The Athlete in Pain

As coaches we tend to see a lot of athletes in pain. It’s just part of the game and it’s going to happen. Some athletes may already be in pain when they join the gym. Others may get painful while training. It isn’t your responsibility to get people out of pain but you’ll certainly be faced with working with this tricky population. The first step to success in this area is understanding what pain is. Once we understand what’s happening with our athletes in pain this knowledge can better guide us with their training. So, what is pain?

Pain is a defense mechanism in our bodies. It is a normal and desirable process that helps to keep us safe. Imagine walking on a beach and stepping on a shard of glass. You’d feel pain, get the glass out, clean the wound and then pamper that area for the next few weeks until it was healed.

In a world without pain you may step on a shard of glass and continue walking without any type of warning. Suddenly you’d pass out catching a glimpse of the trail of red blood behind you as you hit the ground. If you had a friendly sign to let you know something was wrong, you’d have fared much better in that situation. Pain is there to help keep you safe. It is a good thing to have.

The problem is training with pain. Training with pain is not normal and the pain felt is our body trying to notify us of something. Sure, having muscular soreness after training and the discomfort of fatigue while training is normal, but don’t kid yourself. If you or one of your athletes are having pain, we need to do something about it. We can’t ignore it and hope it goes away. We’re better coaches then that.

Pain is all created by our brains. If we had no brains, we’d have no pain. We used to think that we had pain receptors in our bodies that when stimulated automatically sent a pain signal to the brain and we felt pain. Now we know that this process is a bit more complex.

In our bodies we have small receptors in all of our joints and muscles called nociceptors. The job of these nociceptors is to send potentially damaging information up to the brain. In the case of the glass in your foot, nociceptors were activated and they sent this information to the spinal cord. Once this information gets to the spinal cord it is processed again and if deemed worthy continues to pass to our brain. Our brain then processes this information again and determines if the information coming from the foot is worthy of creating pain.

Having a large shard of glass in your foot creating substantial bleeding is certainly something that is alarming to the brain. Because of this we’ll most likely experience some pain.

In our bodies we have thresholds for pain. Take sitting on a hard rock for example. If we sit on a hard rock there is surely less blood flow that gets to the muscles of the buttocks. If we sit there motionless for hours we’ll develop a pressure sore.

However, we don’t feel pain as soon as we sit down. As soon as you sit down the nociceptors are sending information to the brain that the buttocks are not getting blood flow. Initially this is not dangerous and our brain chooses not to produce pain. Five minutes later we continue to sit pain free on the rock. All the while these nociceptors are sending more and more information to the brain. Another 5 minutes go by and now your buttocks are starting to get sore.

You’ve reached a threshold where now the brain is concerned you’ve been sitting too long and it’s time to move. What important to understand in this situation is that there is a threshold for when pain starts.
This doesn’t necessarily mean that you’ve caused damage to your butt muscles just yet, but if you continued then there is a good chance you will. Once again, your brain is trying to protect you.

The same thing goes for too much work in the gym. Let’s say you’re doing a lot of squatting one day in the gym. At first your knee feels fine. After a few sets the knee starts bothering you and continues to worsen as you continue working through the pain. You’ve hit a threshold and now your brain is giving you the signal that something is wrong and expects you to change your activity because of it.

Let’s continue with the above squatting example. Let’s say you continued squatting through the pain. Now your knee is irritated and for the next few days is sore with squatting, lunging and going up and down the stairs. What is happening now is that your knee is extra sensitive. After an injury your brain is attempting to protect you. It creates pain so you don’t go ahead and do anything stupid that may cause more issues in your knee. Because of this certain movements like squatting and stairs can make you more painful.

Pain in your body can be thought of as an alarm system.

Before Pain

Before you’ve experienced any pain in your knee (prior to your squatting incident) you’d have to do a lot of knee intensive work to ever experience any knee pain. Perhaps you’ve never experienced knee pain before despite all of the training you’ve done in the gym. This is the situation displayed above.
After you’ve gotten an injury your knee will most likely feel more like this image. You might be able to go up and down the stairs and walk without pain but anything that stresses the knee in the gym hurts. Basically you can’t do much before you hit a threshold and the knee starts hurting.

So how do we address this sensitive knee?

Well, to start we need to de-sensitize the system. Pain is all generated by the brain. Your brain can be thought of similar to your boss at work. Let’s say I go to work late every day. I don’t get my work done on time, customers are complaining about my attitude and I’m not completing my work projects in a timely fashion. If my boss didn’t fire me outright, he would certainly be on my case about everything. He’d regularly check my time card, double check all of my work and monitor interactions with customers.

Now, what if I started doing my job properly. Let’s say I started showing up early, completing all of my projects in time and started getting rave reviews from customers. My boss would be happy with me and stop checking in on me so regularly.

Pain in the body works in a similar way. If I stop doing irritating movements that create knee pain, work to fix any strength deficits or imbalances and slowly work my way back into the previously offending movements my knee pain will potentially go down. Just like at work, if you do everything correctly your pain levels should go down much like your boss will leave you alone if you’re taking all of the steps to improve.
Our goal is to be like the stellar employee. We want to figure out what is good for the knee and what isn’t and begin down the path of getting better.

What is Pain for Our Athletes?

As we spoke about earlier, muscular soreness or discomfort that comes with fatigue while training and in the 48 hours following exercise is normal and desirable. What isn't normal is any sort of pain that isn’t associated with normal training discomfort.

Your athletes need to know what is alright and what isn't. Here are a few examples of situations that you shouldn’t be training through:

• Any sort of pain not associated with muscular soreness or training fatigue is not normal
• Having sore and achy knees the day following a squat workout is not normal (Some people don’t experience any pain during training but experience pain the following day instead)
• Needing 20 minutes to loosen up a “tight” shoulder joint so that you can train normally is not normal
• “Tightness” felt near a joint that isn’t felt in the right area is not normal
  ◦ Tightness felt in the top of the shoulder during kipping or overhead press
  ◦ Tightness felt in the front of the hip during a deep squat
• Pain or discomfort that forces you to change your technique during lifts is not normal

Keep in mind that pain is very subjective and will vary greatly from person to person. You’ll most likely see individuals that call their muscular soreness (delayed onset muscle soreness) extreme pain and then on the other side of the spectrum those that don’t call anything pain unless it is greater than 7/10 on a pain scale. For some of these individuals you’ll have to dig a bit deeper to see if they’re really experiencing something they shouldn’t be pushing through.

Another interesting phenomena is that some people feel no pain in their bodies while training. They feel it more that night or in the following day or two. These individuals need to take note of the movements performed the day prior and use a bit of detective work to determine offending movements.

How Do We Get Out of Pain?

First of all, if you or any of your athletes are ever concerned they are experiencing pain, it is always a smart idea to refer out to a healthcare practitioner trained to help these people. Pain is complex and there are people out there that have devoted their entire career to helping these people out. Developing a network of healthcare professionals to treat your athletes in need is helpful for a variety of reasons:

• It shows you care about athletes enough to point them in the correct direction
• Athletes get better faster (or they get better when previously making no progress or worsening)
• They get peace of mind that nothing more serious is occurring in their bodies (And if there is then they’ll know it and the proper steps can be taken)

After you’re working with a knowledgeable provider, our goals are to:

• Take away offending movements
• Reduce the alarm system and allow tissues to heal (Remember the boss example from above)
• Re-build capacity slowly and progressively

Over time things heal if the problem is not exacerbated, the offending issue is dealt with and the brain
doesn’t perceive a threat anymore.

At the most basic level we’re trying to calm things down and then build them up afterwards.

### What is the Doctor's Role?

A pretty universal piece of advice for people in pain is to see a qualified healthcare professional.
Coaches need to recommend their athletes go through this step. It’s a no brainer and should be done.
However, it can be a frustrating process. Often times a physician’s advice will be to stop performing the
activity that created the injury in the first place, often blaming the activity for the problem. The physician
can also blame the coach and the training program which creates distrust between the athlete and their
coach.

• “Oh, you were doing kettlebell swings? Of course that’s why your back hurts”.
• “You lifted how much? No wonder your knees hurt. You guys really help us stay in business”.

Another common situation is having a physician with little to no experience treating athletes that enjoy
engaging in intense weight training and fitness. Sometimes this leads to poor advice coming from the
physician and poor patient progress.

• “Now I don’t want you to go back to the gym and doing any clean and snatches.”
• “Now when you go back don’t lift anything heavier than 25 pounds”

These recommendations obviously are not helpful but it happens frequently. This leads to more distrust
between coaches and healthcare practitioners as well as equally confused and frustrated patients.
Finding a qualified professional who understands the athlete’s sport, trusts the referring coach and is
willing to work toward the patient’s goals is a must. You’ll definitely have to search around for good doc-
tors, but when you find one it will all be worth it.

### So What Can a Physician Do for Your Athletes?

#### 1. Get Athletes Out of Pain

One of the most important things these professionals can do is to get athletes out of pain. The goal
is to drive down the alarm systems in the body so athletes can get back to what they want to. These
practitioners are experts in techniques to speed the rehabilitation process up and provide short term
relief. Common treatments may consist of soft tissue work like massage, instrument assisted soft tissue
mobilization, dry needling, pin and stretch, joint mobilizations, manipulations and stretching. These
techniques seek to reduce sensitivity and can be a pivotal piece of rehabilitation.
A good practitioner serves as a coach for the athlete in pain. They determine which movements are good to perform in which amounts and what frequencies. They know when to push their athletes and when to back them off. They’ll know the right modifications to use and how to progressively return to previously painful movements.

2 Evaluate the Athlete

Bodyparts don’t start hurting for no reason. These practitioners serve as detectives in the process of figuring out the root cause of an athlete’s pain problem. A savvy practitioner can accurately determine the area involved in the injury, the mechanism of injury (how the injury occurred), the reasons why the athlete got injured and come up with a plan of care to return the athlete back to training.

Therapists and chiropractors are experts at evaluating movement and identifying causative factors for the injury. Maybe this is a strength issue or imbalance? Perhaps the athlete has not build enough tissue capacity for the amount of training they’re currently attempting? With this information they can provide a treatment program to get the athlete out of pain and keep them that way with training.

What is the Coach’s Role?

Now that we’ve referred out and found help for our athletes we can get to the juicy stuff. What can we do as coaches? Well, we’ve already started on the path. The first step is simple, we just need to understand what pain is. We’ve already covered this in depth in the chapters prior. For a refresher head back to those sections.

Next we need to determine who’s actually having pain. This may sound silly, but it’s often unclear from a coaching perspective. At the start of each class I coach I like to ask if anyone is hurting today or if any of the movements in the workout look like they’ll cause any pain.

This may seem pretty straight forward but often times athletes in pain won’t speak up. Some people expect to have pain while training and accept it as normal. Some athletes are intimidated by the coaches and don’t want to admit pain. Others just don’t want to inconvenience the coach with their issues.

As a therapist I listen to a lot of histories of how these injuries start. There is generally a period of time where these injuries are developing and communication between the coach and athlete is lacking. Over time the pain gets bad enough where it’s not a simple fix anymore and they’ll speak up to someone. You might have to dig a bit deeper to find these athletes and develop a culture in the gym that is sensitive toward handling athletes in pain.

Another useful tool for the coach is learning what an athlete in pain looks like. A wincing face could be a sign of fatigue or a sign of pain. Other athletes will rub a sore joint after an aggravating movement. Some athletes will perform extra “warm-up” for a “tight” joint throughout the session.

Pain also changes movement. If you see an athlete shifting their weight to the right when squatting
perhaps the left knee hurts and they’re offloading the painful side during the movement. Some athletes might short the backswing of a kip not because they’re stiff but because that extra movement causes pain. Maybe the lacking depth in a squat is due to pain in the hole and not a lazy athlete. The first thing to do in this case is to ask if pain is creating this problem. If pain isn’t a player then we know we’ve got to correct their technique, give a regression or prescribe some mobility depending on the situation. If we treat a pain problem like a mobility problem then we aren’t being effective coaches. We may even be making the situation worse.

Again, each athlete is an individual. Some athletes will only report anything over a 9 out of 10 as pain. Everything else is tightness. For others, sore muscles from training are extremely “painful”. You’ll have to read the athlete and give the right advice. This is certainly an art.

Also remember that joint pain the day following a training session is not normal. For example, some individuals with knee pain won’t feel any pain during a training session but will have sore knees the following day with stairs and deep squats. Athletes need to be educated that this is not a normal or favorable thing.

Athletes also need to be educated about where they should feel stretches and strength training movements. It sounds silly but some athletes will think pain is the “stretch or stress” sensation they’re looking for. Some examples:

• A pinching sensation on the top of the shoulder during “lat” stretches
• Tightness in the front of the hip during deep squats
• Tightness behind the knee cap during deep squats and lunges

If you find an athlete with issues as explained above, it’s probably time to refer out to a physician.

After we’ve referred out, what’s next? For one, open up a conversation with the treating professional. It’s going to be a beneficial conversation for all parties involved. The therapist gets valuable information about the athlete from you. The therapist can give you their opinion, what to focus on and what to avoid for the time being. Having a coach as well as a therapist pushing the athlete to perform their home therapy exercises helps to improve compliance. The athlete feels cared for and is excited that they’ve got an entire “team” working on their injury and goals. Ultimately this communication sets the athlete, coach and treating professional up for successful rehabilitation.

Next our job is to allow things to settle. We’re looking to decrease the alarm system. One of my favorite sayings comes from my mentor and physical therapist Mike Reinold. We’re looking for “addition by subtraction.” Basically what that means is that by taking away offensive exercises and lifestyle activities we allow things to settle and make progress. Particular movements or habits (think sitting for low back pain) can keep an area sensitive. If we remove them we progress by the virtue of elimination.

If kipping pullups create your shoulder pain and we continue pushing through them your risk of hurting yourself further increases. If we take them out of the program temporarily, we start slowly feeling better. Just keep in mind that simply taking offending exercises out of the program for some time and then injecting them back in later at the same intensity and volume doesn’t always work. You’ll need to slowly introduce the movements back in, often times at a lower level of difficulty.

Potentially your technique is also off or you have another restriction that is leading to continued pain. Make sure you work closely with the athlete and therapist when attempting to return athletes back to training to ensure you’re checking off every box to ensure the athletes returns safely.
Keep your clients moving and not afraid. Our goal is to keep our clients healthy and progressing towards their goals. What we don’t want to do is stop training completely (However, most will need to modify). Fear of training can be healthy in that it can keep athletes from performing things that further irritates and potentially damages the injured area. Excessive fear can do the opposite. Fear and anxiety that keeps athletes from moving altogether and creates false beliefs about their injury is a bad thing. Keep them moving and make the modifications to continue training pain free.

Slowly rebuild tissue capacity. Tissue capacity is a term popularized by respected tendon researcher Jill Cook. Essentially, the structures in our bodies need to be prepared adequately for the demands of our sports. Think of the amount of hamstring strain injuries that occur in weekend warriors that attempt to go out and sprint for the first time in 15 years. They haven’t adequately built the tissue capacity required to sprint without injuring their hamstring.

Coming back from an injury is no different. We have to rebuild tissue capacity. If it’s been some time since your athlete has performed a given movement then chances are we’ll have to start with easier movements at a lower intensity and slowly build back to where we were before with our training. We can’t expect to take extended time away from a particular movement and then randomly throw it back into your training at the same capacity at some point just because you’re feeling better. Often times this leads to a recurrence of the same pain and more frustration from the athlete. Our goal instead should be to slowly reload the injured area slowly and cautiously. This will require careful attention to programming with specific modification. In the modification sections below we’ll talk about additional examples to accomplish progressive return of athletes to training.

As a last piece of advice we also want to figure out what the root cause of the problem is. This could come from programming errors such as throwing too much at the athlete all at once or from poor technique in a given movement. We’ll have to become detectives to determine the causes and correct them.

Injury Prevention and Keeping Athletes Safe

Recent research from Tim Gabbett is illuminating a few key concepts about keeping our athletes safe and reducing risk of injury. The first key principle is to reduce spikes in training volume. What this means is avoiding large increases in volume or training load at any point during training. Tim’s research shows that increases in training workload resulted in increases in risk for injury. This can easily be applied to our population. We’ll want to avoid spikes in total training volume as well as joint specific training volume. Here are some examples to be aware of:

1. Any particular spike in total volume of training or introduction of new unfamiliar skills
   a. Beginning an olympic lifting program (especially on top of a normal training schedule)
   b. Increasing squat volumes (Smolov and Hatch programs)
   c. Hero WODs and chippers (any workout containing more total volume then what your population is used to)
   d. New members (especially those with no history of recent fitness experience)

2. Old members returning after a break in training
   a. These members may want to pick up exactly where they left off but chances are they’ve lost
some tissue capacity in their time off
b. Athletes returning from long vacations

3. Members who come infrequently
   a. Encourage regular training
   b. Modify movements that athletes are incompetent in
   c. Modify set / rep schemes and volume for movements athletes are prepared for

4. Spikes in Joint Specific Work
   a. Increasing handstand pushup frequency to improve skill and strength
      ○ Extra strength work is great but ramp slowly and be mindful of total work in their normal program
   b. “Randy”, “Karen”, “Murph”
      ○ Members may not be ready for the large increases in volume over a single workout

With this concept in mind it becomes incredibly important to introduce new movements and volume slowly and progressively over time. Hero workouts and chippers are not bad workouts. Hatch and Smolov are not bad programs. They should just be slowly introduced into your programming.

The second concept Tim Gabbett has illuminated is that maintaining a high volume of training can be protective against injury. If athletes are not thoroughly prepared for what’s being thrown at them on a regular basis then the risk of getting injured when tough workouts or competitions pop up increases. It makes sense, prepare the body adequately for the demands of our sports and activities and we’ll be more resilient.

Just keep in mind that our bodies can handle a finite amount of work and even elite athletes will be prone to overuse injuries with too much total work. This amount will be different for each individual and unfortunately we often won’t know how much work an athlete will be able to handle until they start breaking down (pain and injury).

Periodization

Another key to athletic success and injury reduction is periodization. Now, entire texts have been written about periodization and this book is not made to help you understand how to periodize for athletic success. However, several aspects of periodization can help us improve over time and decrease injury risk.

Get Athletes Out of Pain

Programming time off for your athletes after a competitive season provides much needed psychological and physical rest. This helps to restore the endocrine and immune system while improving emotional and psychological well being. This time off is also great to help unload joints and muscles. Just ensure your return to training after time off is slow and progressive in nature. Remember our talk about avoiding spikes in training volume earlier.
2 Varied Yearly Training Periods

Doing the same thing day in and day out in the gym is no recipe for success. Our bodies require time to adapt to a given stimulus (muscle growth, strength and endurance improvements) but if there is not enough variation we stop making progress. This is known as accommodation (reference). Because of this we want to vary our training throughout the course of the year.

The other reason to provide variety in training is to help prevent overuse injury. Certain sports produce specific stresses on the body. For example, distal clavicle osteolysis is an AC joint (joint in the shoulder girdle) dysfunction seen very commonly in powerlifters. It occurs because of the very specific stresses on the shoulder during bench press. It stands to reason that if we do too much bench pressing we can irritate our AC joints. Tommy John surgery is very specific toward baseball athletes because of the unique stress on the ulnar collateral ligament from throwing. Because of the specific stresses that occur in a sport certain areas are prone to increased stress and damage.

One way to mitigate this stress is to vary the exercise stimulus throughout the year. Let’s use the powerlifter as an example. Throughout the training year we can have times where we avoid barbell bench for periods of time. We can consistently change the main pressing movement by using different types of bars, different width grips and different pressing angles. We can alter the sets and reps as well as the bar speed. All of these things serve to vary the stress on the shoulder enough to avoid overuse and avoid accommodation. We want to apply the same idea to our training program.

One of the easiest ways to do this is to split your training up over the course of the year and determine what are the most important aspects to focus on at each portion of the year. We’ll use the goal of preparing for the Crossfit Open as a goal for the training year.

Early Off-season (April and May)

1. Emphasis on deloading overused movements
   a. squats
   b. overhead press
3. Emphasis on strict movements
   a. Strict Pull-ups and Dips
   b. Romanian Deadlifts
3. Implementing more variety in training
   a. Novel movements (Sandbags, carries, crawling, climbing, throwing, jumping)
   b. Working on multiple planes (Front and Transverse)
      I. Rotary throws
      II. Lateral Lunges
      III. Shuffling, change of direction drills
   c. Hypertrophy and tempo work
      I. 3 sets of 8-12
      II. 2-3 second lowering phase
      III. Paused reps
Mid to Late Off-season (June - October)

1. Re-introduce dynamic movements
   a. olympic lifts
   b. dynamic gymnastics (kipping)
2. Focus on maximal strength
   a. Bench, squat, deadlift
3. Skill Work
   a. Strict Muscle-ups
   b. Handstands
   c. Handstand Walking

Pre-season (November - January)

1. Specificity of training
   a. More specific met-con work
      I. Similar energy system
      II. Similar time of workout
      III. Similar exercises (couplet / triplets)
         1. Overhead Squat and Pull-up
         2. Rowing and Thrusters
   b. Bring skills into conditioning environment
      I. Kipping Muscle-ups + Wall Balls + Double Unders
2. Volume build up - Get the body prepared for the amount of volume seen in competition
   a. Slow ramp up to:
      I. Chippers
      II. High volume wallballs
      III. High volume pull-ups
3. Tapering - gentle reduction in training volume in order to peak for competition

In-season (February - March)

1. Maintenance - to keep progress made over training year without affecting ability to perform during competition

In the above outline you can clearly see where we are purposely either pushing or avoiding certain movements. This is ok. We aren’t supposed to be able to peak at any given time throughout the year. In this case we want to peak for the open. It means that during parts of the year our conditioning may be lacking. It may also mean that during parts of the year you’ll be stronger than others. Ultimately I believe this style of training will maximize your ability to peak while also reducing your risk of injury.
Individualization

It’s also important to understand that people are individuals and because of this training must be different from one individual to the next and modifications will have to occur. One of my favorite lessons to tell my patients is some advice I gleaned from Paul Buono. Paul was captain of Crossfit Milford in 2015. Crossfit Milford was the #2 team place winner at the crossfit games in 2015. He’s also an old co-workers and good friend. Paul once told me that he modifies almost every single workout that his coaches write for him. This is because he understands his body. He knows when to push and when to back off. He works around injuries. He has a smart approach to his training. If Paul modifies something almost every training session then we should probably be modifying also.

What one athlete can tolerate and is optimal may be totally different than what another athlete can. This goes for both performance and avoiding injury. One athlete may make the most progress training 5 days per week while another may make the most progress with 3 days per week. The same athlete who progresses at 3 days per week may start to break down and get injured on a 5 day per week program.

Tolerance to exercise is also joint specific. One athlete may be able to handle squatting 3 days per week and another may only be able to handle 1-2 days per week or else their knees will start hurting. For another athlete maybe their low back is the limiting factor in how frequently they can squat. For others maybe deadlifting is the limiting factor and not the squat. It changes for every person and every exercise. For most people it is a learning process that will be fine tuned over time as long as we listen and learn from what our body is telling us. Keep in mind that generally the volume we can tolerate will improve over time as long as we periodize and progress properly.

Some individual considerations to take into account when developing a training program:

- Goals
- Prior training experience
- Age
- Injury history (old shoulder injuries, low back pain etc..)
- Nutrition
- Stress
- Sleep
- Work / life balance

Learn From Your Mistakes

Inevitably, people are going to get hurt in the gym. Obviously we don’t want this to happen but like any other mistake in life, it’s a great time to learn. Did someone rupture an achilles performing high rep box jumps? Maybe you should have programmed more reactive jumping earlier in their off-season. Maybe they have no ambitions of being competitive. Perhaps they should have never been performing higher rep rebounding box jumps.

Having trouble with people pulling hamstrings during sprints? Potentially add in several weeks of build up runs before attempting maximal running with your athletes. Maybe add in more hamstring strengthening into the accessory work of your program.
Having a lot of painful shoulders in the gym? Are your screening your athlete’s overhead mobility and modifying overhead work for those who are lacking? Are you programming too much shoulder intensive work into the program? Are you avoiding spikes in total volume?

Let’s face it. It’s a terrible feeling when someone gets hurt in the gym. It’s the exact opposite of what we wanted to accomplish but it happens. Despite all of our best efforts it’s going to happen sometimes. When it does it’s a great time to reflect and figure out why it happened. Was it something that could have been avoided? Was it an issue with the programming? Was it a technique issue? Was it a supervision issue? Whatever it was, it’s a valuable opportunity to learn and improve your program.

Works Cited:

- Therapeutic Neuroscience Education by Louw
- Explain Pain by Butler and Moseley
- Science and Practice of Strength Training - Zatsiorsky

Modifications

This next chapter we’ll get into the meat and potatoes of the book. When working with the athlete in pain, one of the most potent tools you can use to help them is modification. Remember that part of our goal is to keep our members moving and not exacerbate their pain. If we’re smart about the modifications we use we can continue working toward our athlete’s goals and not worsen their pain and allow the sensitive areas to heal and recover. We’ll be going over each basic movement to be modified, some common injuries we encounter, common mechanisms of injury and ways to modify for these athletes.
Shoulder Impingement Syndrome (Subacromial Impingement Syndrome or SIS)

Shoulder impingement is the most common shoulder injury we see in the clinic. To understand what shoulder impingement is we first have to understand the anatomy of the shoulder.

In the below picture we have the shoulder joint. Here are the key structures:

![Shoulder Anatomy Diagram]

Source: wikimedia commons
1. **The Humeral Head** – This is the top portion of the bone in your upper arm. Normally it should stay snugly fit centered into its socket, the glenoid fossa

2. **Acromion, Coracoid and Coracoacromial ligament** – These structures sit above the humeral head and between the ball and socket providing a small space aptly named the subacromial space.

3. **Supraspinatus Tendon** (part of the rotator cuff), long head of the biceps tendon and subacromial bursa - These structures sit between the humerus and the acromion in the subacromial space as seen above. These are the structures that get impinged upon with this syndrome.

Based on our knowledge of impingement syndrome several things can be occurring:

1. The rotator cuff and scapular musculature is not holding the humeral head firmly into the socket. Because of this the humeral head translates superiorly (goes up) and the contents of the subacromial space gets pinched against the acromion and humeral head. Part of the rotator cuff (supraspinatus), biceps tendon and subacromial bursa are the victims of the impingement. These structures get irritated initially creating inflammation and resulting tendonitis. Over time this stress can create more long term issues such and tendinopathy and eventually rotator cuff tears.

**Understanding Force Couples and Impingement**

Something called a force couple helps to illuminate why overhead pressing can be painful in those with shoulder pain. With overhead pressing the deltoid muscles are heavily involved. Because of the location of the deltoid (Where it originates and inserts), the deltoid tends to pull the humeral head “up” or superior in the shoulder joint when we press overhead.

The job of the rotator cuff is to keep the humeral head centered in the socket. If the rotator cuff is dysfunctional or overpowered by the deltoid then you get the humeral head elevating and pinching (impingement) on the rotator cuff. If the contents of the subacromial space are irritated and sensitive we can have pain. Notice in the picture above you can see how the deltoid is imparting an upward force on the humeral head whereas the rotator cuff pulls the humeral head tight into the socket. Too much deltoid without control from the rotator cuff and the humerus raises up pinching the rotator cuff, biceps and bursa against the acromion.

*Note the direction of pull of the deltoid and how it would cause the humerus to translate superiorly*
This is a vicious cycle. Weakness or dysfunction of the rotator cuff can create shoulder impingement. Impingement and pain can make the rotator cuff even more dysfunctional. When in pain the shoulder musculature generally doesn’t fire appropriately. This potentially leads to more impingement and more dysfunction. The cycle continues until we do something about it.

Now you can see why the rotator cuff is so important with the health of the shoulder. If you have someone with shoulder pain it stands to reason we have to be careful to eliminate shoulder pain during exercise so the rotator cuff can calm down and regain function.

Understanding the Painful Arc of Motion

The next important topic to understand is something called the painful arc of motion. In normal overhead elevation we naturally have decreased subacromial space as we bring our arms overhead. This is normal and natural. However, when the contents of the subacromial space are sensitive it can create pain in a predictable pattern. The reason for decreased subacromial space is due to the angle of pull from the deltoid. When the arm is below 90 degrees of motion the deltoid pulls the humerus superiorly (up) into the acromion. When the arm gets up past 90 degrees the deltoid now pulls the humeral head more into the socket, no longer pulling the humerus superiorly.

The painful arc displayed in the dumbbell press

The painful arc generally occurs in the range of 70 to 120 degrees of overhead motion. Keep in mind that this varies from person to person. However, people with impingement syndrome are generally most painful in the mid range of overhead motion and not at the top range.

It’s also the reason why pressing overhead can be painful but keeping a weight locked out at full flexion overhead may be well tolerated. These are the athletes that report that snatching is not painful but push press is very painful. This is because in a push press the shoulder is producing force through the painful arc where stress on the rotator cuff is at its highest. During a snatch the power to get the weight overhead is generated by the lower body. Your shoulder is essentially unloaded through the painful arc and then gets loaded again as we catch the weight fully overhead. This is an important implication be-
cause our athletes with painful shoulders may be able to perform movements like a snatch when they can’t perform pressing.

**Overhead Press vs. Horizontal Press**

In the overhead press you can clearly see that the shoulder goes all of the way through the painful arc of motion. In the bench press the shoulder more or less stays outside of the painful arc. Because of this, horizontal pressing variations like the bench press are often better tolerated than overhead pressing in painful shoulders.

Also, in overhead pressing the pull of the deltoid is angled to pull the humeral head superiorly. Check back to the above images on force couples for a refresher. In horizontal pressing the pull of the deltoid is more anterior (forward). This is because the anterior deltoid is so active during horizontal pressing and the orientation of those muscle fibers will pull the humerus more forward than superior. For these reasons, some people with pain when pressing overhead can handle horizontal pressing without pain.

Just keep in mind that as we descend into the bottom of a dip, pushup or bench press the shoulder moves into extension. Based on our understandings of joint arthrokinematics we also know that extension of the shoulder will drive the humerus forward. Without adequate control from the rotator cuff the structures in the front of the shoulder get compressed.

Either way, both forms of pressing will stress the shoulder in a different way and we can use this information to help our athletes press without pain.
Why Jerks are Often Times Painless

The push jerk and split jerk is an interesting beast because sometimes we can get away with performing this pain free as long as we don’t have to lower each rep back down to our front rack. Why is this? Let’s go back to the snatch example. When we snatch we don’t load the shoulder through the painful arc. The power is generated through the legs and we catch the weight fully locked out. The same is happening in the push jerk. The power is generated for the lift through the lower body and then the weight is caught with the shoulders and elbows fully locked out. Because of this we aren’t loading the shoulder joint heavily throughout the painful arc. This is good news for us because sometimes our athletes with painful shoulders can jerk pain free if they drop each rep from overhead or utilize jerk blocks.

Rotator Cuff Strength and Fatigue

Obviously after reading the last section it should become apparent that the rotator cuff is extremely important. The goal is to ensure that the rotator cuff is strong enough to handle all of the overhead work we throw at it in the gym. The other important variable is rotator cuff endurance. If the rotator cuff fatigues during overhead work then it stands to reason that we may be creating some impingement as the rotator cuff is no longer able to control motion in the shoulder joint. Many people don’t start having shoulder pain until halfway through a tough set or shoulder intensive session. For the athlete that is coming back from a shoulder injury we need to keep these things in mind when designing a training program. If we throw a met-con at them with a lot of overhead pressing we may run into issues because the cuff is not as robust as we’d like it just yet. We need to slowly ramp up volume for these athletes. This can be as easy as decreasing total repetitions in a given met-con or breaking up your sets (especially if pain kicks in).

Shoulder Pain and Overhead Press Modification

Key Notes

- Overhead press is generally one of the toughest things to perform when painful. It often needs to be taken out of the program temporarily for painful shoulders.
- If you can’t find a pain free press variation, rowing variations are generally well tolerated and serve as a good modification. You’ll learn more about why overhead pulling is generally less painful in the vertical pulling section.
- Pressing in a more horizontal plane (bench press) may be better tolerated than overhead press.
- Reducing the load, slowing down the speed of the lift and increasing the reps can sometimes allow us to still get a training effect and eliminate pain.
Shoulder Pain Overhead Press Modification list

Variations start from most challenging to least challenging. Attempt to use the most challenging exercise that can be performed without pain.

1. **For Split Jerks**
a. Barbell Jerk → Jerk off Blocks → Snatch → 1 arm snatch → oly variant (Clean/snatch pull)

2. **For Push Press / Press**

3. **Handstand Pushup**
a. Handstand Pushup → Pike Handstand Push Up Feet Elevated → Pike Handstand Push Up → Knees on Box Handstand Push Up → Push Up → Horizontal Pull

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Accessory Shoulder Health Work

These exercises can be added to someone’s training program when they are having pain when pressing overhead.

1. Foam roll lats and teres major x 10 passes
2. Thoracic spine foam rolling x 10 reps
3. Ring rows 3 x 8-12 reps
4. Side lying external rotation 3 x 8-12 reps
5. Scaption / front raise 3 x 8-12 reps

**Perform 2-3 x per week in addition to regular programming**
Lower back (lumbar spine) pain is common with overhead pressing. Generally this occurs in individuals who like to extend too much and too frequently in their lumbar spine when performing overhead press.

What we’re interested in are the elements toward the back or “posterior” elements of the spine. In the back of the spine we have a lot going on. Structures back there include:

- Muscles and Tendons
- Ligaments
- Facet Joints
- Boney Structures

When we extend the spine, the posterior elements are compressed which can increase stress on these structures. If we perform enough repetitive extension we can end up in pain. Where I think we end up in trouble with overhead press is that we’re combining extension with compression (due to the weight we’re pressing overhead) which is a double whammy to these posterior elements.

Athletes who utilize a lot of extension of the lumbar spine during overhead activities are more at risk for something called spondylolysis and spondylolisthesis. Spondylolysis is a fracture of one of the posterior elements of the vertebrae. Spondylolisthesis is a fracture along with slippage of one vertebrae on the other.

These injuries are common in sports like gymnastics although anecdotally I’ve seen them occur in overhead pressing athletes. I’ve personally seen them occur in strongman athletes while performing log press. Log press requires quite a bit of lumbar extension and if you do it frequently enough, heavy enough and with poor enough technique it can damage your spine. This person in particular ended up going through surgery to correct the issue.

Being stiff in certain areas can also increase the stress on the posterior spine. These areas are the thoracic spine (limited extension), hip flexors (limited extension) and lumbar spine (limited flexion).
Fortunately for us, we can minimize lumbar extension during overhead pressing. Before we discuss how, let’s discuss why it occurs. Excessive lumbar extension during overhead press can happen for a variety of reasons:

• **Limited Overhead Mobility**
  ◦ Limited overhead mobility from the shoulder or thoracic spine will force lumbar spine extension as a compensation to get the weight overhead.

• **Anterior Pelvic Tilt**
  ◦ Tightness in the front of the hip and lumbar spine coupled with weakness of the core, hamstrings and glutes can lend to this position. Anterior pelvic tilt creates additional lumbar extension, which we’re trying to combat.

[Image: Note the belt pointing down and increased lumbar curve]

• **Strength and Motor Control Issues**
  ◦ Poor technique
    ■ Sometimes we just don’t have the best coaching available to teach us how to keep our spine in a neutral position when pressing overhead
  ◦ Your body’s attempt to find the strongest pressing position
    ■ Extending at the lumbar spine and leaning back before pressing allows our body to utilize bigger and stronger pressing muscles like the pecs. This increased extension may allow for more weight pressed overhead but potentially at the expense of your lower back health
  ◦ Too much load
    ■ This goes hand in hand with the above point. If we have too much load we’ll hyperextend at the lumbar spine to utilize stronger pressing muscles. Hyperextending the lumbar spine also can create some stability in the lumbar spine by compressing these posterior elements. Unfortunately compressing these posterior elements is not a healthy compensation.

As a coach we can often easily modify someone’s technique and often times quickly eliminate someone’s pain. This also means that as a coach we can prevent extension based low back pain if we know to avoid these hyperextended positions.
Press

![Image of Press]

*Excessive lumbar curve vs. neutral*

Jerk

![Image of Jerk]

*Excessive lumbar curve vs. neutral*
**Split Jerk**

*Excessive lumbar curve vs. neutral*

**Handstand Pushup**

*Excessive lumbar curve vs. neutral*
Lower Back Pain and Overhead Press Modification

Key Notes

- Attempt to eliminate pain by modifying technique, in some athletes this won’t work so utilize the modification list below
- Some athletes won’t be able to be coached into good positions simply due to tightness. If an athlete can’t correct movement with cues and the load is manageable you can begin thinking they may have mobility restrictions
- If you believe an athlete is overextending due to excessive weight, lower the load. These athletes generally have fine technique at lower loads and then the form worsens as the load increases.

Lower Back Pain and Overhead Press Modification List

Variations start from most challenging to least challenging. Attempt to use the most challenging exercise that can be performed without pain.

1. For Split Jerks

2. For Push Press / Press

3. Handstand Pushup
   a. Handstand Pushup → Pike Handstand Push Up

½ Kneeling Dumbbell Press  Piked Handstand Pushup
Accessory Lower Back Health Work

These exercises can be added to someone’s training program when they are having pain when pressing overhead:

1. Foam roll lats and teres major x 10 passes
2. True hip flexor stretch x 10 reps
3. Single leg glute bridge (neutral spine)
4. Split stance press RNT x 10 reps

**Perform 2-3 x per week in addition to regular programming**
Horizontal Pushing

• Shoulder
• Wrist

Horizontal Pressing and Shoulder Pain

Subacromial impingement syndrome is certainly a player in horizontal press variations. This can occur due to all of the reasons we discussed in the shoulder pain section with vertical pressing. The angle of pressing changes with horizontal pressing and because of that the forces on the shoulder are a bit different than overhead pressing but otherwise similar. Ultimately we’re going to need more rotator cuff strength and endurance.

What’s new in this chapter will be in the discussion of how certain positions of the shoulder can lead to impingement.

Positional Impingement of the Shoulder

Compression of the subacromial contents can occur due to lack of control from the rotator cuff but also due to the position of the shoulder blade and joint. This can occur from a lack of scapular control and strength as well as from mobility restrictions. Where we see this most often is in movements that require a lot of range of motion like a dip. Dips require a lot of extension of the shoulder joint to perform properly.

Chest up, shoulders back, extended spine

Shoulders rolled forward, upper back rounded, elbows flared out
If an athlete is missing extension range of motion at the shoulder we see several compensations in the bottom of the dip:

- Forward inclined torso
- Limited depth
- Excessive thoracic rounding
- Scapular anterior tilt
- Elbows flair out (Shoulder internal rotation)

The same can occur in the bottom of a pushup as well.

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**Shoulder Health Side Note**

Pushups require much less shoulder extension than a dip. You’d have to be very immobile to compensate in a pushup due to mobility restrictions. Because of this, most people that compensate in the pushup do it because of a lack of shoulder strength and stability. Learn more about this in the sections below.

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Let’s delve into why this is bad from a shoulder health perspective. In the bottom of a dip as we run out of shoulder extension motion, we begin making this up with scapular anterior tilt, shoulder internal rotation (elbows flair out) and thoracic flexion. Basically the upper back rounds and the shoulders roll forward. Thoracic flexion coupled with scapular anterior tilt will bring the acromion down toward the humerus. This decreases the subacromial space impinging upon shoulder structures. Internal rotation of the shoulder brings the greater tuberosity closer to the acromion further increasing impingement. So far, this isn’t looking too good but it’s not over yet. Based on our understandings of joint arthrokinematics we also know that extension of the shoulder will drive the humerus forward. In the bottom of a dip we’re driving the shoulder into end range extension thus pushing the ball forward in the socket. If the rotator cuff is not adequately controlling motion in the joint we may get even more forward motion of the ball in the socket. Given all of the factors we just discussed it’s little wonder that the front of the shoulder can get painful sometimes in people doing dips.

***Shoulder Health Side Note***

Think about the structures that lie in the front of the shoulder. The main area that comes to mind is the long head of the biceps tendon. The long head of the biceps is anatomically prone to dysfunction. The long head of the biceps tendon sits inside the bicipital groove, giving it less access to blood supply. The long head of the biceps tendon (Pictured in red below) also makes a sharp turn as it leaves the bicipital groove on the way to its origin (The supraglenoid tubercle). Because of this angle of pull the tendon may be more prone to pathologic changes over time (Tendinopathy). Biceps tendonitis has been shown in the medical literature to be associated with rotator cuff tears, particularly the subscapularis. It makes sense, one of the main jobs of the subscapularis is to prevent forward translation of the humeral head (the ball coming forward in the socket). If the rotator cuff (the subscapularis in this example) is not working properly, the long head of the biceps can be compressed and take more stress.
It’s not all about mobility

We just made a big stink about limited mobility lending to shoulder problems in the dip. However, athletes don’t have to have limited mobility to end up in poor positions when performing dips, pushups, kipping and muscle-ups. Remember the pushup example earlier in this section. We see athletes all of the time that find themselves in poor positions in the bottom of dips and pushups and have no mobility restrictions at all. Keep in mind that athletes will default to poor positions for a multitude of reasons:

1. Attempting to find ideal length tension relationships of muscles
   a. Muscles tend to be strongest when they aren’t either fully stretched out or fully shortened. Sometimes our technique reflects our body trying to find the strongest position of a muscle to produce force.
   b. Example: Athletes may incline their torso forward in a dip because it puts the pecs and anterior delts in a stronger position to produce force

2. Utilizing passive stability of the shoulder to improve strength
   a. The shoulder capsule (mainly the inferior and middle glenohumeral ligaments during shoulder extension) provide a lot of stability in the shoulder joint while performing shoulder intensive movement. Sometimes our body’s will adopt certain positions to best utilize the stability of these structures. Think of relaxing into the bottom of a dip. The shoulder capsule is going to help prevent movement in the shoulder when the muscles are not active. Theoretically the capsule will take more stress if the musculature supporting the shoulder is not strong enough or if the musculature fatigues before the set is complete. Just keep in mind that relying on this system excessively may lead to stretching of the structures and instability of the joint.
   b. Example: Athletes may reach their shoulder forward in the bottom of a pushup to gain stability from the shoulder capsule and get a few more reps

3. Defaulting to prior strongest motor patterns
   a. If you’ve spent years performing a given movement in a specific way you build muscle memory around your technique. Your body gets strong performing this movement in the way you’ve practiced. The trouble is, sometimes the technique we’ve practiced for years is not the best from a performance or joint health perspective. Making a change is going to require lowering the weights used on a given lift or regressing the difficulty of the movement until we’ve built strength in a better position.
   b. Example: Some athletes may flair their elbow out wide on pushups because that’s they way they’ve always trained pushups and it’s currently their strongest position

4. Never being coached on optimal biomechanics
   a. Sometimes it’s as simple as never having a good coach to cue you how to move properly. In this case after a few cues the movement is stronger and safer.
   b. Example: A few cues for elbow position during bench press may make the athlete feel immediately stronger and can complete more reps during a given set.
Mobility is step #1

If someone lacks range of motion at a joint then the first step is to improve this. This goes for all other movements as well, not just horizontal pressing. We won’t be able to learn proper motor patterns, technique and build strength and stability if we don’t even have the mobility to get into the right positions. Keep in mind that after someone improves their mobility it doesn’t mean they’ll automatically improve their technique. Chances are they’ll default right back to their old habits once the exercise becomes too challenging. We still will need to continue cueing and correcting our athlete’s movement and chances are we’ll also have to regress the exercise difficulty to where technique can be solidified. Then we can slowly progress our athletes back to the more challenging movements (Ring dips, Muscle-ups etc.)

5 Steps to Success

1. **Full range of motion** - Full joint and muscle mobility in all areas required to perform a motion properly
2. **Learning ideal positions** - Building ideal technique and motor control with low level easy to perform movements
3. **Slowly loading ideal positions** - Building strength and stability in proper positions
4. **Transfer to more complex motions** (Muscle-ups, ring dips)
5. **Build endurance for carry-over into met-con**

Correcting Dip Problems

1. **Pec Major / Minor, Anterior Deltoid, Thoracic Spine Mobility**

2. Positional Correction Drills
   a. Tabletop
   b. Assisted Dips
   c. Crab Walks
   d. Muscle-up Transition Drills

3. **Loading P-bar and Ring Dips**
   a. Tempo (Slow lower)
   b. Paused Reps (in bottom of dip)

4. **Muscle-ups, Front Uprise**

5. **Introduction of fatigue with these movements**
Correcting Pushup Problems

1. Regress pushup difficulty and coach optimal shoulder blade position

Subacromial impingement syndrome is an issue with horizontal pressing variations but not always in the same way as with overhead pressing. (For a primer on subacromial impingement syndrome see the section on overhead pressing and shoulder pain) Here’s why.

Varying Angle, Grip and Bar to Alter Pain

Sometimes when we modify our grip (narrow vs. wide), change the angle that we press (incline press vs flat bench press) or change the barbell (neutral grip vs regular bar) we can eliminate pain when pressing.

When we change the angle or barbell we’re also stressing the shoulder in a slightly different way. Maybe a sensitive part of the rotator cuff is no longer being compressed or stressed in the same way when we alter these things. Either way these tricks can be a powerful way to allow a sensitive shoulder to heal while continuing to train.

Changing Technique to Reduce Pain

In a typical powerlifting style of bench press the idea is to bring the shoulder blades back and down while bringing the chest up towards the bar. This technique extends the thoracic spine, locks the shoulder blades into retraction and posterior tilt thus increasing subacromial space. This technique also shortens the range of motion the bar has to travel. Each of these factors may allow your athlete to press pain free.
Distal Clavicle Osteolysis

Subacromial impingement syndrome isn't the only commonly seen issue with shoulders. The other common issue with horizontal pressing (particularly bench press) is something called distal clavicle osteolysis.

Distal clavicle osteolysis commonly occurs in people who lift weights and is essentially irritation to the AC joint which over times leads to degenerative damage. It is theorized that hyperabduction and extension of the shoulder under load places increased traction forces on the AC joint. The deeper into a dip and bench press the more the more extension we get and the more stress on the AC joint. These stresses are also worse with a wider grip. As the grip widens the degree of hyperabduction increases and with it the stress on the AC joint.

Over time this repetitive micro-trauma creates damage and resulting pain with disability. These patients generally present with pain right over top of the AC joint and pain when bringing their arm across their body. It usually worsens with pressing movements and can be worse the night following a day with a lot of pressing.

I personally see this issue in individuals who perform a lot of deep dips and bench press (particularly with the elbows flaired out). It can either be something that occurs slowly over time or often times occurs with 1 rep gone wrong in a heavy dip or press.

Now, your job as a coach is not to diagnose the issue. It’s just important that you’re aware this may be going on. What’s important for this athlete is to avoid pressing that creates pain while the area calms down. Some easy modifications we can try are:

1. Limiting Depth During Pressing and Dips
   • This allows us to avoid as much traction force on the AC joint
2. **Board Press, Decline Press and Floor Press**
   - These variations also serve to decrease the amount of shoulder hyperextension/abduction, reducing traction forces on the AC joint

3. **Close Grip**
   - Close grip pressing decreases hyperabduction of the shoulder, limiting AC joint stress

4. **Powerlifting Style Bench Press** [Picture flat vs power depth from side]
   - Tucking the shoulders blades back and down while reaching the chest toward the bar generally tucks the elbows closer to the body and limits the amount of extension at the shoulder when pressing. These things decrease AC joint stress

5. **Bands and Chains**
   - These variations place less stress on the shoulder at the bottom range of motion and more stress toward the top, decreasing AC joint stress

6. **Change the Angle**
   - Sometimes increasing the angle pressing (incline bench press) is enough to stress the AC joint in a way different enough to eliminate pain

7. **Switch to Pulling**
   - Pulling is normally well tolerated in these individuals and if pressing can’t be modified to eliminate pain then substituting rowing exercises for pulling works well.

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**Shoulder Pain and Horizontal Press Modification Key Notes**

- Lack of rotator cuff control as well as shoulder position can create impingement in these folks
- Attempt to eliminate pain by modifying technique as described above, in some athletes this won’t work so utilize the modification list below
- Pain can sometimes be eliminated by altering pressing angles, switching to dumbbells or other different barbells
- Slow down reps or increase the rep number can eliminate pain while still allowing a training effect
- In those with AC joint issues modifying the depth, grip, angle, technique or exercise variation can often eliminate pain
- When all else fails, switch to a horizontal row variation

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**Shoulder Pain and Horizontal Press Modification list**

Variations start from most challenging to least challenging. Attempt to use the most challenging exercise that can be performed without pain.
1. **For Barbell Bench Press**

2. **For Pushups**
   a. Pushups → Inclined Pushup → Wall Pushup

3. **For Ring Dips**
   a. Ring Dip → Parallel Bar / Between Boxes Dip → Pushup → Inclined Pushup

**Shoulder Pain and Horizontal Press Health Work**

These exercises can be added to someone’s training program when they are having pain when pressing horizontally

1. Band Pull-apart x 10
2. Biceps Curl x 10 reps
3. Reverse Flye x 10 reps
4. Pec Self Myofascial Release

**Perform 2-3 x per week in addition to regular programming**

2 **Horizontal Pressing and Wrist Pain**

You’ll find several people who complain of wrist pain with horizontal pressing. The same thing goes for overhead pressing and in particular handstand and crawl variations. What we believe is happening in these individuals is something called dorsal impaction syndrome.

In dorsal impaction syndrome the back side of the wrist is generally painful when extended and compressed. Think of the stress that goes through the wrist when holding a handstand. In dorsal impaction syndrome the structures on the back side of the wrist are getting compressed due to the unique stresses of bearing weight on an extended wrist (or extending the wrist while pressing a barbell).

As with every issue with pain in this product we recommend seeing a physician or licensed healthcare professional before proceeding with your training. With wrist pain this is even more important because sometimes the pain in the wrist could be coming from a fracture. These fractures are very serious and need treatment right away.
Once more serious injury has been ruled out it’s important not aggravate the area when training. Some ways we can accomplish this are:

1. **Utilizing dumbbells as opposed to barbells for pressing**
   a. Dumbbells reduce wrist extension when pressing

2. **Utilize a fat bar for pressing**
   a. Fat bars place the wrist in less extension for pressing exercises

3. **Have athletes use less wrist extension when pressing**
   a. Cue a more neutral wrist position

4. **Perform pushups with a bar in a rack**
   a. Elevate the feet to get the same horizontal body position as with regular pushups

5. **Perform pushups on the floor supported by 2 dumbbells**

6. **Use wrist wraps to reduce wrist extension and support the wrist**

7. **Turn the wrists out during pushups and other weight bearing on the floor**

Once your athletes are pain free it’s also important that they work towards gaining full wrist extension motion and slowly progress back to stressing the wrist in full extension so they don’t end back up in wrist pain again in the future.

**Horizontal Pressing and Wrist Pain Accessory Work**

1. Lacrosse Ball Forearm
2. Distraction and Extension Mobilizations
Vertical Pulling

- **Shoulder**

In vertical pulling the movement where we see issues with pain is generally during kipping. During vertical pulling exercises we run into trouble with technique, positional problems as well as strength and endurance issues as we discussed earlier with shoulder pain. First let’s discuss some specifics about vertical pulling so we can best modify for and help athletes with pain during these movements.

**Why Does Overhead Press Hurt But Pullups Don’t Hurt?**

In our athletes with subacromial impingement syndrome generally overhead pulling (like a strict pullup) is much less painful in comparison to overhead pressing. This goes back to the explanation of force couples we went over in the vertical pressing and shoulder pain section. In overhead press, the deltoid pulls the humeral head superiorly, potentially creating some pain at the shoulder when the contents of the subacromial space are sensitive. When performing overhead pulling exercises (like pull-ups) the deltoid is relatively inactive whereas the musculature that depresses the humeral head (like the lats) are very active.

In overhead pressing the deltoid is pulling the humerus upwards and with a lack of rotator cuff force coupling we get impingement. In overhead pulling the deltoid is not pulling the humeral head up but the opposite is occurring. The lats are pulling the humeral head down away from the acromion decreasing compression on the rotator cuff. This is great because generally painful shoulders tolerate rowing and pulling well when they don’t tolerate pressing.

**Positional Impingement of the Shoulder**

Just as in the dip, certain positions of the shoulder blade and shoulder will create more stress on the shoulder. These positions create impingement not just from a lack of rotator cuff control but from compression of the subacromial contents due to the position of the shoulder blade and joint. This can occur from a lack of scapular control and strength as well as from mobility restrictions.
Impingement from tight lats

Tightness in the internal rotators of the shoulder, particular the Latissimus Dorsi (aka the Lats) and Teres Major will cause compensation when we perform vertical pulling exercises like a kip (toes to bar, pull-up etc.)

To better explain this concept let’s further explore the Lats:

- The lats attach from the humerus (upper arm bone), down to the thoracolumbar fascia, which inserts directly into the pelvis. You can see this in the picture of the lats in red.
- The lats function to extend and internally rotate the arm as well as to extend the lumbar spine. They are very active during vertical pulling.
- When restricted, the lats have the potential to limit shoulder flexion (bringing the arms overhead), external rotation (rotating the thumb back) and lumbar flexion. The restrictions we see at the shoulder are what is most important for shoulder health.

If you have an athlete with restricted overhead motion because of tight lats then when you try to force overhead mobility you’ll create compensation. Think of it this way. Let’s take an athlete with restricted overhead mobility due to lat shortness and have them perform a kipping motion. Where you’ll see the compensation is during the backswing or arch portion of the kip, where maximal shoulder flexion is required. Compensation can be seen in several ways:

1. The hands get much wider (on rings)
2. The elbows will bend
3. The lumbar spine will arch excessively
4. The backswing will be limited in motion
5. The shoulder will internally rotate
Shoulder Health Side Note

The Pecs are also internal rotators of the shoulder. Having tight pecs can also cause shoulder compensation when performing overhead motions. This is more common in overhead movements that require a wide grip like a snatch. This is simply due to the anatomy of the pecs and that they restrict overhead motion more with a wider grip than narrow grip. During narrow grip movements (like jerks, handstands and kipping) the lats and teres major are usually more at fault whereas in the wide grip movements (snatch, overhead squat) the pecs probably play a larger role.

In orthopedic medicine there is a test for subacromial impingement syndrome. It’s called the Neer’s test. In the Neer’s test the patient’s shoulder blade is stabilized, the shoulder is internally rotated and then shoulder is then fully elevated. The test is designed to bring the greater tuberosity into contact with the acromion of the shoulder. The rotator cuff, bursa and long head of the biceps gets compressed or impinged with this test. The thought is that if there is damage or sensitivity in those structures, you’d get a positive test (pain).

In a situation where the lats are stiff and we’re forcing our athletes into full flexion like in the kipping example above; the shoulders will internally rotate once we reach the end limit of our flexion. Now the shoulder is in full flexion and internal rotation, just as in the Neer’s test. Remember that the Neer’s test was designed to recreate impingement of the shoulder as a test for impingement syndrome. We may be creating impingement syndrome by forcing our athletes into these positions. This means that the rotator cuff is getting impinged upon with each pull-up, toes to bar or muscle-up. This may not hurt on the first reps or the 100th but over time these athletes can develop painful shoulders. Once they’re in pain we need to understand these mechanics so we can learn how to modify appropriately.

For these athletes it’s important that we strive to improve their range of motion and also not to force a big backswing during their kip. Often times with these athletes, shortening the backswing and tightening the kip can eliminate shoulder pain.

Video of tightening kip swing for shoulder pain modification

We also want to focus on gaining as much range of motion with these athletes from their thoracic spine (upper back). If extra motion at the shoulder is creating problems it makes sense that getting it from another joint can be helpful.

How the Shoulder Blade Affects Rotator Cuff Health During Kipping

The other variable that’s important with overhead motion is what we do with our shoulder blade. As we bring our arms overhead the shoulder blade is meant to upwardly rotate and posteriorly tilt. Both of these motions increase subacromial space. If we block upward rotation by “packing the shoulder blade down” we’re actually bringing the acromion closer to the humeral head and creating impingement. This is important because shoulder packing is a popular term and often utilized when it shouldn’t be for shoulder health.
So how do we teach proper overhead motion? First we need to clear up any mobility restrictions. If we’re limited with overhead mobility then we won’t be able to achieve proper positioning overhead, plain and simple.

Once mobility is cleaned up or after mobilizing we want to reinforce better motion at the shoulder blade. I’m a fan of the reach, roll and lift drills to accomplish proper shoulder blade positioning. Here’s what we accomplish with this tool:

1. **Reach** - Promotes upward rotation of the scapula, clearing space between the humerus and the acromion
   • [Pics upward vs downward]
2. **Roll** - Promotes external rotation of the shoulder clearing space between the greater tuberosity and the acromion
   • [Pics IR vs ER]
3. **Lift** - Promotes posterior tilt of the scapula further increasing subacromial space
   • [Pic from side]

[For a video demonstration of how to accomplish this while hanging click HERE](#)

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**Shoulder Health Side Note**

The position of the shoulder blade is directly affected by the ribs and thoracic spine. A flexed or rounded thoracic spine will contour the ribcage in a way that promotes anterior tilt of the scapula. We’re looking for posterior tilt of the scapula for increased subacromial space and subsequent shoulder health. This is why thoracic spine extension mobility is so vital for healthy shoulders.

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After this explanation hopefully it becomes apparent of the need to properly teach overhead positioning for your athletes. This progression is also something that can potentially eliminate shoulder pain in the athletes you are currently dealing with who have pain while kipping.

The other area where athletes run into trouble in the shoulder during vertical pulling is when they lack control in the joint. The rotator cuff and humeral depressors (lats) keep the ball of the shoulder centered in the socket during vertical pulling. If these structures are not strong enough or if they fatigue they may not control motion in the shoulder joint well.

If we lose control in the bottom of a pull-up the humeral head is free to migrate up and cause forceful impingement of the rotator cuff. This is the same mechanism as in the Neer’s test described earlier. Without control from our musculature we’re also relying more heavily on the passive structures of the shoulder to control motion in the shoulder joint.

The culprit movements for this mechanism of injury are usually higher repetition kipping pullups. During a kipping pull-up the momentum to complete a repetition occurs at the bottom of the pull-up. Power is generated there in order to get the chin or chest to the bar and then gravity pulls us back down to the starting position. As we fatigued the descent becomes harder and harder to control due to fatigue. Meanwhile we can usually squeeze a few more reps in because we’re generating momentum from a kip. We just don’t have the endurance left to control the descent of the pullup well.
If your athletes are moving quickly through a higher rep set with minimal to no rest between sets they aren’t allowing adequate time for muscular recovery and the shoulder is stressed more and more with each repetition. We can combat this by picking rep ranges that are appropriate for the athlete in front of us. We can also combat this by building strength and stability in the bottom position of our pullups.

Video of scap stability video bottom of pullups

The next problem is that many people simply don’t have the strength to perform a pull-up. Obviously those without adequate strength should be working on their ability to perform a few pullups before going to kipping.

The problem with using a kipping pullup variation that is too challenging for people is that they end up losing their hollow / arch timing due to lack of strength. What we end up seeing is an athlete struggling to get their chin over the bar. Inevitably they don’t pull high enough, aren’t able to push away at the top of the pull-up and can’t get back into a hollow position before hitting the bottom of the pullup. At this point they don’t have the momentum to create another arch position and they lose their kip.

Also, this lack of pushing away at the top of the pullup leads to hitting harder at the bottom of the pull-up. This increases the stress on the shoulder and diminishes the ability to link reps together. You can see a video of Dan demonstrating this in the lecture portion of vertical pulling.

A better way to progress athletes is not to focus on getting the chin over the bar but instead finding a happy intermediate by not pulling as high and being able to push away at the top of each rep. This will allow athletes to learn the timing better and allow them to focus more on hollow and arch positions (in a safer way)

C-kip Progression Video

The same can be used for learning how to butterfly with athletes. If they don’t have the strength they can still work on the timing and positions.

Butterfly Kip Progression

Shoulder Pain and Vertical Pull Modification

Key Notes

- Lack of rotator cuff and scapular control can create impingement and reliance on passive structures in the bottom of a pullup
- Decrease repetitions or utilize an easier kip variation for these folks
- Focus on strict strength
- Lacking mobility of the shoulder internal rotators can create impingement in the back swing (arch) portion of kips
- Improve shoulder and thoracic spine mobility
- Switch to a more horizontal row variation to avoid impingement at the bottom of a pullup
• Attempt to eliminate pain by modifying technique as described above, in some athletes this won’t work so utilize the modification list
• Coach movement through the upper back and tighten the kip
• When all else fails, switch to a horizontal row variation

**Shoulder Pain and Vertical Pull Modification list**

Variations start from most challenging to least challenging. Attempt to use the most challenging exercise that can be performed without pain.

Chest to Bar Pull-up → Chin Over Bar Pull-up → Intermediate Variation → Strict Pull-up → Underhand Grip Chin-up → Ring Row → Inverted Row

**Shoulder Pain and Vertical Pull Health Work**

These exercises can be added to someone’s training program when they are having pain when pressing horizontally.

1. Foam Roll Lats and Teres Major x 10 passes
2. Thoracic Extensions Over Foam Roller x 10
3. Accentuated Negative Chinups
4. Scapular Strength and Endurance Exercises

**Perform 2-3 x per week in addition to regular programming**
The next part of our program is a bit different than the other sections. In the movements discussed thus far we spoke about how certain movements can create pain in our athletes and how to modify accordingly. Horizontal rowing doesn’t tend to cause pain with our athletes. When is the last time you heard an athlete say they got hurt when performing ring rows. It doesn’t really happen. In reality horizontal rowing is usually the movement we modify to when people are in pain.

Horizontal rowing is also different because it is generally not a movement that we focus much on with our exercise selection. Most of our upper body movements are generally either vertical pushing or pulling. Pull-ups, jerks, push press and handstands are much more common than single arm rows. Horizontal rowing doesn’t get much attention. In some gyms the only horizontal rowing you might see is on an erg for rowing.

This is unfortunate because horizontal rowing is a very safe movement that is excellent for the health of our shoulders. Horizontal rowing is a great strengthener for the musculature around the scapula as well as one of the only movements that helps strengthen scapular retraction. Slight scapular retraction helps put the musculature around the shoulder blade and rotator cuff in the best position to produce strength. Replacing some of the higher volume of pressing in our programs with more horizontal pulling will help to reduce some of the compressive stresses on the rotator cuff, thus improving overall shoulder health and performance.

It makes sense that making this movement a more common part of our programming is important. These are our favorite horizontal rowing variations.

1. Single arm row - With dumbbells or barbell
2. Ring rows
3. Prone dumbbell row on incline bench

We believe most athletes should be including a horizontal pulling variation in their program at least once per week. More competitive athletes should probably be including horizontal rowing at least twice per week with some sort of rotator cuff and scapular stability exercise incorporated up to every day.

Upper Body Works Cited:

The Guide to Modifying Workouts When Athletes Have Pain

• Arthrokinematics: http://www.physio-pedia.com/Arthrokinematics
• Biceps Tendonitis: http://www.physio-pedia.com/Biceps_Tendonitis
Hip Hinge

- Deadlift
- Clean
- Snatch
- Kettlebell Swing

Common Problem Areas

Low Back

Generally the main area where people experience pain with hip hinge patterns is with the lower back. Fortunately for us, the stress on the spine during squatting is very similar to hinge patterns. We still deal with compression, shear and positional problems.

Where the deadlift is different from the squat is in the amount of shear forces the spine is faced with. This is due to the increased forward inclination of the trunk when deadlifting in comparison to the squat.

Notice the difference in torso angles

Because of this those who have low back pain often times can squat with a more vertical torso but can’t deadlift without pain. It’s also the reason why deadlifting with a sumo stance or using a trap bar can be more comfortable. We’ll focus on positional problems and shear forces in this section because they are typically the most problematic with hip hinge and low back pain.
The spine generally is strongest in what is known as a "neutral zone" (research note). This is when the spine is mid-way between full bending and extending. In this position the spinal musculature is in its strongest position to both produce force as well as to resist the shearing forces we just spoke about.

As discussed in the overhead press and squatting section, the spine generally doesn’t respond well to loading in too much extension (arching) or flexion (rounding). With too much extension we end up with irritation of the posterior elements of the spine we spoke about in the overhead press section. Loading the spine in flexion is a known mechanism of injury for the intervertebral discs.

Because of this our best plan of action is to learn this neutral zone and then learn how to brace in this position. For some athletes, learning how to brace in neutral is enough to eliminate lower back pain. Check out the video below for a demonstration of how Ryan and I like to teach bracing.

Debell and Pope videos of bracing and finding neutral spine

Just keep in mind that once you learn how to brace and find a neutral position of the spine you’ll have to learn how to reproduce this position and brace during all movements where the spine is challenged.

Dealing with Positional Problems

Just as with squatting and low back pain, some individuals won’t be able to handle certain positions of the spine when deadlifting. Where we see this is usually in the bottom position of a deadlift or snatch. Naturally there will be some lumbar flexion in the bottom of a deadlift. For some athletes this is too much to handle. These athletes often do better with deadlift variations that limit range of motion. Rack pulls, romanian deadlifts (taken from the rack) and other shortened range of motion deadlifts could fit the bill here.

Lower Back Pain Side Note

If someone is limited enough with mobility in their hamstrings they will get compensatory lumbar flexion when they try to deadlift (and snatch especially given the wide grip and extra hip flexion required). If you have an athlete with poor mobility (enough to cause lumbar flexion when deadlifting) they should always use a modification that allows them to lift with a neutral spine position.

If you suspect your athlete has a mobility issue then use a straight leg raise to assess.
Modification Key Points

1. **Teach braced neutral position**
2. **Change torso angle to reduce shear forces**
   a. Trap Bar Deadlift over Straight Bar
   b. Sumo Deadlift
3. **Gain full range of motion**
   a. Mobilize the hamstrings and neural structures to improve straight leg raise >70 degrees
4. **Trial a reduced range of motion deadlift to see if it eliminates pain**
   a. Rack pull / elevated deadlift
   b. High handle trap bar
   c. Reduced range romanian deadlifts taken from rack

Deadlift Modifications

Exercises shown are from most to least challenging for the spine.

Deadlift → Trap Bar Deadlift → Sumo Deadlift → Rack Pull → Barbell Romanian Deadlift → Dumbbell Romanian Deadlift → Kettlebell Deadlift → Banded Pull Through → Barbell Hip Thrust

Snatch Modifications

Exercises shown are from most to least challenging for the spine.

Snatch → Hang Snatch or Pull from Blocks → Deadlift Track
Clean Modifications

Exercises shown are from most to least challenging for the spine.

Clean → Hang Clean or Pull from Blocks → Deadlift Track

Kettlebell Swing Modifications

Exercises shown are from most to least challenging for the spine.

Kettlebell Swings → Deadlift Track

Accessory Spine Health Exercises

Based on the anatomy of the spine, the forces associated with pain and an understanding of the biomechanics of deadlifting we can give these athletes several exercises as homework to help them improve their spinal health.

• Straight Leg Raise
• Active Knee Extension
• Controlled RDL (eccentric focus)
• Lat Lock + Abdominal Stiffness
Split Stance

- Lunges
- Split Jerks

Common Problem Areas

- Knees
- Low Back
- Big Toe

1 Knee Pain and Split Stance

The discussion of knee pain in split stance is going to rely on the concepts described in the section of knee pain during squatting. As a recap our main concerns are going to be:

1. Compressive Forces
2. Patellofemoral Alignment

Compressive Forces

As described before, compressive forces in the knee generally increase as the knee bends more under load and when the quadriceps become more dominant. Remember that as the torso becomes more upright with a given lift (squat or split stance variation) the quads become more active as well.

Left = Positive shin angle, Right = Vertical or negative shin angle
The greater the positive shin angle, the more force on the knee.

We can change this shin angle through a few easy cues. Also note that in the jerk and lunge variations with a more vertical shin our athletes have taken a longer stride length and in the lunge the torso is inclined further forward. This helps to place more stress on the hamstrings, less stress on the quadriceps and thus less stress on the knee.

Lastly, striding forward during a lunge (walking lunge) vs. a split squat or reverse lunge places more stress on the knee joint as well. This is due to the quadriceps on the stride leg having to decelerate the body after landing from a step.

With these concepts in mind we are equipped with several modification ideas to help these athletes in pain.

**Knee Health Side Note**

These suggestions do not take into account the back leg (trail leg) during a lunge. The trail leg in the lunge is definitely taking stress. The rear leg in a lunge is producing force primarily through the quadriceps (and less in the hamstrings) and because of this the compressive forces on the knee increase. Because the knee bend is generally minimal individuals with knee pain don’t often have pain in their trail leg during lunges. Just be careful of variations with more knee bend on the back leg like rear foot elevated split squats. They may not be tolerated in individuals with knee pain.

**Rear Foot Elevated Split Squat Video**

**Split Squat Modification Key Points**

1. **Focus on split stance variations with a more vertical shin**
   a. Lunges with a vertical shin
   b. Having your athletes taking a longer step backwards with lunging accomplishes this
2. **Decrease depth of lunge variation**
3. **Favor reverse lunges and split squats over walking lunge variations**
4. **Substitute single leg deadlifts as a last effort**
5. **Consider load between front and rear foot**
   a. Placing more weight on either the front or rear foot will increase the stress on the leg more heavily weighted
**Split Jerk Modification Key Points**

1. **Limit depth of split stance / lunges**
   a. Place mats under back knee when lunging / split squatting
   b. Catch split jerks with less depth
2. **Substitute Power Jerks for Split Jerks**

**Patellofemoral Alignment**

As described earlier in the knee pain and squatting section, patellofemoral alignment is important when performing split stance exercises. Keeping the patella tracking smoothly in the femoral groove will help decrease stress on structures underlying the patella. We do this by ensuring our athletes have their knee tracking over their 2nd toe during split stance exercises.

Again, how does this alignment get out of whack?

1. **Poor Mobility** - Refer to the squat and knee pain section for expanded information
   a. Ankle, Tibia, Groin, Hip
2. **Weakness** - Refer to the squat and knee pain section for expanded information
   a. Hip, Foot
3. **Motor Control Issues**
   a. Often times people have never been coached to keep proper alignment of the foot and ankle
4. **Strength Issues** - Refer to the shoulder pain and compensation section for an expanded explanation
   a. When the load is too heavy our bodies can compensate in order to get additional strength to finish a lift

**Split Stance Side Note**

*During split squat variations the strength of the hip, core and foot is even more important than in the squat. Because the trail leg is not matched next to the lead foot, extra control from the core, hip and foot is needed to help prevent hip drop and knee in.*
Generally for our athletes having trouble with knee alignment we need to figure out why they are falling into poor positions and then coach them into better positions when performing split stance exercises.

**Modification Key Points**

1. Cue proper alignment of knee over toe
2. Normalize ankle and hip mobility
3. Keep load low enough to ensure proper biomechanics

**Knee Pain Lunging Modifications**

Exercises written from most stress on the knee to least stress.

Forward Lunge → Reverse Lunge → Split Squat Variations → Modified Depth Split Squat Variations → Hip Hinge Variations

**Knee Pain Split Jerk Modifications**

Exercises written from most stress on the knee to least stress.

Split Jerk (ensure front shin is vertical) → Power Jerk
Accessory Knee Health Exercises

Based on the anatomy of the spine, the forces associated with pain and an understanding of the biomechanics of split stance exercises, we can give these athletes several exercises as homework to help them improve their knee health.

- Wall sit Isometrics
- Rear foot, front foot and standard split squats
- Hip extension stretching with anterior chain activation

Low Back Pain and Split Stance

Recall our conversation about lower back pain while pressing overhead (In the shoulder pain and overhead pressing section). If we extend too much while pressing then the posterior elements of the spine get compressed and can become painful over time.

In the split jerk there is more challenge to keep the spine in a neutral position than in other pressing variations. This is because the trail leg in the split jerk can pull your spine into increased extension. This can happen for several reasons:
1. Tightness in the anterior hip
2. Trail leg knee is kept too straight
3. Poor coaching - discussed in more depth in overhead pressing and low back pain section
4. Too much load - discussed in more depth in overhead pressing and low back pain section

If the anterior hip musculature (hip flexors) is tight on the trail leg in the jerk the muscles will pull your spine into increased extension. Also, if your trail leg knee is kept straight it will also pull your spine into increased extension.

Obviously we want to correct these 2 things if we want to decrease stress on the spine and eliminate pain.

**Modification Key Points**

1. **Teach athletes neutral spine position**
   a. Teach this in the finished position of a split jerk
2. **Ensure the athlete’s trail leg knee is bent enough to allow a neutral spine position**
3. **Mobilize the anterior hip if tight**
   a. Hip flexor stretches
4. **Mobilize limiting structures up the chain**
   a. Thoracic spine
   b. Shoulders
5. **Keep load appropriate for the athlete**
   a. Athletes will adopt poor positions when the load is too great. Keep load low enough to keep proper technique and only increase when correct form is displayed

**Accessory Lower Back Health Exercises**

Based on the anatomy of the spine, the forces associated with pain and an understanding of the biomechanics of split jerks we can give these athletes several exercises as homework to help them improve their knee health.

- Barbell / ab wheel roll-out
- Split stance overhead press RNT
- Lunge with RNT

**Big Toe Pain and Split Stance**

Split stance movements require a lot of extension of the great toe. We normally don’t think about this until our big toes hurt and we try something like a lunge.
Like most other areas of the body our job is to modify our training until the areas calms down, our athletes get evaluated by a skilled medical professional and we get a plan to slowly reload the area after the pain subsides. The two major movements where our athletes get into trouble when they big toe pain is during split jerks and split squat variations. Lucky for us it’s easy to switch to a power push jerk variation or rear foot elevated split squat to modify effectively.

Lower Body Works Cited

- Solving the Patellofemoral Mystery: https://mikereinold.com/biomechanics-of-patellofemoral/
• Hip kinematics and kinetics in persons with and without cam femoroacetabular impingement during a deep squat task, by Bagwell, Snibbe, Gerhardt & Powers, in Clinical Biomechanics (2015)
Common Problem Areas

1. Lumbar Spine
2. Knee
3. Hip

Lumbar Spine Pain During Squatting

During the squat, there are several different types of forces on the spine. We’ll go over these in order to help you understand how best to work with these athletes. These are:

1. Compressive Forces
2. Shear Forces
3. Positional Issues

Some athletes with low back pain have difficulty handling shear forces. Others have trouble with compressive forces or certain positions of the spine. Some have trouble with 2 or even all 3 of these forces. Understanding what an athlete can or can’t handle allows us to modify accordingly.

All three of these forces are taking place in the spine when we squat. However, as we described previously most individuals will present with more difficulty handling certain types of forces. Here are some examples to help clarify our point.

Example 1: An athlete that is intolerant to positional changes
This athlete can squat to just above parallel with absolutely no pain. Once they go deeper, the spine begins to flex and pain occurs. If we give this athlete a more shallow squat they can train pain free.

Example 2: An athlete intolerant to shear forces
This athlete can squat pain free when they keep a very vertical torso. Once they start to incline forward pain occurs. We reduce shear forces when we squat with a vertical torso.

Also keep in mind that in some individuals the pain will be bad enough where squatting will just be off the table temporarily until pain subsides. Let’s go over these forces more in depth.
Compressive Forces

Compressive forces are defined as forces acting down the long axis of the spine. This is the force that directly presses the vertebrae together when squatting. In other words, the more weight on the bar, the greater the compressive forces on the spine.

In this patient the more weight on the bar, generally the worse their pain is. These patients tend to hurt as soon as they lift the bar out of the rack to squat. These patients also tend to have pain when they rack the bar after a set as soon as the spine is unloaded.

With this knowledge in mind we can develop modifications for these athletes.

Modification Key Points

1. Decrease the load or pick a squat variations that creates less compression
   a. Front Squat over a Back Squat
   b. Overhead Squat over a Front Squat
2. Goblet Squat or Kettlebell Front Rack Squats
   a. Limitation comes from the weight the athlete can hold and not from large compressive forces and pain
3. Single Leg Variations - The total compressive load is lowered given the legs are generally the limiting factor in this lift and not the spine
   a. Lunge, Step-up
   b. Unilateral loaded variations - These increase challenge to the core and hip without increased compression

Compressive forces act straight down along the spine

Kettlebell in opposite hand as stance leg
Share Forces

Shear is defined as a force that acts parallel to the mid-plane of the disk of a specified motion segment. These forces are occurring at a 90 degree angle to compressive forces.

Think of it this way. During a task like bending forward one vertebrae will be subject to sliding forward off of the vertebrae below. Your facet joints, ligaments and musculature all help to prevent this. The more forward torso inclination a given squat variation has, the more shear forces the spine is subject to. These are the athletes that have trouble with squat variations where the torso is inclined forward. Generally a low bar box squat will be very painful whereas an upright torso front squat will be tolerated quite well. These patients also have difficulty with deadlifting (given the inclination of the torso).

Modification Key Points

1. Choose squat variations that require an upright torso
   a. Overhead, Front and Goblet Squats
   b. Consider using a heel lift to keep your athlete more upright
2. Single leg variations are generally pain free because of the upright torso
   a. Split Squats, Lunges, Step-ups
   b. Utilize a shorter step to keep the torso more upright
Positional Intolerances

Positional intolerance refers to individuals who have pain when their spine is in a certain position.

Often in lower back pain if the individual can load their spine in a neutral position then they won't experience pain while squatting. As soon as the spine starts to round (or flex) the pain starts. This is important because in the bottom position of both squatting and deadlifting the spine will naturally flex some. Some athletes won't be able to tolerate this when their lower back is painful. If we limit the depth of the squat in these individuals often times we can avoid flexion and subsequent pain.

Lower Back Health Side Note

Some backs don’t tolerate flexion well but others don’t tolerate the opposite motion, extension. Remember our lower back pain and overhead pressing example from earlier in the book.

Modification Key Points

1. Coach your athletes to maintain a neutral spine position and how to brace while squatting
2. Choose squat variations that limit full depth
   a. Box Squats, Powerlift Style Squats, ¼ Squats
3. Consider using a heel lift
   a. Adding a heel lift will increase the depth an athlete can achieve before the lumbar spine begins to flex
4. Modify amount of toe out and stance width
   a. Increasing the amount of toe out and stance width can often allow an athlete to squat deeper with less lumbar flexion
5. Mobilize the hips and ankles
   a. More mobility at the hip and ankle will allow you to squat deeper before the lumbar spine starts to round
6. Single leg variations are generally pain free as long as the spine is kept in a neutral position
   a. Split Squats, Lunges, Step-ups

Squat Modifications

Exercises shown are from most to least challenging for the spine.

Back squat → Front squat → Goblet Squat → Air Squat → Split squat
Lower Back Pain and Squatting Health Exercises

- Based on the anatomy of the spine, the forces associated with pain and an understanding of the biomechanics of squatting we can give these athletes several exercises as homework to help them
- Mobility Work
  - Soleus Stretch and Foam Rolling
  - Posterior Hip Stretch on Hands and Knees
- Strengthening
  - 45 degree back raise or glute ham raise
  - Dead Bugs and Bird Dogs

2 Knee Pain During Squatting

Just as in the spine we have 3 major concepts to discuss in order to understand how to best work with these athletes:

1. Compressive Forces
2. Patellofemoral Alignment

Just as with the spine, there are a multitude of different stresses on the knees when we squat and all aspects are important to understand so that we can modify appropriately for these athletes.

Patellofemoral Pain Syndrome (PFPS)

Patellofemoral Pain Syndrome is far and away the most common injury we see clinically for athletes who have pain during squatting. These athletes generally complain of pain somewhere in the front of the knee, usually around or behind the knee cap and the pain generally worsens as they descend deeper into a squat. Several structures on the undersurface of the knee cap can get irritated in this condition. PFPS may result from a dysfunction in patellofemoral compressive forces as we'll discuss below.

Patellofemoral Compressive Forces

These are the forces that come from the patella compressing the structures behind it. The amount of force is related to how much quadriceps activity is present coupled with the depth of the squat and how much boney contact there is between the patella and the femur below.
Generally, compressive forces in the knee have been shown to increase as we descend deeper into a squat, maximizing around 90 degrees of knee flexion (depending on the study and activity). Beyond 90 degrees, the research is mixed as far how much compressive force the patellofemoral joint is exposed to. Some studies show decreased stress as we descend below 90 degrees.

What I see generally in the clinic is that people who present with knee pain have worsening pain as they descend deeper into a squat. The deeper they go the worse it is. Because of this they can’t tolerate exercises that require a lot of loaded deep knee bending (Deep Squats). If we decrease how much knee bend is required during squatting exercises we can decrease these forces and eliminate pain.

The next consideration with knee pain and compressive forces relates to the angle of the shin while squatting. When we squat with a more upright torso two things happen:

- The quadriceps muscles are more active
- The knee flexion angle is greater

Both of these factors will increase patellofemoral joint stress. It’s the reason why a box squat with a vertical shin tends not to aggravate people’s knees when they’re painful but a front squat to the same depth does.

Modification Key Points

1. Limit depth of squat variations
   a. Box Squats, ¼ squats
2. Make squatting movements more “hip dominant”
   a. Cue that athlete to send their hips back further when they squat and choose squat variations that require a less upright position

Observe the difference in shin angle
3. **Substitute squat variations for hip hinge variations**
   a. Limiting knee bend will decrease knee pain in these individuals
   b. Deadlifts, Good Mornings, Power Olympic Lifts

## Patellofemoral Alignment

Patellofemoral alignment is the next important concept we’ll discuss as it relates to PFPS and pain during squatting.

At the knee joint we have contact between 2 bones, the patella (knee cap) and femur (thigh bone). The patella sits inside of a groove in your femur and aligns like a train on train tracks. As we squat the patella is supposed to slide smoothly in alignment in the femoral groove. Sometimes this doesn't happen and the medical term for this is patellar maltracking. The idea is that patellar maltracking increases patellofemoral compressive forces. If the alignment is off and compressive forces increase then the structures underneath of the knee cap can get irritated and potentially damaged.

How can we tell if this is occurring in our athletes? We look to see if the knee is tracking over the 2nd toe. We should see that the knees are not coming in while lifting and the toes are not spinning out further then the knees.

[Note the optimal alignment on the left vs. toe out and knee-in on the right]
How does this alignment get out of whack? This can happen for a variety of reasons:

1. **Poor Mobility**
   a. Limitations at specific joints can cause the knees to come in or the toes to spin out
   b. Hip
      i. External Rotation
         • Posterior Hip Muscle Tightness
      ii. Horizontal abduction
         • Groin Tightness
   c. Ankle
      i. Ankle dorsiflexion
         • Ankle Joint (Talocrural)
         • Soleus
      ii. Tibial Internal Rotation
         • Joint Restriction

2. **Weakness**
   a. Hip
      i. Hip Abduction and External Rotation
   b. Foot
      i. Foot Intrinsic

3. **Motor Control Issues**
   a. Often times people have never been coached to keep proper alignment of the foot and ankle

4. **Strength Issues**
   a. When the load is too heavy our bodies can compensate in order to get additional strength to finish a lift

Generally for these athletes we need to figure out why they are falling into poor alignment and then coach them into better positions when squatting. It may be a tall task to correct movement in these athletes but it will pay dividends in their long term knee health.

**Modification Key Points**

1. **Cue proper alignment of knee over toe**
   a. For squatting, lunging, step-ups, box jumps, pistols and all other lower body movements

2. **Normalize ankle and hip mobility**
   a. Modify depth of squat until the athlete can display healthy squat mechanics

**Knee Health Side Note**

Just as in the spine, shear forces occur in the knee while squatting. Anterior shear forces on the knee are greatest as we descend between 0 and 60 degrees into a squat. Posterior shear forces are greatest at 50-90 degrees. If you have an athlete rehabilitating from a major ligament injury or they are lacking an ACL or PCL from a previous injury then shear forces become a more important consideration. Shear forces tend not to be the largest factor in the fitness population that we see clinically.
Knee Pain Squatting Modifications

Exercises written from most stress on the knee to least stress.

Front Squat → High Bar Back Squat → Low Bar Back Squat → Low Bar Box Squat (limited depth) → Hip Hinge Variations

Accessory Knee Health Exercises

• Based on the anatomy of the knees, the forces associated with pain and an understanding of the biomechanics of squatting we can give these athletes several exercises as homework to help them improve their knee health
• Mobility Work
- Rear foot elevated ½ kneeling hip flexor stretch
- Soleus Stretch and Foam Rolling
• Strengthening
- 4-way resisted stepping
- Single Leg Bridge Leg Lifts

2 Hip Pain During Squatting

Most pain problems in the hip we see regularly have something to do with a dysfunction called femoral acetabular impingement (FAI). FAI generally occurs in the bottom of a squat. The reason why this occurs is because of the boney anatomy of the hip.

Unlike the shoulder joint, the hip joint has a lot of boney stability. This comes from a deeper hip socket. In the shoulder, most limitation in the shoulder is coming from either muscular or capsular tightness. In the hip joint our range of motion is limited in certain directions by the contour of the ball and socket joint. What this means is that the reason for your limitation could be coming from bone contacting bone in the hip.

What makes this worse sometimes is that everyone has a different shape to the ball and socket joint of the hip. In some individuals they have a different shaped ball. This is known as a CAM deformity. In a CAM deformity there is extra bone on the ball portion of the socket.

Debell Link to Hip Variation Article

Some individuals have extra boney coverage of the socket. This is known as a pincer deformity. Everyone also has a different position of their sockets (version). Some sockets point more forward (anteversion). Some sockets point more backwards (retroversion).

What ends up happening in these individuals is that when they get into the bottom of their squat they get contact of the ball up against the socket. This contact can compress or “pinch” structures in the front of the hip. These athletes generally complain of a painful pinch or tightness in the front of the hip.
They often associate this “tightness” as a normal sensation due to restricted hip muscles (usually hip flexors). These athletes also tend to stretch their hip flexors due to the thought of muscular tightness in the front of the hip limiting their squat depth. In reality, the “tightness” of the hip musculature is really a compression of structures in the front of the hip.

The rectus femoris muscle is one structure that attaches on the anterior capsule of the hip. It’s little wonder that it feels good to stretch this muscle after it’s been forcefully pinched after squatting. Most athletes allow this pinching to go on until the pain is bad enough to force them to give up squatting.

This misconception can be problematic especially because FAI is correlated with labral tears in the hip. FAI and labral tears of the hip are also correlated with arthritis over time as well as more individuals undergoing total hip replacements later in life.

Because of these reasons it’s extremely important that we don’t continue to deep squat in patients that present with these symptoms. If squatting is painful it should be modified to eliminate pain.

**Different Strokes for Different Folks**

The next discussion we’ll have is about squat stance. Ideal squat stance will vary widely based on the coach and the athlete. There are world class athletes that squat with the toes straight ahead and world class athletes that squat with the toes pointed out. There are world class athletes that squat with a narrow stance and world class athletes that squat with a wider stance. What I’m getting at is that as coaches we should be more concerned about finding the stance that is best fit for the individual squatting in front of them. We shouldn’t be trying to have our athletes conform to a specific stance. This is because of the aforementioned differences in the ball and socket joint. Limitations are coming from boney problems and that can’t be “mobilized” unless a surgeon wants to go into your hip and take some bone away.
I can’t tell you how many athletes I see with this problem and just a small tweak in their stance is enough to completely eliminate their pain. Adding some toe out and widening the stance might be enough to clear the boney impingement in the hip and create enough space to eliminate the FAI.

**Modification Key Points**

1. **Attempt to modify squat stance to eliminate symptoms**
   a. Increase toe out
   b. Narrow or widen stance
2. **Limit Depth of Squat Variation**
   a. Box Squats
   b. ¼ Squats
3. **Pick More Upright Squat Variations**
   a. A more upright torso requires less hip mobility and can alleviate impingement
   b. Front and Overhead Squats in Substitution for Back Squats
4. **Add Ankle Mobility**
   a. More ankle mobility will decrease the need for additional hip mobility in a deep squat
   b. Mobilize the ankles
   c. Add a heel lift (oly shoes)
5. **Modify pelvic position**
   a. Extending the lumbar spine excessively and anteriorly tilting the pelvis will bring the socket portion closer into contact with the femur
   b. Ensure athletes aren’t overextending in the bottom of the squat

**Squat Modifications**

Exercises shown are from most to least challenging for the hip.

Back squat → Front squat → Overhead Squat → Goblet Squat → Box Squat (limited depth and upright) → Split squat

**Accessory Hip Health Exercises**

- Based on the anatomy of the hips, the forces associated with pain and an understanding of the biomechanics of squatting we can give these athletes several exercises as homework to help them improve their hip health
- **Mobility Work**
  - 90-90 Hip Stretch
  - Soleus Stretch and Foam Rolling
- **Strengthening**
  - Off-set loaded split squats
Conclusion and Final Remarks

So there you have it. You’ve just finished a monster learning experience and we both hope you’ve come out with some valuable tools to help work with your athletes in pain. Our goal is to equip you with some basic principles about pain and the biomechanics of joint stress so you can make better decisions with these athletes. Like any other learning experience now your job is to go out and apply these principles. As you start implementing these modification strategies please refer back to our flow sheets so that you can easily access our modification ideas and exercises. Thank you for supporting both of us. We love our jobs and it’s people like you that allow us to continue helping others and leading the lives we love.