Instructor's Corner

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What is the proper method of sweeping a stone?

—**Pushdi Brum**

There is no other sport that has anything as remotely silly-looking as a couple of sweepers furiously sweeping a stone to the house. Yet, as silly as sweeping looks to the casual viewer of curling, it is perhaps the most important aspect of shot-making. In this article we will explore some of the myths and realities of sweeping, based on recent scientific studies of sweeping effectiveness. Much of this work was carried out at the University of Western Ontario for the benefit of Canadian Olympic curling teams.

What does it matter?

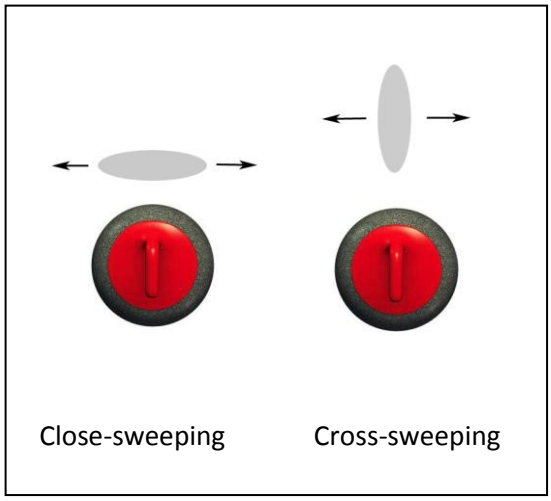
The conventional wisdom is that a pair of strong sweepers, if sweeping from pillar to post on keen ice, can carry a rock 10-15 feet farther than it would have traveled without sweeping. That's as much or more than the width of the house! The effects of sweeping are especially dramatic toward the end of the travel of the stone. Video studies suggest that strong sweepers can carry a stone an additional 6-7 feet over the final 1/3 of travel down the sheet. Even a heavy clean will cause a stone to run an additional 2-3 feet. (That's something to think about!)

The power of sweeping explains why elite men have better shooting percentages than the top women curlers. The men aren't necessarily better shots: their sweepers can more often make up the difference in weight or line. We know from instrumented brooms that men are as much as twice or more as effective as women in transferring energy to the ice during the sweeping motion [J. Bradley, *J. Sports Sci. Med.* **2009**, *8*, 495-500]. This is due to increased broom pressure on the ice (which is influenced by body weight) as well as sweep rate (which is influenced by upper body strength).

Well-thrown curling shots should normally be swept 50-80% of their travel down the ice. This gives a team a great deal of control over both curl and distance, and makes drawing the 4-foot a lot easier for the shooter: tee-line draw weight can settle on the 4-foot if you are up to 2 feet heavy or 9 feet short with a good pair of sweepers!

How does one sweep most effectively?

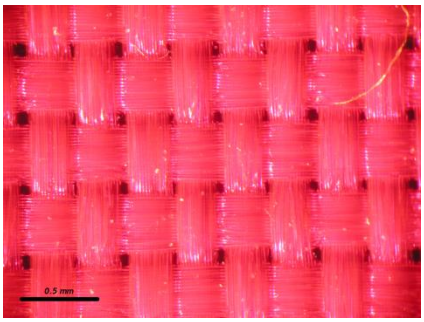
An age-old argument is whether it is important to sweep close to the stone (close-sweeping—see figure) or to sweep across the stone to cover more ice area (cross-sweeping). Here, studies with instrumented brooms are both surprising and definitive. Close sweeping concentrates broom energy over a narrower swath of ice than cross-sweeping, and raises the temperature of the ice significantly more over the area swept. However, as the stone travels down the ice, the broom will trace out a zig-zag path of warmed ice, with the intervening ice untouched. It turns out that although cross-sweeping warms the ice a little less, it heats the ice more evenly in the path of the stone, and



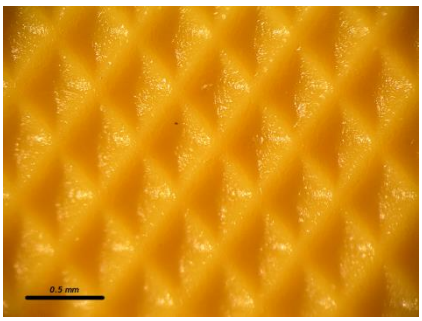
is significantly more effective overall. Sweeping angles of 45-90 degrees across the path of the stone is the most effective motion. Interestingly, these studies find that while it is important to sweep close to the stone, sweeping within 3 feet of the stone is effective. Beyond that distance, the ice warmed by sweeping will cool before the stone passes over it. The effectiveness of a third sweeper is ZERO. So skips and thirds, stay in the house and watch the line.

Equipment

So what about the newfangled, hi-tech broom heads? Do they work? In a word, yes. Two advances have become nearly standard in modern synthetic broom heads. First is the use of extremely waterproof fabric material. Only a few years ago, synthetic broom heads were covered in a fairly coarse coated nylon material such as 1000 denier Cordura Nylon. More recently, manufacturers have moved to less coarse, more highly waterproof materials. The reason for the switch is to avoid the absorption of water by the cloth covering of the broom head. It was discovered that the efficiency of sweeping declined dramatically when broom heads became wet from melted frost. Modern broom head materials are virtually impervious to water. If your broom is sopping wet, you have to warm not only your broom and the ice under it, but the load of water you are carrying as well. One of the unfortunate properties of water is that it has a tremendous heat capacity—that is, it takes a whopping amount of heat energy to change is temperature (one calorie per degree centigrade per gram of water, to be exact.) Heat that goes in to warming the water your broom head is not going into the ice. One of the latest advances in brush materials is fabric that have fused, artificially textured surfaces. These materials are extremely waterproof and significantly more abrasive to ice than woven fiber fabrics. The difference in these materials is significant, as seen in the micrographs below:



200 denier Cordura nylon fabric



Artificially textured brushing surface (Hardline IcePad)

The second advance was to add a reflective material (the "Equalizer" heads use a metal foil) underneath the cloth cover of the broom head. The idea is this reflective material will re-direct some of the frictional heat generated by sweeping back onto the ice. The effectiveness of this innovation is dramatic. Testing with competitive women and senior men showed that the reflective heads were as much as 50-100% more effective in transferring heat energy to the ice than traditional curling broom heads. Elite women curlers benefited less, and elite men did not benefit at all from this technology, presumably because they are much stronger and fit, and could generate maximum heating without the reflective material.

So if you want to increase your sweeping powers, keep your broom heads dry and take advantage of the new reflective heads. (I'll have more to say about the artificially textured brushing heads later in this article).

Can you affect curl by the way you sweep?

I get this question a lot when discussing curling with new curlers or non-curlers. Traditional, cloth-based brush materials cannot change the direction of the stone very much by sweeping it. Mostly all you can do is to change its rate of curl by sweeping. If a stone is walking sideways near the end of its travel, you canʾt make it turn straight down the sheet again by sweeping it; you can only carry it farther and straighter *in the direction it's currently going.* Having said that, there may be some sweeping tricks up your sleeve.

Corner sweeping. While it used to be illegal, corner sweeping is now allowed by the curling rules at all levels. Corner sweeping involves sweeping only partially across the path of the running surface of the stone. Supposedly, corner sweeping on the ‘‘low side’’ (the side toward which the stone is curling) will make stones run a little straighter, and corner sweeping on the ‘‘high side’’ will help stones curl a little more than normal. Iʾm skeptical that this actually works or has a sound theoretical basis: I think there is something else at work (see below).

Switch sweeping. Switch sweeping is based on the corner-sweeping principle, but relies on the idea that a brusher will apply more broom pressure when the broom is closer to oneʾs body than when it is farther away, and that the sweeper closer to the stone has a stronger corner-sweeping effect than the sweeper farther away from the stone. So, theoretically, if the sweeper with the stone is sweeping from the low side, the stone will run straighter; conversely, if the sweeper with the stone is sweeping from the high side, the stone will curl more. You may catch the pro skips on TV yelling ‘‘Switch!’’ as a shot comes down the ice: they are asking the sweepers to change who has the stone to get more or less curl as needed. Ideally, if you are throwing takeouts, you should station your sweeper closest to the stone on the low side to keep it straighter. I think this actually works to some degree, but not for the reasons given here.

What we've learned from artificially textured brush heads

In October 2015 players began to suspect that artificially textured brush heads might have a more significant effect on influencing the path of stones than traditional cloth brushing materials. These concerns became so serious that 20+ top teams in Canada signed a pledge to not use these materials in competition. Some teams using the artificially textured brush materials discovered that a variation of ‘‘switch-sweeping’’ with one sweeper could strongly influence the amount of curl of a thrown shot. By sweeping at a 45 degree angle from the low side, rocks could be held exceptionally straight; sweeping at a 45 degree angle from the high side produced more than the normal amount of curl. Depending on the exact design and effectiveness of the material, the effect can be dramatic. (Balance Plus introduced a brush material for one competition that had a freakishly strong effect on the path of stones. It is not available commercially and has been pulled from competition. It was apparently released to make a point about artificially textured brushing materials.)

What is happening here? How does switch-sweeping really work? It is very likely what is happening is that brushing produces fine scratches in the ice which gently guide stones in the direction of the scratches. It has been shown that scratches that stones leave in the ice when they are thrown cause them to curl (Nyberg *et al*., *Wear* **2013**, *301*, 583). Scratches deposited by brushing can have a similar effect. If brushing produces scratches angling left, the stone goes gently but persistently more left; if the scratches angle to the right, the stones go to the right. The new, artificially-textured brushing materials have made this more obvious than before. It is possible that these new artificially textured brushing materials (Hardline IcePad, Balance Plus EQ+, Olson Glacier) are too effective. There is enough concern as of this writing (November 2015) that equipment regulations may be promulgated by curling associations to define acceptable materials for synthetic brushes.

Final words

So there you have it. You now know more about sweeping than you ever wanted to know. Take advantage of the latest sweeping technology and experiment with sweeping techniques to improve your game. Most of us can use all the help we can get on the ice. But keep your eye on the rules. Things may change…

Good curling! Have a question for Instructor's Corner?
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