Evaluating The Dynamic Movements Of The Snowboarding Turn

- Recruitment:
- Age: 27 Years Old
- Weight: 5’ 10’’
- Height: 210 lb.
- Previous Injuries: No major previous injuries

Filming Method: Recorded one turn action with two galaxy s8’s from the top and side view. I filmed with my phone as the top view while my brother filmed the side view with his phone as the rider rode down a slippery grassy hill (did not have immediate access to snow at time of recording).

Chosen Because: The subject is a long-term, experienced, casual snowboarder. Very comfortable snowboarding and has been doing it recreationally for 13 years. Also, has experience teaching others how to snowboard, including how to do turns.

Description:

There is something truly captivating about watching an experienced snowboarder careen down a mountain side leaving a curving-edged path from their board’s wake. The amount of control in one board with edging, pressure and steering, is crucial for success in carving down a mountain. With each turn, the rider must utilize their boards heel side edge or toes side edge to alternately switch all the way down the snowy surface. While traveling down a mountain, there are three different types of turns a rider can accomplish, each distinguished by the different degrees of the board’s edging: There are skidded turns, with board at low angle and mainly used in beginners or advanced rider’s slowing down, edged turns, higher degree of tilt and are used by intermediates and advanced riders trying to create more edge grip in loose snow, and carved turns, the highest degree of tilt so the rider is on the edge of the board, meant to keep and gain speed. As shown in the image directly below, Fig. 0.1, the degree of edge is directly tied to how much of your board is on the snow. This also correlates to the rider’s speed, as more board contact slows the rider down.

Originally, this paper was to focus on carve turns specifically, but the example video was done over grass, so the board edge was not able to grip grass like it would with snow. So, in the references instance, the turns ended up being closer to edged turns. Regardless of these three different categorizations of snowboarding turns, they are all usually approached in the same general manner. All the specifics of every turn will be different depending on speed, terrain, and various other individualistic factors, but all riders will need to follow the same guidelines to prep for any of these three types of turns. Before attempting, however, the rider must find their overall neutral snowboarding position. This position involves the ankles, knees, and hip joints to be relaxed and slightly flexed, feet should be shoulder width apart, hands turned medially to your body, and head facing forward. This described position is used to start turns from a rest. However, when an individual is engaging in consecutive turns, the neutral position can differ to

have deeper flexion in the three major joints being analyzed [Coxal Joint, Tibiofemoral (TF) joint, & Talocrurual (TC) joint] due to increased speeds, individual preference, or change in terrain. The next sections will go over the specifics of the actual turn and its three phases: initiation, control, and completion & preparation.

Phase 1: The Initiation Phase

This first phase is known as the initiation because this is the true beginning of any snowboarding turn when the rider physically starts to commit to the turning action. There are two main ways to start this initiation phase: When the rider releases off the boards edge while finishing a previous turn or when the rider is starting from rest and take initiative by turning the board downhill and shifting their weight to turn. In both instances, gravity will pull the ready rider forward into the downward slope prepping the rider for a snowboard turn.

In Fig. 1.1, we can see the rider in their neutral position, as described in the section above, just starting to let gravity guide him down the hill. In this neutral position both legs, through the sagittal plane, are experiencing partial hip flexion at the Coxal joint, partial flexion at the TF joint, and partial plantar flexion at the TC joint. With his weight evenly distributed, the rider is becoming oriented with his balance and center of mass (COM) before gravity speeds him up and he attempts to turn. The agonist achieving this slight degree of flexion through the hip during this isometric stance would be the Iliopsoas (Psoas Major & Iliarus). The antagonist would be the Gluteus Maximus and since the flexion in this stance is more minor, no other muscle would be a synergist. The agonist for the TF knee joint would be the Hamstring muscle group (Biceps Femoris, Semimembranosus, and Semitendinosus) while the antagonist would be the Quad muscle group (Vastus Lateralis, Vastus Medialis, Vastus Intermedius and Rectus Femoris). Depending on the rider, the flexion at the knee may be deeper than shown, which does warrant the inclusion of more major synergists like Popliteus, Gracilis, and Sartorius. Lastly, the agonist in charge of the plantar flexion of the TC ankle joint would be the Gastrocnemius and Soleus with their main antagonist being the Tibialis Anterior. Some ankle muscle stabilizers that might help during this isometric contraction, if the plantar flexion is extreme enough, include Plantaris, Flexor Hallucis Longus, and Flexor Digitorum Longus.

Now that the rider is balanced in this neutral snowboarding position, picking up speed, in Fig. 1.1, the rider must now fully transition into phase one and initiate a turn. The upper body does a very noticeable transversal rotation in anticipation for the turn, but there are more subtle movements happening in the legs to analyze that actually cause the turn. The leading leg, the rider’s right, is getting an increase flexion at the TF joint as the rider shifts their entire COM over that leading foot to release pressure from their back leg. The back leg continues to match the front legs increase degree of flexion at the TF knee for balance and also continues to have weight lifted off in preparation to extend for the edge change part of the turn in phase two. The Coxal joint will try to remain isometric as the riders’ main control over their COM, and the TC joint will bounce between slight concentric or eccentric contractions due to the terrain and overall texture of snow. The hamstring muscle group would include the largest muscle change, as the leading legs hamstring muscle group is concentrically contracting with the extra weight while the back leg is eccentric contraction with the lost weight.

Phase 2: The Control Phase

This phase refers to the body of the turn where the snowboard is guided into and through the turn's major curve motion. It is known as the control phase because the rider must use pressure, edging, and steering to direct and control their board to engage in an edge change. This edge change, from heel to toe edge or from toe to heel edge, is what causes the board to face it in a new direction and should always happens at the start of the control phase.

During the control phase, the crucial edge change can be viewed in both Fig 2.1 from side view and Fig. 2.2 from the posterior view. A couple things happen at once to create this turn. To start with, the riders leading leg first had the TC joint press further into plantar flexion to pressure the board onto the board's toe side edge and start an angle for the carving motion to follow. This flexion would be in effect from the Gastrocnemius and Soleus agonist muscles being further concentrically contracting in the sagittal plane (leaving the Tibialis Anterior to be the antagonist muscle). Above that, at the TF joint, the knee tries to stay level for stability, with attempts to stay in an isometric contraction, but, due to terrain and other factors, it is undoubtedly going to do some slight concentric and eccentric contractions to compensate for the uneasy riding terrain. The Coxal joint is also a point of stability and balance during an edge change with an isometric contraction. Since the TF joint is compensating for the uneven terrain, the Coxal joint only needs to keep the rider balanced and adjust the COM as needed during this turn. These movements and moments of stability are mainly achieved through the Quad and Hamstring muscle groups.

While this is all happening to the rider's front leading leg, the riders back leg is eccentrically contracting through the sagittal plane at the TF joint to extend posteriorly. The agonist muscles involved in this action would be made up of the Quad muscle group and the antagonist muscle group would be the Hamstring muscle group. Along with the TF joint extension, the rider also applies an increase in pressure through concentric contraction with his back foot through plantar flexion at the TC joint to get the board on its edge. The Gastrocnemius and Soleus muscles are still the acting agonist muscles while the Tibialis Anterior is the antagonist muscle. On a brief side note, if the rider is attempting a heel edge turn instead of a toes edge turn like the one being referend in this analysis, the main difference within the muscles would be the swapping of the agonist and antagonist muscle groups at the TC joint. Together, the TF and TC joints, along with surrounding muscles, cause the board to swing into an angled slope downward with the rider's weight placed on the toe side edge of the board. While the TF and TC joints are doing the moments of the action, the Coxal joint is there for stability and can experiences a slight decrease in the degree of flexion during this time.

Phase 3: The Completion & Preparation Phase

This is the last phase where the rider is controlling the final moments of the current turn while also foreshadowing for the following carve. This phase focuses heavily on steering while maintaining the progressive edging and pressure from the control phase. The rider must also be trying to control the board enough to go back through their neutral position, or something close to that, to initiate the next turn.

During this final phase, the rider is controlling the outcome of the edge turn motion and preparing for the following turn as seen in both Fig. 3.1 and Fig. 3.2. The TC joint is responsible for increase concentric contraction as the rider flexes their ankle harder to dig their toes and toe edge of the board into the mountain side. The more extreme the plantar flexion, the higher

probability of doing a true carved turn and, ultimately, more control and speed is achieved. Since the plantar flexion in the sagittal plane is so extreme at this point, weaker and synergist muscles, such as the Plantaris, Tibialis Posterior, Flexor Digitorum Longus, Flexor Hallucis Longus, Peroneus Brevis, and/or Peroneus Longus, might become involved to help the agonist Gastrocnemius and Soleus and antagonist Tibialis Anterior. While the TC joint activates in plantar flexion, TF knee joint is increasing the flexion in the sagittal plane to bring the riders COM lower and make the rider more controlled. The front knee flexes slightly more, but it is truly in the back leg where the majority of this new flexion from the TF knee joint is coming from, as seen most evidently from the deep bend in the knee in Fig 3.2. This deep flexion helps control the turn's trajectory and preps the rider for the next turn by starting them off with a lower COM and giving that back-leg room to extend for the next turn. The agonist for the knee would be the Hamstring muscle group while the antagonist would be the Quad muscle group. Since this turn is taken deeper than the original start position, it is safe to assume there would be more synergist muscles involved during this stage. These include the Popliteus, Rectus Femoris, Gracilis, and Sartorius. Even though this is where the deepest flexion of the knee occurs in the three phases, the rider must also be preparing for the next turn and be ready to eccentrically contracts the TF joint and come back out of that deep flexion. Since, in the next turn, the back leg needs to have no weight on it to preform another turn. It is all about striking a healthy balance between concentrically and eccentrically contracting the TF joint during the edge change of a turn. Lastly, the Coxal joint does slight flexion, seen in Fig. 3.2, as the COM pull has the rider leaning forward over the balls of their feet. Not a large flexion, so probably using only the Sartorius and Ilioposas.

Conclusion

When it comes to doing turns in snowboarding, everyone does it a little different every time they do it. There are basic motions to replicate and follow through, but the degree of each edge, the pressure on the board, steering and many other factors are always causing individualistic differences depending on the terrain, weather, riders comfort levels, rider's speed, etc. However, the path towards mastering the snowboarding turn relies on the joints and muscles described in the three phases of initiation, control, and completion & preparation. Once the biomechanics of the turn are understood, a rider can take a much more objective approach to mastering this snowboarding technique essential and train their muscle in preparation for carving down a mountain side. In no time at all, a hardworking rider will soon be able to leave a curving-edged path from their board's wake down a steep mountain. All it takes is some practice, time, and understanding over one's muscles and joints.

Work Cited:

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