Introduction

Hockey is a sport that demands many different athletic qualities to ensure success. Players must be able to display speed, agility, strength, balance, stability, and flexibility all while skating on two 3-mm-wide by 28-cm-long steel blades (length varies). It can be difficult to train the many hockey-related physical qualities over the course of a season in such a way as to target sport-specific muscles and improve on-ice performance. To help remedy this, various hockey players in Canada have been using a dragging sled (Figures 1-10) for the past several years to enhance conditioning in a sport-specific manner. Combined with a solid on- and off-ice training program that focuses on periodization to gradually build athletes up toward a peak for the start of the playoffs, using the sled is one of many training tools players can use to form a synergistic yearly plan. Although many training modalities can contribute to enhanced sport conditioning, this article will focus on the use of sled dragging for improved hockey performance.

About the Sled

Sled dragging was developed as a training device that sprinters and power athletes such as weightlifters or football players could use to develop explosive properties in the hip and leg musculature. The sled has 2 flat rails angled upward in the front for maximum stability. On top of that is welded a mounting platform with a perpendicular bar that can hold a variety of weight plates (up to 500 lb). Chains are then attached to the top loop of both rails, which then converge to 1 heavy chain onto which attachments are then added. Pulling the sled can be performed with a wide assortment of 1- and 2-handled attachments, belts, or harnesses, depending on the training stimulus required (Figures 1-8). It is advisable to use the sled on a flat grass field (such as a soccer or football field) in which enough room to maneuver the sled exists. For most training purposes, any flat, straight run of 150 m long by 20 m wide is adequate for proper sled training.

In the winter if dry ground is not available outside, coaches can hook up a tire in the same manner as the sled for a similar workout (Figures 9 and 10). The tire has holes predrilled so that chains can be pulled through and fastened. A sheet of plywood big enough to enter the tire and prevent weights from coming through onto the ice is inserted into the bottom of the tire. Weights are placed inside the tire and then arranged to prevent them from spilling out onto the ice. Dragging the tire on the ice can provide a greater sport-specific workout (because it directly simulates the necessary training environment in hockey) and add a fun challenge for players at the end of practice throughout the season.

Physiological Demands of Hockey

To determine which training methods are best for sled dragging, it is important to figure out the physiological demands of hockey. Players are required to wear approximately 25 lb of protective equipment while they play 18 to 26 shifts (20 to 32 for defensemen) for 45 to 60 seconds (5). A typical shift is characterized by short, 2.0-second accelerations...
followed by coasting and deceleration of about 2.1 seconds, for a total average time period of 150 seconds (including stoppages in play) (1, 6). Forwards typically have a 1:3 work:rest ratio based on 3 regular lines (which is common in North American hockey), and defensemen can have a 1:1, 1:2, or 1:3 ratio, depending on the player, time of the game, location of the puck, etc. Heart rates during this time can reach 85–90% of maximum and then drop again while sitting on the bench (13). All told, most players work very strenuously for 15-25 minutes within a 60-minute game that is distributed over approximately 165 minutes of actual time.

Benefits of Sled Dragging

Most sled-dragging workouts focus on 3 main training functions because it helps to target the skating musculature and develop acceleration with anaerobic work and improve aerobic conditioning.

Within the skating motion, it is imperative that the muscles be trained in a sport-specific manner for maximal carryover to sport performance. Training to improve lateral movement capabilities, for instance, requires exercises that are performed in lateral movement patterns (11). Many actions in hockey such as lateral movement and directional changes are primarily single-leg actions, and it is important to be as specific as possible with training for maximum benefit (15). Dragging the sled is a closed-chain multijoint exercise that allows the posterior muscle chain to be worked in a functional skating motion as opposed to strength training in which muscles are trained with less functional specificity. Junior players who have used the sled for conditioning the skating stride report a
noticeable increase in skating stride length and efficiency. Although this is not substantiated by empirical evidence, it suggests that players have developed greater strength in the skating muscles, which might allow them to increase the stride length because of an improved ability to generate force in the skating push phase.

In terms of injury prevention, conditioning the skating musculature is critical. The skating technique, for instance, greatly taxes the muscles of the legs, hips, vastus medius, and lateralis (9). Unfortunately, in most strength training programs, the specific muscle groups involved in lateral movement, the abductors and adductors, are often neglected (14). Given the amount of skating involved in games and practices, it is important that these muscle groups be strong, flexible, and balanced in strength to avoid injury (17). Sled-dragging drills such as the hockey stride and crossover stride (Figures 1 and 3) can be effective in working certain leg muscles that are undertrained with skating alone. When using the sled in combination with other exercises such as the skating treadmill, slide board, and roller-skating, the sport-specific musculature can be trained in a variety of ways to improve lateral movements.

Developing initial acceleration in the skating stride is a vital component to becoming a better player because 2-second bursts of speed (such as a defenseman racing for a loose puck or a forward moving into position for a pass) are required from the player up to 30 times within a single shift (6). In most sports, the rate of force development (essentially acceleration) is attained within approximately 10-15 yd (0.6–1.5 seconds) (16). Because all movements in hockey (skating, shooting, body checking) are full-body and multijoint and many are explosive (12), it stands to reason that the training protocol follows these guidelines. Sled dragging can help train first-step quickness because the weighted sled can provide just enough resistance so the player can focus on quick starts in a normal sprinting or skating-specific motion. The use of weighted sleds for acceleration training, such as sport loading, is a technique designed to improve explosive concentric movements such as sprinting speed (16). When various handle attachments are used with the sled, multidirectional actions and power can be used to train effectively.

Although many experts agree that hockey is primarily an anaerobic sport, there is an aerobic component that must be trained to ensure success (3, 8). The critical measure specific to ice hockey is the ability of the oxidative energy...
system to replenish phosphocreatine and adenosine triphosphate concentrations, in turn allowing for high-intensity performance to be repeated (1). Loading the sled with a relatively heavy weight and walking with it (while using a variety of attachments) can help train cardiovascular efficiency and also developing the hip and leg musculature.

### Specific Techniques in Sled Dragging

Using the sled correctly for the purpose of developing the hockey-specific musculature is critical for a successful functional skill transfer to the ice. In the skating action, the upper body angle should stay around 45 degrees, and the knee angle when the leg is fully retracted should be at least 90 degrees or slightly lower (7). Although concessions can be made to this recommendation because of the lack of glide in the sled-dragging motion, keeping a deeper knee bend will aid the training effect of the hockey player. The coaching staff (including the strength and conditioning coach) should monitor all workouts, and especially early-season workouts to ensure correct technique is demonstrated with all sled-dragging activities.

This section will describe and illustrate 10 sled-dragging techniques that help develop and train the hockey stride. It is advisable to experiment with different drills to find out what techniques and areas of the skating stride your team wishes to specifically target.

#### Hockey Lunge

The athlete should get into a correct skating stride (as explained above), place a weight belt on backward (with the harness hook facing backward), hook the sled up to the back of the weight belt, and lunge forward from side to side mimicking the back-and-forth nature of the hockey stride. Players should be instructed on fully abducting the leg along with the other leg and then pushing off with a full range of motion stride to the other leg (Figure 1). Using a stride width of 22 to 29 in. is optimal because the best skating strides have this type of width from foot to foot (4).
**Forward Stride**

Much like the hockey stride, the athlete puts on the weight belt backward, hooks on the chain to the back of the belt, and walks with a deep knee bend forward, focusing on a long, full range of motion lunging step for each repetition (Figure 2).

**Cross-Over Stride**

The cross-over stride involves using a 1-handle grip and starting with a perpendicular stance in front of the sled. The athlete begins by crossing the back foot (the one closest to the sled) over the front foot. Once the back foot is crossed over, the front foot stretches out in a forward direction and steps away from the back foot (Figure 3). The action mimics the cross-over action in a hockey turn and puts a great deal of focus on the abductor and adductor muscles.

**Bent-Over Stride**

Designed to target the hamstrings more effectively, the bent-over stride is very similar to the forward stride except that the upper body has a greater forward lean to it (20–30 degrees). The athlete walks with a deep knee bend and forward lean while holding a 2-handle grip attachment behind the body (Figure 4).

**Reverse Stride**

Using the sled backward, a reverse stride puts most of the force on the quadriceps muscles. The player puts the weight belt on the normal way (the buckle facing forward) and faces the sled. After hooking up the chain, the athlete gets into a deep knee bend and begins taking long strides in a backward direction (Figure 5).

**Ankle Stride**

Two straps are attached to the ankles for this dragging exercise, and the athlete pulls the sled in a forward motion by flexing the hip flexor and quadriceps muscles to step forward (Figure 6). An upright body angle and less knee bend is generally used for this exercise, but any of the drills such as the forward stride or hockey lunge can be used with ankle straps. Light weight and careful attention to proper technique is essential for this training drill.

**Forward Sprinting**

The athlete assumes the same position as with the forward stride and hooks up the sled in the same manner. At this point, the athlete can get into a starting position of a sprint and then forcefully explodes forward, sprinting with the sled in tow (Figure 7).

**Sprinting Drills**

Very similar to the forward sprinting, the sprinting drills exercise can be used with a wide variety of attachments and harnesses to provide a suitable resistance while sprinting (Figure 8).
Forward Sprinting on Ice
The player (in full equipment) hooks up the sled the same way as in the forward sprinting drill and proceeds to explosively skate forward, thus towing the sled behind (Figure 9). When the sprint is finished, care must be taken to grab the chain and control the sled to prevent any injury or damage to the rink. Coaches should use this drill with the greatest of caution to prevent any horseplay or player injury.

Cross-Over Stride on Ice
Similar to the cross-over stride on dry ground, the player stands perpendicular to the sled and with 1 hand pulls the sled while crossing over with the legs to mimic a hockey cross-over (Figure 10).

Logistics of Sled Training
Having a plan for the workout prevents dead time in which athletes are standing around while the equipment is being set up. Because a hockey team usually has no more than 30 players, groups of 2 or 3 can be set up to use 10 to 15 sleds with a variety of attachments. The necessary weights and attachments must be available to the groups and a precise training schedule for that day's training must be clearly explained before starting the program.

The logistics of this type of training are rather unique because the sleds and attachments must be shared by players due to the cost and storage problem associated with 30 sets of training equipment. By splitting the players into groups of 2, the coach can work an out-and-back method of sled dragging, in which the player drags a selected weight for a set distance forward and then turns the sled around and comes back to the starting point at which play-
er 2 equips the sled and starts off. If the groups are split into 3, then player 1 drags the sled to player 2, player 2 takes the attachment from player 1 and drags the sled to player 3, and so on, for a prescribed workout.

**Special Considerations When Using the Sled**

Dragging the sled can be very tough on the body because of the external weight dragged behind the athlete in a variety of training protocols. It is imperative that a good warm-up and stretching session be performed for 15 minutes prior to any dragging activities. A light jog followed by some easy stretches, focusing attention to the Achilles tendon, hamstrings, glutes, hip flexors, quadriceps, and low back areas is appropriate. Before using the sled, athletes should additionally warm up the body with some general ballistic actions and light sprinting, followed by a sport-specific warm-up of the skating musculature.

Athletes should be counseled on the proper use of the sled and the various safety precautions necessary to load and unload the sled between sets. A list of guidelines and rules concerning the sled (as determined by the strength and conditioning professional) should be made available to every athlete in the program. Finally, every athlete should work out in proper gym attire (cross-training shoes with significant lateral strength and shock absorption and loose-fitting clothing) (2).

**Suggested Workouts for Hockey Specificity**

When constructing workout protocols for players, it is important

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg strength</td>
<td>Upper body</td>
<td>No strength</td>
<td>Leg strength</td>
<td>Upper body</td>
<td>No strength</td>
<td>No strength</td>
</tr>
<tr>
<td>Quick feet drills</td>
<td>Slide board interval session</td>
<td></td>
<td></td>
<td>Roller blade interval session</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sled dragging</td>
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<td>No sled</td>
<td>Sled dragging</td>
<td>No sled</td>
<td>Sled dragging</td>
<td>No sled</td>
</tr>
</tbody>
</table>

Note: Weight training includes heavy basic movements such as squat, deadlift, bench press, rows, pull-ups, shoulder press hack squats, multidirectional lunges, eagle squats, etc. for 4–6 sets of 6–9 repetitions depending on the athlete. Core areas, neck, and stabilizer muscles are trained each morning according to a pre-set daily routine. Quick feet drills include read-and-react drills, the agility ladder, agility courses, hockey-specific plyometrics, etc. Functional workout includes tire flipping, weighted wheelbarrow pushing, water-filled keg lifting, car pushing. Slide board workout focusing on the skating stride for sets of intervals.
to gradually implement new training procedures using a periodization model that encourages steady progress and limiting poor technique and potential injury. Sled-dragging workouts can be used during the 3 main phases of the season, the off-season, pre-season, and the competitive season. Within each of these phases, there are many subphases that are used to take the athlete through a transition or peak for the playoffs. Special attention must be given to forces beyond the strength and conditioning professional’s control such as team travel, a busy league schedule, and weather conditions, which may limit the necessity to perform a sled-dragging workout.

**Off-Season.** The off-season is a time when players must make the most of their time to improve size and strength, eliminate weaknesses, and develop a base fitness level for the upcoming season. The goal for using the sled is to develop a base level of fitness and technical prowess so that the athletes are comfortable adjusting to higher volume and intensity levels later in the season. During this time, the greatest amount of weight will be used (in a periodized manner), and the basic exercises outlined earlier such as forward striding, cross-over strides, and reverse striding should be performed 3 times per week on the same day that legs are trained (Table 1). A sample weekly workout schedule for the sled is included (Table 2).

### Table 2
**Sample off-season sled dragging workout plan**

<table>
<thead>
<tr>
<th>Monday/Saturday</th>
<th>Forward stride (5 × 80 m, heavy weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Backward stride (5 × 40 m, moderately heavy weight)</td>
</tr>
<tr>
<td></td>
<td>Bent-over stride (4 × 60 m, heavy weight)</td>
</tr>
<tr>
<td></td>
<td>Cross-over stride (3 × 40 m each side, moderate weight)</td>
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<tr>
<td></td>
<td>Totals: 1160 m, moderate intensity (45 minutes to complete)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thursday</th>
<th>Hockey stride (4 × 50 m, moderate weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cross-over stride (4 × 30 m each side, heavy weight)</td>
</tr>
<tr>
<td></td>
<td>Sprinting (4 × 30 m, very light weight)</td>
</tr>
<tr>
<td></td>
<td>Totals: 560 m, light to moderate intensity (30 minutes to complete)</td>
</tr>
</tbody>
</table>

*Note: Keep rest breaks short until you can successfully complete another set. Choosing a weight for each exercise is a personal decision. Base all weights on the heavy set, which should be tough enough so each set is difficult to complete.*

### Table 3
**Sample preseason week (power cycle)**

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg strength</td>
<td>Upper body</td>
<td>No strength</td>
<td>Leg strength</td>
<td>Upper body</td>
<td>No strength</td>
<td>No strength</td>
</tr>
<tr>
<td>Plyometric</td>
<td>Quick feet drills</td>
<td>No strength</td>
<td>Plyo board</td>
<td>Quick feet drills</td>
<td>Slide board</td>
<td>No sled</td>
</tr>
<tr>
<td>session</td>
<td></td>
<td></td>
<td>interval session</td>
<td></td>
<td>interval session</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>Functional</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>strength</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>workout</td>
<td></td>
</tr>
<tr>
<td>Sled dragging</td>
<td>No sled</td>
<td>No sled</td>
<td>Sled dragging</td>
<td>No sled</td>
<td>Sled dragging</td>
<td>No sled</td>
</tr>
</tbody>
</table>

*Note: Weight training includes power cleans, clean and jerk, snatch, push press, squats, deadlifts, eagle squats, pull-ups, multidirectional lunges, shoulder press, Romanians, rows for 4–5 sets of 2–6, depending on the exercise and athlete.*
Intensity are already high, the athlete should use no more than 3 dragging sessions per week (Table 3). A weekly workout plan is outlined for illustrative purposes (Table 4).

Competitive Season. Throughout the competitive season, those athletes that might use the sled (junior players and above) will no doubt have a demanding competition schedule. In most junior leagues, the teams play more than 40 games a year (around 80+ for major junior) and even more than that in European and North American professional leagues. Schedules will often involve long travel schedules (sometimes by bus), poor sleeping conditions, and up to 5 on-ice practices a week (depending on the team). The amount of free time to follow an optimum training plan can be rather limited. Using the sled at this time of the year (if at all possible because of adverse weather conditions) can therefore be difficult and should focus on short workouts concentrating on improving quickness and speed. A better alternative is to use tires for dragging on the ice (Figures 9 and 10) up to 2 times per week because this might not present a logistical, financial, or scheduling conflict for the team. In some cases, 1 or 2 strength-training sessions might be substituted for an additional tire-dragging practice if no facilities for proper training are available to the team. A sample weekly plan is included (Table 5).

### Table 4

**Sample preseason sled dragging workout plan**

<table>
<thead>
<tr>
<th>Day</th>
<th>Workouts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday/Saturday</td>
<td>Sprinting (6 x 40 m, light to moderate weight)</td>
</tr>
<tr>
<td></td>
<td>Backward stride (4 x 30 m, moderate weight)</td>
</tr>
<tr>
<td></td>
<td>Hockey stride (94 x 50 m, moderate weight)</td>
</tr>
<tr>
<td></td>
<td>Cross-over stride (4 x 20 m each side, moderate weight)</td>
</tr>
<tr>
<td></td>
<td>Totals: 720 m, high intensity (45 minutes to complete)</td>
</tr>
<tr>
<td>Thursday</td>
<td>Hockey stride (4 x 50 m, moderate weight)</td>
</tr>
<tr>
<td></td>
<td>Cross-over stride (4 x 30 m each side, heavy weight)</td>
</tr>
<tr>
<td></td>
<td>Bent-over stride (4 x 30 m, heavy weight)</td>
</tr>
<tr>
<td></td>
<td>Totals: 560 m, light to moderate intensity (30 minutes to complete)</td>
</tr>
</tbody>
</table>

**Note:** Keep rest breaks short until you can successfully complete another set. Choosing a weight for each exercise is a personal decision. Base all weights on the heavy set, which should be tough enough so each set is difficult to complete.

### Table 5

**Sample competition week**

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
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</thead>
<tbody>
<tr>
<td>Total body</td>
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<td>Total body</td>
<td>No strength</td>
<td>No strength</td>
<td>No strength</td>
<td>No strength</td>
</tr>
<tr>
<td>Quick feet drills</td>
<td></td>
<td></td>
<td>Aerobic run</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tire dragging on ice</td>
<td>No sled</td>
<td>Tire dragging on ice (optional)</td>
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<td>No sled</td>
<td>No sled</td>
<td>No sled</td>
</tr>
<tr>
<td>Game @ 1900 h</td>
<td></td>
<td></td>
<td>Game @ 1900 h</td>
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<td>Game @ 1500 h</td>
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</tr>
</tbody>
</table>

**Note:** Weight training includes heavy basic movements such as squat, deadlift, bench press, rows, pull-ups, shoulder press hack squats, multidirectional lunges, eagle squats, etc. for 2–3 sets of 4–7 repetitions, depending on the athlete. Core area, neck, and stabilizer muscles are trained each morning according to a preset daily routine. Quick feet drills include read and react drills, the agility ladder, agility courses, hockey-specific plyometrics, etc. Functional workout includes tire flipping, weighted wheelbarrow pushing, water-filled keg lifting, car pushing. Aerobic run is a light 20- to 40-minute run to prepare the body for the upcoming game.
Conclusion
The game of hockey is a fast, tough sport that requires a solid training program to prepare athletes for the demands of the game. It is important that coaches stress sport-specific training (especially with the skating movements), with a firm commitment to building up weak links throughout the body to help prevent injuries. The dragging sled is a unique conditioning tool that players and coaches can use to develop the sport-specific actions and physical preparation that is necessary to compete in the game of hockey.

References

David Pollitt is the strength and conditioning coach for the Banff Hockey Academy and the owner of Optimal Performance Strength & Conditioning Consulting.