

# WHEN STEEL MEETS ICE

# What Do We Know about Skate Sharpening?

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To most people, the term “sharpening” does not conjuncture any degree of precision. Pencils, knives, scissors, axes, hoes, and lawn mower blades are routinely sharpened against a grinding wheel, where the exact angle of the cutting edge interfacing with the stone does not seem to greatly affect the result — the cutting ability of the implement. Stones and oils have also been traditionally used to remove the burrs left from the grinding to achieve a highly successful result. But is this the best practice in the case of sharpening skates, especially those used in competitive sport?

With all forms of skating, the practices used in skate sharpening, coupled with athletic superstition, have led us to believe that every aspect of the blade is of utmost importance and has the potential to influence on-ice performance. Similar parallels can be drawn in other sports. For example, in cycling, an improperly inflated tire can affect the cyclist’s speed and control, and in football, the players choose the style and length of their cleats based upon the size of the player and the demands of the position. If the same reasoning holds true for on-ice performance, we should question whether a 6’5” and 230lb defenceseason should use the same skate sharpening as a 5’10” and 180lb forward, or whether a long track speed skater should have the same grind as a short track speed skater, or whether an ice dancer should have the same sharpening profile as a free skater.

The scientific literature on ice sports such as hockey, figure skating, and speed skating has primarily focused on the physiological, biomechanical, and technical aspects of sport-specific performance. However, limited research has been devoted to what appears to be an essential component — the athletes’ point of

contact with the ice. Typically, skaters entrust their skates to technicians, equipment managers, or skate sharpeners to provide them with the sharpening that will give them an edge on the ice and assist to optimize performance. Skaters generally select those who have earned a good reputation. As a result, skate sharpening has historically gained the reputation of being a secretive trade or “black magic”, performed only by those approved by the skating community. Our purpose is to provide some essential facts and dispel some of the myths associated with current practice in skate sharpening.

## THE ANATOMY OF THE BLADE

The skate blade is comprised of three physical dimensions — length, width, and height. In terms of skate sharpening, these dimensions are utilized to define two radii (figure 1) — the radius of contour and the radius of hollow. Specific aspects of each radius have been proposed as governing the performance of the skate blade and defining the blade–ice interaction.

The **radius of contour** (ROC) defines the shape of the length of the blade and is more commonly referred to as the “rocker” or the profile of the blade. By viewing a blade from the side, it can be seen that skate blades are not flat. The shape of the blade determines how much of the blade is in contact with the ice. Typical contours for hockey and figure skating are 7-, 8-, 9-, and 10-foot radii. This means that if several blades, all contoured with a 10-foot radius, were placed toe to heel in a circle, the end result would be a circle with a radius of 10 feet. Furthermore, the longer the radius, the flatter the contour, and, consequently, more of the blade will be in contact with the ice.

Practically, if manoeuvrability and agility are the goals of the sport, discipline, or position, it may be preferable to decrease the amount of blade in contact with the ice or skate on a shorter contour. However, if stability and balance are the goals, a longer contour is preferable. This contrast is seen when comparing the contours of the skates of a person who plays defence to those of a goalie. The skates of goalies tend to have flatter contours. Since long track speed skating does not require quick turns, but rather long strides and speed, more blade contact is beneficial. Long track speed skaters have been known to achieve success skating on 125-foot contours; that is, essentially flat blades. Although short track speed skating requires the athlete to manoeuvre through sharper turns than long track, the goal is still speed; therefore, the contour used by these skaters is significantly flatter than for hockey or figure skaters.

Traditionally, good sharpening was defined as an even and uniform contour; however, the current practice is to shape the blade with multiple contours, which has proven to be very effective. Multiple contours provide the skater with the opportunity to utilize the benefits of skating on both longer and shorter contours by shifting the weight to a specific area of the blade. It is imperative, however, that regardless of the number of contours, the blade be void of “humps and bumps” in the rocker. This is typically caused by the application of uneven pressure to the grinding wheel when sharpening and translates to the skater as a feeling that she or he is skating on an uneven ice surface.

The **radius of hollow** (ROH) is the groove in the width of the blade defining the two edges — the outside edge and the inside edge (figure 1). This groove can be deep or shallow, depending on the desired effect. The deeper the ROH, the higher the edges, which creates more of a “bite angle” between the edge and the ice. With a

greater bite angle, the skater holds the ice better and feels more confident during starts, stops, and turns. However, this also translates into more dig into the ice, and, thus, it takes more energy to accelerate. As a result, speed is often sacrificed.

The ROH is created by the radius of the grinding wheel. A short radius creates a deeper groove or hollow. Conversely, a longer radius will result in a shallower or flatter edge. Skate sharpeners use several systems to define the depth of hollow. For example, in some practices, A is deep, B is moderate, and C is shallow, or in others, 1 is deep, 2 is moderate, and 3 is shallow. Skaters can potentially improve their ability to skate if they learn the requirements for their activity and determine the radius of the cut that best suits them. If a skater specifically asks for sharpening by the radius, there is less chance of disappointment. There is a wide variety of choice in radius cuts, ranging from 5/16” to 1 1/2”. The deeper radius cuts are sometimes referred to as suicide cuts, because of the height of the resulting edges. More shallow cuts result in a flatter blade.

The **levelness of the edges** (figure 1) refers to the height of the inside versus the outside edge. Even edges are deemed desirable and are the result of high-quality sharpening. Often, a young skater’s inability to turn in both directions with the same ease or to use both edges equally is blamed on poor technique or ability, when, in fact, it could be the result of a poor sharpening.

The **pitch** of the skate (figure 1) is determined by the height of the blade and the position of the apex or pivot point. The importance of the pitch lies in its potential for changing the lie of the blade on the ice, thereby directly affecting the balance of the skater. If the height of the blade is higher at the front of the blade than the back, a backwards tilt will be created, giving the skater the feeling of skating uphill. The proper lie allows the skater to be more efficient in

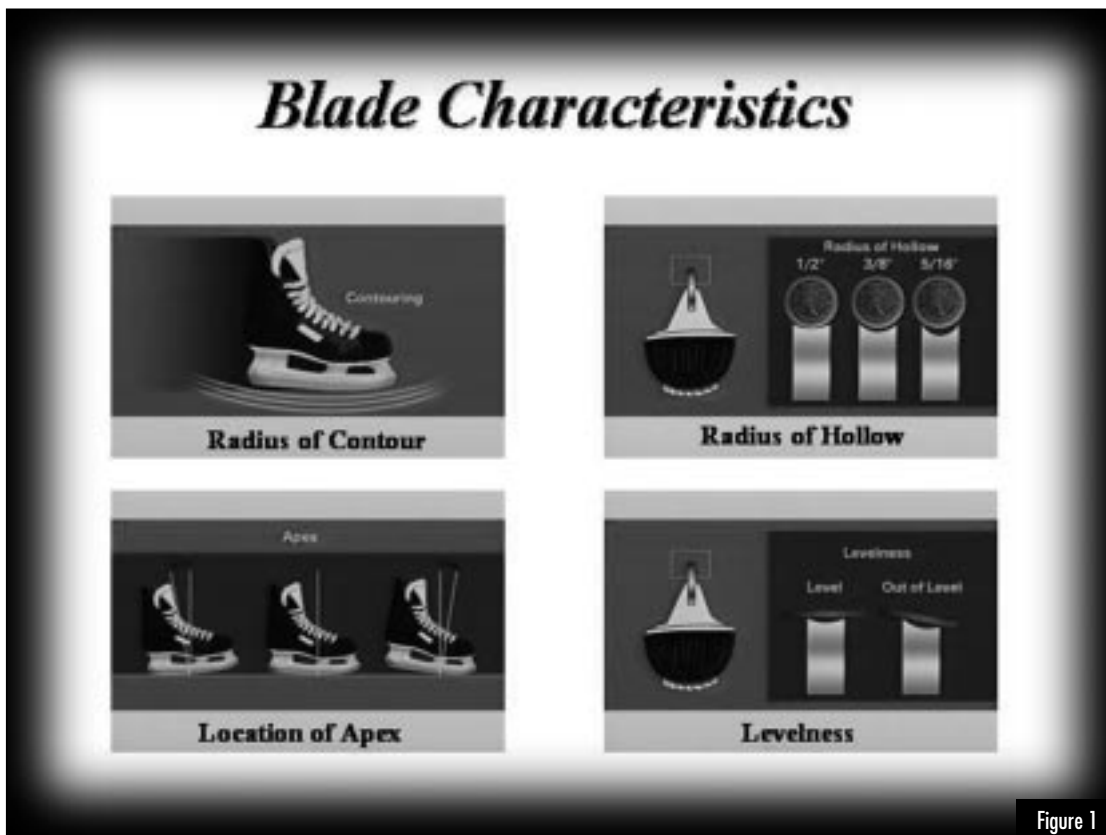


Figure 1



Figure 2

movement and make the transitions between forward and backward skating easily.

### **HOW IS A SKATE SHARPENED?**

Blades are sharpened with a rotating grinding wheel or stone (figure 2). Prior to sharpening, the wheel is “dressed” or shaped, so that the radius of the circular cross-section of the grinding stone is translated to shape the ROH on the blade. The skate boot and blade are secured into a carriage that holds the blade’s surface perpendicular to the grinding wheel. To create the appropriate ROC, or to shape the blade, several protocols are used, ranging from manual templates to computer-driven contouring devices. Regardless of the system employed, the blade is ground to a predetermined shape consisting of one or multiple contours. To create an ROH, the blade is passed along the rotating grinding wheel on the bottom of the blade. It is imperative that the blade be kept perfectly aligned with the grinding wheel so that the edges are ground evenly. The goal of the sharpening is to remove just enough metal from the bottom of the blade to renew the edges. The edge of a well-sharpened blade should feel smooth, void of burrs and rough cuts. Following grinding, a finishing process of polishing the blade assists in removing any metal burrs that can cause a bite. The final product of a good sharpening is a blade with a smooth and satin feel. It is well known that although a sharp blade can cut, a properly sharpened edge free of burrs will not rip the skin.

### **WHAT DO WE KNOW ABOUT SKATE SHARPENING?**

**Sidney Broadbent** has been branded the father or pioneer of skate sharpening. An engineer by trade, Broadbent defined and conceptualized the geometry of the blade and the interaction of the blade with the ice. The operational definitions used today to describe the science of skate sharpening are credited to his efforts. Although empirical evidence supporting the contribution of specific skate sharpening characteristics to performance is limited, in practice, there

is a general consensus that sharpening can significantly affect a skater’s performance. To investigate the hows and whys of this effect, the On Ice Laboratory at Brock University recently carried out a series of studies to quantify the performance effect achieved as a result of altering specific skate sharpening parameters.

The initial study was conducted to address the question of preference and explore “what hockey players are really skating on”. Forty-eight male hockey players vying for a position on the varsity hockey team volunteered to participate in the study. Three geometric blade

measures were obtained from the right skate of each player. The ROH, ROC, and levelness of the blade’s edges were assessed. Measurements were performed in the final week of tryouts to ensure that players involved in the study were serious candidates and valued their equipment as a contributing factor to on-ice performance.

Results indicated that the most popular ROH was between a 5/8” and a 1/2” grind. The ROC ranged from 7–10 feet, with the majority (40%) of the players skating on a 9-foot ROC. Given that the majority of commercially available ice hockey blades are manufactured with a 9-foot radius, this may suggest that (i) contouring is not a routine practice among skate sharpeners, (ii) players are not informed that the contour can be changed, and (iii) a 9-foot radius is conducive to optimal performance for all players. The most significant and somewhat alarming result was that 64% of skate edges assessed were uneven. To the knowledge of the researchers, there is no evidence to suggest that uneven edges are an advantage to performance; rather, this result was assumed to be a result of poor sharpening. In summary, the results of this preliminary study indicated that blade-sharpening profiles were extremely variable, and the rationale provided by the players for the selection of their profiles was that it was predominantly left to chance. Typically, players entrust their skates to a technician without a thorough understanding of the sharpening received or the impact that sharpening can have on performance.

These results highlighted the need to explore more fully the blade–ice interaction, including tailoring the blades of the players and evaluating on-ice performance to assess the contribution of skate sharpening. The second study was undertaken to investigate the effect of ROC on skating performance. Players completed on-ice tests of aerobic endurance while skating on a random selection of different contours. An experienced technician applied the customized contours to the participants’ skate blades. Blade sharpening variables other than ROC were held constant across all players. The players were

## Methods of Checking the Levelness of Edges

- Penny Test
- Commercially available Quick Square™



Figure 3

informed that the sharpening of their blades had been tailored; however, they were not provided with any specific information on the degree of change in the contour applied. Prior to testing, players were given an on-ice familiarization period to adjust to their new skate blade contour. The results of this study revealed significantly different on-ice test scores while skating on different ROCs. Higher aerobic endurance measures were achieved when subjects skated on the contour that was customized by height and weight. Simply put, larger skaters performed better on flatter contours. From this study, it is suggested that there is a relationship between the size of the players and the optimal ROC when performing endurance-like events.

Given what we know about the physical demands of the sport of hockey, the anaerobic or sprint-like activity is as important as the players' ability to skate for extended periods of time. Therefore, a third study was conducted to investigate the effect of ROH on anaerobic performance. Players were asked to perform an on-ice anaerobic test on three selected hollows. Again, the results of this study supported the need to customize blade sharpening specific to both the sport and the player. Heavier skaters were able to maintain higher skating speeds when skating on a shallower ROH. However, a hollow that was too shallow reduced the bite angle between the blade and the ice, thus causing the player to lose grip and, consequently, achieve slower speeds. This trend was also seen in the lighter players; however, the lighter players performed better than the heavier players on the deeper hollows. This is primarily due to less weight loading the blade and biting into the ice. Practically speaking, these results are congruent with what we know about speed skating. Long track speed skaters perform best with virtually flat hollows. However, the technical demands of speed skating do not require the athletes to perform quick turns, stops, and starts. For hockey players to execute

these skills effectively, they require a deeper hollow in comparison to speed skaters. The question is, how deep? This study was able to identify that weight is a practical criterion that can assist skaters in selecting their optimal ROH.

In summary, our data to date have provided empirical evidence to support the claim that skate sharpening can make a difference. Ongoing investigations are currently in progress to further explore the dynamics between skate sharpening variables and on-ice performance. The potential to improve performance via a small change in this critical piece of equipment is an area of research that is of significant practical importance to both recreational and elite level skaters.

### **SKATE SHARPENING TIPS FOR COACHES, ATHLETES, AND PARENTS**

On-ice coaches and athletes must be educated consumers. It is not necessary to be able to sharpen the skates yourself, but you should know how the skate blade performs when sharpened correctly and what is correct for a given skater. Here are some of the most commonly asked questions and answers:

**ARE NEW SKATES READY TO SKATE ON?** Not necessarily. It is always recommended to sharpen new blades before taking them onto the ice. Although they may come with a factory grind, chances are they are not the same grind you may be familiar with.

**DO YOUR SKATES NEED SHARPENING?** This is the most common question asked by parents and coaches; unfortunately, many skaters do not know the answer. Skaters should take note of how their skates feel when sharpened. Once that feeling disappears, it is probably time to sharpen again.

**HOW OFTEN SHOULD I SHARPEN MY SKATES?** This varies from skater to skater, as it is primarily a function of how individuals take care of their skate blades, how often they skate, and how intensively they skate. If the edges become damaged, sharpening is required immediately. Damage to the edges can be caused by walking on gritty surfaces, skating on poor ice conditions or dirty ice, or wearing skate guards that have not been cleaned regularly. Blades will certainly last a lot longer if they are exposed just to the normal wear and tear of the ice surface. Furthermore, the longevity of the sharpening is also a function of the amount of ice time the blades have seen and the intensity of skating. The bottom of a freshly sharpened blade will appear to have uniform sheen. Wear on the blade causes this surface to appear dull; dull blades require a trip to the sharpener.

**DO GUARDS OR SOAKERS HELP PROTECT THE BLADE?** Guards should be used only when the skater is walking on surfaces other than the ice. Guards should not be left on the blades between skates. Blades will start to oxidize and rust if left in a wet environment inside the guard. Rubber mats are installed in arenas with the intent of protecting the skate blades from damage; however, these mats are also walked on by dirty shoes and boots, with the result that sand and grit are often left behind. Therefore, it is recommended that a skater never walk on any surface, except ice, with a bare blade.

**HOW LONG SHOULD BLADES LAST?** The intent of sharpening is to restore the edge quality. If this process is done correctly each time skates are sharpened, approximately 0.001" of metal is removed. New blades typically have more than 0.1" of "sharpenable" depth on the bottom surface of the blade, which means that there is the potential to sharpen the blade 100 times. Mistakes are more costly. The process of correcting a poor sharpening takes off much more metal. Skilled and careful sharpeners can prolong the life of a blade.

**WHAT ARE COMMON SHARPENING FLAWS?** Uneven edges are the most common sharpening flaw. If the centre of the grinding wheel is not aligned with the centre of the blade, one edge will be higher than the other. Skaters will feel that one edge grabs while the other slides. Drastically different levels cause the blade to persist in pulling either to the outside or to the inside edge.

**ARE MY EDGES LEVEL OR SQUARE?** Ideally, the centre of the hollow is halfway between the two sides of the blade. If it is not, one edge will be higher than the other and will have a sharper bite angle. If too far off, the effect will be asymmetrical edge strength (for example, inside edge grabby, outside weak) and flats that want to turn. Check that edges are level after sharpening. A penny test is a common method to assess levelness (figure 3). Place a penny on the bottom of the blade and "eyeball" to see if the penny is flat. A flat penny means that the edges are even; a tilted penny indicates a levelness problem. Commercial devices, such as the Quick Square, can assist in detecting uneven edges.

When you step on the ice, make sure that your skates are ready to perform! ❄️

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