

get wise to basic mechanics of snowboarding

TEXT AND IMAGES BY LOWELL HART

If your beginner snowboarding students tell you that their calves hurt when they perform toeside maneuvers, do you encourage them to a) tighten their boots, b) sit down and rest, c) practice on their heel edge for awhile, or d) adopt a “no pain, no gain” attitude and just deal with it?

If you chose any one of these solutions rest assured that each may help a guest with calf fatigue (well, maybe not that last one if you’re savvy about customer service). However, none of these options address the underlying cause. This is where you—and your students—might benefit from having a more thorough understanding of basic mechanics of movement options on a snowboard.

An instructor well versed in mechanics would recognize a comment about tired calves as a cue to see *how* the student tilts the board on its toe edge. If a guest feels calf fatigue on toeside maneuvers, it’s most likely because he or she achieves the tilt by pushing the toes away from the knees. This tiptoe movement (plantar flexion) will tip the board on edge, but it relies heavily on the calf muscles. In essence, it’s like doing multiple sets of calf raises in the weight room—after awhile even the most fit athletes will feel the burn.

The knowledgeable instructor would encourage the student to tilt the board by pushing the knees out over the toes. This alternative movement option uses a larger lever for better mechanical advantage in tilting the board (i.e., the bones of the lower leg as opposed to the shorter bones of the foot), and results in more efficient toeside edging. What might seem like an insignificant tactical change could mean

the difference between a first-time rider who gives up on the sport because it’s “too hard” and one who becomes a life-long snowboarder—primarily because he or she was taught the appropriate *movement option* to create the desired aspect of board performance.

key aspects of board performance

Good riding is based upon a properly aligned, balanced, and relaxed stance. When in this “reference alignment,” the rider’s pelvis and shoulders are perpendicular to the plane of the front foot, the center of mass is aligned over the working edge of the board, weight is equally distributed between the feet, and the upper body is perpendicular to the slope (fig 1). Note, however, that the rider does not remain in this reference alignment all of the time. Rather, it’s a position from which the rider performs the movements needed to influence board performance.

To analyze riding you must break it down into the basic components of board performance. *Each and every* exercise you ask students to perform should be used to develop one or more of the following

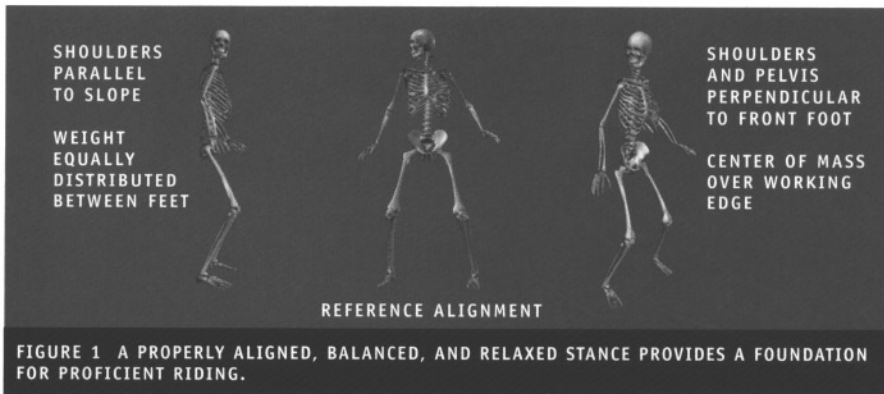


RIDER: MIKE BUTLER; PHOTOGRAPHER: LOWELL HART

PHOTO 1 TO TILT THE BOARD ON EDGE, A RIDER CAN CONTRACT THE CALF MUSCLES AND EXTEND THE TOES AWAY FROM THE KNEES (LEFT). HOWEVER, A BETTER OPTION WHEN TILTING ON EDGE FOR AN EXTENDED DURATION (E.G., DURING A SIDESLIP, GARLAND, OR FALLING LEAF), WOULD BE TO RELAX THE KNEES OUT OVER THE TOES AND USE THE LOWER LEG AS A LONGER AND MORE EFFICIENT LEVER (RIGHT).

performance considerations:

- ▶ Tilting the board: The rider needs to tilt the board onto its toeside and heelside edge, and adjust the amount of tilt.
- ▶ Twisting the board: The rider needs to torsionally twist the board to engage or release the edge at the tip or tail of the board.



- ▶ **Regulating pressure on the board:** The rider must regulate pressure against the board and along the length of the board.
- ▶ **Steering the board:** The rider must accurately control the direction in which the board is pointing.

To influence board performance, snowboarders make two basic types of movements: *flexion/extension* and *rotation*. To help students improve their riding you need to identify which part(s) of the body they should move to appropriately influence board performance and then direct the timing, intensity, and duration of that movement.

It's important to understand that a rider can choose between several *different* movements to create the same aspect of board performance. Each movement option is useful, yet geared to very specific situations.

For example, you can lean your whole body (a movement option) to tilt the board on the toeside edge (an aspect of board performance), or you can push your knees out past your toes (a different movement option) to achieve the same effect. If your students use the first option to perform their first J-turns, they'll probably tip over to the inside of the turn. However, if they opt for the knee movement, they'll keep their center of mass over their base of support and be much more likely to complete the maneuver successfully. Both movements will tilt the board on edge, but in this specific situation the movement of the knees is more appropriate.

As an instructor you should be familiar with each of the movement options that create board performance. (Luckily, the possibilities are limited because the body can only move in certain ways.) In addition, you need to know the specific situation in which each movement is most appropriate. To help students achieve their riding goals quickly, it's important to set up riding tasks that develop the particular movement option that works best for each situation.

To teach students how to use a particular movement option, it's important to practice using only that movement, even though they'll blend the options differently for each situation encountered when they're out riding. For example, to rip a carved turn a rider might initiate edging through a movement of the foot but add leverage by moving the hip into the turn as he or she redirects momentum. In essence, riders must *isolate* movement options to acquire mastery, but they must *blend* those movements when they ride.

Because each aspect of board performance is used for different purposes, riders must also be able to perform the appropriate movement without affecting other aspects of board performance. In other words, flexing and extending movements performed to regulate pressure must work independently of the movements used to tilt the board, etc. Most breakthroughs in riding come about through exploration of the different movement options used to control the snowboard.

tilting the board

Our bodies are comprised of levers (bones), which we use for mechanical advantage when we move. Short levers can be moved quickly (as when flicking on a light switch) but do not generate much leverage. Long

levers can generate more leverage (as when using a long crowbar to move a big rock) but move more slowly because the longer lever arm must travel a greater distance. When you tilt your snowboard on edge you continually choose between different-length levers depending on whether you're seeking quickness or additional leverage (fig. 2).

To tilt the board, you can

- ▶ *use a movement of the ankle* to push the toes away from the knees or pull the toes toward the knees. This uses the bones of the foot, the smallest levers available to tilt the board on edge, and is well-suited to situations in which you must adjust the amount of tilt or create tilt without moving the center of mass laterally (e.g., in slow-speed maneuvers or on ice). It's also useful when riding on catwalks, making small adjustments to the amount of tilt, making lightning-fast edge-angle adjustments, adjusting the shape of carved arcs, and boosting a cross-under move.
- ▶ *use a movement of the knee*, bending it out over the toes (on the toeside) and slightly straightening it to pull the lower leg against the highback of the binding or boot (on the heelside). This uses the lower leg bones (tibia

continued

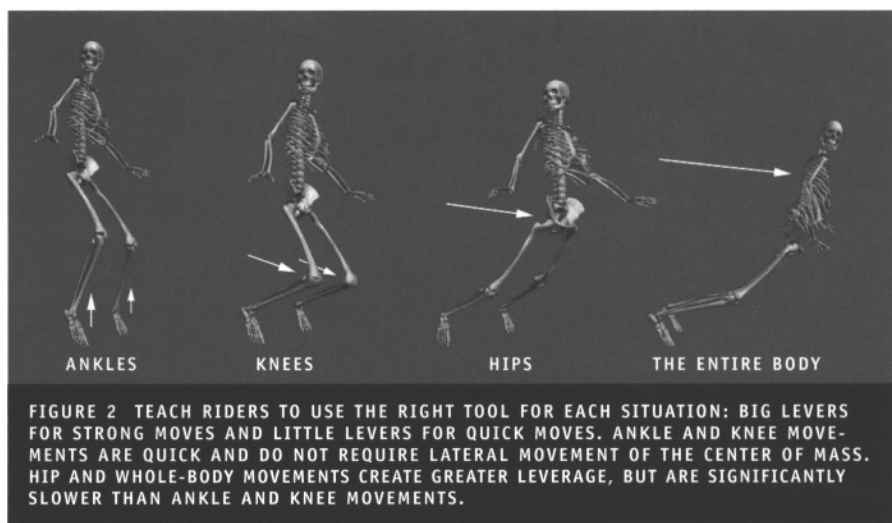


FIGURE 2 TEACH RIDERS TO USE THE RIGHT TOOL FOR EACH SITUATION: BIG LEVERS FOR STRONG MOVES AND LITTLE LEVERS FOR QUICK MOVES. ANKLE AND KNEE MOVEMENTS ARE QUICK AND DO NOT REQUIRE LATERAL MOVEMENT OF THE CENTER OF MASS. HIP AND WHOLE-BODY MOVEMENTS CREATE GREATER LEVERAGE, BUT ARE SIGNIFICANTLY SLOWER THAN ANKLE AND KNEE MOVEMENTS.

continued from page 32

femur, hips, and whole body) generate more leverage. Note that these pressure-distribution movements rely on well-fitting boots and a supportive boot/binding interface for maximum effectiveness.

To manage fore and aft pressure on the board, you can

- ▶ *invert the ankle* (i.e., turn the sole of the foot inward) or *evert the ankle* (i.e., turn the sole of the foot outward). This is a quick but very weak fine-tuning movement.
- ▶ *move the knees toward the tip or tail of the board*. This movement can provide a brief shot of pressure that's useful when performing quick leveraging movements in the bumps, adjusting the shape of carved arcs, and riding on ice.
- ▶ *move the hips toward the tip or tail of the board*. This movement uses longer bones and is good in situations in which you need to apply extra leverage to the tip or tail or to weight a portion of the board for longer duration. It's particularly useful when getting off a chairlift, initiating turns, performing J-turns, doing tip and tail rolls, and pulling off ollies and nollies. Runs in powder, bumps, and slush also benefit from application of this movement.
- ▶ *move the entire body toward the tip or tail*. This movement is useful when performing tip rolls, tip and tail manuals, nose presses, flips, and backflips.
- ▶ *Push up on the front foot while pushing down on the rear foot, or vice versa*. By flexing or extending your legs in opposition to each other, you can quickly exert pressure along the length of the board to absorb bumps, adjust flotation in powder, perform ollies and nollies, and drop into the halfpipe. This movement is also useful when performing the "toy soldier walk" riders sometimes use to move across a flat area.

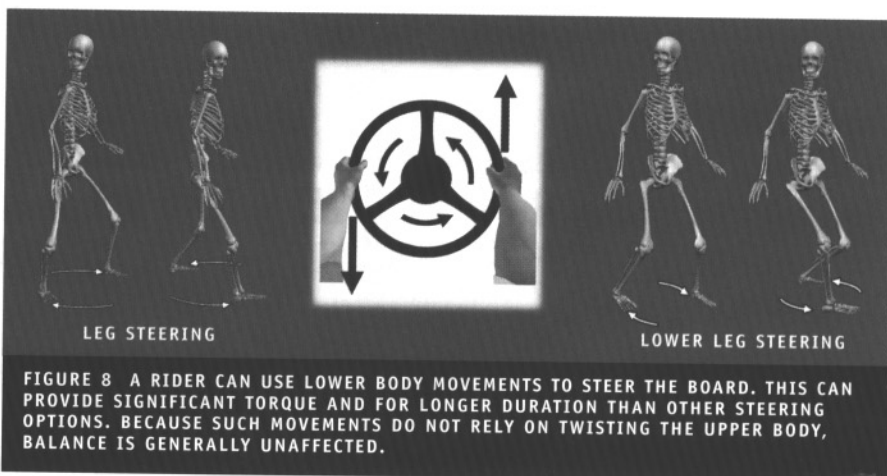


FIGURE 8 A RIDER CAN USE LOWER BODY MOVEMENTS TO STEER THE BOARD. THIS CAN PROVIDE SIGNIFICANT TORQUE AND FOR LONGER DURATION THAN OTHER STEERING OPTIONS. BECAUSE SUCH MOVEMENTS DO NOT RELY ON TWISTING THE UPPER BODY, BALANCE IS GENERALLY UNAFFECTED.

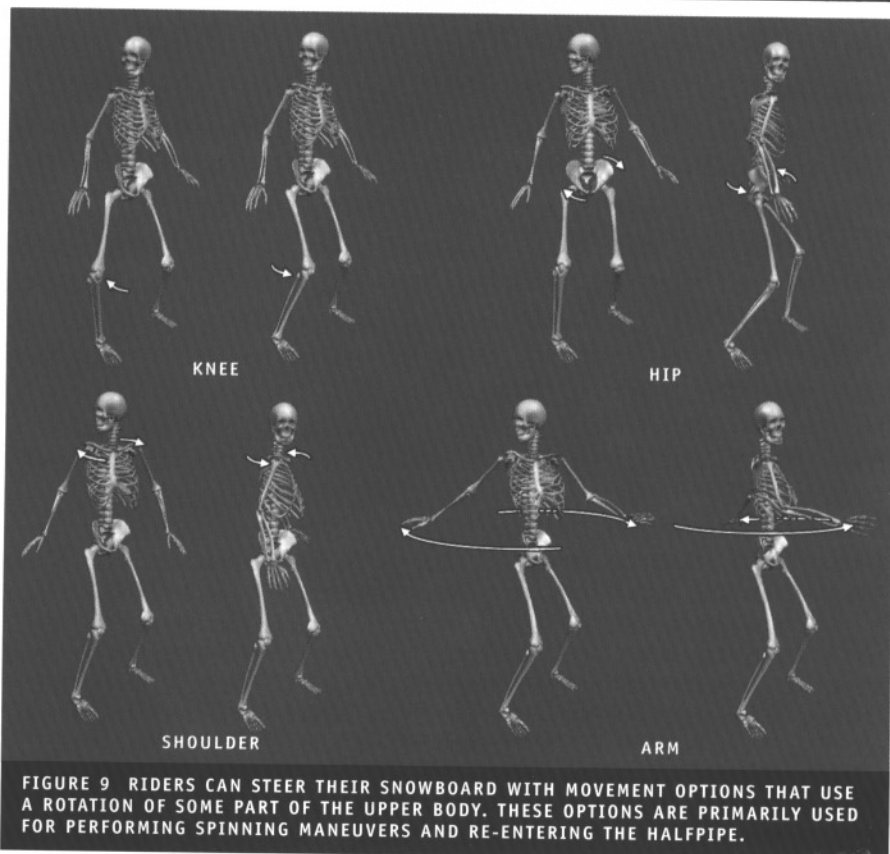


FIGURE 9 RIDERS CAN STEER THEIR SNOWBOARD WITH MOVEMENT OPTIONS THAT USE A ROTATION OF SOME PART OF THE UPPER BODY. THESE OPTIONS ARE PRIMARILY USED FOR PERFORMING SPINNING MANEUVERS AND RE-ENTERING THE HALFPIPE.

steering the board

Steering movements, which control the direction in which the board points, can be divided into three distinct rotary mechanisms: leg steering, upper body rotation, and counter-rotation (figs. 8–10). Each involves different underlying mechanics and, like the other movement options, each is best suited to a specific situation.

As with the movements used to create edging, twisting, and pressure control, steering options that originate close to the board (i.e., moving the feet and legs) are quicker and generally offer greater control.

Riders create these steering movements by contracting muscle groups to turn one segment of the body against the other. It's

continued on page 56

and fibula, or tib/fib) as longer levers to tilt the board, providing more leverage than using a movement of the ankle. It's still a quick movement and, like the ankle movement, can be used to tilt the board without moving the center of mass laterally. When using this movement to tilt heelside, your bindings and boots must support sufficient forward lean (fig. 3). This movement is useful when skating and also when performing J-turns, falling-leaf turns, sideslips, and garlands. It's also helpful on ice, in zipper-line bump runs, and short turns with no deviation from the fall line.

- ▶ *use a movement of the hip/spine* by moving laterally over the toe or heel edge. This relies on an even longer lever (the femur and tib/fib) to achieve tilt, and is useful in situations in which you need to tilt the board against greater forces (e.g., turns at higher speeds). It's also well-suited to making medium- to long-radius turns at high speed, performing high-speed carved turns across the fall line, and riding in powder.

- ▶ *use a movement of the whole body.* Obviously, this is the biggest lever you have (unless you wear a very tall, heavy hat or like to snowboard on stilts). Applying the whole body to a tilting maneuver allows you to carry the forces associated with a high-energy turn through the skeleton rather than through an angulated joint. This movement is useful for giant slalom, super-G, and downhill turns, high-speed carved arcs, long-radius turns at high speed, and riding in powder.

Keep in mind that for any movement that uses levers, you can move either the top or the bottom of the bone to achieve the same result (i.e., to tilt the board you can push your knees out past your toes or

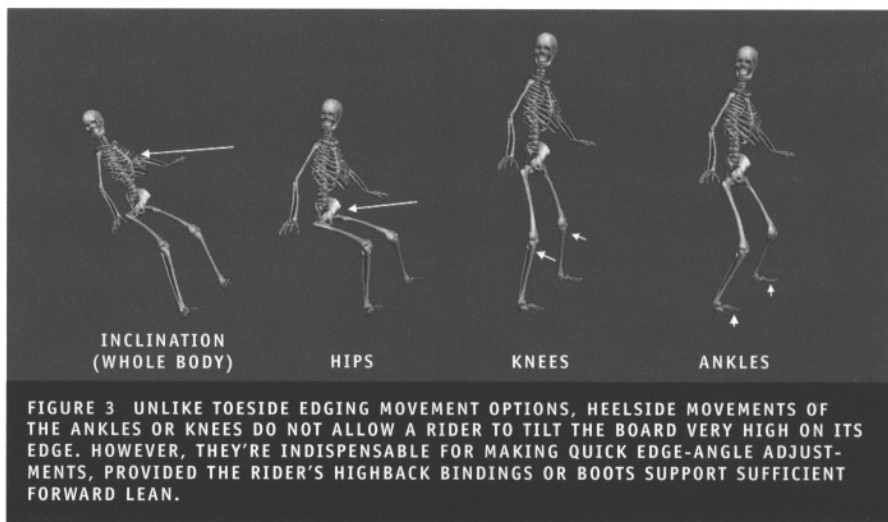


FIGURE 3 UNLIKE TOESIDE EDGING MOVEMENT OPTIONS, HEELSIDE MOVEMENTS OF THE ANKLES OR KNEES DO NOT ALLOW A RIDER TO TILT THE BOARD VERY HIGH ON ITS EDGE. HOWEVER, THEY'RE INDISPENSABLE FOR MAKING QUICK EDGE-ANGLE ADJUSTMENTS, PROVIDED THE RIDER'S HIGHBACK BINDINGS OR BOOTS SUPPORT SUFFICIENT FORWARD LEAN.

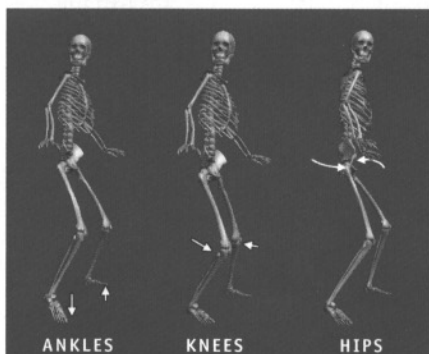


FIGURE 4 TORSIONAL TWIST CAN ENGAGE THE TOE EDGE TOWARD THE TIP OF THE BOARD AND MOVE THE HEEL EDGE TOWARD THE TAIL IN THE OPPOSITE DIRECTION. THE MOVEMENT IS QUICK WHEN ACHIEVED WITH THE ANKLES, BUT THE KNEES PROVIDE MORE LEVERAGE AND CAN HELP MOVE THE BODY INTO A TURN. BECAUSE THE TOP OF THE FEMUR IS ANCHORED TO THE PELVIS (LIMITING THE RANGE OF MOVEMENT OF THE LEVER ARM), ROTATING THE PELVIS TO CREATE TORSIONAL TWIST IS BOTH WEAK AND SLOW.

move your feet and board underneath a stabilized knee). In this case, moving the feet and board is generally quicker—and easier—than moving the mass of the larger body segments.

torsionally twisting the board

Similar to tilting the board, you use different-length levers to impart torsional twist along its length (figs. 4 and 5). This allows you to selectively engage or release the edge along the length of the board to initiate and complete turns.

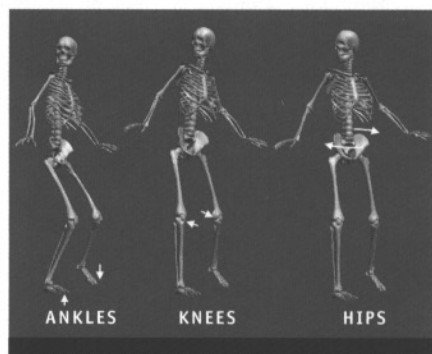


FIGURE 5 TORSIONAL TWIST CAN ENGAGE THE HEEL EDGE TOWARD THE TIP OF THE BOARD AND MOVE THE TOE EDGE TOWARD THE TAIL IN THE OPPOSITE DIRECTION. AGAIN, THE MOVEMENT THROUGH THE ANKLES IS QUICK, BUT KNEES PROVIDE MORE LEVERAGE TO MOVE THE BODY INTO A TURN. TORSIONAL TWIST THROUGH THE HIP IS WEAK AND SLOW.

To twist the board, you can

- ▶ *use a movement of the ankles* to push the toes on the front foot away from the knees and pull the toes on the rear foot toward the knees. This movement uses the bones of the foot as small levers that twist the board along its long axis. It's useful when riding on catwalks and flat areas, and for making quick, fine-tuning adjustments to edge angle.

- ▶ *use a movement of the knees* to push out and away from the toes. This movement uses the tib/fibs as longer board-twisting levers. It's useful

continued on page 32

continued from page 30

when performing traverses; garlands; falling-leaf turns; first turns; linked, skidded turns; carved turns; and turns in the bumps.

- use a twisting movement of the pelvis to move the top of the front and rear femurs in opposite directions: toward and away from the toes and heels, respectively. Although this uses a longer lever (the tib/fib and femur), the amount of tilt and force is limited by the femur being anchored to the pelvis. (You can move the top of the lever arm approximately half the width of your pelvis.) This movement is both weak and slow, but it's nevertheless useful when performing on-the-snow 180s, on-the-snow 360s, tip rolls, and tail rolls.

managing pressure on or against the board

You can flex and extend your legs to manage pressure against the board and either accelerate the mass of the body toward or away from the base of support (i.e., the snowboard) or accelerate the base of support toward or away from the center of mass (fig. 6). Generally, moving the base of support is quicker than moving the mass of the body.

To manage pressure on or against the board, you can

- flex the legs to lower the center of mass or extend the legs to raise the center of mass, relative to the base of support. These movement options are useful when performing basic turns or linked, skidded turns; launching and landing "big air" maneuvers; and performing gap jumps in the bumps or jump turns in the steeps. You will also use flexion and extension for ollies and jump 180s.
- flex the legs to raise the board or extend the legs to lower the board, relative to the center of mass. This is a quick movement option that's useful when getting off the chairlift, absorbing

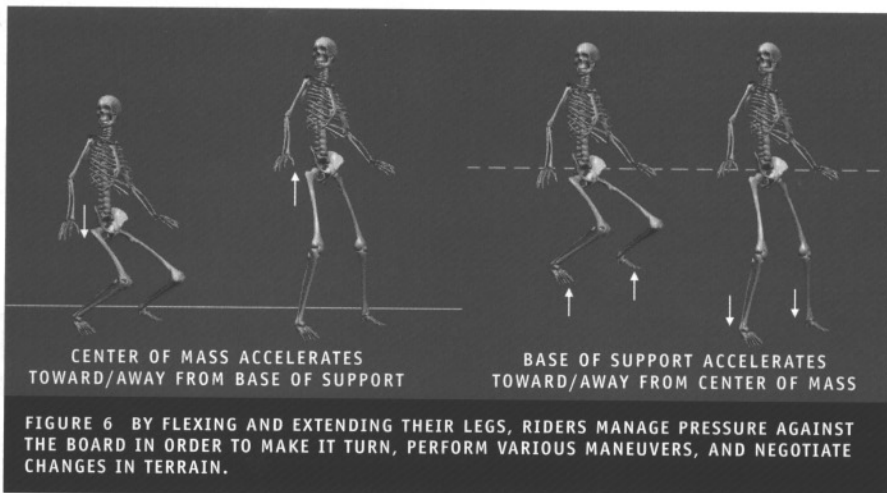


FIGURE 6 BY FLEXING AND EXTENDING THEIR LEGS, RIDERS MANAGE PRESSURE AGAINST THE BOARD IN ORDER TO MAKE IT TURN, PERFORM VARIOUS MANEUVERS, AND NEGOTIATE CHANGES IN TERRAIN.

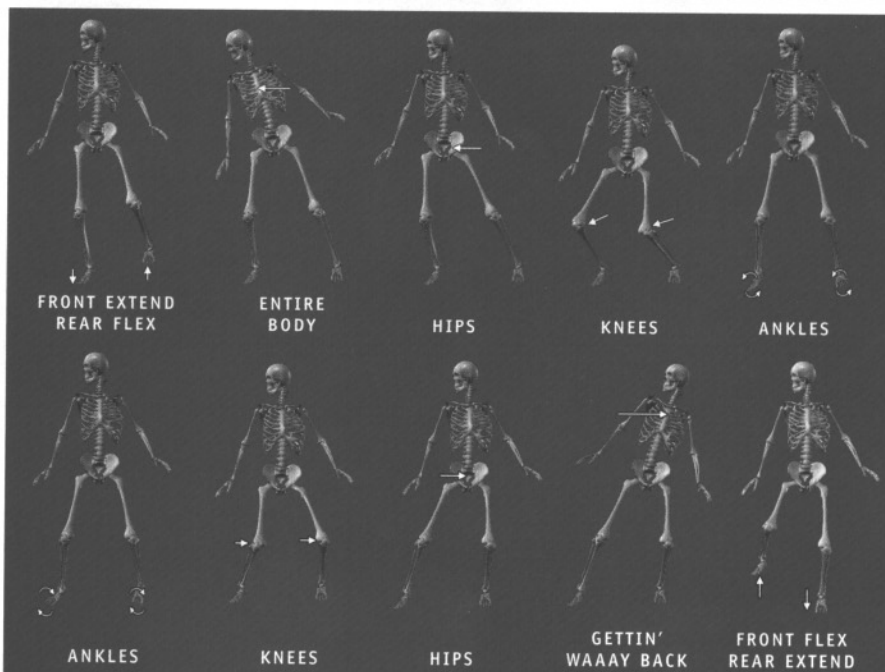


FIGURE 7 RIDERS HAVE AT THEIR DISPOSAL A VARIETY OF MOVEMENT OPTIONS THAT INCREASE PRESSURE UPON THE TIP OR TAIL OF THE SNOWBOARD. THE ANKLES AND KNEES ALLOW QUICK MOVEMENTS USEFUL FOR FINE-TUNING PRESSURE DISTRIBUTION, AND THE HIPS AND WHOLE BODY PROVIDE MORE LEVERAGE BUT SLOWER MOVEMENTS. KEEP IN MIND THAT, IN ADDITION TO MOVING THE BODY, THE RIDER CAN ALSO SLIDE THE BASE OF SUPPORT UNDER THE BODY TO ACHIEVE THE SAME EFFECT MORE QUICKLY AND EFFICIENTLY.

bumps, pre-jumping knolls, and performing railslides. It comes into play in racing and ice riding and also during dynamic carved turns, retraction turns in the steeps, and moves used to "porpoise" the board in powder.

managing fore/aft pressure

Again, you use levers in your body to

distribute fore and aft pressure along the length of the board (fig. 7). This allows you to balance through changes in the speed of your board, adjust the flotation of the board in deep snow, and pressure the tip or tail to influence turn shape. Little levers (the ankles and knees) produce quick movements; big ones (the

continued on page 34

continued from page 34

impossible to rotate the whole body as a unit (unless it's acted upon by an *outside* force—such as wind, a tree, another rider—or through resistance created by engaging the sidecut or using torsional twist to turn the board).

To control direction, you can

- *use leg steering, also called “foot steering,”* to move the feet and legs under a stable upper body. This option provides quick, accurate steering with a large range of motion and can involve the whole leg (i.e., you move the femur in the ball and socket joint where it joins the pelvis) or just the lower leg (i.e., you move the tib/fib under a stabilized knee).

The latter movement is quicker and stronger. Movement of the feet and legs provide the quickest, most accurate way to steer a snowboard in the largest variety of situations. Leg steering is useful when performing traverses; garlands; falling-leaf turns; first turns; linked, skidded turns; carved turns, and switch turns. It's also helpful in the bumps and when performing pivot slips, “late” 180s, and reverts.

- *use upper body rotation* to turn in the desired direction, transmitting stored energy to change the board's direction. This is a “one-two” movement in which the movement of the upper body must slow or stop before energy can be effectively transmitted to the board. The farther the initial rotation is from the board, the longer it takes to transmit the required energy. Whether this rotation starts with the knees, hips, or shoulders, for most turns it is slower and less accurate than leg steering. It also creates less turn-aiding torque and for shorter duration. It's very useful, however, when doing on-snow and aerial spins, re-entering the halfpipe, and performing

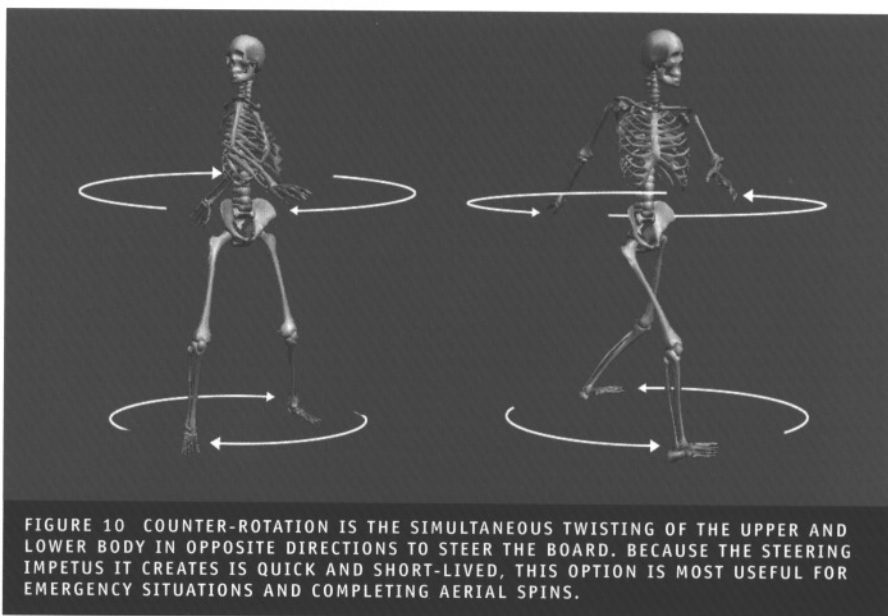


FIGURE 10 COUNTER-ROTATION IS THE SIMULTANEOUS TWISTING OF THE UPPER AND LOWER BODY IN OPPOSITE DIRECTIONS TO STEER THE BOARD. BECAUSE THE STEERING IMPETUS IT CREATES IS QUICK AND SHORT-LIVED, THIS OPTION IS MOST USEFUL FOR EMERGENCY SITUATIONS AND COMPLETING AERIAL SPINS.


long turns in deep, heavy snow.

- *use counter-rotation,* which calls for a simultaneous twisting of the upper and lower body in opposite directions. When the board is unweighted, twisting the upper body one way makes the feet and board pivot the other way, thanks to Newton's Third Law of Motion, which states that “for every action there is an equal and opposite reaction.” Because this steering movement is so brief, this option is not well-suited for steering through a round arc. It's mostly used for emergency stops or turns and to complete aerial spins such as “shifty” and mid-air “late” 180s.

conclusion

Knowledge of mechanics won't be the sole factor in creating effective lessons—you still need to apply sound learning concepts and have strong interpersonal and guest service skills—but it is a critical component of good teaching. Solid technical understanding of how different movement options affect board performance makes for better lesson planning, riding assessment, and feedback, which will make you a more effective teacher.

Keep in mind, however, that it's still important to teach to *outcomes*. Students don't take lessons to just learn movements. They want to learn to *ride*...to make their first turns and eventually head for the powder, ice, bumps, and steeps. Your knowledge of these movement options—and the steps you take to help students *apply* them—will help your students quickly achieve the riding outcomes they desire.

Of course it's best to not burden your students with all of these elements of board performance at once. Provide them with only the option that will enable them to reach their desired riding outcome (e.g., using a movement of the knees and ankles to tilt the board to ride icy halfpipe walls). Leave the other ones for future lessons because, undoubtedly, your satisfied students will be back! 

A former member of the AASI Snowboard Team and author of The Snowboard Book, Lowell Hart is co-author of Vail Resorts' Snowboard Handbook, which is the primary resource for this article. He currently serves as a snowboard trainer/examiner in AASI's Rocky Mountain Division and is the snowboard training and development manager at Colorado's Keystone Resort.