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SKIER'S FITNESS TRAINING GUIDE

Train Your Way to Better Skiing

A CoreSkiing.com White Paper

"We don't rise to the level of our expectations, we fall to the level of our training."

-Archilochus

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INTRODUCTION

Chapter 1

I love to ski. Probably more than anything else in my life. I also love weight training, which is how CoreSkiing originated. By pursuing the two things I love, I discovered a training routine that is so effective but counterintuitive that I decided to write it down, package it up and share with anyone who wants to improve their skiing.

With over 40-yrs of strength training experience, and more recently, years of trial-and-error in developing an effective off-slope training program, I discovered a relatively simple, but highly effective exercise routine that completely transformed the way I ski.

White Paper Prepared by
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What I've discovered after years of effort is that off-slope ski training doesn't have to be difficult or time consuming to yield significant improvement in your skiing ability. What is important is to be deliberate and choose the right exercises. Through functional training methods, i.e. - those that replicate the movements experience while skiing, you can pre-condition your muscles and nervous system. The results are improved balance, coordination, strength and reaction times, all of which have a direct impact on your skiing level and confidence.

My own efforts to improve my skiing ability and endurance didn't start in a book but actually started in the gym. I wanted to develop a go-to routine that I could use in the gym that would transfer to the slopes. Since I was working and living in Houston I was unable to ski as much as I would have liked so there was always a transition period the first few days of most ski trips. So while the mind was willing the thighs or energy levels often gave way hours earlier than what I had hoped for.

Throughout my life I have always had some connection to weight training. Early on it was through competitive Power Lifting and later just as a way to try to stave off the fat in an attempt to maintain some dignity as my body aged. So my initial response was to get into the gym and start hitting the weights – particularly focusing on the legs.

It took years of trial-and-error to get it right but what I discovered was that all the training methods and exercises I had focused on so much in the past were not the exercises that were yielding the greatest returns on the slopes. Yes, training that included heavy squats and deadlifts did help to a degree and allowed me to power through the times when in the past I may have fallen but what really improved my agility and response time on the slopes were the exercises involving instability and the core.

This white paper highlights the importance of core training for skiers and moreover - why training for skiers is really different than most other sports. What I experienced by emphasizing the principles and exercises outlined in CoreSkiing.com was:

- ✔ Improved overall sense of balance and endurance
- ✔ Less fatigue and muscle burn - far less lactic acid build-up
- ✔ Improved coordination and reaction times through muscle & neural patterning
- ✔ Increased overall sense of confidence on the slopes

WHY CORESKIING?

Chapter 2

My initial efforts at developing an off-slope training routine centered around the traditional strength training exercises. For example, leg-curls, leg-presses, squats, power-cleans, lunges etc. Many of the strength training exercises that are now a part of the CrossFit movement, but have their origin in early strength training programs. After several years of trian-and-error, I started to notice that the exercises where I was noticing the most significant benefits of off-slope training to on-slope performance were not the traditional strength training exercises, but rather those were I was

involving compound movements and incorporating imbalance and instability training into the routines.

Seeing these benefits I grew curious and wanted to know more so I started to dig into the research studies on skier performance and training. This effort led me to a pivotal study by Hintermeister et. Al., where the researchers monitored electromyographic (EMG) activity of both US and British Slalom and Giant Slalom team members. EMG is a method where on-skin sensors are used to essentially monitor the electrical impulses within the muscles to determine activity levels. What was novel at the time was their conclusion that alpine skiing requires relatively slow eccentric and concentric muscle movements as compared with more traditional sports. (Berg, Hintermeister).

- Concentric Contractions - where the muscle shortens as tension is increased - pushing, pulling etc.
- Eccentric Contractions - where the muscle lengthens as tension increases. More like a spring or shock absorber.
- Isometric Contractions - where the muscle is held in static tension rather than shortening or lengthening.

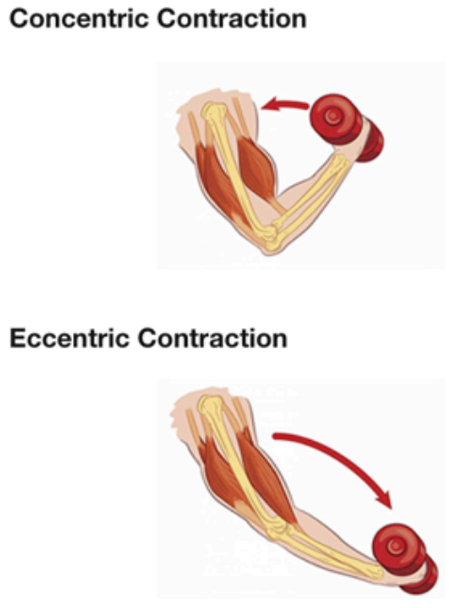


Figure 1

Initially these results seemed contradictory to me. My initial impression of top level skiers such as, Bode Miller, Lindsey Vonn or Ted Ligety moving at top speed, from all appearances looked pretty “explosive” to me. But in reality, studies show there to be relatively slow muscle movement and not actually explosive muscle action but more the “catching” response of the eccentric muscle movements and static or “isometric” muscle action.

An example of day-to-day eccentric muscle movement would be walking down steps or landing after a jump. This totally make sense when you think about the fact that a skier is essentially always working against gravity – either slowing momentum, fighting g-force while turning, landing a jump etc.

Moreover, the studies show the level of eccentric muscle contractions to be twice (2x) as great as concentric muscle contractions. This is opposite of most sporting activities, where concentric muscle contractions tend to dominate.

Not to say that ski pros don’t need to train for maximum concentric muscle strength, they do. It takes a significant amount of peak muscle strength to withstand the g-forces experienced by these athletes in say a GS-turn for example. But most of us will never reach these peak levels.

Looking in hind sight it started to make sense as to why I was seeing the benefits. My program had over time evolved from training for explosive power through high speed – high force exercises, and rather started to build around the low speed - negative force exercises.

➡ An additional benefit - *By focusing on the low speed exercises there is adaptive benefit of developing movement specific strength and balance and lowers the risk of training related injuries.*

I also began to better appreciate the benefits to skiing of developing a strong core through exercises that focus on developing the "kinetic-chain".

It seems these days the "Core" is everywhere in fitness. A Google search using the search terms "core fitness" returned over 13 million results while "core strength" came up with over 12 million results. You may be wondering then, with so much information readily available do we really need more information on Core training? For skiers - the simple answer is yes. As you will see in the next chapter, the core is central to almost every aspect of skiing.

Once referred to as the "powerhouse" by Joseph Pilate, founder of the Pilates movement (Akuthota), the Core generally refers to nerves and muscles that support the lumbar-pelvis-hip complex(Gamble), Fig. 2, in order to stabilize the spine, pelvis and the "kinetic chain" during functional movements.

The kinetic chain is the notion that the muscles, nerves and joints of the body act as individual links within a chain, and these links act together to induce movement, such as throwing a ball. The limbs, joints and nerves - these links - function together in a complex chain to allow movement.

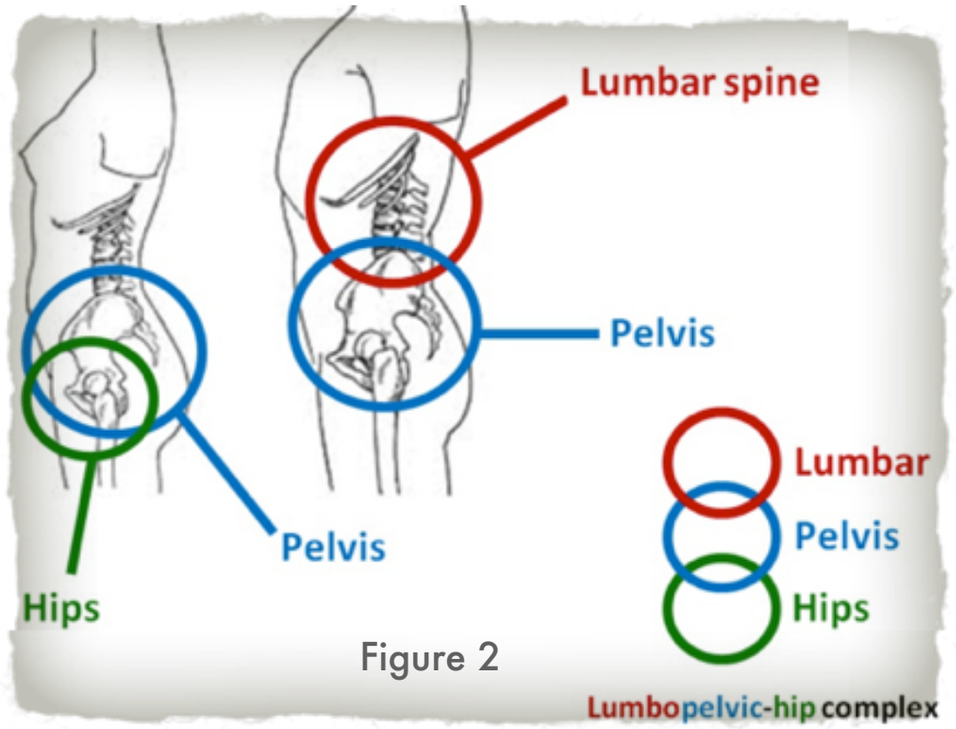


Figure 2

For a skier, the kinetic chain extends from the feet, legs, hip, torso, shoulder, arms and hands – with the Core being central link to all movement. Core musculature plays a role in the transfer of torques and momentum throughout the kinetic chain and thus highly correlated with optimal performance across sports. As the center of this kinetic chain, the Core then provides the foundation or engine for all limb movement (Akuthota).

During the act of skiing, the body's core is constantly engaged - constantly shifting center of gravity momentum from left-to-right and up-and-down, which is initiated though the arms, shoulders and hips. The limbs are working to absorb gravity-induced forces and transition the body throughout the turns. All these forces are joined and radiate through the core, the center of the kinetic chain for skiers.

One thing that is interesting about the muscles of the core, what makes them unique, is that they can function in what is referred to as Co-contraction – where the muscles work together – contracting both eccentrically and concentrically - to form a rigid torso.

This function of Co-contraction allows the utilization of core musculature for more efficient transfer of lateral and axial forces through and across the body to maintain a balanced center of gravity. "Further, studies suggest a strong core allows strength to radiate out peripherally to the more distant regions of the body."(McGill) One possible ski related example of strength radiating outward would be a skier working to maintain balance over the center of the skies while exerting pressure through the lower leg and ankle to control edge contact on the downhill ski when performing a high speed turn.

A strong core may also lower the chance of injury. "The well trained core is essential for optimal performance and injury prevention." (McGill) Poor core stability, which is typically defined as muscle weakness in a specific group of core muscles (e.g. hip abduction), is predictive of a number of injuries, such as anterior cruciate ligament injury, anterior knee pain, hip pain (iliotibial band syndrome), low back pain, and improper landing kinematics.

The consensus of the sports research is that its important to not isolate just on the muscles of the core but it was "important to consider the demands at all joints and muscles in the "kinetic chain", including those distal and proximal to the core. It's unlikely that a single joint or muscle acting in isolation will contribute to performance decrements or injury risk."

- **Skiing involves a high degree of ECCENTRIC muscle contractions and this makes it unique from most other sports. As a result, those many hours focused on training for "explosive" movements severely limited the benefits of training for skiers.**
- **There is a strong inter-relationship between external limbs and core and to be truly effective, any core related training must be mimic the activity at hand and must incorporate loading the external limbs as part of the exercise movements.**

SKI BIOMECHANICS 101

Chapter 3

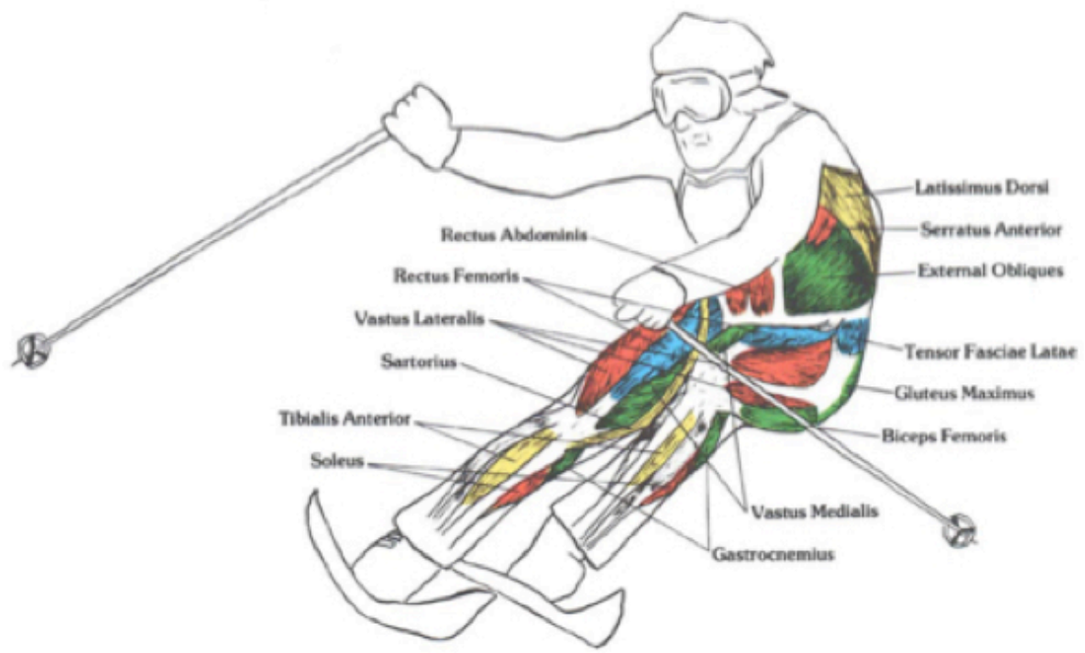
One of the easiest ways to understand and to better visualize the importance of the “core” for skiing is to review some literature on skier performance and biomechanics. A detailed study of downhill or alpine skiing would show a complex series of interrelated-movements that allow the body to adjust to changing conditions and forces while maintaining the body mass in balance, where the reactive responses are more or less dictated by the laws of force and motion. By understanding and visualizing the roles each of the major muscles play with respect to skiing it is easy to see why the core is so important.

Hip-Torso Angulation

- Upper torso and legs form angle at the hips which allows the body to angulate to better bank the edges of the ski to maximize control of the skies line and speed

- Upper torso is angulated forward and away from slope as center of mass is positioned through hips onto the outside ski

- Angulation and rotation at the hips provides balance and better ability to absorb shock



- Shin muscles engaged to sustain fore-aft balance

- Quadriceps engaged to maintain balance and counter resist centripetal & gravitational forces

- Glutes, hamstrings and abdominals are engaged in eccentric absorption of the shock of changing terrain

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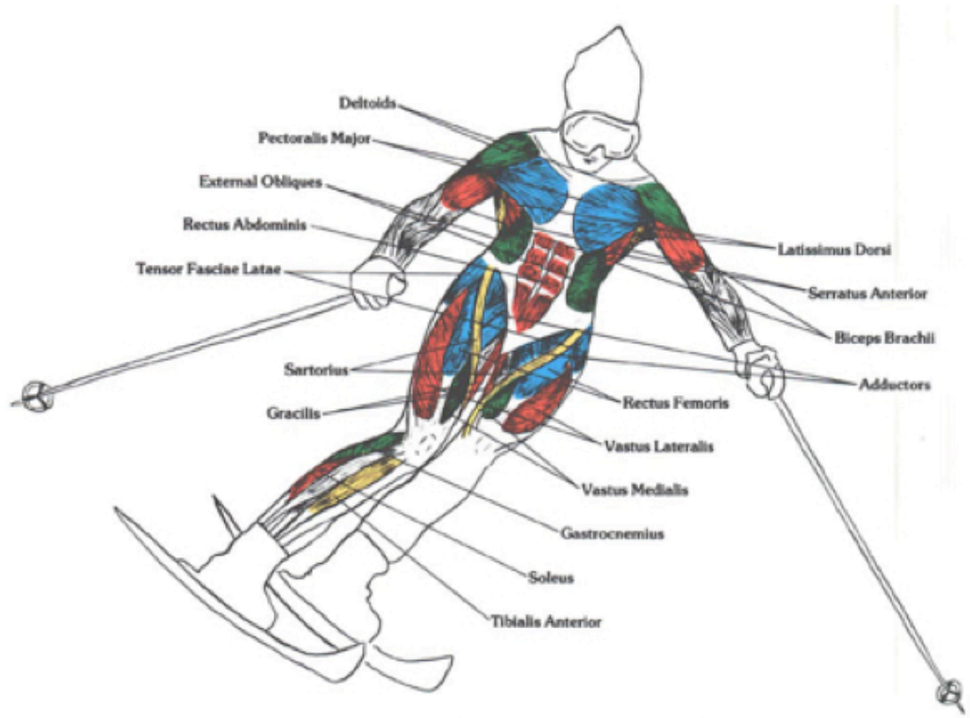
Transition & Counter-Rotation

- Transition period between completion and initiation of next turn
- Shoulder rotation initiated by pole plant changes center of mass, stabilizes body
- Counter rotation centered around the waist with feet and legs pivoted in opposite direction of chest transitions skis and sets up for next turn



- Shoulder and upper torso engaged during pole plant and counter-rotation
- Abdominals engaged to raise and lower torso over skis during transition between turns
- Quadriceps engaged to maintain balance

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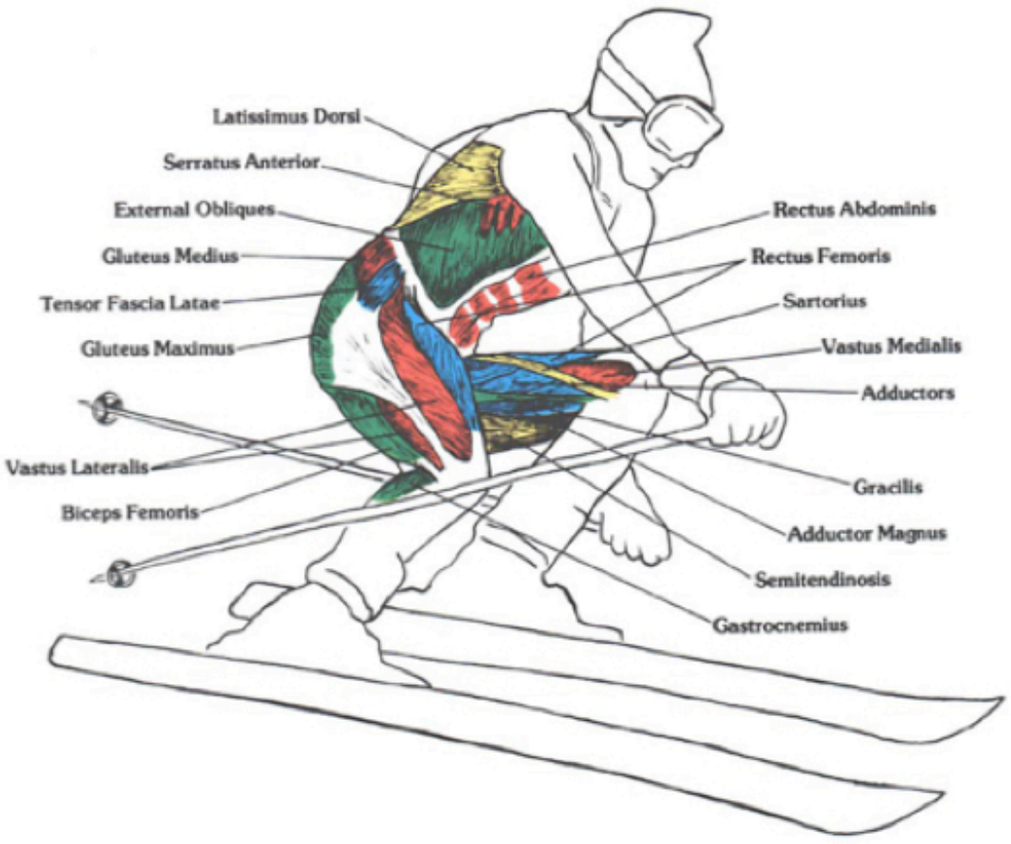
- Hips drop to lower center of mass and better maintain balance

- Ankle, knees and hips flex to allow angulation of the knee for better edge control and steering of skies

- Maximum eccentric torque developed on outside leg (Hintermeister et al 1995)



- Active rigid core absorbs and counteracts upward forces

- Quadriceps engaged in concentric/ isometric contraction to maintain balance and resist centripetal & gravitational

- Glutes and Hamstrings engaged to resist eccentric forces of changing terrain

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BRINGING IT ALL TOGETHER THROUGH INSTABILITY-BASED-

Chapter 4

I use a lot of balance training and functional training. Basically it's where you add an element of instability training to a regular exercise. So whether it's on the physioball or the Bosu ball or just balancing on one leg, I try to incorporate an unstable plane and/or movement to the exercise, so the body's doing two or more movements."

- Steve Nash, Eight-time NBA All-Star

The exercises that comprise CoreSkiing™ involve instability and multi-limb movements. Instability initiates the kinetic chain and activates the core muscle group to a greater degree than would be possible on stable surfaces alone or with weights, especially for untrained athletes. Instability training has been shown to help improve balance, joint stability, proprioception, and neuromuscular control in athletes.

An effective strength and balance training program such as CoreSkiing, works to improve motor patterning urologic adaptations via training utilizing unstable conditions. This neurologic adaption is critical to the effective transfer of the base training benefits to better on-slope performance.

Briefly, here's what I've learned:

- **"It's imperative the training program emulate the specific muscular actions and velocities that will be encountered in the particular sport at hand. Adding an instability training component to strength training or plyometric training workouts, with the use of equipment such as balance discs and stability balls has been shown to improve neuromuscular motor patterning. This leads to improved coordination and confidence in performing a skill and a decrease in co-contraction during instability." (Behm, Hydren).**

- Instability training isn't a cure-all for every sport but the consensus is that an athlete who performs on an unstable or "slippery" surface (i.e. skiers, trail runners) must train on equally unstable surfaces to improve performance and reduce the risk of injury. (Ruez) Skiing at its basics is pretty much a controlled slide down a slippery frozen surface – which means that to be effective, off-slope or dry-land ski training needs to incorporate instability.

- In general, performing tasks on unstable surfaces such as a Stability Ball led to greater activation of the core muscles, including; external obliques, transverse abdominus, internal obliques, erector spinae and rectus abdominus levels when compared to stable surfaces. Since the core is the "powerhouse" of the body and the critical link for transfer of forces and momentum within the kinetic chain anything we do to strengthen the core leads to a more efficient transfer of forces across the kinetic chain.

- Instability can also be achieved without unstable devices. Strength training is more often bi-lateral using either a barbell or pair of dumbbells. Unilateral exercise on the other hand may involve a single dumbbell and as such induce a torque across the torso, providing another type of unstable exercise. Unilateral exercises have been shown to induces greater muscle activity within the core. (Behm, Colado)

Everything has limits and instability training is not always the better way to go. Certain free weight exercises typically performed on stable surfaces, such as back squats and deadlifts, actually see lower activation of the core muscles when these exercises are performed on unstable surfaces.

The main reason for the lower activation of the core muscles is that the unstable surface tends to lower the maximum force output of the exercise as compared with a stable surface. Studies have shown

that increasing the resistance of a stable surface exercise, such as the deadlift, results in increases in the core muscle activation. So in effect, the instability training can be a detriment to core activation.

The answer then lies in utilizing a combination of exercises performed on both stable and, unstable surfaces. The CoreSkiing™ program utilizes unilateral movement and unstable surfaces to increase balance and core stability as well as exercises performed on a stable surface (i.e. back & front squats, deadlifts) to maximize core muscle activation and power.

In respect to improving athletic performance, its been shown that improving balance and stability may lead to increased strength and power. To maximize the benefits of the program, it's possible to build a stable base by improving balance and stability through the CoreSkiing™ exercises and once this is achieved move to build greater power though the use of squats and deadlifts.

SAMPLE EXERCISES

Chapter 5

The following illustrates two exercises that have become part of the CoreSkiing.com ski fitness program

The CoreSkiing Gym

“Lateral Side Lunge”

The lateral side lunge is especially effective at stimulating eccentric muscle action within the hamstring and external obliques during the deceleration phase of the exercise. The narrow shoulder width stance and alternating from side-to-side utilized in the side lunge with weight seems to better replicate the body position and momentum shift experienced on steep ski terrain or high speed decent

To position for the start of the side lunge with weight, stand upright with while holding a small dumbbell or weighted exercise ball and place feet hip width apart. Start by extending one leg to the side and in the same motion extend the arms and ball towards the toe while moving to a single leg squat position. Pause at the bottom before pushing up and back into the upright position. Immediately step out with the opposite leg and repeat the routine. Repeat the process for a total of 8 reps per side. Remember to consciously maintain a firm core throughout the exercise, particularly while lowering of the weight toward toes.

“Bosu Snatch Squats”

The Overhead Snatch is great for challenging the thigh and core muscles to improve overall balance as well as help improve hip mobility.

Grasp a weighted bar and step onto the BOSU ball positioning your feet slightly off-center, about hip-width and aligned slightly forward with toes lower than heal. Position bar overhead with hands wide in an Olympic snatch position. Slowly lower your body into a squat position while holding the bar overhead. Hold this position for a few seconds before slowly returning to the upright standing position. Repeat this movement for a total of 4-6 repetitions.

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