Skating for Speed:
A study of the factors relating to better skating and increased speed on the ice

Justin Rosen

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Watching great skaters like Sergei Federov or Paul Coffee fly down the ice, they seem to move about the rink almost effortlessly! Spectators many times ask, “How did they become such a fast skater?” Since the beginning of organized ice hockey, coaches and players have been trying to figure out the answer to this question. After all, skating is the most important skill in the game and one that must be mastered as all other skills are built upon a strong skating foundation. If a player is weak on his skates, routine skills such as passing, shooting, playmaking, body positioning, checking, etc. will all suffer accordingly. The best players generally are the ones who can get to the puck the fastest and generate the most separation from the other players with their speed. Much research has gone into this area of speed development, and I can tell you there is no easy path to success. Players like Federov and Coffee did not become fast skaters overnight; it took years of hard work, dedication and attention to detail to gain their skating success. In scientific terms, speed is described as distance over time (S=D/T). From this equation one can easily see that in order for speed to increase on the ice, one of two things must occur. The distance covered in each stride and/or stride length must increase, or time between strides must decrease. Many coaches have their own personal opinions about skating and how to increase speed. These opinions are based on what their coaches have told them in the past, some old wise tales, word of mouth, literature, videos among others. Many coaches will tell you that speed of the player is biologically determined, while others point to specific training such as plyometrics or weight training, and still others to technical aspects such as posture, skate design, etc. The fact is, there are many factors that contribute to increased skating speed. I will show that although genetics and biology due play a small role, there are many things one can do to maximize their speed potential if the approach is well rounded and a strong work ethic is present.
Before I look at what can be done to improve skating speed, I will look at one biological factor that cannot be controlled: the amounts of fast twitch/slow twitch muscle fibers in the body. I have heard the statement that there is no way for an athlete to get faster if his body is not genetically designed for speed, meaning that there is a high percentage of fast twitch muscle fibers. In fact David Robson in his article “How do fast twitch muscle fibers influence athletic performance,” that athletic success depends to a degree on fast twitch/slow twitch muscle fiber composition.” I think this statement is very misleading to the ice hockey player. The average player has approximately 50/50 make-up of fast twitch/slow twitch muscle fibers in muscles contributing to movement. Fast twitch muscle fibers are used in short burst activities, while slow twitch fibers have a greater role in longer endurance activities. When we contract our muscles we neurologically activate a specific motor unit, which is a group of muscle fibers and the single motor nerve that activates the group. Within a motor unit there can only be one type of fiber--fast twitch or slow twitch (Robson). The motor unit we invoke depends largely on the strength of the contraction, where as a strong contraction that is maximized will invoke the motor units consisting of fast twitch muscle fibers. While it is true that some players may have a lower percentage of fast twitch fibers than others, the point of emphasis must be to train the brain and body to activate these fast twitch fibers and increase their muscle output. By doing this, the athlete’s success is not so much predetermined by genetics, but is based on a willingness to improve and a commitment to hard work.

So how do we train these fast twitch motor units to make them fire more rapidly and increase their muscle output? One of the most effective methods is to target the specific muscle groups relating to skating speed using plyometrics. The term plyometrics is defined by Donald Chu in his book *Jumping into Plyometrics* as “exercises that enable the muscle to reach maximum strength in as short a time as possible” (2). Plyometrics,
sometimes called jump training, has its roots in Europe and Russia, where athletic trainers have been using it for some time with great success. These exercises are anaerobic in nature and “allow maximum energy to be stored in the muscle before a single explosive act, using maximum power is performed” (Chu, 7). Quality of movement over quantity is stressed with maximum effort per single repetition. The muscles used in skating should be the main concern when doing plyometric training. Studies have shown that the two most active muscles in the propulsion phase of skating are the vastus medialis and the vastus lateralis, which are part of the quadriceps muscle group (“Characteristics of high performance skating”). Other muscles that are highly utilized while skating include the gluteus maximus, the muscles on the inside and outside of the hip (adductors and abductors) and many others that not only provide power for propulsion, but also assist in recovery, balance and joint stabilization (see Appendix 1a & 1b). Plyometric exercises are structured scientifically to reduce the response time of the muscles and to harness the potential elastic energy that is stored during the contraction cycle. During each stride there is a lengthening (eccentric) contraction followed by a shortening (concentric) contraction. This transition is known as the amortization phase. As the weight of the body is pressed onto the thrusting leg, the muscle is lengthened quickly whereas sensors in the muscle detect this and contract quickly to protect itself from injury. Biology experts refer to this contraction as the myotatic response (Chu, 3-7). This type of contraction caused by the myotatic response is the fastest type that the human body produces. Plyometric training can additionally shorten the response time, as studies have shown that the length of the amortization phase is highly dependent on learning. Also, as the muscle is stretched in the eccentric contraction, elastic energy is stored and can be utilized as kinetic energy if the eccentric contraction is followed by a powerful concentric contraction. Think of it as a rubber band stretching, where on release it snaps back to its original length. One thing that must be noted is that if there is
even a minimal delay in the concentric contraction, the potential elastic energy will be lost as heat generation (Chu, 4). A few examples of hockey specific plyometric exercises, most of which can be done both on or off ice, include lateral skate hops over barriers (cones, hurdles, etc.), lateral single leg hops, stationary hops, 45 degree hops, 45 degree single leg hops, squat jumps, split squat jumps, and tuck jumps. (See appendix 2) There are many more of these types of exercises ranging from easy, for beginners and young athletes, to more complex for the advanced. Plyometric exercises can actually be started at very young ages, though you should check with a certified trainer or physician before implementing any type of plyometric routine. Look at the game of hop scotch, for example, which could easily be classified as a plyometric exercise. Children of very young ages play this and other similar games involving jumps and hops regularly. Plyometrics can prove to be quite a valuable tool for the hockey player as it is easy to see the benefits that plyometrics can offer as it relates to more speed and power in skating, stopping and starting, and lateral movements as well.

Are plyometrics the panacea for the hockey player that wants to train to become faster? The answer is no, plyometrics must be complemented with strength training, flexibility exercises as well as anaerobic and aerobic conditioning. When I talk about strength training for hockey I am referring to weight lifting in a designed fashion not only to increase strength in the skating muscles, but also to provide stronger joint stabilization, better balance and coordination. The latter components are critical in sustaining proper technique and form, which are very important in becoming a fast skater. I will elaborate on this later. Donald Chu states that when “training for explosive power...athletes best develop it by focusing on multi-joint, ballistic weightlifting exercises such as cleans, snatches, push presses, and various forms of squat(s)” (“Explosive power”, 87). In other words, hockey players should do exercises that ensure that many of their muscles work together in harmony to perform. This develops the ability of the muscles to produce
smooth efficient movement. For instance, this training is much different than that of bodybuilders who isolate muscles in a quest for increased size and definition. A basic rule of sport specific strength training is to train the body the way it is required to perform in the game environment, which trainers refer to as “specificity” (Kubachka). Specificity for the hockey player means gearing your training to target the muscles and actions most commonly encountered on the ice. Obviously if a player is trying to increase speed, training of the legs is of great importance. In addition, training of the core area of the torso, especially in the abdominals and lower back is also key. Skating and hockey in general, involve a great number of rotational movements which generally start in the torso area. Leg strength that is not proportional to torso or core strength can contribute to slower speeds and certainly put the athlete in a high risk for injury. When lifting weights, hockey players should stay between 6-15 repetitions, with the end number based on the amount of reps that will cause complete fatigue of that muscle group. Peter Twist suggests, “quality versus quantity,” preferring to “overload the muscle maximally each set during a shorter workout to promote strength gains and time efficiency” (62-64). Twist also suggests using “negatives” or lowering weights slowly with resistance. This causes increased muscle tension and “eccentric strength.” These gains allow for more speed as the muscles can contract quicker and more powerfully.

The question always arises, “At what age can strength training begin?” In the past, it had been generally accepted that strength training could not start until somewhere around the age of puberty. Though you should never begin a strength training program for a youth athlete without first consulting a physician or certified trainer, researcher Avery Faigenbaum suggests that significant muscle gains can be achieved by athletes as young as 6 years old. His program utilized the use of light medicine balls; strength building exercises using balls, bands, light dumbbells and child-sized weight machines (Faigenbaum). This may seem absurd to most parents and coaches, but is in fact
supported by The American Academy of Pediatrics (AAP) in their policy statement for strength training by children and adolescents. The AAP states “...adolescents and preadolescents may use strength training as a means to enhance muscle size” and “in addition to the obvious goal of getting stronger, strength training programs may be undertaken to improve sports performance.” Repetitive maximum lifts should be avoided by young children, though, as their growth plates are still vulnerable to injury. Used properly though, strength training can actually stimulate bone growth and development and increase bone mineral density. Strength training can also significantly reduce the amount of injuries to young athletes. Faigenbaum states that, “some heath care providers believe that approximately 50% of overuse injuries sustained by young athletes could be prevented if children were better prepared (physically) to play the game.”

Flexibility is another important asset of the fast skater. Flexibility has been defined as “the range of motion about a joint” (“Improving Speed”). We all know that stretching is important before physical activity to prevent muscle damage, but how many coaches and parents stress the great benefits of stretching just after exercise or on off days? In relating this to speed gain, one can assume that greater flexibility will increase range of motion about the joints. This, in turn will give the athlete more distance to apply muscular force. Also stretching can facilitate the ability to produce complete extension in the legs during the skating stride. In fact, one common problem that many hockey players have is that they are unable to fully extend their hamstrings. This severely retards their stride and can cause injury to this muscle as well as the lower back. This is especially true in adolescents whose bones are growing so fast that their muscles have not adapted and stretched to accommodate the change in length. Stretching also facilitates blood flow in the muscles and increases elasticity which allows the muscle contract and relax more quickly (“Stretching For Ice Hockey”). Post activity stretching is actually the best time to increase flexibility. At this time the muscles are warm and the most pliable
which allows for the most gains in flexibility. Stretching after activity will also help to prevent injury, reduce soreness and reduce the potential for muscle spasms (“Functional Flexibility for Ice Hockey”). Special attention must be focused on proper technique when stretching. Players must ease into the stretch slowly and allow the muscle to be relaxed during the stretching exercise. Bouncing or trying to stretch a muscle fast will invoke the myotatic response to occur as the brain tries to protect the muscle from over stretching, thus causing it to contract. “Stretching across a contracted or tight muscle ultimately leads to the formation of inelastic scar tissue,” which athletes trying to improve speed definitely want to avoid (Twist, 24).

Anaerobic and Aerobic conditioning do not generate speed per say, but are both important if the athlete is to retain their speed over the coarse of the activity. Anaerobic conditioning can best be described as speed endurance. Anaerobic activity is one that does not require oxygen, but relies on the ATP-PC and anaerobic glycolysis system of energy within the body. Without getting too technical, the ATP-PC system is used in short burst, high intensity activities and generally lasts for less than 15 seconds. Then the body relies on anaerobic glycolysis, using the blood glucose stores (carbohydrates) for energy of which lactic acid is a byproduct. (“Conditioning”). Lactic acid causes slower movements as well as that burning sensation we have all felt at the end of a long shift! These energy systems have a limit of 60-90 seconds, but peak at 35-45 seconds, which compares to the normal shift of a hockey player. The ability to retain quick neuromuscular response and increased muscle output gained through training and consistently apply those under stress and fatigue is the goal of anaerobic conditioning. With increased anaerobic stamina, the player will be able to perform over a much greater period before the lactic acid builds up higher than the body’s ability to remove it. This type of conditioning also can make your muscles more efficient by causing a decrease in production of lactic acid as well as creating a higher pain tolerance to its burning effects.
Anaerobic conditioning can also increase the amount of glycogen stored in the muscles, thus utilizing more of your carbohydrate intake and less being stored as fat. Anaerobic conditioning is best achieved through interval training, for example sprint intervals or running stairs. The key is to use 100% maximum efforts with adequate rest periods in between. Rest periods are important as they allow the energy systems mentioned earlier to be restored before the next use. For hockey players a work to rest ratio should be similar to that in a game, which is 1:2 or 1:3 (Twist, 47-51). This equates to a shift length, for example, and would be approximately 45-60 seconds of training followed by 90-120 seconds of rest.

Aerobic conditioning also can help as it allows the player to recover faster and thus generate his maximum speeds over extenuated periods of exercise. This type of conditioning trains the oxygen supply system of the body and is directly related to the body’s ability to recover from physical exertion. The oxygen supply system refers to not only the amount of oxygen that the lungs can absorb, but the amount of oxygen the lungs can transfer and store in the bloodstream and the volume at which the heart can push the blood through the body. The increase in blood flow gained through aerobic conditioning allows for the rapid removal of lactic acid. Oxygen is required for the body to metabolize lactic acid and generate more ATP-PC for anaerobic use. Building aerobic stamina is best achieved by doing exercises that increase the heart rate to at least 150 beats per minute and maintaining that rate for 15-20 minutes or more. Activities such as jogging, riding a bike, cross country skiing and recreational skating are all good examples of exercises that improve aerobic conditioning.

In order to use increased power and strength gained through training, one must be able to execute consistently with proper form and technique. Unfortunately for many young players, these areas are not adequately stressed. Many coaches are under the false impression that through the course of more drills and more skating, the players will
instinctively pick up on these traits. This is absolutely not the case. Form and technique must be stressed beginning at the youngest age all the way through to the advanced skater.

Proper form begins number one with proper knee bend. Well know power skating instructor Carrie Keil has said that “...knee flexion is the secret to stability, stride length, and ultimately, speed” (“Increasing Knee Bend”). Skating with the legs straight is virtually impossible, so most players will skate with some degree of knee bend. The goal is to try and get the knee bend as close to a 90 degree angle as possible. The amount of knee bend directly influences how far away from the body you can push against the ice with your thrusting leg. As I have said, speed is distance over time, so the farther you can extend the thrusting leg the greater impact it will have on your skating speed. International power skating instructor Robby Glantz also strongly emphasizes the importance of proper knee bend. He states that “...this much is AUTOMATIC, the more you bend your knees--whether you are skating forwards, backwards, or turning--the better your control, balance, speed and power.” In his video Secrets to Hockey Speed, Glantz suggests the knees to be at least 2 inches over the toe of the skates. This can be measured by holding the hockey stick vertically against your knee and measuring the distance between the shaft and the toe. Proper Knee bend also allows for more efficiency in the skating stride. Skaters with improper knee bend may appear to be striding more frequently and have quicker feet, but in effect the are going “nowhere fast” and just making themselves tired. In addition, deep knee bend also lowers the center of gravity providing the skater with much more stability to execute powerful strides.

Having a forward lean of the trunk is also an element of correct skating form. Players are often told to “keep their back straight” when skating. Many interpret this to mean that their back should be straight up and down. The back should be straight, with no arch, but be angled forward at the waist to almost a 45 degree angle with the ice with
the chest located directly over the gliding knee. This allows for a straight line of force at full extension through the thrusting hip, leg, ankle and toe (Stamm, 40). With the chest located over the gliding knee they will be able to transfer their full body weight onto the returning thrusting leg. I will next discuss this and the proper technique to maximize the speed of the skater.

In order to generate the most distance on each skating stride and do so in the least amount of time to maximize speed, perfecting the skating technique is of utmost importance. Proper weight transfer, effective use of the blades edges, good mechanics and fluid upper body movement are several aspects of good skating technique that enhance performance. Next, I will break down the act of skating into three distinct phases and explain the role that the above mentioned factors play in developing the proper skating technique to become a faster skater.

Generally skating can be broken down into three phases: drive, glide and recovery. The drive phase begins with the feet aligned under the body in a “V” position with the ankles in a near touching position and the toes pointing out. Although I have discussed what it means to have good skating form, I must reemphasize the importance of a good 90 degree knee bend is order for the technique to be effective. For explanation purposes I will begin with the right skate beginning the drive phase. First, the right arm is in a forward swing facilitating the alignment of the chest over the right knee and ensuring full transfer of weight onto the right skate blade. As this point the ankle flexes inward allowing the inside edge of the driving skate to cut sharply into the ice. The driving force starts with a push against the blade beginning with the hip, through the thigh, knee, ankle and ends with a sharp snap of the toe. As this force is applied the right arm continues forward and the left arm swings back. The driving force should be implemented at roughly 45 degrees to the direction of travel, with the hips remaining square. A common error of young skaters is to apply the force of the push to be too much
to the back. This is how the force is applied on land while running and is at first difficult for new skaters to adjust to. The push against the blade should start near the heel, proceed through the middle of the blade and end at the toe. The last part of the drive or the “toe snap” is many times executed poorly or not at all and its importance is not adequately stressed by coaches. Full leg extension all the way through the toe is important to generate the maximum stride distance from the power that you apply.

The glide phase begins on the left skate at about the midpoint of the extension of the right driving skate. At this point the weight begins its transfer onto the left skate again facilitated by the forward swing of the left arm. Here the body weight is dispersed equally on both the inside and outside edges of the left skate. Again the knee is bent deeply in a preparation for the upcoming drive phase of the left skate.

At the point where the left glide skate ankle is about to flex inward in preparation for the next drive phase and the right skate has reached full extension is where the third phase or recovery occurs. At this point the right skate toe has just “snapped,” and as it leaves the ice it is brought back or “recovered” under the body. It should be recovered in a straight line as quickly as possible with the foot staying in the toe out/heel in position it left the ice. When it recovers under the body feet are again in the “V” position ready to begin the drive phase again, this time with the left skate, and begin the glide phase now with the recovering right skate. As you can see, the faster the drive skate is recovered, the faster the gliding skate of the other leg can begin the next drive phase. In fact research has shown that the ability to recover the skate blade quickly is a factor that all fast skaters have in common.

One point that I would like to further discuss is that of the arm swing. I have noted its importance in facilitating proper weight transfer over the skate edges. Proper movement of the arms helps to develop a rhythm in the skating process to create a fluid skating motion. In addition, Laura Stamm points out that full arm extension encourages
full leg extension, where “short, choppy arm swing encourages short, choppy strides” (44). The swing of the arms should move in a diagonal line from the back outside to forward towards the midline of the body with the elbows remaining close to the sides. The forward arm should not cross the midline or the elbows swing out away from the body as this will create lateral or twisting movement in the torso and decrease forward speed.

I have now discussed several topics that are very influential in developing increased skating speed including: biology, training, form and mechanics. One important topic remains: the skates. The hockey skates are the link between the body which produces the skating strides and the ice surface on which it applied. It is absurd to devote countless hours of hard work to developing your skating and overlook the importance of this most important piece of equipment. The boot construction, proper fit, the blades and the way they are sharpened are all important factors critical to the effective transfer of a powerful skating stride to ice in a manner to generate more speed.

First, the boot must be well designed to provide proper support, especially in the ankle area, while still allowing good ankle flexion. Many of today’s skates have extremely stiff boots and can be difficult for young and inexperienced skaters to break in. Though they are designed this way to give adequate support, the break in time may be significant. It would not be wise or fair to fit a hockey player into a new pair of skates and then expect them to use them for the first time at a tryout or training camp. A good idea for younger skaters may be to buy a used pair of high quality skates that provide good support and have good blades, but are broke in and easily adjustable to the skaters foot. I have found, with my experience, that many young players feet outgrow their boots just about the time they are fully broke in and the most comfortable to wear! The fit of the boot should be snug, with the toes coming to a point near the toe but not touching. The width should be accommodated so that the feet and toes are not cramped causing
restriction in blood flow and causing pain. Skates that are too big or too wide will cause the foot to slide in the boot during skating maneuvers and result in a loss of power. This will also cause painful blisters and a premature break down of the boot. The laces should be tight, but not over tight as this will restrict ankle flexion and can cause what skaters refer to as “lace-bite,” which begins as a tingling feeling progressing to severe discomfort as the blood flow is restricted to the foot. One way to measure a proper width and tightness is to observe the eyelets. They should be in a straight line up the front of the boot with roughly 2 inches apart, with no drastic inward or outward bowing. Players should also refrain from putting tape around the ankles, and instead invest in a pair of skates with a more appropriate fit. I have found that many young players like their skates very tight, and ask me to tighten them “as tight as I can!” Over tightening of the skates will not allow proper knee bend. For instance, in order for the knee to bend forward, the ankle must also bend forward and push through the tongue. For this reason Laura Stamm advises against players pushing the tongue of their skates up under the bottom of the knee pads. Restrictive ankle flexion due to over tightening of the laces also will not allow the player to flex the ankle inward in the drive phase to get a good bite of the blade against the ice. This will definitely take away from the potential speed of the player!

The blades should be made of high quality steel. The higher the quality of steel, the more resistance they will have to dulling and damage due to pucks, sticks and others objects contacting the blades during the coarse of play. Finding a knowledgeable professional skate sharpener is also essential. Sharpening creates the radius of hollow of the blade (figure 13.1), thus forming an inside and outside edge on each skate blade needed to cut into the ice for movement and maneuvering. Blade hollow radius for hockey skates generally stays in the 3/8”-3/4” range. The amount of hollow can be adjusted depending on the skater’s
weight, ability and personal preference. The smaller the radius of hollow used on the skate sharpening wheel, the deeper the hollow will be. A deep hollow will allow the edges to cut into the ice better which will help the skater to accelerate faster, but will make turning and stopping more difficult, especially for inexperienced skaters. Conversely, a shallow hollow will make stopping and maneuverability easier as the blades can slide across the ice on both edges without digging in causing the skater to fall. The player must decide what is best based on trial and error, and what feels best for them.

Having the skate blades custom profiled is another option. Skates normally come from the factory with a generic radius. This is not to be confused with the radius of hollow which I discussed earlier. The radius refers to the arc of the blade corresponding to a circle with a length of that radius. For example most skates come with a radius somewhere between a 9’ and 11’ (see Figure 14.1). This means that if you drew a circle with that radius, you could place the skate along the line and the blade would follow the contour of the arc of the circle. The bigger the radius, the more blade that will be touching the ice at any time. More blade on the ice can help to generate more speed as there is more surface area to apply force to the ice and add to increased stability, but can cut down on the ability to execute quick turns and maneuverability. Most younger and inexperienced skaters should probably choose a larger radius in the 11’ range. Advanced skaters sometimes move to a 9’ or smaller radius depending on their personal preference. Many times the skates will need to be contoured after damage by an inexperienced skate sharpener. In talking with Dave Mathewson of the Ultimate Edge Power Skating, he cites improper sharpening as a major problem in players not reaching their full skating potential. He has found that many inexperienced skate sharpeners start to grind at the toe of the blade with firm pressure,
and as they move down the blade, will tend to exert less pressure and move faster until they reach the heel. This causes an unproportional amount of blade to be ground off, taking greater amounts from the toe area and less towards the heel. This not only causes a decrease in balance, as the area of blade in contact with the ice is minimized, but also results in less power per stride. This loss of power is due to less area of blade to apply muscular force, and the fact that it completely negates the ability to execute the important “toe snap.” The “toe snap” is not possible because the toe area of the blade is ground away and no longer in contact with the ice at the end of the stride.

As you can see, much is involved in becoming a fast skater. With so many factors contributing to skating and speed development, it is clear that the athlete must develop a well rounded approach and train with precise attention to detail. As I said in the beginning paragraph, the road to success is not an easy one, yet it is one that is attainable to any athlete with a strong work ethic and the will to succeed. The ability to fly around the rink like Sergei Federov or Paul Coffee may seem like a long shot, but is certainly an attainable goal. These players were not born great skaters but believed in themselves and worked hard toward their goals. A wise man once stated that “the only thing that stands between a man and what he wants from life is often merely the will to try it and the faith to believe that it is possible.”
Appendix 1a: Muscles Related To Ice Skating

1- Illiopsoas: Primary function
- skating: recovery phase (striding and crossovers)
- foot speed

2 - Extensors: Primary function
- skating: turn-out and extension

3 - Adductors: Primary function
- skating: recovery phase
- inside leg extension on crossovers, agility

4 - Abductors: Primary function
- Striding: extension of the leg
- agility and lateral mobility

5 - Sartorius: Primary function
- skating: crossovers, pivots

**Quadriceps Group**

6a - Rectus Femoris: Primary function
- skating: transitional stride and in extension
- tight turns and crossovers
- quick starting and stopping

6b - Vastus Intermedius: Primary function
- skating: Origin of stride and Transitional striding phase
- Crossovers, tight turns
- Quick starting and stopping

6c - Vastus Medialis: Primary function
- skating: Beginning of stride.
  Low position. Critical to good knee flexion

6d - Vastus Lateralis: Primary function
- skating: end of striding phase on turn-out.

7 - Tibialis Anterior: Primary function
- recovery of foot after extension, heel cuts
- driving to the net, stability

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Appendix 1b: Muscles Related To Ice Skating

1 – Lower Back Stabilizers: Primary function
- skating balance and body alignment

**Gluteals**

2a – Gluteus Medius: Primary function
- skating: Striding and extension

2b – Gluteus Minimus: Primary function
- skating: Striding and extension

2c – Gluteus Maximus: Primary function
- skating: Thrusting

**Hamstring Group**

3a – Semitendinous: Primary function
- skating: Recovery phase

3b – Bicep Femoris: Primary function
- skating: Recovery phase

3c – Semimembranosus: Primary function
- skating: Recovery phase

4 – Gastronemius: Primary function
- skating: thrusting power at end of stride
- extends foot at end of stride. Critical to maximize speed
- agility and lateral mobility
- critical element in backward skating extension ("C"-cuts)

5 – Soleus: Primary function
- critical at origin of stride.
- begins extension of foot

6 – Achilles Tendon: Primary function
- skating
- extension of foot
- poor flexibility effects ankle flexion which limits knee bend and stride length

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Appendix 2: Example Plyometric Exercises

**Hexagon Drill**

*Start:* Make a hexagon (six-sided box) with tape on the floor, with sides about 24 inches long. Stand in the center of the hexagon with feet shoulder-width apart.

*Action:* Jump across one side of the hexagon and back to the center, then proceed around each side of the hexagon. This may be done for a specific number of complete trips around the hexagon or for total time.

**Two-Foot Ankle Hop**

*Start:* Stand with feet shoulder-width apart and the body in a vertical position.

*Action:* Using only the ankles for momentum, hop continuously in one place. Extend the ankles to their maximum range on each hop.

**Double Leg Hops**

*Start:* Stand with feet shoulder-width apart.

*Action:* Squat down and jump as far forward as you can. Once you land, jump forward again. Use quick double arm swings and keep landings short. Do in multiples of three to five jumps.

**Tuck Jump with Knees Up**

*Start:* Stand with feet shoulder-width apart with your arms by your sides.

*Action:* Jump up, bringing the knees up to the chest and grasping the knees with the hands before the feet return to the floor. Land without bending forward. Repeat the jump immediately.

**Tuck Jump with Heel Kick**

*Start:* Stand with feet shoulder-width apart and your body straight with your arms by your sides.

*Action:* Jump up and kick the buttocks with your heels. Repeat the jump immediately. This is a quick-stepping action from the knees and lower legs. Swing the arms up as you jump.

**Lateral Jump over Barrier**

*Start:* Stand alongside a cone or hurdle.

*Action:* Jumping vertically but pushing sideways off the ground, bring the knees up to jump sideways over the barrier.

**Split Squat with Cycle**

*Start:* Spread your feet far apart, front to back, and bend the front leg 90 degrees at the hip and 90 degrees at the knee.

*Action:* Jumping up, switch legs positions – the front leg kicks to the back position, and the back leg bends up and comes to the front. While bringing the back leg through, try to flex the knee so that it comes close to the buttocks. Land in the split-squat position and jump again.

**Lateral Bounds**

*Start:* Feet shoulder-width apart.

*Action:* Perform skating motion between two marks on the ground, one yard apart. Work on lateral movement. Swing leg should come behind the planted leg.

**Single Leg Hops**

*Start:* Stand on one leg.

*Action:* Push off with the leg you are standing on and jump forward, landing on the same leg. Your opposite leg should swing to increase momentum. Once you land, take off again. Your feet should move as if you were on a hot plate. Perform sets on both legs.

**Split Squat Jump**

*Start:* Spread your feet far apart, front to back, and bend the front leg 90 degrees at the hip and 90 degrees at the knee.

*Action:* Jump up, using your arms to help lift. Hold the split squat position. Land in the same position and immediately jump again.

(“Dry Land Training”)
Works Cited


