

Treating Anterior Knee Pain and the Basketball Athlete: Part II

by Art Horne

Last week we addressed two of the most common problem areas, the ankle and hip along with some talk about limiting summer pick-up games and knowing when to refer. Below are two points that I'm sure you've addressed but worth mentioning again along with perhaps one that may have the greatest impact on preventing your athletes from suffering knee pain in the first place.

Hip Strength Rules

Besides the mountain of evidence supporting the role of the hip and it's contributions to knee pain (which I'll mention later), you'll see the name [Charlie Weingroff](#) many times throughout this article. Charlie not only follows evidence based practice, has a ton of NBA experience but also practices what he preaches, a rare occurrence when it comes to the fields of physical therapy and athletic training. If you're interested in discussions about posterior chain work, pulling from the racks and box squatting as a means to the end of knee pain, you won't find me discuss those here. My goal is simply to provide a few simple tools for you "knee pain tool box." That is not to say however, that the previously mentioned exercises, are not important. In fact, if we did a better job at all of these in our athletes we'd probably also see less knee pain in the first place. Charlie is clearly the expert in this field and I'll leave it to him to discuss these concepts in a future post. So, if your basketball athlete already has knee pain here are a couple of exercises I've had some success with.

Clams

We have all done these with our athletes, and my interest here is not show you an exercise you already know but challenge you to do this exercise just a bit better in an effort to achieve the results you're looking for. How many times have you watched your athlete chat it up with their friends while performing this exercise only to walk by and see their low back rotating and flopping around like a fish out of water?

Points of Emphasis:

1. Rotate the top hip slightly forward and down to place the posterior fibers of the glute med into an anti-gravity position (Kendall, McCreary, and Provance, 1993).
2. Many beginners have trouble disassociating their hip motion from their lumbar spine. Try placing the athlete's lumbar spine flat against the wall *along* with aforementioned slight hip rotation to teach this movement while emphasizing glute med activation.



START POSITION



END POSITION



LUMBAR ROTATION



LUMBAR STABILIZED AGAINST WALL

Reverse clams

As Bill Hartman so kindly pointed out to me while visiting Boston prior to the [2010 BSMPG Basketball Symposium](#), this exercise may not need any resistance at first, and in fact, many of the tall guys with knee pain may actually not be able to perform this motion against gravity at first, or at least through its full range of motion as was the case in the basketball athlete that Bill evaluated for me. In the event that your athlete lacks this motion or strength some simple assistance throughout the ROM by you will do the trick, then progressing to full range against gravity, and then finally band or cuff weight.

Point of emphasis: have athlete squeeze a small ball or towel between knees.



Glute med hip extension combined with abduction

I first saw this exercise performed after traveling to Vancouver Canada and visiting [Nico Berg](#) (third PT down from Charlie). Nico spoke at BSMPG First Annual Boston Hockey Summit and did such an incredible job that I flew from one coast to the other to see him out in Vancouver. If you stay up late and watch the Lakers play you'll notice a number of their athletes warming up with "Core-X Bands." They were created by [Alex McKechnie](#) who works alongside Nico at Lynn Valley Physical Therapy. If you're ever in the Vancouver area I would highly recommend visiting their clinic – clearly one of the best Physical Therapy and Performance centers I've ever walked into.

The emphasis of this exercise is placed not just on the glute med but instead coupling this motion with hip extension.

Points of emphasis:

1. Turn top foot slightly down as to internally rotate femur and position the pelvis similar to the clam position discussed earlier.
2. Drive heel into physioball while abducting leg.
3. Move ball in a slow and controlled manner along the wall for set number of reps.

To watch this video click [HERE](#)

Bent Knee Bridges

Another favorite I picked up during my travels to Vancouver. This exercise combines and integrates the best of McGill's bracing work while isolating the glute med. Your athletes will tell you exactly where it is working and how very hard this simple looking exercise is! We start by prescribing 5 reps of 5 seconds to begin, and increase reps as we progress.

Points of emphasis:

1. Top leg stays elevated. Although the bottom leg is the target, additional hip abduction adds to the difficulty of the exercise.
2. Teach and incorporate all cues from traditional side bridge position as well.

To watch this video click [HERE](#)

Integrated Physioball Abduction Squat

Yes, another favorite I picked up from Nico. This one smells a bit more like basketball so if your athlete got through the first couple of exercises, reward them with an exercise that is "basketball specific" and on that they can relate to (they won't even know their doing more glute work!)

Points of emphasis:

1. Initiate abduction in start position
2. Drive knees outward as you would in a normal squat against the Physioball

To watch this video click [HERE](#)

Still not convinced hip strength is causing your knee pain?

Souza, Richard and Christopher Powers. "Differences in Hip Kinematics, Muscle Strength, and Muscle Activation between Subjects with and without patellofemoral pain". JOSPT. 2009; 39(1): 12-19.

- "...individuals in the PFP group demonstrated increased hip IR, decreased hip muscle strength and differences in hip muscle recruitment"
- "Our finding of hip abduction weakness in the PFP group is consistent with the results of Ireland et al and Bolgla et al, who reported significant decreases in hip abduction torque production in females with PFP."
- "The observation of increased activation of the gluteus maximus in combination with the finding of decreased hip extension strength and increased hip IR suggests that subjects with PFP were attempting to recruit a weak muscle, perhaps in an effort to control hip rotation."

Kibler, et al. The Role of Core Stability in Athletic Function. Sports Med. 2006; 36 (3)

- "Weak hip abductors and tight hip flexors are seen in association with anterior knee pain and chondromalacia"

Leetun DT, Ireland ML, Wilson JD, et al. Core stability measures as risk factors for lower extremity injury in athletes. Med Sci Sports Exerc 2004; 36 (6): 926-34.

- "Alterations in hip muscle activity are associated with increased hip varus and hip flexion positioning and increased knee valgus positioning in squatting or landing maneuvers, all of which increase load on the ACL. A recent longitudinal study looked at core stability parameters and found that weakness in hip ER was correlated with incidence of knee injury."

Cowan, et al. "Altered hip and trunk muscle function in individuals with patellofemoral pain". Br J Sports Med 2009 43:584-588.

- "The results of this study demonstrate an alteration of hip and trunk muscle function in individuals with PFP."
- "When individuals with PFP completed the stair stepping task, there was a delay in activation of both anterior and posterior GM and an alteration in vasti control."

Cichanowski HR, et al. "Hip Strength in Collegiate female athletes with patellofemoral pain". Med Sci Sports Exerc. 2007 Aug;39(8):1227-32.

- "The results of this study show that hip abductors and external rotators were significantly weaker between the injured and unaffected legs of the injured athletes."

Just in case you didn't get it....

- Athletes who experienced an injury over the course of a season displayed significant weakness in hip abduction and external rotation (Leetun 2004)

- Preseason hip adduction strength was 18% lower in the players who subsequently sustained an adductor muscle strain compared with that of uninjured players
- NHL players who improve hip strength during off season are less likely to sustain strains during season (Tyler) (I know it's hockey, but hip strength is hip strength)
- Before hip intervention, hip strains had incidence of 3.2/1000, 8% of all injuries; after intervention, hip strains had incidence of .71/1000 and only 2% of all injuries (Tyler)
- Clinical goal: adduction strength should be at least 80% of abduction strength. Hockey player is 17x more likely to have adductor strain if strength is less than 80% of abductor strength. (Tyler)
- Study showed that if hip adduction strength is 95% of abduction strength, hockey player will be uninjured during season. If adduction strength is only 78% of abduction, player is likely to be injured during season (Tyler)

Vertical Tibia:

Suggested Reading: Effect of Knee Position on Hip and Knee Torques During the Barbell Squat by FRY, ANDREW C.; Smith, J. Chadwick; SCHILLING, BRIAN K. J of S&C Research, 2003

Whether it was in the athletic training room or strength and conditioning area, at one time or another we've all demonstrated to our athletes that while performing lunges and squats their knees shouldn't travel too far over their toes. But how much attention is really being paid to this routine during actual training? At this past year's [Basketball Symposium](#), Charlie Weingroff challenged all of us to rethink this simple concept.

For as long as I can remember I have had our men's basketball team perform single leg reverse slide lunges as one of the options for a single leg hip dominant exercise. Depending on the time of the year and points of emphasis we'd cycle this movement with either a barbell on their back, or have them perform an asymmetrical movement holding a one DB or KB.

[Video: reverse slide lunge with barbell](#)

[Video: reverse asymmetrical slide lunge with KB](#)

As the athletic trainer and strength coach for men's basketball I always thought I was doing a relatively good job of coaching this exercise and thus, our guys were performing it fairly well. After Charlie's presentation I went back and revisited this old exercise with fresh eyes and realized we were not doing as well as I originally believed. This summer we took a step back initially to re-teach this movement, and as we approach the end of our summer training program we have clearly taken three steps forward.

As a result of Charlie's presentation, we have subsequently developed a "vertical tibia" progression that we will follow with all future incoming athletes as well as those suffering from knee pain to ensure increased hip movement and posterior chain recruitment while minimizing stress on those already suffering from unhappy knees.

Single Leg Vertical Tibia Teaching Progression

** Note: although these are in relative order from easy to hard, more than one may be used in the same phase or training period. For example: we may still use a body weight split squat during our warm-up and box squat in the same day.

1. [Split Squat with shin in front of bench](#)
 - a. Hands behind head, pull elbows back, do not allow shin to touch bench.
2. [Reverse Slide Lunge](#)
 - a. Same emphasis as before, limit use of back leg while "driving" through heel of front leg.
3. EQI (Eccentric-Quasi- Isometric) with Rear Foot Elevated
 - a. After mastering body weight, increase difficulty with holds prior to externally loading. Remember, long levers make this exercise a lot harder than it looks.



4. [Reverse Slide Lunge with external load](#)
 - a. Loading with a DB or KB is much easier when training groups and requires less set up. Progress to Barbell for older athletes that can handle more load while still maintaining the vertical tibia position.
5. [TRX-Assisted single leg squat](#)
 - a. Assistance from TRX enables athlete to progressively load leg as tolerated.
 - b. We choose to perform this exercise with the leg back to maintain a neutral spine.
6. [Single leg squat off box](#)
 - a. In the past I'd place this exercise into our basketball training program and look up to only see the guards able to complete it really well. I still want the entire team to get to this point, but with 7 foot guys mixed in with freshmen that move like a new born deer, to get to this end clearly needs a logical progression.
 - b. It's difficult to keep the tibia vertical during this maneuver as you can see, so anyone with knee pain would automatically be eliminated from this exercise.

Eccentric Strengthening

Although the concept of a “vertical tibia” *could* be debated, the one exercise that has stood the test of time and continues to be supported by a mountain of evidence in the fight against anterior knee pain is the use of eccentric strengthening.

In a 2005 article by Jonsson and Alfredson in which they compared painful eccentric quadriceps training to painful concentric quadriceps training in a group of athletes with knee pain (jumper’s knee), the eccentric trained group demonstrated far superior results (no surprise here), and even after 32.6 months 7 patients or nine tendons in total were still satisfied with the treatment. In fact, six of the seven patients returned to previous (before injury) activity. The seventh patient? They stopped participating in their previous activity for reasons not related to their knee pain but were still active and participating in other knee loading recreational activities. Besides the obvious success of the eccentric training, it should be noted that, *“three patients (four tendons) in the concentric group did not continue the training programme after the 6 week follow up, due to severe tendon pain during and after training.”* Although this cannot be directly correlated, it does lend credibility to Weingroff’s thoughts on the “vertical tibia” and that loading this joint concentrically with a positive shin angle does nothing except aggravate existing problems or create additional ones – especially in an athletic population that lives in an already knee dominant position.

The primary challenge with a painful eccentric patellar tendon loading program and the basketball athlete can simply be found in the title of the program – PAINFUL. Therefore, compliance and thus an emphasis on patient education is of the upmost importance. The second challenge with this programming is daily vigilance. In the above study, a protocol of 3 sets of 15 repetitions, were performed twice daily, 7 days a week for 12 weeks. Needless to say, with summer vacation time, pick-up games, personal time and of course weekends at the beach, our athletes are not adhering to a protocol as strict as this, yet we expect the same results. This is a perfect example of where an integrated approach by the athletic trainer and strength coach TOGETHER, can make a significant impact on an athlete’s pain level and long term performance since this exercise can be accomplished in either room with little equipment.

Remember, when the exercise no longer is painful, add load in the form of a weight vest or a back pack and continue.

“the training was suppose to be painful, and when there was no pain in the patellar tendon during training, the load was to be increased to reach a new level of painful training by gradually add weights to a back pack. The patient themselves decided how much pain was acceptable.” (Jonsson and Alfredson, 2005)



start position



end position



loaded with weight vest

Have your athlete lower themselves downward with one leg slowly and ascend with two legs
3 sets of 15 repetitions, performed twice daily, 7 days a week for 12 weeks (sounds like summer time fun to me)

“Does the eccentric loading exercise have to be done on a slant board? Can’t I just do it by performing really slow step downs?”

Good Question - Well yes, but if you’re going to invest the time into an exercise you might as well get the most bang for your buck right? You wouldn’t spend \$100 on a share Canada Dry Ginger Ale when you can get a share of Pepsi at the same price. So what exercise gives you the most return on investment?

Answer - In a study which compared eccentric step downs to eccentric decline squats (on a slant board) the results at 12 months favored the slant board, although the step downs did prove beneficial. As did the previous study, the slant board group exercised into tendon pain and progressed their exercises with load. The step down group performed a single leg squat on a 10 cm step, but exercised without tendon pain and progressing instead with speed then load. Both groups participated for 12 weeks.

Conclusions: “Both exercise protocols improved pain and sporting function in volleyball players over 12 months. This study indicates that the decline squat protocol offers greater clinical gains during a rehabilitation programme for patellar tendinopathy in athletes who continue to train and play with pain.”

Suggested Readings:

Superior results with eccentric compared to concentric quadriceps training in patients with jumper’s knee: a prospective randomized study. Jonsson P, H Alfredson. *Br J Sports Med*, 2005; 39:847-850

Eccentric decline squat protocol offers superior results at 12 months compared with traditional eccentric protocol for patellar tendinopathy in volleyball players. Young et al. *Br J Sports Med* 2005;39:102-105

References:

Kendall, F.PI, E.K. McCreary, and P.G. Provance. 1993. *Muscles, Testing and function*. 4th ed. Baltimore: Williams & Wilkens