Stance Quadruped Rocking Stretch
5) Standing Cross-Body Hamstrings Stretch
6) Prone Press Up Stretch
7) 90° Pecs Stretch

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Special Topics In Injury Prevention

The primary goal of a training program is to keep players in the game. After all, it does not matter how talented a player is if he is watching from the stands. As with all prevention initiatives, we need to start by understanding what injuries are keeping players out of games. To this end, the most common injuries in hockey are (in no particular order):

1) Shoulder dislocations/separations
2) Concussions
3) ACL/MCL tears
4) Adductor/Hip Flexor Strains
5) Hip Labral Tears
6) Sports Hernias

Of these, the first three are almost entirely “trauma” or contact related. The best prevention here is to beef up the surrounding musculature, ensure balance around the joints, educate players on how these injuries occur, and encourage players to keep their heads up to better anticipate the collisions that cause these injuries. The high velocity, high impact nature of hockey that makes it the most exciting sport in the world is also what makes some of these injuries inevitable.

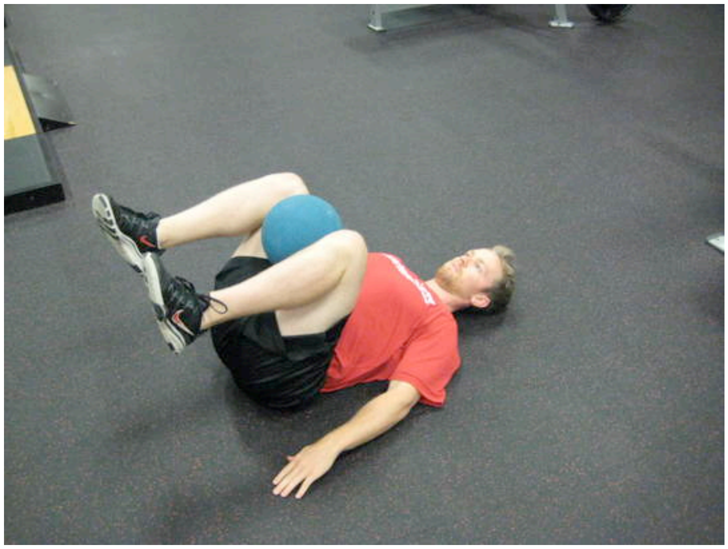
The latter three injuries, however, are largely preventable if specific steps are taken. Let’s address these injuries one at a time.

Adductor/Hip Flexor Strains

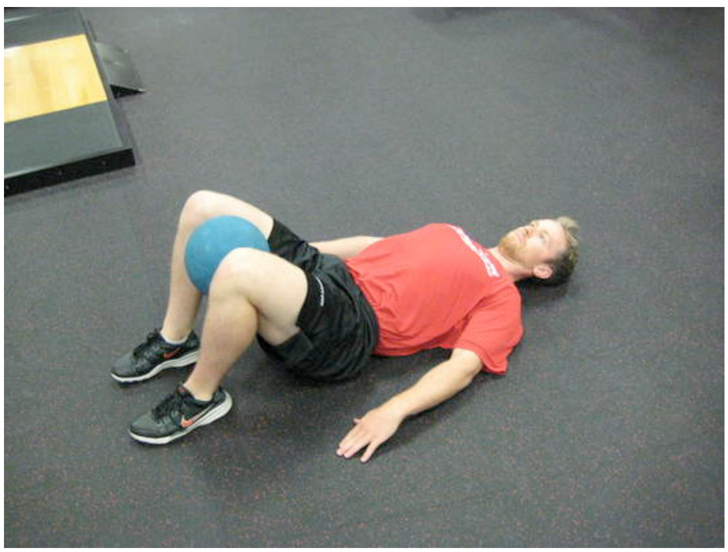
These injuries present during the pre-season when players first return to the ice, and in-season during times of high skating loads. Knowing this, it’s logical to conclude that these injuries result from under-preparation, and/or over-use/under-recovery.

Off-season preparation is a must. The players that neglect this in consideration of their high level of talent almost always have problems later down the road. During this time, prevention comes down to restoring full ROM through the hips, proper neuromuscular control, and balance in strength and stiffness of the surrounding musculature. All the tools for accomplishing these tasks have already been presented in this book. The major muscle deficiency associated with these injuries is “psoas dormancy”, where the psoas major is providing inadequate force at the right times. Another overlooked aspect of preparation is training the adductors and hip flexors in diagonal movement patterns similar to those encountered on the ice. Following the hip progressions, especially for the anterior and medial musculature, presented earlier will help restore proper muscle function.

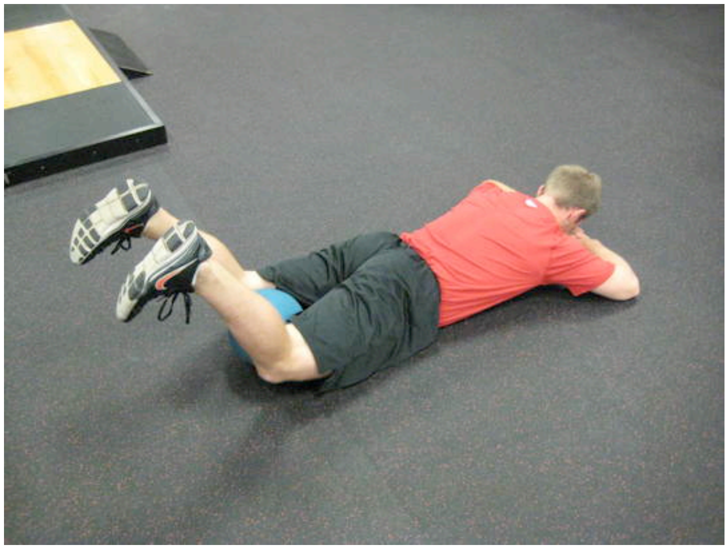
In some cases, strength and stiffness imbalances are severe enough to justify extra work. This is true of players that have a history of true adductor or hip flexor strains and frequently experience nagging “tweaks”. In these cases, the gluteal muscles are overstiff/strong relative to the hip flexors/adductors. The extra work should consist of additional stretching for the glutes and performing a med ball “crush” circuit. This circuit consists of crushing a light medicine ball between the knees for 20-30s in 6 different hip positions:



Maximal Hip Flexion, Knees Flexed 90°

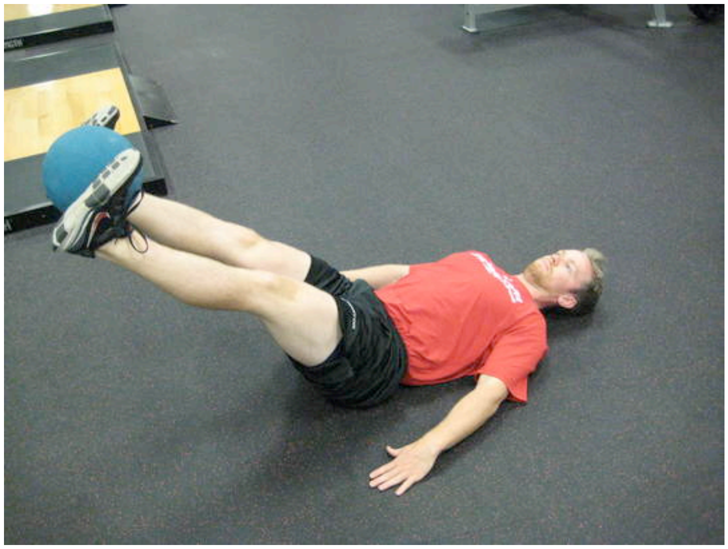


Midrange Hip Flexion, Knees Flexed 90°

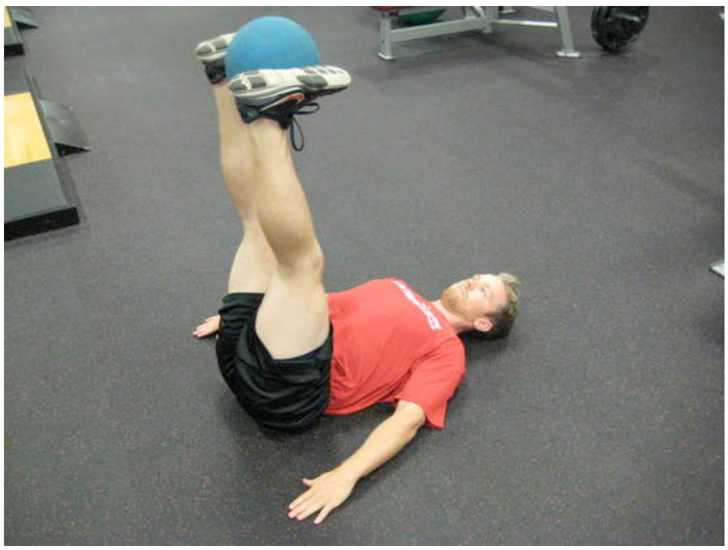


Maximal Hip Extension, Knees Flexed 90°

Maximal Hip Extension, Knees Extended



Midrange Hip Flexion, Knees Extended



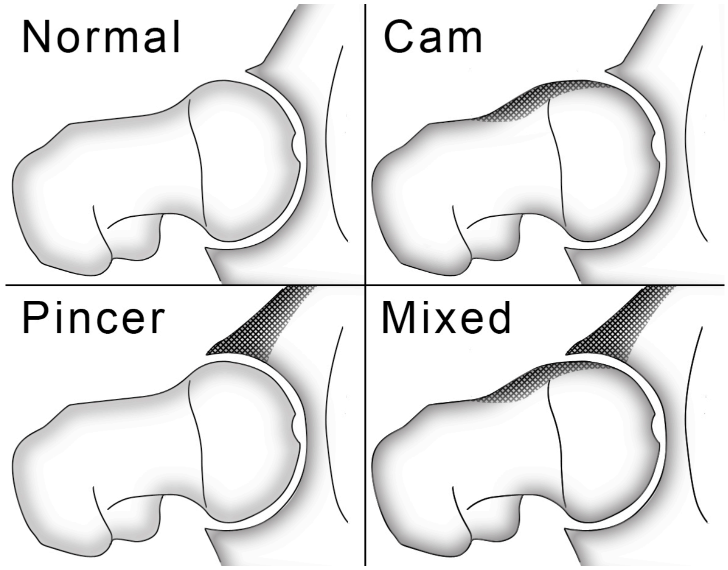
Maximal Hip Flexion, Knees Extended

These positions will emphasize the co-contraction patterns between the hip adductors and flexors or extensors. Paired with glute stretching, it will also help restore balance across the hips. The imbalance tends to clear up with 2-3 weeks of focused work.

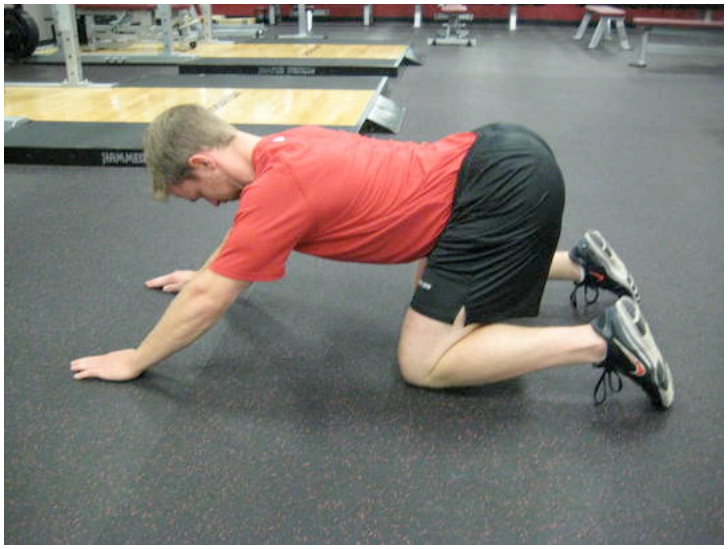
Hip Labral Tears

It seems that the number of hip labral tears amongst hockey players is increasing. At a minimum, the identification of and attention toward these injuries is increasing. In fact, one study found that up to 54% of ASYMPTOMATIC elite level hockey players (21 pro, 18 college) had hip labral tears (Silvis et al, 2010). This study raises some questions about the importance of finding these injuries with MRIs when the players aren't in any pain, but that's a different discussion. The problem with these injuries is that the surgery is intense, requires an extremely long recovery period (6+ months), and almost invariably leads to early onsets of osteoarthritis. Pain or not, these injuries are worth preventing.

One of the major predisposing risk factors is impingement at the hip. Impingement is categorized as either CAM, pincer, or mixed. CAM impingement refers to a loss of the offset between the femoral head and neck. One of the proposed mechanisms for this is a slipped capital epiphysis during the developmental years. A slipped capital epiphysis refers to some sort of fall or pounding (such as jumping out of a tree) that causes the growth plate near the femoral head to shift slightly, decreasing the head/neck offset. This theory may explain why so many hockey players suffer from this affliction, since most young players, especially goalies, are required to do lots of knee touches/drops in an effort to teach them how to get up quickly. Of course, hockey players aren't the only population to suffer from impingement, but the high stress demands placed on the hip joint tend to exacerbate any underlying problems. Pincer impingement, in contrast, involves an extension of the hood of the acetabulum. In both cases, one of the major limitations is in hip flexion past 90°.



One way to assess for this abnormality is using a quadruped rocking test.



Quadruped Rocking Test

Perform 8-10 reps of quadruped rocking and note:

1) Total hip flexion ROM with a neutral spine
2) The amount of hip abduction and external rotation ROM
3) The “feel” at end-range

Hip flexion ROM is pretty self-explanatory. Generally as someone performs this exercise, their knees will slide out a little more, but their feet will stay in the same place, which increases the amount of hip abduction and external rotation ROM. This is a sign of compensation for a lack of true hip flexion. The “feel” at end-range is one of the most enlightening parts of this test. If the athlete feels tight in the back of his hip at end range, it is likely that this limitation can be worked around using some standard soft-tissue work and stretches. More frequently, players will feel it in the front or inside of their hip joint, which is a sign of impingement.

While there is only so much that can be done to prevent reactive on-ice movements that want to drive the hip past

90° of hip flexion, there is plenty that can be done off the ice to prevent impingement-related labral damage. Because these players have a structural limitation that will prevent them from flexing the hip past 90°, they should be actively coached to stay above this range during all of their movements, including double-leg and single-leg lifts, core work, and jumping patterns. In fact, because of the reduced degrees of freedom at the hip and spine associated with double leg lifts, players with signs of impingement should steer clear of double-leg lifts altogether. By keeping them above 90° of hip flexion and teaching them how to move athletically in this range, it is possible to minimize damage to the labrum and reinforce safe, functional movement patterns that they can defer to on the ice.

Sports Hernias

Sports hernias are tricky. While the diagnosis of a sports hernia seems to be increasing both in prevalence and media attention, the injury remains poorly understood and defined.

The primary reason for the confusion surrounding sports hernias is that there is no established definition of this injury. In fact, there isn't even an agreed upon name for this injury, as sports hernias have also been referred to as athletic pubalgia, sportsman's hernia, Gilmore's groin, athletic hernia, hockey groin syndrome, Ashby's inguinal ligament enthesopathy, incipient hernia, and osteitis pubis (Swan & Wolcott, 2006). A sports hernia diagnosis tends to be given in situations involving an athlete that has chronic pain in the lower abdominal or upper proximal medial thigh area that is further aggravated by rapid rotational movements, sudden changes in direction, and anything that increases intra-abdominal pressure (coughing, holding your breath, etc.). Typically these symptoms have persisted for an extended period of time and have not responded to non-operative treatments (rest, ice, heat, antiinflammatory drugs, stretching, etc.). Physical inspection is unable to find any true hole in the abdominal or inguinal wall or protruding tissue, which are characteristics of "traditional" hernias (Nam & Brody, 2008). Essentially this means that sports hernias are not hernias at all, and that the diagnosis is given because no other diagnosis can be made. Naturally, then, the question is: What is a sports hernia?

The most commonly accepted definition of a sports hernia is a weakening of the posterior inguinal wall. It is important to note, however, that this is one of MANY proposed definitions. Complicating the issue further is that sports hernias rarely occur in isolation. According to Swan & Wolcott (2006), surgical inspection also reveals:

1) A deficiency in the posterior wall of the inguinal canal
2) A deficiency of the transveralis
3) A tear/strain in the conjoined tendon (common tendon of the internal oblique and transversus abdominis
4) Dilation of the internal inguinal ring
5) Thin or torn rectus abdominis insertion
6) Thinning or tearing of internal or external oblique aponeuroses
7) Entrapment of ilioinguinal, genitofemoral, obturator, femoral, iliohypogastric, and lateral femoral nerves
8) Adductor tendinopathy
9) Iliopsoas complex strain

Symptoms can also be referred from injuries such as osteitis pubis, hip labral tears, femoroacetabular impingement, stress fractures of the hip bones, hip joint degeneration, lumbar spine and SI joint injuries, digestive tract diseases, even a “sports hernia” on the opposite side. This means that an injury on the left side may be asymptomatic on the left side, but produce symptoms on the right side.

It is thought that the rapid changes of direction and strong rotational movements may be responsible for causing a progressive degeneration of the posterior abdominal wall. The absence of these injuries in youth hockey, and the increasing prevalence among collegiate and professional players suggests two possible mechanisms for this progressive injury:

1) The significant forces and stresses associated with higher level athletics overwhelm the lower abdominal/hip myofascial system over time; and/or
2) The injuries are progressive degenerations that don’t manifest symptoms until later in a player’s career.

The scientific literature has only revealed two modifiable risk factors: a decrease in hip range-of-motion (Bizzini et al, 2007; Verral et al, 2007), and a strength imbalance between the adductors and abdominals (adductors being relatively stronger; Diesen & Pappas, 2007). This understanding provides a framework by which to start working to prevent sports hernias.

The key is balance. It may be the case that abdominal wall strain injuries are most common in ice hockey athletes because of an adaptive postural change. More times than not, hockey players have the short, tight hip flexors that cause an anterior pelvic tilt. Noting that the rectus abdominis, internal and external obliques, and trasversus abdominis all have attachments on the anterior pelvis and pubic ramus, an anterior tilt would increase the stretch and accompanying stress to these muscles and their associated fascia. Consequently, every movement involving a lengthening of these tissues would cause a significant stress to the points of insertion and relatively thin aponeuroses of this musculature. It would be premature to say that this is definitely a mechanism or causative factor. However, this pattern leading to anterior pelvic tilt seems to be especially prevalent in older (18+) and more experience hockey players; sports hernias are also more prevalent in this population.

Taking everything into consideration, it seems the best way to prevent sports hernias is similar to the best way to prevent other hip injuries:

1) To maintain hip range-of-motion
2) Prevent excessive anterior pelvic tilt
3) Strengthen the adductors and abdominal musculature

While the second two points may seem unique, these points are just different ways of saying we need to restore balance in strength and stiffness across the hips. Again, the exercises to accomplish these tasks have already been presented in this book.

Take Home Message

There are glaring commonalities in the strategies geared toward preventing these injuries that plague hockey players. The exercises are the easy part, but it is only half the battle. Another common theme amongst players that suffer these injuries is that they play year-round and don't take sufficient time away from the ice. Remember that injuries result from overuse AND under-recovery. It is important to find the right balance between stimulus and recovery. If a player suffers a soft-tissue injury, it is likely the result of an imbalance stemming from too much attention to on-ice activity and not enough attention to restoration.

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Year-Round Training Considerations

Introducing Periodization

Periodization refers to the practice of altering the volume and intensity of various training stimuli in an effort to allow players to peak at the right times. With hockey, this is as much of an art as it is a science. Elite level teams will play over 100 games in a successful season; youth teams seem to play more and more games every year. Unlike preparing for the Olympics, which is what many periodization concepts originated, hockey players must be able to "peak" to an extent on a weekly basis. This reality spawns an incredible insight:

Off-season preparation is of paramount importance!

Before getting into how to vary training stimuli based on the time of year, it's necessary to identify how progress will be monitored. Depending on the purpose, testing can be a great tool or a complete nightmare.

The Truth About Testing

Youth hockey players do not need to be tested. This statement will inevitably "ruffle the feathers" of youth coaches and parents all over the world, but it is a well-documented fact that adolescent players get bigger, faster, and stronger as a natural part of development. All players develop at different rates. Intuitively everyone knows that. Some players are 12 going on 9, and others are 12 going on 18. If youth players are following a quality training program (and they will be if the concepts discussed in this book are followed!), they will absolutely make accelerated progress compared to if they had not.

Testing can be a great motivator for young players, if the emphasis is on using the results as something to train to beat. Unfortunately, testing is rarely used to gauge progress within an individual player. Most frequently, it is used as a point of comparison between players, which is completely senseless. Because all players are at different stages of their development, and because the emphasis for younger players should be on building solid training habits and on-ice skill development, off-ice testing as a comparison point provides invalid data and sends the wrong message to players and parents. At the more elite levels, when natural development differences are minimal, testing becomes more logical and almost a necessity.

Testing Parameters

If testing is going to be performed, the focus should be on performance not capacity, and the tests should be clearly oriented toward assessing a specific performance quality. As an example, a classical way of assessing a hockey player's conditioning was through the use various VO_2 Max tests. These tests were geared toward objectifying a player's aerobic capacity. While physiologically interesting, the results from these tests have little value in predicting on-ice ability. In other words, capacity is not the same thing as performance. Instead, an interval-based running or skating test would provide more information on the player's ability to work at high levels and recover quickly.

Another common mistake manifests through strength tests that use arbitrarily chosen set weights for maximum repetitions. This clearly stems from the influence of football (notably the 225 lb maximum repetition bench press test), but it doesn't make sense for those athletes either. If one player performs a bench press test for max reps with 155 lbs (the weight used at the NHL combine) for two reps, and another player does it for 14 reps, the test is assessing two completely different qualities amongst those players. For the first player, the test is one of maximum strength. For the second, the test is one of muscular endurance. The same analogy can be made for bodyweight maximum repetition chin-up tests. If the goal is to assess maximum strength, it makes more sense to choose a set repetition scheme than a set load.

Valuable Off-Ice Hockey Tests

The list below presents quality tests to assess various aspects of athleticism.

1) Movement Quality

   Functional Movement Screen

2) Speed and Acceleration

   30-Yard Sprint Time (Times at 10, 20, and 30 yards)

3) Lower Body Power

   Broad Jump (Max distance)

4) Full Body Power

   Hang Clean (1-3 repetition max)

5) Lower Body Strength

   Trap Bar Deadlift (1-3 repetition max)

   Back Leg Raised Split Squat (3 repetition max)

   Reverse Lunge (3 repetition max)

6) Upper Body Strength

   Bench Press (3 repetition max)

   Chin-Up (3 repetition max)

7) Core Endurance

   Front Plank (Max time)

   Side Plank (Max time)

8) Conditioning

   6 x 200-Yard Shuttle (Time and drop-off with 90s rest between)

Year-Round Hockey Training

The hockey training year can be broken down into smaller parts. This practice of breaking down a year to smaller parts with differing training emphases is referred to as periodization.

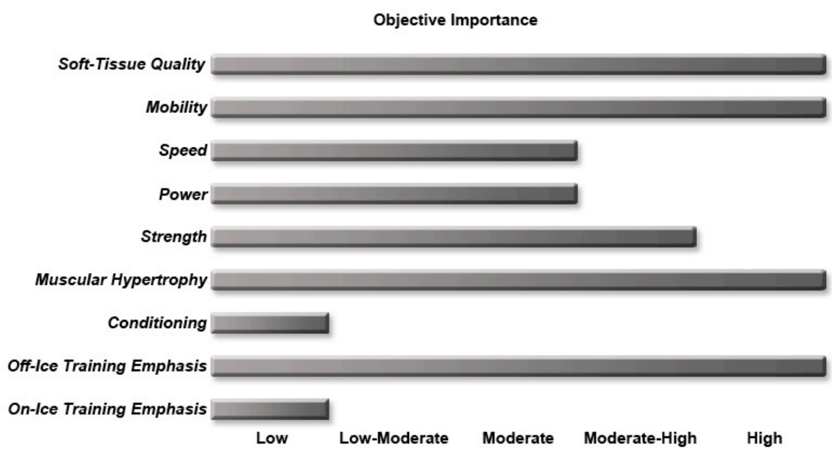
Hockey periodization plans can be categorized using the following time periods:

1) Off-Season
2) Pre-Season
3) In-Season
4) Post-Season
5) Recovery Period

This provides a general framework to guide training. Each of these time frames can be further broken down, with specific guidelines for what the training emphasis should be during these times.

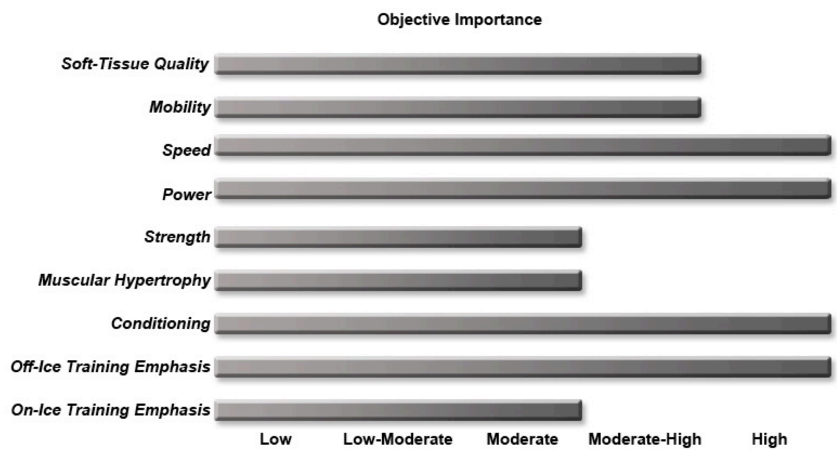
<u>Off-Season</u>

Phase 1: 12-16 weeks before pre-season

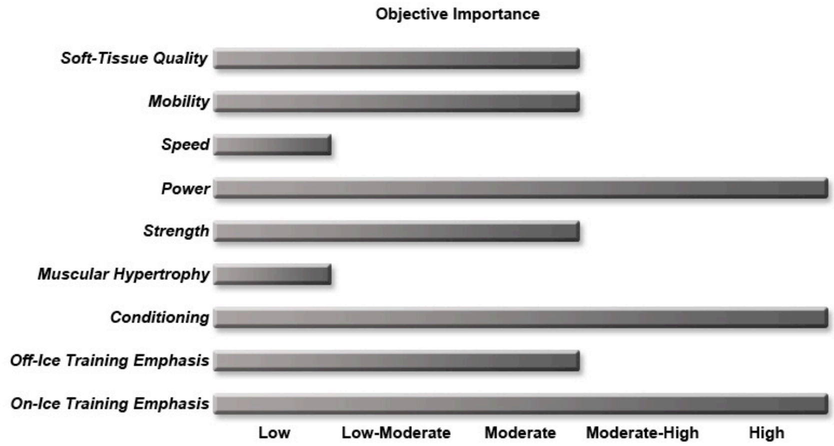


Phase 2: 8-12 weeks before pre-season

Phase 3: 4-8 weeks before pre-season

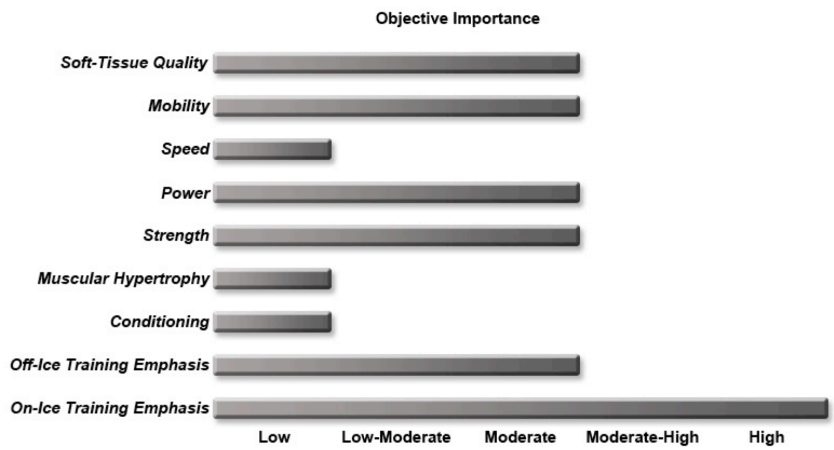


Pre-Season: 0-4 weeks before season

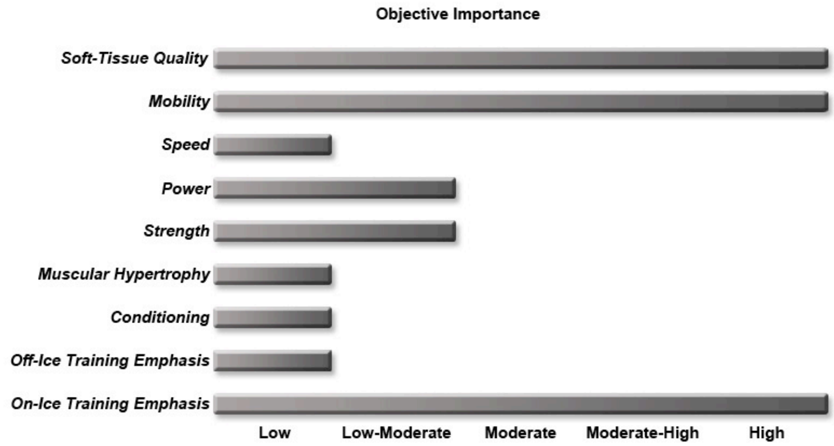


In-Season

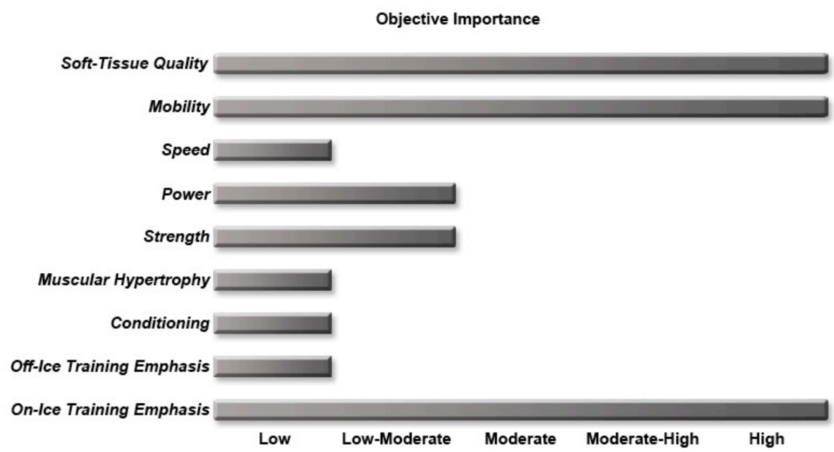
1st Half



2nd Half

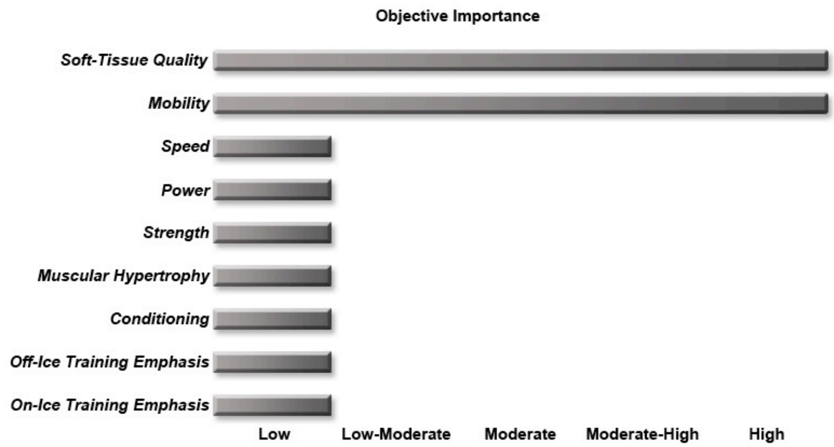


Post-Season



Recovery Period

Phase: 2-6 weeks post-season



An analysis of these guidelines reveals a few big picture trends.

The early off-season is the time to make gains in muscular size and strength, while introducing speed and power training. The emphasis on conditioning is minimal because it does not take twelve weeks to develop high levels of hockey specific conditioning.

The latter aspect of the off-season is characterized by a decreased emphasis on size and strength work and an increased emphasis on speed, power, and conditioning. In accordance, the overall volume and intensity of strength training will need to go down to account for the increased volume of transitional speed work, Olympic lifts and med ball variations, and high intensity interval training. During the off-season, most players should be training 3-4 times per week.

As the pre-season sets in the off-ice emphasis is on developing work capacity through resistance training and body weight circuits. At this time, the volume of on-ice practices beings to increase substantially, and players will be getting a lot of their speed, power, and conditioning work on the ice. During the pre-season, players should continue to train 2-4 times per week.

At the commencement of the season, the training emphasis is mainly on improving power and strength (especially in players with a young training age), while maintaining the on-ice speed and conditioning that was developed during the off-season and transferred to the ice during the pre-season. At higher levels, off-ice conditioning work may need to be done for players that are not getting sufficient ice time during games to maintain their conditioning levels. Once the season sets in, players should cut back their training to 1-2 times per week based on the amount of available time they have.

About mid-way through the season, fatigue accumulation becomes an issue, and the overall emphasis of off-ice work becomes maintenance. At this time, it’s a great idea for players to spend some extra time doing self-myofascial release and mobility work, and making more frequent appointments with their manual therapist. Players should also get their Vitamin D levels checked around this time, as the seasonal changes can have significant impacts on their sunlight exposure, and consequent energy levels, amongst other things.

During the post-season, training takes a huge back seat to on-ice requirements, but should not be neglected. At the highest levels, post-seasons can last several months, providing an adequate time for significant detraining. The key is to mix in the training at times that will gives players maximal resting time before their next game. This may involve post-game training sessions. Players should do their best to continue to train 1-2 times per week during this time.

The final stage of the training plan is arguably the most important and undoubtedly the most neglected. The importance of rest, recovery, and regeneration has been a recurring theme throughout this book. Taking some time away from the ice and formal training provides players both a physical and mental break. At this time players should pay extra attention to their soft-tissue work, and stay active doing other things, like hiking or playing tennis, but avoid following a regimented training program.

Conclusion

Implementing The Perfect Plan

As we near the wrap-up point of this exciting journey through the intricacies of comprehensive hockey training, I want to reiterate a couple points that you may have forgotten. I have put a lot of emphasis on acknowledging the underlying neuromuscular and physiological demands of hockey. I think that's the starting place. Understand the demands of the game, and train accordingly. I have also made an effort to detail the training systems we use with our players at Endeavor. With that said, I must emphasize that there is no such thing as a perfect program. Ultimately, you will need to adapt the guidelines I've presented based on your specific situation. Things to consider include:

1) Number of players
2) Chronological Age
3) Physical and Social Maturity
4) Training Age
5) Athleticism
6) Your Training Expertise
7) Equipment Availability
8) Space Availability
9) Schedule Availability
10) Management/Coaching Staff Requirements

Depending on whether you're a player, coach, parent, strength and conditioning coach, some of the above things may be more applicable than others. The point is that your goal should be to design the best possible program for your situation, not to directly mimic someone else's (including mine).

I wish you the best of luck as you begin to develop training programs that have profound impacts on your (or your players') hockey careers. Never forget, the underlying key to all success is sustained, dedicated effort!

About The Author

Kevin Neeld has rapidly established himself as an international authority on hockey training and development with a reputation for creatively applying an extensive knowledge in functional anatomy, biomechanics, neural control, and injury prevention to get his athletes superior results.

Currently Kevin serves as the Director of Athletic Development at Endeavor Sports Performance in Sewell, NJ, where he is sought after for his expertise in both performance enhancement and injury resistance. Kevin has helped players surpass previous performance bests following a multitude of common hockey injuries, including shoulder and hip labral tears, sports hernias, chronic groin and hip flexor strains, and low back pain. As a recognized expert in the field, Kevin continues to work with clients currently playing in the National Hockey League, American Hockey League, Ontario Hockey League, NCAA Division I collegiate, United States Hockey League, New England Prep School, and Tier I Elite travel programs.

Kevin received his Master’s degree in Kinesiology with a concentration in Exercise Neuroscience from the University of Massachusetts Amherst, and his Bachelor’s degree from the University of Delaware with a major in Fitness Management and a minor in Strength and Conditioning. He is a Certified Strength and Conditioning Specialist through the NSCA and has completed the Precision Nutrition Level 1 Coaching Certification.

For more information on how Kevin can help you achieve your performance goals, visit www.KevinNeeld.com and register for his free hockey training and athletic development newsletter!

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"FINALLY I've found a book that summarizes everything I’ve learned over my last 35 years in the strength and conditioning industry."

Rob McLean
Strength and Conditioning Coach, Colorado Avalanche

"This book is an excellent resource for any coach, player, or parent looking for proven training techniques and strategies.”

Darryl Nelson
Strength and Conditioning Coach, USA Hockey NTDP

"Kevin's book is an extremely rare comprehensive look at the present state of ice hockey training. Without question I highly recommend this for any strength and conditioning coach."

Peter Friesen
Strength and Conditioning Coach, Carolina Hurricanes

Ice hockey is one of the most physically and mentally demanding sports in the world. Competing at elite levels requires a unique combination of refined skill and overall athleticism. Without exception, truly maximal performance stems from comprehensive preparation.

In Ultimate Hockey Training, hockey development expert Kevin Neeld details exactly how you should design and progress your off-ice training to continually improve on-ice performance. Neeld’s system includes assessments, exercise progressions, and year-round training guidelines to help you realize your full potential. Specific injury prevention strategies are identified to not only make you a faster, stronger, and better conditioned player, but also more durable one.

Ultimate Hockey Training is the most complete hockey training system ever developed, a must-have resource for any player or coach.