



Competition-Coaching Introduction Advanced (T2T)

Step 6 :

Flexibility training



**Reference Material
for Dryland Workshop**



PARTNERS IN COACH EDUCATION

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6.1 Introduction to Flexibility Training



Figure 1: Skiers stretching after a run (Photo Credit: stixnstonz.wordpress.com)

6.1.1 Why Flexibility is Important

Flexibility can play an important role in the proper execution of skills and movement patterns in all sports including skiing. Being too tight in certain areas can make certain ski techniques difficult to perform. For example classic striding can be limited due to ankle flexion or hip extension. Furthermore weight room techniques such as deep squats or overhead presses can be hindered by lower limb and shoulder flexibility respectively. It is therefore important to maintain a flexibility routine as part of a ski training program, especially targeting areas with limited range of motion. This section of the coaches' reference material will focus on examples of stretching principles and technique. Dynamic warm up routines will be covered in more depth in the recovery and prevention section of the competition-development reference manual.

6.1.2 Overview of Flexibility Training Types

Just as there are different types of flexibility, there are also different types of stretching including static, active, dynamic, ballistic and PNF.

Each type of stretching is based on one or more of these facts:

- Flexibility increases when muscle tension is reduced.
- Flexibility increases when force is applied to increase range of movement.
- Flexibility is specific to a joint. It can vary from joint to joint and with the direction of

movement. For example, an athlete could have good shoulder flexibility, but poor trunk flexibility.

- The range of motion at a joint can be limited by bone or soft tissue. Soft tissue includes ligaments, tendons, cartilage, joint capsules, and muscle.
- Flexibility increases when connective tissue (muscle sheath and tendon) are lengthened. By contrast, flexibility decreases when connective tissue is shortened; for example, even a few days in a cast can cause connective tissue to shorten and resist stretching.

Static stretching is the most frequently used stretching technique. Due to the body's stretch reflex static stretches must be gentle and held for a long enough period of time to over-ride this contractile reflex and avoid damage to the muscle. Therefore static stretches should be held for at least 30 seconds. Research shows static stretching can alter neuromuscular properties; lessening a muscles capacity to respond to neural input. Therefore static stretches should customarily be done post-exercise and only done prior to exercise when a particular muscle (group) is too tight to perform the activity.

Active stretching requires you to actively use the opposite muscle group than the one you are trying to stretch. An example of this is a standing quad stretch where you activate your gluts to pull your knee back (as opposed to pulling your knee back with your arm as you would if you were doing a static stretch). As with static stretches, active stretches should customarily be done at the completion of an activity.

Dynamic Stretching: warms up the muscles while stretching them, without altering neuromuscular properties. Examples of dynamic stretching are forward lunges, butt kicks and running A's. It is important to utilize dynamic stretching for pre-activity stretching.

Ballistic stretching should no longer be used, based on the concern that it may lead to micro-tearing at the musculo-tendonous junction.

PNF stretching utilizes autogenic inhibition; where the muscle group being stretched increases in "stretchability" after an isometric contraction. An example of this would be doing a standing quad stretch pulling your heel to your butt, activating your quads by trying to straighten your knee holding for 10 sec, relax and pull your leg back to increase your quad stretch.

To summarize, as part of warm up, athletes should include dynamic stretching. Should a particular tightness affect your ability to perform use static, active or PNF stretching techniques to loosen the problem area. Following exercise spend some time doing active, PNF or static stretches.



Figure 1: dynamic stretching should be part of a good warm-up(Photo Credit: Jessie Diggins)

6.1.3 General Stretching guidelines

When performing stretching and flexibility training, the following stretching guidelines are applicable to all individuals of different genders and age groups:

- When stretching a muscle, the goal is to gently separate the muscle's origin and insertion.
- On a scale of 0-10, where 0 = no stretch and 10 = muscle damage, a stretch should be between 3 and 5 out of 10.
- Flexibility gained from a stretching session will be lost within 2.5- 3hrs post-stretching. Therefore in order to improve flexibility it is important to stretch regularly throughout the day.

For specific stretching considerations for different ages and genders/age groups the following table is a useful guide for coaches working with developing athletes:

Age Group	Female	Male
Adolescent Female 0-10 Male 0-11	- Very flexible, but still a good time to develop good stretching and warm-up/cool-down habits.	- Flexible, but less so than females. - Growth spurts occur where bones may grow faster than the muscles that attach to them. This means frequent stretching is required to prevent damage to muscles and tendons
Young Adult Female 11-17	- Still flexible, however more attention to maintaining flexibility is required.	- Decreasing flexibility. - Continued growth spurts, requiring continued stretching
Adult Female 18 + Male 19+	- Decreasing flexibility, requiring stretching of tight muscle groups to enhance function and prevent injury.	- Poor flexibility requiring continued stretching of tight muscle groups to enhance function and prevent injury.

Figure 2: specific stretching considerations for different ages and genders/age groups

6.2 Guidelines for Developing Flexibility



Figure 3: stretching outdoors(Photo Credit: Backcountry.com)

Prescribing flexibility programs for T2T athletes can be somewhat bewildering for T2T coaches as there is a wide range of different stretching types and ways to perform each stretching motion. The following table lays out the training variables to consider when developing flexibility programs.

Variable	Key points...
Type of training	<ul style="list-style-type: none"> • Individually or with the assistance of a partner
Activities/ movements	<ul style="list-style-type: none"> • Reaching the limit of the range of motion under control and with no pain • Stretching the muscles and connective tissues
Intensity	<ul style="list-style-type: none"> • Performed so that some tension is felt in the muscle being stretched, but no pain
Duration of each repetition	<ul style="list-style-type: none"> • Varies with the type of stretching: <ul style="list-style-type: none"> ○ 30 seconds or more for static stretching ○ Up to 20 seconds for active stretching ○ Up to 15 seconds for assisted stretching using the proprioceptive neuromuscular facilitation (PNF) method.
Number of repetitions	<ul style="list-style-type: none"> • At least one exercise for each of the major muscle group • Where applicable, do the exercise on both the right and the left sides of the body.

	<ul style="list-style-type: none"> • 3 to 4 repetitions of each exercise, using the same kind of stretching (passive, active, etc.) for all reps.
Duration of recovery between repetitions	<ul style="list-style-type: none"> • A few seconds
Duration of recovery between sets	<ul style="list-style-type: none"> • Optional; relatively short
Type of recovery	<ul style="list-style-type: none"> • Passive, or gentle, relaxed movements
Position in training session	<ul style="list-style-type: none"> • Stretching should <i>follow</i> a vigorous general warm-up: • Do moderately intense aerobic activity lasting at least 10 to 15 minutes; this can vary, depending on the time it takes to elevate the temperature of the muscles and connective tissue, especially in a hot or cold environment. • Use the muscle groups that will be stretched. • Be sweating by the time flexibility training starts. • Do static stretching exercises first, then active stretching exercises, then assisted stretching exercises, and finally dynamic stretching exercises. • Within a session, move from the general (major joints) to the specific (sport-specific joints and ranges of motion). • Do specific flexibility training late in the session, when the muscles are warm.
Safety considerations	<ul style="list-style-type: none"> • Stretch muscles only when they're warm. • Avoid jerky movements when doing stretching exercises. • Keep muscle stretching under control at all times. • If any pain occurs while stretching, slowly decrease the intensity of the stretch. • Breathe slowly and stay relaxed when stretching. • Stretching must be viewed as an individual activity; don't compete against one another when doing flexibility training. • Partners who assist in flexibility training must apply force slowly and in a controlled manner.
Position in training	<ul style="list-style-type: none"> • Focus on static stretching first.

program	<ul style="list-style-type: none">• After a few sessions of static stretching, start extending the stretch slightly beyond the limit of the range of motion; for example, if trying to touch the toes, grasp the ankles to pull the body a bit closer to the toes.• Then introduce active stretching, assisted stretching, and dynamic stretching — in that order.• Three to five sessions a week.
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6.3 **Static Stretching**

Static stretching is the most common type of stretching used by athletes and coaches in their training programs and there are many reasons to include static stretching into training plans including:

- **Improving or maintaining range of motion**

Example: Stride length in classic skiing can increase dramatically with hip flexer and glut flexibility.

- **Returning muscles to their pre-exercise length**

In sports that include many repetitive movements such as skiing, muscles that are contracted repeatedly may become shorter over time. While this may benefit the specific skill being repeated, it may cause performance in other skills to suffer.

Example: Poling motions can cause one of the deltoids (shoulders) muscles to become shorter as the muscle adapts to skiing's high hands position. For cross training, quadriceps muscles would be at an optimal length during cycling but not running.

- **Maintaining or improving posture**

Good posture minimizes the incidence of chronic injuries in the extremities. Static stretching over time helps minimize sciatica and thoracic outlet syndrome (a reduction of the space through which the blood vessels and nerves supplying the legs and arms pass), both of which are related to overuse injuries in the extremities.

Improving posture often takes weeks or months of diligence. Muscles that are repeatedly contracted and become shorter over time can have a significant negative effect on posture.

Example: Frequent striding can cause the hip flexors to shorten. Shortened hip flexors in turn contribute to an anterior rotation of the pelvis. This rotation may increase the risk of lower-back, pelvis, and hamstring injuries as well as poor posture.

As previously mentioned static stretches should be done post-exercise when muscles

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are warmed up and only done prior to exercise when a particular muscle (group) is too tight to perform the activity.

6.3.1 Static Stretching Examples

The following are examples of static stretches that are important for skiers to perform to ensure that they can properly perform all ski techniques correctly, especially if they have identified areas that have limited range of motion (see section 9.6 on flexibility evaluation).

1. Hamstring

- Sets: 3-5
 - Frequency: Every 3 hours
 - Hold: 30 sec.
- 1) Hands supporting active extended leg; point and flex foot. Other leg bent.



Step 1



Step 2

2. Hip Flexor

- Sets: 3-5
 - Frequency: Every 3 hours
 - Hold: 30 sec.
- 1) Place bolster under right leg, start with right knee on the ground and left knee straight ahead.
 - 2) "Stop the flow" and tuck pelvis under by drawing your belly button up towards your chest.
 - 3) Lean slightly forward, keeping back straight, until a stretch is felt in your right thigh / hip flexor.



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Step 1

Step 2

3. Quads

- Sets: 3-5
 - Frequency: Every 3 hours
 - Hold: 30 sec.
- 1) Stand on your unaffected leg and bend your affected knee up. Grab the top of the affected ankle with the same hand.
 - 2) Maintain your hold on the ankle, while you bring your knee back down, in line with your body.
 - 3) Maintaining a flat straight back, engage gluts to extend knee back.
 - 4) Hold the stretch, keeping your lower back neutral. Do not arch your back.



Step 1



Step 2

4. Soleus

- Sets: 3-5
 - Frequency: Every 3 hours
 - Hold: 30 sec.
- 1) Stand facing the wall with one foot in front of the other, angle front foot so toes are on wall and heel is on ground
 - 2) Lean into the wall with knee bent and heel on floor.



Step 1



Step 2

5. Hip/Glute

- Sets: 3-5
 - Frequency: Every 3 hours
 - Hold: 30 sec.
- 1) Support weight on hands as you extend one leg behind you and fold the other underneath, knee pointing forward, outside of ankle on the ground, heel by hip - lower into stretch
 - 2) Maintaining forward posture with your torso
 - 3) To increase this stretch rotate pelvis forward. *do not arch back*



Hip/Glute Stretch



Side View

6. ITB Roller

- Sets: 3-5
 - Frequency: Every 3 hours
 - Hold: 30 sec.
- 1) Lay on the roller so that the roll sits under the side of the leg just below the hip joint. Support some of your weight through your hands and opposite leg (which is crossed out in front of the leg on the roll).
 - 2) Roll back and forth from below the hip until just above the knee.



Step 1



Step 2

7. Lats

- Sets: 3-5
 - Frequency: Every 3 hours
 - Hold: 30 sec.
- 1) Start in a 4 point position
 - 2) Grasp something in front of you that is stable
 - 3) Slowly lower your bum towards your heels



Lat Stretch

8. ReverseBench

- Sets: 3-5
 - Frequency: Every 3 hours
 - Hold: 30 sec.
- 1) Lay on foam roller with knees bent and neck and back in neutral alignment
 - 2) Start in bench press position; squeeze shoulder blades and drop elbows to the ground.
 - 3) Move hands back keeping elbows on ground.



Step 1



Step 2

9. Snow angels(pecs)

- Sets: 3-5
 - Frequency: Every 3 hours
 - Hold: 30 sec.
- 1) Lying on the foam roller with your back and head supported start with your arms at your side and palms faced up.
 - 2) Raise arms over head being sure to keep the back of your hand on the ground.



Step 1



Step 2

10. Standing airplanes

- Sets: 3-5
 - Frequency: Every 3 hours
 - Hold: 30 sec.
- 1) Standing facing a wall with feet up against wall, place hands and forearms on the wall at 90 degrees
 - 2) Keeping hips square rotate to the Right looking at the Right wrist
 - 3) Repeat to the Left.



Back view



Side view

11. Tricep

- Sets: 3-5
 - Frequency: Every 3 hours
 - Hold: 30 sec.
- 1) Stand up straight and tall, place one hand behind your head and reach with fingertips for lower back
 - 2) Taking other hand place onto elbow of opposite arm and gently push downwards.



Tricep Stretch

12. Tricep & Lats

- Sets: 3-5
 - Frequency: Every 3 hours
 - Hold: 30 sec.
- 1) Take towel in hand and raise elbow above head letting the towel drop down your back.
 - 2) Reach behind back with free hand and grasp towel.
 - 3) Gently pull arm up back. *Keep good posture!



Tricep/Lat Stretch

6.4 Other Types of Flexibility Training




Static stretches covered on the previous pages are the basic type of flexibility training that train to train athletes should be familiar with. As previously mentioned are five main types of stretching used in flexibility training:

- ✓ Static stretching
- ✓ Active stretching
- ✓ Assisted stretching
- ✓ Dynamic stretching
- ✓ Ballistic stretching (not recommended)

All of these types of flexibility have different methods of execution and ways in which to perform the exercise. The table below provides a description and examples of the different types of stretching.

Type of Stretching	Description	Examples	Notes
Static Stretching	<ul style="list-style-type: none"> • Get into the starting position for the stretching exercise • Assume the stretched position slowly and in a controlled manner; at this point, the muscles are stretched only slightly • Increase the intensity of the stretch progressively and in a controlled manner until the limit of the range of motion is reached; at this point, some tension is felt, but no pain • Hold the position for 20 to 30 seconds, more if possible • At the end of the stretch, release the tension slowly, and get into the starting position again • Stay relaxed, and breathe normally throughout • Repeat 2 to 4 times • If applicable, repeat the stretch for the other side of the body 	<ul style="list-style-type: none"> • Sitting toe touch performed slowly • Hold one leg in front of the body, rest it on a chair, and stretch the hamstrings 	<ul style="list-style-type: none"> • Apply light force throughout the stretch • When the limit of the range of motion is reached, the muscles opposing those being elongated do not contract to allow the stretch to increase further • Don't use bouncing movements at the end of the stretch • If pain occurs during the stretch, slowly decrease the intensity of the stretch • Static stretching: <ul style="list-style-type: none"> ○ Is easy to learn ○ Produces little soreness ○ Has a generally low risk of injury ○ Doesn't trigger the myotatic stretch reflex
Active Stretching	<ul style="list-style-type: none"> • The steps involved in active stretching are very much like those for static stretching, except that the <i>athlete's own force</i> is 	<ul style="list-style-type: none"> • Stand on one leg, lift the other leg out in front of the body as high as possible, 	<ul style="list-style-type: none"> • Active stretching doesn't trigger the myotatic stretch reflex

	<p>used to move the body part to be stretched and brings it into the appropriate stretching position</p> <ul style="list-style-type: none"> • Stretch in a controlled manner • Hold the stretch position for 10 to 20 seconds • Repeat 2 to 4 times • If applicable, repeat the stretch for the other side of the body 	and twist from side to side	<ul style="list-style-type: none"> • Static stretching is preferable when the elasticity of the muscles being stretched (agonists) restricts flexibility • Active stretching is preferable when the weakness of the muscles being stretched (agonists) restricts flexibility
Assisted Stretching	<ul style="list-style-type: none"> • Assistance may come from self-applied force, from a partner, or from a device (e.g., a towel or rubber tubing) 	<ul style="list-style-type: none"> • Wrestling moves • Partner- assisted movements where the partner puts pressure on a limb 	<ul style="list-style-type: none"> • Assisted stretching: • Involves a greater range of motion than in other types of stretching • Is very effective at increasing the range of motion • Can lead to some muscle soreness and stiffness • Stretch to as full a range as possible before getting extra stretch from either self-applied force or force from a partner
	<ul style="list-style-type: none"> • Assisted Stretching with Self-applied Force • Apply force in static or active stretching to increase range of motion • For instance, when stretching the neck, lean the head to the side, and use the hand to apply some force to increase the range of the stretch 		<ul style="list-style-type: none"> • Apply force slowly and in a controlled manner
	<ul style="list-style-type: none"> • Assisted Stretching with Force from a Partner • The dominant form of assisted stretching with force from a partner is proprioceptive neuromuscular facilitation (PNF) • The following variant of PNF is called contract-relax PNF technique: 		<ul style="list-style-type: none"> • The effect of the inverse myotatic reflex makes it possible to increase the range of motion after the isometric contraction • There should be at least 48 hours between PNF stretching routines

	<ul style="list-style-type: none"> • Perform a slow, controlled, and holding stretch where the limb reaches the limit of motion  • Have a partner assist in a position that enables the partner to provide resistance to the limb being stretched  • At a signal from the partner (e.g., "push"), perform a 3-to-4-second progressive isometric contraction again, provided by the partner. The tension in the muscle previously stretched increases gradually, but no movement occurs  • Follow this progressive contraction with a near-maximal isometric contraction lasting about 5 seconds • The partner <i>must not</i> allow the limb whose muscles are being stretched to move. • At the end of the isometric contraction, relax the muscle(s) for 3 to 4 seconds (the partner may signal the start of the relaxation period) • The partner applies <i>controlled force</i> to passively increase the degree of the stretch • Hold the new stretching position for 10 to 15 seconds. Repeat 2 to 5 times from the starting position • A variant of contract-relax PNF called contract-relax antagonist-contract PNF differs only slightly from contract-relax PNF: • Follow the steps for contract-relax PNF up to and including the 3-to-4-second relaxation period 		<ul style="list-style-type: none"> • Do only one exercise per muscle group • PNF stretching is not recommended for children or adolescents • If PNF stretching is a separate exercise session, do it AFTER a thorough warm-up consisting of at least 10 minutes of light aerobic exercise and some static and dynamic stretches • Partners must always apply force slowly and in a controlled manner • Partners must assume a stable position that enables them to resist the force generated during the isometric contraction
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	<ul style="list-style-type: none"> • While the partner applies force to the limb and increases the stretch, perform a submaximal concentric contraction with the muscles that work opposite the ones being stretched • Hold the new stretching position for 10 to 15 seconds • Repeat 2 to 5 times from the starting position 		
<p>Dynamic Stretching</p>	<ul style="list-style-type: none"> • Start with a thorough warm-up and appropriate static and active stretching exercises • Then do sport-specific movements in sets of 8 to 12 repetitions • Do movements slowly at first (e.g., half speed), and progress to faster movements • As movements get faster, the range of motion increases • A few sets may be necessary to reach the full range of motion • Stop if any signs of fatigue appear or form deteriorates 	<ul style="list-style-type: none"> • Leg action that mimics kicking a ball (soccer player) • High knee raises, with an emphasis on knee height and arm action (sprinter) 	<ul style="list-style-type: none"> • Triggers the <i>myotatic stretch reflex</i> and must therefore be performed with caution • Potentially hazardous if done incorrectly • Initially, coaches should supervise this type of stretching to ensure correct form and appropriate intensity

Figure 5: description and examples of the different types of stretching

6.5 Other Considerations

When programming flexibility training into athlete training plans, ensure that the following pointers are taken into consideration to help optimize gains.

- ✓ Before planning a flexibility program, identify the muscle groups and movement patterns that require flexibility training. Use the sport-specific movements required, including the extreme body positions, as the baseline for analyzing the athlete’s current flexibility level and the improvement needed.
- ✓ Many exercises can help athletes improve their flexibility, and there are often several variations of the same exercise.
- ✓ Most exercises can be executed using more than one stretching method (passive, active, etc.).
- ✓ To maximize gains, establish specific times outside the regular training sessions, warm-up, and cool-down for flexibility training. If time restrictions apply, schedule activities designed to improve flexibility for the end of a session, not the warm-up.
- ✓ Athletes can do several flexibility training sessions a day. For instance, one flexibility session can take place at the end of a morning workout, a second one later in the day.
- ✓ To build strength at vulnerable, stretched-out positions, perform static (isometric) contractions, and hold them for three to five seconds.

- ✓ Varying flexibility training can help athletes adhere to the program. Vary the types of stretches, exercises, and equipment used (towels, resistance balls, etc.) to add variety and effectiveness to the program.
- ✓ Athletes can significantly *increase* flexibility in about 12 weeks. In many cases, athletes can *maintain* (or even improve) flexibility through sport-specific training, as it develops patterns of joint flexibility unique to that sport. For example, swimmers develop flexibility in their shoulders as they train. Nevertheless, once athletes have achieved adequate flexibility through a stretching program, they should do one flexibility-specific training session per week.
- ✓ Unlike the other athletic abilities, which all deal with energy systems, flexibility is concerned with bone and soft tissue. Soft tissue includes ligaments, tendons, cartilage, joint capsules, and muscle.



6.6 Testing Flexibility

Athletes at the Training to Train stage of development should have their flexibility tested at regular intervals throughout the training and competitive season to ensure that ski specific training is not impinging on their mobility. The following flexibility test and standards will allow you to evaluate athlete flexibility and easily identify areas that require extra flexibility training intervention. Remember to record athlete results from this evaluation over time to note improvements and regressions.


Required tools:

- Foam roller
- Measuring tape
- Protractor
- Flat Table at least two feet off the ground



TEST: Lats/ upper back

Description	Female Ideals		Male Ideals	
	Age: 0-10	Age: 11+	Age: 0-11	Age: 12+
Supine on Foam Roller Chin tuck, back flat, straight arm over head Distance: Radial head (thumb side of wrist) to the Floor (cm)	0 cm	8 cm	0 cm	13 cm
				

TEST: Shoulder Mobility

Description	Female Ideals (cm)		Male Ideals (cm)	
	Age: 0-10	Age: 11+	Age: 0-11	Age: 12+
Standing, one arm over and in back of head, other arm in small of back and try to get the two hands to touch.	Touch	<1 hand space between 2 hands	Touch	<1 hand space between 2 hands
				

TEST: Ankle Soleus

Description	Female Ideals		Male Ideals	
	Age: 0-10	Age: 11+	Age: 0-11	Age: 12+
<p>Shoes off. Heal on ground bend knee as far forward over foot as possible and place foam roller level at this location.</p> <p>Measure end of great toe to foam roller. (cm)</p>	17cm	12cm	17cm	12cm
<div style="display: flex; justify-content: space-around;">   </div>				

TEST: Hip Flexor / Quad / Iliotibial Band (ITB)

Description	Female Ideals		Male Ideals	
	Age: 0-10	Age: 11+	Age: 0-11	Age: 12+
Supine lift knee to chest keeping back flat on table. Let leg hang off table.	Femur able to rest on table 90 degrees angle of knee Femur in line with trunk	Femur able to rest on table 60 degrees angle of knee Femur in line with trunk	Femur able to rest on table 90 degrees angle of knee Femur in line with trunk	Femur able to rest on table 55 degrees angle of knee Femur in line with trunk



TEST: Hamstrings

Description	Female Ideals		Male Ideals	
	Age: 0-10	Age: 11+	Age: 0-11	Age: 12+
Supine, lift leg up keeping knee straight. Measure straight down from medial malleolus. (inside ankle bone)	Ankle in line with Greater trochanter (hip)	Ankle between greater trochanter and knee.	Ankle in line with Greater trochanter	Ankle between greater trochanter and knee.



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