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Clinical Management of the Rock Climbing Athlete Recorded June12, 2020

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PhysicalTherapy.com Course #3758

- [Calista] Well today's course is titled Clinical Management of the Rock Climbing Athlete and it's my pleasure to introduce Dr. Jennifer Sauers to physicaltherapy.com. Jennifer is the CEO and owner of Onsite Movement, which is a private physical therapy practice in Las Vegas, Nevada specializing in treating rock climbing injuries and improving climbing performance. She is a, of the university of Maryland School of Medicine with a doctorate degree in physical therapy. Jennifer also currently serves as adjunct faculty at the College of Southern Nevada teaching anatomy and physiology. Jennifer is a member of the rock climbing and special interest group at the University of Southern California, as well as the American Physical Therapy Association's orthopedic section. She holds her certificate in dry needling from the American Academy of Manipulative Therapy. Thank you so much for being here with us today, Jennifer, and at this time, I'm gonna turn the classroom over to you.

- [Jennifer] Thank you, Calista. Hello everyone, it is a pleasure to be with you today and thank you so much for joining me here and I am excited to get into today's topic. Okay, just a couple of disclosures here. I have no specific affiliation with any product or service you may see here. And Calista already gave me a lovely introduction, thank you. So the learning outcomes for this course are, after this course, you will be able to describe at least three basic rock climbing terminology and styles of climbing. You'll be able to outline at least, I'm sorry, outline the basic techniques of rock climbing as they apply to human biomechanics. Identify at least three common injuries found in rock climbing. And outline at least two effective injury management strategies for both the acute and chronic setting. So, first of all, we wanna talk about why rock climbing? So, why is this important to learn about? Why bother learning about climbing? Well, historically, climbing has been a very niche sport performed by a select group of outdoor enthusiasts. However, over the past really couple of decades, rock climbing has seen an exponential surge. So just in the past five years, the rate of growth of indoor climbing gyms has actually exceeded the growth of regular health and fitness

clubs in the US so it's a pretty exciting time for the sport of climbing. It's seeing this kind of exponential growth and what will be for this growth here? So in 2018, there was an Oscar winning film that debuted called "Free Solo" featuring Alex Honnold, and if you haven't seen this film, I highly recommend that you check it out. I believe it is on either Netflix or Hulu at the moment, but this film really gained really international attention from the rock climbing community, as well as those outside of the rock climbing community, really for the first time.

So this kind of put rock climbing in the spotlight, really across the country and across the world. In addition to that, rock climbing will be making its first ever debut in the upcoming Olympic games, which was supposed to be this summer and unfortunately is postponed, but when they do occur, rock climbing will be in the Olympics for the very first time. So what does all this mean? It means that potentially you may see a rock climber come into your outpatient therapy clinic in the near future and that wouldn't be too surprising. So it will be important to kind of know a little bit about the sport. So before we kind of get started and dive into the injuries that are involved with rock climbing, we're just gonna talk about a bit of the basics here. So that that way, if you don't have any personal experience with rock climbing yourself, you can still feel confident treating a rock climber.

So first, there are many, many different ways to be a climber. It's sort of analogous to saying that someone comes in that is a field sport athlete versus a goalkeeper or perhaps a marathon runner versus a sprinter. If someone comes into your clinic and says that they're a runner, that's really not giving you enough information about the athlete, you need to know a little bit more about them, same thing that goes with climbing. If someone comes into your clinic and says that they're a climber, it's really not giving you enough information about the way that they participate in the sport. Rock climbing is not as well defined as other organized sports, such as soccer, football, baseball. There's not really one way that people do it. So therefore it's

important to kind of come up with a framework on how you can go about deciding how that individual interacts with the sport. So this is what I like to call the climber profile here that you see on the slide, and this is sort of an initial needs analysis of the climber. So before you even kind of dive into what injuries they may be presenting with, it's important to just figure out what kind of climber they are. So there'll be some key interview questions that you want to ask them and these are going to include questions about age, discipline, difficulty, and location and we're gonna get into all four of these in a minute here. And then in addition to that, we're gonna learn about the biomechanics of climbing. So on a global movement perspective, how does the climber move their entire body?

And then from a local perspective, how are they manipulating their hands around the holds? Okay, so the climber profile, like we said, these questions to ask age, discipline, difficulty, and location. So the first one would be age and what I mean by age is really, for obvious reasons you would already want to know or you would know how old the individual that you're seeing is, and you wanna compare that to their training age. So how long has he or she been climbing? And these two things are gonna tell you various things about the individual.

For example, if you have an individual with finger pain from climbing and they are a youth athlete, you may be thinking more along the lines of an epiphyseal growth plate fracture perhaps in a finger in a youth that's developing versus pulley injuries, which are more prevalent in adults. So just the age of the individual can give you some information about differentially diagnosing their finger. In addition, there are connective tissue adaptations that come along with experience. So in 2015, this article cited at the bottom showed that with climbers with over 15 years of experience, it showed that they have thicker annular pulleys and thicker joint capsules compared with those that are beginner climbers. So just like any activity that you do, the stress of the sport is going to provide the adaptation that you are seeing in the athlete, same thing goes for

climbers. So this is important to kind of keep in mind when treating a climber, knowing how much experience they have will tell you something about the adaptations that their body and their connective tissues have been put through. In addition, just the time that they've been participating in the sport allows for the motor control development and the technical skill development. So the sport of rock climbing is highly technical, requires a lot of skill development. And the time that they've been participating just gives you that information about how much time that they've had to develop that motor control. On the other hand, they may have been also developing some habits, so perhaps some poor habits, and if they've been climbing a long time, it doesn't really give you that information as far as are they developing poor habits or are they developing that good technique and motor control.

So just to keep those two things in mind is important. And then as well as habit formation, you want to know a little bit more about the frequency that they participate in the sport. So they could be a climber that comes in that says that they've been climbing for 15 years, but climb once a month or once every few months. So are they someone that is a more casual climber that kind of just does it every now and then or do they follow some sort of structured training program and they're very committed to the sport? So that is also some questions that you definitely want to ask the athlete. Okay, so the second kind of pillar that we're going to go over here is the rock climbing discipline.

So just like we talked about with the analogy to an organized sport, if you have someone that comes in that plays soccer, you wanna know, are they a midfielder? Are they a goalkeeper? So what is that analogous to in rock climbing? Well, there are three major disciplines of climbing that we're gonna go over, which are bouldering, sport climbing and traditional climbing or trad climbing. So these three are the most common disciplines. There are other ones we won't be getting into, but I will show you a slide just so you can see what those other ones are for your reference. And these three

disciplines really have a difference in energy systems that are involved, the technique and the training methods that you'll see. So you can use this information to create a more sport specific rehab plan. So if you don't know the discipline that the climber is participating in, you could really be doing them a disservice when creating the rehab plan, because you won't be kind of training them in the appropriate way to get them back to the sport that they do. So we're actually gonna come back to this slide at the end so I'm gonna skip it for a minute and we're gonna go to bouldering here. So the first slide is going to be discussing the first discipline of bouldering. So in bouldering, you can see here from the photo, no ropes are used and the climber is only going about 10 to 15, maybe 20 feet high at the most.

So they're not going up that high when they boulder, however, they are doing short kind of all out intense bouts of activity. So this is kind of an all out effort with long rest periods because the individual is able to land on the ground, they can completely rest and recover, there's no logistical reason why they need to continue. So they just can rest on the ground and then give another kind of full out effort.

So this is generally associated with the greatest amount of power and anaerobic fitness involvement. And as you can see here in the photo, I'm just gonna use this little pointer here, this little black thing here is the pad so this is protecting the individual if they were to fall. So it keeps them safe. If they slip and fall on the ground, they have that protection there. So this kind of rock climbing is very, very commonly performed in the gym and as well can be performed outside as you're seeing here. The next discipline is sport climbing. So with sport climbing, you are using a rope, as you can see in the photo, and this type of climbing is more continuous. So the climber can get upwards of 50 to 100 plus feet high with this type of climbing and they need to utilize short rest periods because they're placing the rope through the carabiner as you can see here, I'm just gonna get out this pointer again. So they're putting the rope through this carabiner here and that keeps them safe if they were to fall. So because of this, they're

not able to give those kind of full out efforts because they need to manipulate the rope and they need to manipulate some gear to keep them safe. So for this reason, it's more of a moderate to high intensity activity, not a complete full out maximal intensity type of climbing. However, this in an experienced climber would not take a really long time to do, to kind of clip the rope in there. So with a climber with more practice, they can do that quite quickly. So they are able to climb at a higher intensity because it doesn't take very long to do this with someone with experience. This can also be performed in the gym. So if you have a rock climber that comes into your clinic and says that they only climb in the gym, they could be doing this type of climbing as well. And then the last type of climbing is traditional climbing or trad climbing.

So with this type of climbing, a rope is also required, although you can't really see from the photo there, it is trailing behind the individual. This climbing is also a continuous climbing of 50 to 100 plus feet in the air and this requires a little bit longer rest periods because the individual has more equipment that they have to manage. So in this photo, you can see this sort of green device here, which is called a cam or a Camalot, and that is what they are placing into the rock in order to protect their fall. So not only do they have to put the rope through, like in the last photo, they have to now manipulate this gear and this equipment can actually become quite heavy when they're climbing up and using it.

So, because they've got more equipment, it's heavier, they have to do this extra step, they're certainly not able to go at a fallout intensity because they just have more equipment to manage. So their intensity level is going to be just a little bit lower usually than that sport climbing is. This is not performed in a gym so if you have someone that comes in and says that they just climb in the gym, they would not be doing this type of climbing. And these are also sort of generalizations about these disciplines, of course, you could have someone with a lot more experience that could be doing this at a higher intensity, but for the most part, this is kind of how people interact with the

different disciplines. Now, I'm gonna go back to that slide that we skipped, here. So this is kind of a summary of what we just talked about. So as you can see, bouldering is more of a maximal intensity. So you're using more of that phosphocreatine system or anaerobic system with bouldering because you're able to give really those full out efforts and then you're able to rest on the ground, completely recover and then give another kind of full out effort. So for those reasons, bouldering is the discipline associated with the most anaerobic fitness. And then you have sport climbing where you have a little bit of equipment that you need to manage, but if you get really efficient, if you get good at it, you can do that quite quickly and you can still kind of give a pretty near max intensity.

However, because you're climbing up a little bit higher, it's a longer activity as compared to bouldering. And then you have traditional climbing, like we said, there's more equipment, it's heavy so you're really not able to go at a full out intensity, certainly not. So that would be a little bit less kind of in the moderate to high intensity realm. And then, so with all of these disciplines of climbing, because there is an element of this kind of technical aspect where the individual is going at sort of a kind of intermittent spurts of activity, there is an element of anaerobic fitness with all of these disciplines and that's why they're overlapping quite a bit here.

However, the aerobic aspect of climbing may come into play just for the individual that needs to get to the climb. So a lot of times, if you have a rock climber come into your clinic and they climb outside, they might say that they have a goal of climbing a specific route, but in order to get there, it's a two hour hike to get there and that would not be uncommon. So with your rehab program, you might need to structure in some aerobic fitness training in order to train the individual to hike two hours in order to get to their climb. So that would not be uncommon either. And if they're doing very, very easy climbing that is very continuous, that may also be sort of an aerobic activity as well. So that's why there's a lot of overlap with these energy systems and it's more of a

continuum rather than a hard and fast sort of difference with these systems here. So let me just continue on here. We'll just kind of look at these slides one more time as we're passing them. Okay, so here are the other disciplines. We're not going to get into these, I'm not going to read them to you, but just for your reference that there are other ones as well. So it does become quite complicated in terms of all of the different aspects that someone could be involving themselves in here, but this is just for your reference there.

Okay, so the third kind of pillar of this climber profile, this needs analysis prior to even looking at injury is going to be looking at the difficulty level. So this is also going to play into that energy system chart that we just had because the technical difficulty that they're climbing at is going to tell you a bit about how intense of an activity that they are doing. So for the United States, not to confuse you, but there is a different system for European climbing, but we're just gonna stick to the United States scale.

So this is how a climber is going to tell you how difficult they're climbing. So this could be anywhere from, it would be said as a 5.5 to a 5.15 and that's how it's going to be stated when they come in. This is for roped climbing. So this would be for the sport and traditional type of climbing. This is the scale, and you can kind of see there how the numbers advance, so from a beginner, intermediate to advanced, that is how the individual is going to tell you how difficult they're climbing. So a good question to ask them might be, "What is the highest difficulty that you've achieved?" And they'll tell you 5.12 or whatever it might be and then, "What is kind of the average climbing rating "that you usually climb at?" So that's just gonna give you a little bit more information about the difficulty level and the advancement of your athlete there. So for bouldering, there is a completely different scale, which is called the V scale and for bouldering, it goes from V0 to V16, and you can see the breakdown there. So it's a little bit more straightforward, and this would be just for someone that is a bouldering athlete. So there are two different types of scales here. Same thing you could ask them, "What is

the highest level that you've achieved?" And so on. Okay, and then the fourth kind of question that you would want to ask your athlete is the location. So we just touched on this a little bit, but just to reiterate a bit here, are they an indoor only climber? So if they only climb in the gym, there are certain things that you are going to be kind of considering different than if they are an outdoor only climber. So this is very common for people to just be climbing in the gym and they don't really have an interest in climbing outdoors. So if they only climb in the gym, they may be susceptible to more over-training or just an increase in volume, because it's very easy to go from one climb to the next, to the next, to the next in the gym, because they're all right next to one another and it's very, very easy to just kind of overdo it in a way. When someone is an outdoor only climber, you have to consider more logistical aspects of the sport, such as, like we said before, the hiking or the endurance training that they might need.

For example, as I mentioned, someone may be requiring a two hour hike before they get to the climb and then they get there, they perform it and then to get to the next climbing area that they wanna go to, it might be another 30 minute hike. So there are a lot more logistical considerations that you wanna think about with someone that only climbs outside. And for this reason, because it usually takes a long time to kind of get there, get set up, potentially they have a less of a volume issue for climbing outside. Now, if someone does a little bit of both, then you just need to ask your individual athlete a little bit more questions about their specific issues and maybe what's going on there, but those are just some good things to keep in mind. Okay, so just to recap again, I think we kind of touched on all of these pretty well here so just key questions to ask. Age, their age versus their climbing age or their training age. The discipline, sport, I'm sorry, bouldering, sport climbing, or traditional climbing. The difficulty rating that they climb. And then the location, indoor versus outdoor. Okay, so now we're gonna talk a little bit about the biomechanics of rock climbing. So before we get into the specific biomechanics of climbing, we first wanna consider what makes a rock climber successful at the sport. So in 2019, they actually did a systematic review in the

"Journal of Exercise Science & Fitness" on this very topic. So the title of this review was the "Determinants for success in climbing." So they compared advanced and elite climbers to novice and non-climbers and they found that advanced climbers have these things in common, increased whole body, I'm sorry, increased whole hand grip strength, stronger and more efficient finger flexor muscles, better postural stability and control. And then some anthropometric measurements that elite climbers have are lower skinfold thickness, lower body fat and larger forearm volume. And then they have this iceberg profile, which is a psychological profile which is characterized by vigor and less tension, depression, anger, and fatigue.

So this iceberg profile has actually been studied on elite athletes and they have found that elite climbers kind of fall into this category of the iceberg profile. Interestingly, anxiety was seen with both novice climbers and elite climbers. So elite climbers are not exempt to having anxiety as one might be surprised to know. And then they found that elite climbers do not have a correlation, I'm sorry, elite versus novice climbers, there was no correlation to height, BMI, or arm span being a defining factor. So in order to become kind of an advanced climber or to improve your climbing performance, we're gonna talk about some general global movement strategies that advanced or more experienced climbers exhibit.

So in general, there is an unequal weight distribution side to side. So unlike a sport like weightlifting, where you have equal weight going through both arms and both legs typically, rock climbing is a very offset sport or off balance sport in terms of load. So you might have more load on one side of your body versus another and that is a very common thing in climbing. You also usually have three points of contact at any given time, sometimes two. And then the sport itself is really just a series of isometric holds between movement. So for someone that climbs more slowly and statically, this isometric hold time might be around seven to nine seconds. And someone for that climbs a bit faster and dynamically, this isometric hold may be three to five seconds.

And not to say that climbing slower or faster is either good nor bad, they're just different techniques and different styles. So we will get into a little bit more specifics on that and we'll show you some examples of that as well. And then the foot work and what's happening from the waist down is really, really important in a climber and I can't stress this enough as well. Because climbing is a very upper extremity intensive sport, but a lot of people tend to forget that the lower body really does matter a lot. So what you're doing with your feet and your foot work allows for the conservation of the upper extremity. So the upper extremity is being conserved when you have really good footwork and technique and that can be the difference between someone kind of lasting on the wall and completing their climb and someone not completing their climb. So again, static versus dynamic, like I said, not either one is better or worse than the other, they're just different styles.

And climbers may employ these two styles, both in the same climb or they may kind of have a tendency, usually, a climber has a tendency to climb a certain way. So the climb that they're about to do may lend itself better to one style versus the other. So for example, if the holds are spaced really far apart, you might have to climb a bit more dynamically in order to reach it. However, usually climbers have a kind of go-to style so no matter what the climb, someone may come in that just kind of usually climbs more statically and then another person may usually just climb more dynamically. So usually people have sort of a go-to style. So what does this mean? Static climbers are more smooth and fluid with their weight shifting and movements. Their transitions are a bit slower. And like we said, they have these longer isometric hold times in between their movement for about seven to nine seconds. And that's typically associated with those roped disciplines, although not always the case, you could certainly see someone bouldering that employs this sort of static and smooth climbing style. On the other hand, people that climb more dynamically are much more choppy and quick with their movements. They have powerful transitions, shorter isometric hold times, and typically more associated with bouldering. But like I said, that's kind of a generalization, you

could certainly climb this way and be a roped climber. And like I said, climbers will usually kind of have one of these kind of go-to styles. Okay, so we're going to play this video here and we're going to show you what a static climber would look like. So this is a patient of mine and as you can see, she's holding on for about seven seconds or so with each hand before she ascends up and she's kind of going one foot, one arm at a time there. Very slow, very controlled. Okay, and then we'll move on to the next video and this is going to show you a contrast of what a dynamic style would look like. So this is sort of a montage of a dynamic kind of style.

So as you can see, a lot more power associated with this type of climbing. I'm just gonna play that one more time here. So power is force times velocity, right? So you have to generate the force in a shorter amount of time. So dynamic climbers have more power behind their movements. Okay, and then we'll just move on to the next slide there. Okay. So now we're going to transition and talk a little bit about local movement strategies. So how are climbers manipulating the holds that they're grabbing onto? The most commonly held grip is called the crimp grip and we're gonna talk a lot about this today. So the crimp grip can be defined in these sort of ways and Cooper in 2019 defined them in this way.

If you read articles, they may define them slightly differently, however, we're going to be kind of going with these definitions here. So a crimp is a small edge where you can only use your fingertips. So picture yourself kind of grabbing sort of a pull up bar and you can get your entire hand around it. A crimp is something that you can only get your fingertips around. So it's a very tiny edge that allows only for the fingertips and there's different ways that you can perform this grip. So an open hand grip. The proximal interphalangeal joint would be at an angle, I'm sorry, that should be greater than 90 degrees. So the angle at your PIP joint should be greater than 90 degrees of flexion with the DIP joint also in flexion. A half crimp. The proximal interphalangeal joints are going to have about a 90 degree angle there, so they're gonna be at a right angle. And

then a full crimp, the proximal interphalangeal joint is going to be at an angle less than 90 degrees. So it's going to be more flexed and the DIP joint is going to be in hyperextension. And we're gonna show you some pictures of this so don't worry about kind of memorizing that there. So here is a depiction of what we just talked about. So for the open hand grip, the angle is going to be greater than 90 degrees. So you can see here that the proximal interphalangeal joint, oops, here is at a greater degree, it's more extended. And then the distal interphalangeal joint is also in flexion. With the half crimp, the PIP joint is about at a 90 degree angle. And then with a full crimp, the PIP joint is more flexed. So the angle is less than 90 degrees and the distal interphalangeal joint is hyper-extended. So these three grip types are very common and this is how climbers would interact with a small edge. Other climbing hold types here, sort of a menu of hold types that differ depending on the rock. So a jug would be kind of like that pull up bar or something that you could get your entire hand around. A sloper would be using kind of the surface area of your fingers and puts a little bit more strain on your wrist and your wrist flexors.

A pocket is something that you can only fit three or less digits in and these pockets may be either shallow or deep. So you can see here three finger, two finger or one finger. So you can really see how much stress rock climbers are putting through their fingers. Other hold types which are including kind of the entire upper extremity would be something called a gaston maneuver. So this would be internal rotation of the shoulder and abduction of the shoulder. So picture yourself kind of opening a sliding glass door perhaps to your backyard, that position that you're putting your arm in sort of internally rotating and abducting your elbow to the side is called a gaston maneuver. And then in addition, an undercling would be where the hold is kind of on the bottom side, and that would be engaging more of the bicep. So we're gonna come back specifically to this gaston maneuver, and talk about this more when we talk about shoulders. Okay, so now that we've kinda got those basics down, we're going to dive more into rock climbing injury considerations. So let's look at a little bit of statistics

here. So in 2015 in the "Wilderness & Environmental Medicine" journal they did a study where they compared to decades in time and they actually also authored the study of the kind of 2000 era as well. So they compared the injury rates in climbers over two decades to see what's going on with climbing related injury. So around the 2000 era, it was about a 50/50 split between acute injuries and overstrain or chronic injuries. And now in the 2010 era, it's leaning a bit more to those chronic injuries. So more climbers are kind of getting these overuse injuries versus acute. And then they also broke it down by body region. So around the 2000s, the upper extremities accounted for about 2/3 of the injury, but then around the 2010s, upper extremity injuries accounted for 91% of all climbing related injuries.

And this isn't too surprising because climbing is such a upper extremity intensive sport. A lot of these injuries are happening to the upper extremity. So that is quite an alarming statistic though, that almost all injuries are related to the upper body. They also broke it down by individual body part. So now you can see that in this 2010 era, about 50% of all injuries are finger injuries followed by shoulder, forearm and elbow. So really the entire upper extremity represented there, but specifically 50% being finger related injuries. Not surprising after we saw the slide on how many different ways the climbers use their fingers.

So then they broke it down by what type of finger injury. So pulley injuries have been the most commonly injured area in a rock climber for some time and now it's representing about 1/3 of all injuries are pulley injuries. So this kind of bit of our chart here is going to be focused on these pulley injuries and we're gonna dive a bit deeper into what these are and what that means. Some other finger related injuries include capsulitis, tenosynovitis and epiphyseal fractures, as we said, are seen in youth. Okay, so where is the annular pulley? So I'm just going to go out on a limb and say that most physical therapists are probably not seeing annular pulley injuries very often in the general public, because this injury is not very common amongst the general

population, however, is very, very common in a rock climber. So we're gonna do a little bit of an anatomy review here. So there are five annular pulleys of each digit. As you can see on the anatomical picture on the left, they are labeled A1 through A5. And then I've just taken a photo of my own hand here to show you and if you're looking at your own finger at home, you can kind of compare where these pulleys are on your own finger. So you have the tendon of the flexor digitorum superficialis and flexor digitorum profundus coming down here encapsulated by the tendon sheath, which is in blue and the tendon is running underneath of these pulleys.

So the function of the pulley is to kind of act as a strap. It is a ligament that attaches from the bone to the other side of the bone and acts as sort of a strap to hold the flexor tendons close to the bone. So it's holding the flexor tendon in place, that way we're able to do fine motor movements with our fingers and our flexor tendons can stay close to our bone the entire time. So that is a function of the pulley. So we're gonna talk about the relationship between the closed or full crimp position and the annular pulleys. So again, with the full crimp position, that is where the proximal interphalangeal joint is flexed at an angle that is less than 90 degrees of flexion with the DIP joint in hyperextension.

So the joint is flexed at about a 60 degree angle there, the DIP joint hyper-extended. A lot of times you'll see climbers kind of wrap their thumb around their DIP joint to give them a little bit more force. And this closed or full crimp position places the most biomechanical strain on the A2 pulley than any other grip position. So in rock climbers, the A2 pulley is the most affected followed by the A4. So we're just gonna go back and check that out one more time. You can see the A2 pulley here between the MCP joint and the PIP joint. So in that area right there is where most of the climbing injuries dealing with the annular pulley are occurring. And then and the second place that they're occurring is this A4 area. And this is due to this full crimp position most of the time. Now, what is the mechanism for this occurring? So usually in the "Journal of

Biomechanics," they looked at this question. So they found that usually the mechanism of injury for annular pulleys is caused by an eccentric load. So if the finger is in this fully flexed position, it's going from flexion to an extended position very quickly. So this can happen if there's a sudden increase in load due to a foothold slipping unexpectedly. So this is probably the most common scenario where the individual has their finger in this position and then they slip and they are loading that finger into extension or eccentrically loading it very, very quickly so that can cause this pulley injury to occur. And then in addition to just slipping unexpectedly, their forearms could just tire out and their hand could kind of open up so in the same sort of eccentric loading fashion. So what are the symptoms? What does this feel like? What does this look like? Sometimes the climber will come in and say that they've heard an audible pop when this occurs.

There could be swelling, pain to palpation. And then in only very serious cases, you would see this bowstringing of the flexor tendon. So this red line here that you see on the photo is representing the flexor tendon, and you may see it kind of bowstringing away from the bone only in very severe cases of multiple pulley ruptures. So in 2003, also in the "Wilderness & Environmental Medicine" journal, they did a kind of overview of how we can grade these pulley injuries. So if this occurs, we need kind of a way to grade the severity of the injury.

So this is good for your reference to know, that they are graded from a scale of one through four and in a grade one pulley injury, that would just constitute a pulley strain. In a grade two, there would be a complete rupture of the A4 or partial rupture of the two or three. In a grade three, there would be a complete rupture of the A2 or three, and remember the A2 is kind of the one that's most susceptible. And then the grade four, there would be multiple complete ruptures combined with some lumbrical or ligament damage. And then as you can see at the bottom, most of these, actually all but one, can be treated conservatively. And only in the event of a grade four with

multiple ruptures, in addition to other damage of the hand, would you require surgical repair. So this is great news for us as rehab professionals, that we can really manage these injuries conservatively in most cases. So when injury is indicated, like I said, in a grade four, they will do a palmaris longus tendon graft or an extensor retinaculum graft. So how are these usually diagnosed? Well, the gold standard of diagnosing a pulley injury is going to be a diagnostic ultrasound. So this would differ from a sort of therapeutic ultrasound that you might see in the clinic where the ultrasound is used for therapeutic reasons. This would be a diagnostic ultrasound where you are getting an image of the finger and you are seeing the distance between the flexor tendon and the bone. So the way that it is diagnosed is using the measurement between the tendon and the bone in the finger. So if the distance between the tendon and the bone is over two millimeters, that is sort of the threshold, according to these studies, that is used to diagnose a complete pulley rupture.

Anything that's less than two millimeters would be either a pulley strain or perhaps a incomplete or partial rupture. So that kind of two millimeter threshold is important to know. An X-ray can be used if you're concerned about an avulsion fracture perhaps, and an MRI would be reserved for only those cases that the ultrasound is unclear. So if the MRI is going to be a little bit more costly usually, and the diagnostic ultrasound is very accurate and is a bit more convenient for the patient. So here's an example of what this would look like. So here you are seeing a depiction of the midpoint of the proximal phalanx and the distance that you're seeing there with the arrow is the distance between the tendon and the bone. And in this image, they have measured a distance of 4.7 millimeters. So this would be diagnosed as a complete A2 pulley rupture here. Now, I know that the slide is very, very busy, however, what if you do not have access to a diagnostic ultrasound, it's not readily available in your clinic, what can you do as a clinician to kind of give your best clinical diagnosis and judgment on how severe the individual's injury is? So in 2019, just last year, there was a study that came out of the "Journal of Hand Therapy," looking at some potential schemes that we can

use as rehab professionals just sort of put this injury in a category. So giving your kind of best clinical judgment as far as how severe that their finger injury is. So on the left side of the graph here, I'm sorry, the left side of the chart, you see these categories of pain, active range of motion, resistive testing, and palpation. So these are things that we do all the time as physical therapists so this should be very familiar to us, but we are kind of extrapolating these things that we do to rock climbers. So with pain, if the individual is limited with their daily activities and climbing, those are things that you first wanna know. And then with range of motion, if there's either no range of motion loss, there's at least 25% range of motion loss, or over 50% range of motion loss of their digit, that is the next kind of assessment that you want to do.

And then with resistive testing, as you can see there, we are comparing the pain that they're experiencing between these three grip types that we learned about. So the sloper grip, the half crimp and the full crimp, and the sloper is also known as the open handed grip. So those three grip types, and if they're having more pain with the full crimp position, that would be more indicative of a pulley injury. And then for the severe category, if they're having weakness and pain of any and all of those hand positions, that would be indicative of a severe injury.

And then when you're doing the palpation to the area, so if you're just feeling kind of your own finger there at home in that A2 pulley region, and you have to provide maximal pressure to feel a little bit of pain versus minimal pressure to feel pain, that would also give you an idea of how severe their finger injury is. So this is a great reference to use if you've got a climber that comes into your clinic and you want to kind of have a starting off point in diagnosing kind of how severe their injury is. And because also most of these finger injuries can be treated conservatively, it really is a better way to go as far as being able to clinically diagnose it without getting an image, if that is appropriate, because usually these are treated conservatively. Okay, so this was also kind of adopted from that study. So in the study that was mentioned

previously, this is how they tested the finger. So on the top, you can see that open handed grip. So we've just got the finger with the PIP joint at that greater than 90 degree angle and we're testing the finger strength there. In this one, we've got the finger at that 90 degree angle, which would be the half crimp grip position. And then with the last one, we've got the finger flexed to a degree that is less than 90 degrees with the distal end in hyperextension. So we're kind of mimicking those grip types and seeing if the patient is experiencing pain. So that's all really fine and well, however, there are definitely limitations to this clinical diagnosis. First, being that it is very difficult to rule out differential diagnoses of finger injuries without imaging.

So there is a lot of other injuries that we should consider in addition to just the annular pulley of the finger and these differential diagnoses may include a flexor tendon strain. So if someone's got a strain of their flexor digitorum superficialis or flexor digitorum profundus, they would most likely also have pain with those resistive tests. So it is not a end all be all to just do the resistive testing, because you're gonna have pain in different diagnoses of the finger. You could also have some collateral ligament strain, tenosynovitis, volar plate injury, epiphyseal fractures, like we said before, and climbers may also have a combination of injuries.

So it becomes a bit difficult to be 100% certain, however, most rehab programs are going to be quite similar in their approach. So sometimes it is kind of worth if the injury is not, you know, you're not seeing that bowstringing and it's not looking like it's very, very severe, sometimes it's just best to kind of start off with a conservative rehab program to see how they respond. However, if you are concerned that it would be a severe injury or you just feel unsure, then definitely doing that ultrasound diagnostic test is going to be your best bet. So again, here's a busy slide for you, but a good reference. So this is just an algorithm and kind of a summary of what we just talked about. So the first thing that you wanna know is how their injury occurred. Like we said, did they slip suddenly, was it traumatic or has this been going on for a long time?

If it was an acute injury, did they hear that pop? Did they have pain and swelling? And then can you visibly see that bowstringing of the tendon? If you can visibly see that, then you are pretty confident that it is going to be a higher grade injury and you want to get a referral out for this individual. If the individual has more of a chronic injury, you're not seeing the bowstringing, they're just kind of complaining of some mild pain, sort of that chart that we looked at is kind of pointing toward maybe a mild or maybe moderate injury, you wanna start with a conservative approach.

And then if this conservative approach seems like it's not working, then that's when you want to refer them out as well. So this is a good algorithm just to keep handy, to see when it would be appropriate to refer a patient with finger pain and when it would be appropriate to just start with some conservative management. Okay, so we're going to come back to finger injuries. Let me just go back a slide here. We're going to come back to finger injuries a little bit later to talk about the treatment strategies. So we're gonna move on and talk about elbow injuries a little bit.

So elbow injuries, like we saw in that study, are accounting for approximately 9% of all injuries. A lot of times these elbow injuries are associated with tendinopathies of the elbow. So most often, individuals have medial epicondylitis, also referred to as climber's elbow, not just golfer's elbow, in this population. And then also lateral epicondylitis can be seen, but we're going to kind of use some examples going with this medial aspect of the elbow and kind of giving you some examples of how we would go about treating this in a climber. Other injuries that you may see with the elbow could be some nerve entrapment around the elbow, that would be another one that is sort of another common injury that you can see. Okay, so again, just a quick and dirty anatomy review here. So if we're talking about the medial elbow, we're talking about the common flexor tendon area. So what are the muscles that are around this common flexor tendon area? We have the flexor carpi ulnaris, flexor carpi radialis, we also have the flexor digitorum superficialis, not the flexor digitorum profundus, that

does not attach to the medial elbow. So we have that superficial digitorum muscle. We also have the pronator teres, so that's another muscle that kind of attaches to that medial elbow. And then in some cases also the palmaris longus. So we're gonna come back to these and we're gonna come talk about this when we talk about treatments. Okay, so some current concepts in tendinopathy treatment. This could be definitely a whole lecture in and of itself, however, what is the research saying about how to manage tendinopathy? So what do we know? Well, we know that normal physiologic loads are required for tendons to maintain their homeostasis. So with loads that are either too high or too low compared to what the capacity of the tendon currently is is going to cause some trouble for your patient.

And we know that healthy adaptation occurs when tendons are placed under loads greater than approximately 70% maximum voluntary contraction. So you need the load to be high enough in order for the tendon to adapt. So if you're exercising with your patient and the load is not high enough, then you're likely not getting the result that you want and you're not getting the adaptation to the tendon that you are looking for. And tendinopathies can result, like I said, when the load is either too high or too low from what the tendon can currently handle, which can impair the ability of the cells to maintain that normal function.

So just keeping these concepts in mind that our tendons have a capacity that they are at currently. If we go too high or too low from that capacity, we are potentially going to be causing some issues, but they're never gonna get stronger and adapt unless the loads are high enough. So we kind of have to play this kind of game with our tendons to get them to adapt in a healthy way, but not excessively overdo it. Okay, so in a rock climber, what are the considerations that we want to keep in mind when someone comes in with elbow pain into our clinic? So a lot of the times there are very classic things that may be happening that you wanna know about. So usually with a beginner climber, they're gonna be doing a lot of over gripping of holds. Picture climbing for the

first time, you're sort of going to want to grab on and hold on for dear life, because it's scary. It's a scary sport, you're up high, you've never done it before so you're gonna have a tendency to really overgrip those holds more than you need to. This happens a lot. Also just the amount of repetition. So we all know that tendinopathies can occur with just repetitive overuse. So like I said, when someone's inside of the climbing gym, they can be doing a lot of repetitive gripping more so than a lot of other usual daily activities. So this can lead to strain of that common flexor tendon area. Large volumes of climbing, like I said, inside can contribute to this overuse. And then we see that usually beginner climbers really bend their elbows constantly in order to hold themselves close to the wall and that is just a technique issue that is not optimal. So that is kind of sign of a poor technique that leads to this excessive kind of overuse of the tendon.

And then when people are climbing routes that are over vertical, so they're more overhung, they're going to just be stressing their upper body in general more. So a combination of all of these things is why people kind of tend to have these elbow problems. So we're gonna look at this video, actually, this is another client of mine that came in. So here we go, here. So this is actually a client of mine that came in to the clinic with elbow pain and I'm gonna give everyone to kind of just watch how he's climbing there and then we'll play it one more time.

Okay, so I'm gonna play this one more time and I'm gonna point out a few things here. So he, like I said, did come in with elbow pain and what he's doing that you can see is he's really pulling with his upper body and his elbows are quite bent as he's pulling. So I'm just gonna pause the video right there and you can see that the right arm is bent, his elbow is sticking out to the side and he's really pulling himself up with his arms. And you can kind of follow him up doing that, and he is a beginner climber. So we are gonna move on to the next video here which is going to demonstrate someone with a little bit more experience. So this climber is more experienced and as you can see,

when she is climbing, she is moving her hips, kind of twisting around her feet. Her arms are very straight when she's resting. So she's just kind of working out the moves there. And she straightens her arm, gets her hips close to the wall, kind of turns her body and then straightens her arms as she's ascending. She's bending her elbows just to get to the next hold, but when she gets there, she straightens her arms out. So there's a lot more variation in the straightening of the arms, the bending of the arms, the moving of the hips. She's looking at her feet and placing them precisely where she wants them, kind of shaking out her arm a little bit. So that is kind of what a more advanced climber would look like. She's got a slow and static style as well, like we learned about before, and she's moving her hips a lot to get them close to the wall when she needs to move upwards on the wall there.

Okay, and then we'll just return to the slides. So again, we will come back and talk about the treatment of the elbow in a little bit here. So we're gonna kind of re-address and build off of these topics as we go, but we're gonna talk about shoulders a little bit. So like I said, shoulders also account for a large percentage of all injuries in climbers. Some common shoulder injuries that you may see would be SLAP tears, impingement syndrome of the shoulder and a shoulder sprain. Those all would be common shoulder injuries. So the mechanism for these injuries. A SLAP tear you could have as a traumatic event, like a fall onto the shoulder.

Climbers also they do a lot of falling. You could also have a SLAP tear from an overuse or degenerative mechanism as well. Impingement syndrome is another one that happens a lot in climbers due to poor rotator cuff strength combined with these movements. And this is from the slide earlier, this is that gaston movement or that kind of sliding glass door open to the backyard movement. If you kind of are at home, you can kind of practice that movement yourself. So if you're climbing something that's kind of overhung and you have a lot of weight on your upper body in combination with doing a move like this, in combination with also having poor rotator cuff strength,

you're really setting yourself up for some shoulder issues there. And the shoulder sprains can happen just like in any other sport from overuse and degeneration or like I said, performing these really upper extremity intensive type of climbing maneuvers without an adequate base of strength. So sometimes just building up just general base of strength in a climber is really important. Okay, so now we're gonna talk about rehab strategies. So what are some ways that we can manage these injuries? So we're gonna kind of come back and highlight these three areas that we just discussed, the fingers, the elbow, and the shoulder. We're gonna talk about what therapeutic exercises for a climber might look like, and then we're gonna talk about some progressions and return to sport considerations. So return to sport for a climber may look a bit different than say return to sport in an athlete that's participating in an organized sport. Because a lot of times rock climbers, they don't have a coach, they don't have any sort of formal training so we're gonna talk about what return to sport might look like. Okay, so we are going to kind of touch base on those grades of pulley injuries first.

So when we talked about how to grade the annular pulley injuries in a grade one through four, now we're gonna talk about what to do about it once you've got the grade of the injury kind of assessed. So the first topic that we wanna talk about is immobilizing the finger. Is immobilizing the finger necessary or is it not? Kind of depends on the severity of the injury. So if you've got a grade one pulley injury, no immobilization of the finger is needed. You could tape the finger, and we'll talk about some strategies for taping a finger and then return the climber to climbing at about six weeks after you go through a rehab program and we'll talk about that too. A grade two injury or a moderate pulley injury would require some immobilization perhaps and this is a study in 2003, that kind of gave these kind of general recommendations. So these recommendations can be found in that study if you'd like to take a deeper dive. So in a grade two, immobilization for about a week and half is recommended followed by taping. And then for a grade three or four in a more severe pulley injury, immobilization of the finger. So when we say immobilization there, we're talking about kind of a full

immobilization of the finger in extension. That would be indicated as well, followed by this pulley protection splint. So this here, until six weeks post-injury. So with a grade three or four, this pulley protection splint comes into play and we are going to show you what that looks like, then followed by taping. So with these more severe injuries, there is an additional step that is recommended. So this is what a pulley protection splint looks like. It's a piece of thermoplastic material that can be custom molded to fit the individual's finger very snugly. So you would custom make this for the individual climber and then if you can see here on the side, it has these little bumps out on the side to provide some vascularization to the finger.

So we don't wanna completely cut the circulation off. If this splint is too tight, we wanna have those kind of bulges on the side so that way the finger can get adequate blood flow. So they did a study also in 2016 to figure out, are these pulley protection splints actually effective? Are they actually doing what want them to do? So they looked at a cohort of climbers with A2 and A4 pulley injuries, diagnosed them upon injury via diagnostic ultrasound, and show that they had a tendon bone distance of, if we're looking at the A2 pulley there, 4.4 millimeters, and we know that that would constitute a complete pulley rupture.

And then after they used the pulley protection splint, it did decrease that tendon bone distance after a period of healing. So they concluded that the pulley protection splint is an effective conservative treatment modality for pulley ruptures. It helps to reduce that tendon bone distance while the pulley is healing. So while the pulley is healing, we don't want to be putting additional strain on it by having that flexor tendon kind of pull it away from the bone. That's gonna put too much strain on that area while it's healing so we do wanna keep the tendon close to the bone in the healing process and the pulley protection splint has been shown to do that. So after a period of time where the finger is being immobilized and after we have adequately protected it with the splint, we're going to wanna restore the range of motion of the digit and a way that we can do

this is with finger tendon glides. So these are going to be an introduction to getting back to the full range of motion of these finger digits and ensuring that the flexor tendons are gliding smoothly through those annular pulleys. So we'll play this video here, and if you're at home following along, feel free to follow along 'cause all you need is your hands. So it would look something like this. It's gonna play a couple times so you'll have some opportunities to try this. So you're gonna start with a hand that's fully open. You're gonna go down into kind of that crimp or hook then a fist, and then a flat finger grip, and then back to the fist, kind of back to that hook position and then up. So let's try again. Into the fist, into kind of like a lumbrical type of grip and then back up, and one more time so you can see it there.

Oh, there it goes. Okay, so that would be a good introduction for your patient that's just coming off of a pulley injury to restore their range of motion. Okay, and then we talked about taping techniques. So there's also a study done to see what type of technique is optimal for a climber with a pulley injury. So they compared this H-taping technique that you see in the middle, where the two pieces of tape are kind of cut and the center is left intact to a circumferential technique where the finger is just wrapped in a circular fashion.

And they concluded that the H-taping technique was shown to reduce that tendon bone distance by 16%. So the way that you would do this is you would take the center piece there that is intact and you would put it on the palmar aspect of your PIP joint, and then you would wrap those ends around the knuckle, either on top or on the bottom of the knuckle there that you see on the left side of the screen. So doing this was a more effective way to hold the tendon closer to the bone than just doing a circumferential method, but be aware that they did use Leukotape in that study, so not the tape that you're seeing on the screen here. So they used a bit of a thicker tape to keep the tendon close to the bone there. And then just kind of a note that prophylactic taping of the finger is not generally recommended because we do want the tendon to

adapt. We wanna put a healthy amount of stress on the tendon. So we don't want to kind of hinder that by taping the finger when there is no injury. Okay, so now we're gonna talk about remodeling the flexor tendon and progressing into strengthening. So when you have a climber that's coming off of a finger injury, it's really important to do some structured strengthening program for their fingers before you send them back onto the climbing wall. So you wanna progress the patient through a loading program once their mobility is restored. So you wanna work on that mobility of their fingers first and then, like I said, loading is gonna be really important to return them to sport, improve the capacity of their finger strength.

So right here, as you see in the photo, this is a hangboard. This is a commonly used piece of equipment for climbers. This is how they train their fingers. A lot of rock climbers have these at home. So if you have a rock climber come in, they more than likely have this at home, they definitely have them at the climbing gym. But this could be part of a home exercise program because they likely already own one of these so keep that in mind as you're prescribing your exercises. So this is the way that you would kind of be positioned on it, you would just hang and then take your feet off of the ground.

Okay, like I said, using a hangboard is going to be optimal because climbers are already familiar with this piece of equipment. It's sort of analogous to if you had like a soccer player come in and you wanna get them kind of doing dribbling drills just to get them engaged with their sport again, psychologically, that's really important. So for a climber, if you have this equipment, they're gonna feel really engaged, you're gonna build some rapport with the patient, they're gonna be more interested in doing the rehab if you include this piece of equipment. And not only that, a hangboard is really an optimal way to allow for this longitudinal loading of the finger flexors, because it creates that optimal reorganization of the collagen fibers. So the collagen fibers in our fingers are already running in that parallel fashion in a normal, healthy tendon and the

position of the hangboard and you hanging down vertically is going to encourage that healthy reorganization of collagen fibers in a very climbing specific position. So it looks like climbing, they have got their hands overhead so for all these reasons a hangboard is gonna be kind of your go to piece of equipment. And modifications are also possible. So if you have a climber come in that's a very new climber, their tendons may not likely be adapted to just hang by their fingertips like that if you're very, very new to the sport, so you can modify this and I'm gonna show you ways to do that. So this would be a way to modify that. So you are going to want to kind of hang the weight from the ground. This will be a great way to kind of minimize that load if they are a new climber and you can really regulate how much weight you're putting through these finger flexors.

Also, if they've got any sort of shoulder injury or reason why they're having difficulty getting their arm overhead, you can still train their finger flexors in this way with their arm down by their side. So to determine the load tolerance, so how do you know how much weight is appropriate for the patient? You're going to wanna start by just experimenting with these different positions. So either, like I said, for a new climber, you may want to start like this, and then I'm just gonna advance one slide so you can see the photo that I'm gonna show you. There are ways to either add or remove weight.

So in the photo on the left, the climber has added weight to their body using a kettlebell and a harness. So they've got over their body weight. And then on the photo on the right, they've got under their body weight, because the pulley system that you can see there is decreasing their weight, so they're offsetting their weight. So you're going to wanna kind of play around with these adding and removal of weight and ask the patient what their symptoms are. Are they experiencing a lot of pain? Then you're going to want to subtract some weight either by doing it as you can see here, or with that pulley system that we just looked at. If they're not having any symptoms and

they're a very, very trained climber, you may wanna add some weight. So you want to slowly load their tendons for about five to 10 seconds, kind of ask them some questions and elicit perhaps a low grade amount of their familiar finger symptoms that they were experiencing. So there are other ways to figure out the load tolerance. So there are some technologies that you can use, some dynamometry type devices that are really, really handy. So this is one of those devices. So the individual's got this same sort of block of wood there that they're grabbing a hold of and they're just pulling on it isometrically and that device is reading out the amount of force that they're producing.

So this is a way that you can really kind of quickly determine their load tolerance because they're pulling as much as they are able to tolerate and you can get a numerical value from this type of device. Really, really handy. Similar to the kind of cumbersome aspect of kind of testing someone's one rep max, it gets kinda clunky, you have to kind of do a bit of warming up, trial and error, it gets very cumbersome quickly. It's the same sort of thing that happens when you're trying to determine their load tolerance with the adding and removal of weight. So this really takes care of that and kind of knocks out that kind of back and forth that you would need to do. If you don't have something really fancy like that, another option would be to just use a regular bathroom scale.

So we're gonna play this video here. So you can use just a bathroom scale, have the patient stand on it, have them pull on the hangboard, and as you can see, just play it one more time there, it's a short little video. They're pulling and their heels are lifting up. So you just do a bit of math to subtract their body weight that they started with and the body weight that they were able to remove by pulling on their fingers. So that would be kind of a low tech way to get a numerical value for their load tolerance. All right, and we'll kind of go back to the slides there. Okay, so then what does a initial loading program look like? So once you've kind of decided what orientation you want

to load their fingers in, how much weight you wanna start with, an example protocol would look something like this, where you begin with an open handed grip style. Remember you don't wanna start with that kind of fully flexed hand, you wanna start with a more open grip that's gonna put less strain on the pulleys. And the purpose of this kind of initial loading program is to just introduce their finger flexor tendons to some load again after a period of time off or perhaps they're new to loading their fingers, this would be a great place to start. So you would hang on the hangboard or pull up on the device from the ground for about five to 10 seconds, and then give yourself a really good rest of about two or three minutes. You could repeat that three to five sets and then perform two to three times a week.

So that would be a really easy and safe and comfortable rehab protocol to start with there. And then you could gradually increase the intensity over time as their tendons adapt and as their pain decreases and they get used to the activity. So once they're comfortable with doing sort of that really easy loading program, you wanna progress it to something that looks more like the way that they climb.

So the purpose of this progression would be to mimic the demands of the climbing a little bit more closely. So as we've been talking about, if they've got that sort of slow and static style, you wanna hang a little bit longer, perhaps, so that seven second hang time is going to mimic the amount of time that their hand is on the hold. And then a three second rest period is going to be mimicking the amount of time that it takes them to take their hand off the hold and then reach up and grab the next hold. So when they're climbing, they've got their hand off of the hold for about three seconds. So doing this on the hangboard like this makes a lot of sense. So it would look something like this, where you're hanging for seven seconds, resting for three seconds, and perhaps repeating that about five reps, taking a break and then you can repeat a couple sets of that. If they're have that more faster, dynamic sort of choppy style, you might wanna hang for a little bit shorter of a time so maybe a five second hang and a

three second rest period, and that would mimic kind of their climbing style. So again, just tying into the fact that you really wanna know your athlete and know what kind of style they have, know what kind of climber they are to create the rehab program. So I'm gonna show you what this would look like if you gave this to a patient for their home exercise program. So we'll play this video here. Okay, so this is someone doing a seven second hang and a three second rest. So they've taken their feet off the ground, hanging for seven seconds, resting for three, so just staying there, maintaining the position and then continuing on. Seven seconds on, three seconds off and so on. So that's what that would look like as a rehab program and your fingers aren't going to know if you are hanging on a hangboard or if you're climbing on a climbing wall, the same load is going to be applied.

So it's a really way to mimic rock climbing. Okay, and we'll go back to the slides there. Okay, so we're gonna kind of talk about how to manage those elbow injuries next and we're gonna tie everything together, kind of as a caveat that not any one injury is really siloed into its specific body part in and of itself, so we do wanna look at the whole body as well. So we are going to tie that all in at the end. So when you've got someone with elbow pain, like we mentioned before with the climbers that we were watching the video of, you wanna start by doing some relative rest.

And what I mean by that is not just telling the climber to stop climbing, but we wanna really look at their technique, look at their training habits, we wanna really have a conversation with the climber. So a lot of times when someone has elbow pain, there's more to the story. There's usually a technique issue that's going on or perhaps a training issue in terms of too much volume. So you could ask the climber to just start by climbing on less than vertical terrain so they've got less weight on their upper extremity to give their arms a break. Decrease their climbing volume a little bit. So if they're climbing at the gym every single day of the week, perhaps encourage them to maybe try every other day to give them a rest in between. More importantly than that

though, you really wanna look at their technique. So I personally will videotape, of course with the patient's permission, videotape my clients climbing and then I'll share it with them. 'Cause a lot of times your patient is not going to know how to articulate their style and perhaps you can videotape them without disclosing what exactly you're looking for. So that way you can just see kind of what they do and then you can share with them from a biomechanical standpoint, what kind of things may be not ideal or optimal. So if you don't have access to a climbing wall in your clinic, you could just ask the patient, if they could bring in a video of them climbing, have one of their friends take it at the gym, bring it into the clinic and spend some time really hashing out their biomechanics a bit. So what you wanna look for, like we said in the slide before, is that kind of intermittent straightening of the arms.

You wanna give those elbows a break by not having them constantly bent. So shaking them out, kind of having them straight, focusing on the movement of the hips and the footwork is gonna be really important and refraining from over gripping. So those things to chat about with your client that comes in with elbow pain. So we're gonna look at just a snapshot of these two climbers. This is the same video that we looked at earlier. And as you can see, they're in the same relative position, they've got their right foot higher than their left foot and they've got their arms overhead.

But you can see that they've got differences with the way that they're holding the hold. So the climber left, you can almost tell that he's kind of over gripping, it's hard to see from a picture. But he's really sticking his elbows out, really aggressively kind of bending his arms and then with his leg, you can see that the right knee is facing the wall and the front of his toe is on the hold. So when he's in that position, his hips are sitting back and they're not getting close to the wall. So because his hips are further back, it's putting more stress on his upper body. Whereas you can see what the climber on the right, she's got her hip externally rotated and she's got the side of her great toe on the right on the climbing hold. So because she's got that external rotation

of her hip, she's able to get closer to the wall. She's got her arm straight and she's able to be more relaxed with her upper body. So perhaps with the climber on the left, even though he's coming in with elbow pain, maybe he has a restriction in his hip mobility. So you might wanna start by assessing and treating his hip mobility for his elbow pain. So not always just looking at the body part in question, but really looking at their biomechanics and their style and the way that they're climbing to really figure out where to start with your treatment.

So once you kind of have the client in your clinic and they do have some kind of tendinopathy type symptoms, what the research is suggesting about tendinopathy is sort of mixed as far as the effect of exercise. So some studies are suggesting that exercise may increase the number of collagen cross-linkages, so it actually has an effect on the physiology of the tendon itself. Whereas other studies are saying that exercise actually has little to no effect on the actual physiology of the impaired part of the tendon. So what does this mean? Does this mean we shouldn't exercise at all? No, it just means that the pathological portion of that tendon may not actually heal or return to normal, but there is likely a sufficient amount of healthy tissues still there.

So the saying focus on the doughnut not the hole, is really saying that the hole is the pathological part and we need to focus on the doughnut, which is the kind of healthy tissue and we know that the healthy tissue can adapt with load. So we want to put the tendon under those kind of 70% max voluntary contraction loads in order to strengthen the tendon because it's unclear in the research, whether or not exercise is actually affecting that pathological portion. So we're gonna talk about a couple of ways to address tendinopathy, and this can really be extrapolated to other injuries, not just climbing injuries, of course. So there are a couple of different ways in the research that they are suggesting to treat tendinopathy and that's gonna include isometric, eccentric and heavy slow resistance. So there's a lot of benefits to starting your rehab program with isometric loading. It's been shown to have an analgesic effect. It can be less

fatiguing compared to formal strength training or regular strength training. It's optimal when mobility is limited due to pain or injury. And like we've been saying for this duration of the chat, the sport of rock climbing is very isometric itself. So it's very climbing specific doing isometric exercises because it mimics the climbing and body positions during climbing. You can also avoid compressive forces on tendons with isometric loading if you've got the joint angle in an optimal position. And it also has been demonstrated to carry over into dynamic performance, which is actually really interesting. So a commonly suggested protocol for isometrics is a 45 second hold five times two to three times a day. So quite frequent, however, the volume is not high, so only five times and about, but you're doing this for multiple bouts per day.

And you wanna progress, like I said to that 70% to allow the tendon to adapt, increase its capacity. So if we're taking the example of the medial elbow, here are some examples of how we could directly address the medial elbow with isometrics. So if you had an isometric wrist flexion exercise, it would just look like this where the patient's hand is supinated there and they're holding onto a weight and you'd wanna progress that weight up so it was intense enough for the individual. So perhaps you're starting lower if their pain is not allowing, but as pain allows, you want to increase that weight, like we said to about 70% intensity.

Another one could be an isometric pronation. So for this, you would need kind of an extended weight. This is kind of a modified barbell and the individual is resisting the pronation of their forearm. So they've got their arm in kind of this half pronated, half supinated grip and they are holding it isometrically. Other isometrics you can progress to. So not directly talking about the medial elbow, but these are a lot of climbing specific type of isometric positions here. So you've got a pull up position on the bottom left. You could modify this if this is too difficult for the patient by doing sort of a modified pull up position. And then you could also do an isometric bench press for those antagonist muscle groups. So always that would be great to add isometric

strength training to your rehab program. And the other two that we're gonna talk about are eccentrics and heavy slow resistance exercises. So eccentric exercises have a lot of evidence in the literature. They've gotten a lot of the spotlight in terms of tendinopathy because they've been shown to clinically reduce pain and improve outcomes in a lot of studies. But I will also add as a caveat that it is not clear, like I said, if these clinical improvements are actually addressing the actual tendon physiology of that pathological portion, but clinically they've been shown to improve function in those with tendinopathies.

So this protocol is adopted from the Alfredson protocol, pretty famous one from 1998, still used pretty widely nowadays. So this is three sets of 15, twice a day for 12 weeks so quite high in rep. So if you're doing 45 reps twice a day, that's 90 reps per day for 12 weeks increasing intensity over time. So this study was looking specifically at the Achilles tendon and they were increasing weight by wearing a backpack on their back over time. So that is kind of a common protocol that you'll see for eccentrics. And then heavy slow resistance has actually been gaining a lot of spotlight in the literature, because it has been also demonstrating really good clinical outcomes.

There's a correlation to actually a reduction in neovascularization, which is an abnormal blood vessel formation in the tendon, increase in fibril density and greater longterm patient satisfaction. So here's an example of protocol for heavy slow resistance training. The main differences is that this is recommended for three times a week, so every other day, and you are gradually increasing the intensity, but decreasing the volume over time. So over time, this set rep scheme would be lower and your intensity would be much higher. So if we've got some examples, we'll just kind of run through all three of these examples, kind of one in a row here. Of eccentric, so if we're talking about the medial elbow, again, these are ways that you can apply eccentrics to that medial elbow. So this would be an eccentric pronation exercise, where the individual is resisting the supination of their forearm. So working that pronator teres muscle, which

is attached to the common flexor tendon region. And you need some sort of extended weight to do that one. And then the next exercise would it be just an eccentric wrist curl, and I'm sure that we've all kind of seen this exercise in the clinic before. So just assisting the weight up and then slowly lowering it down. And again, you'd want to increase the intensity. So you'd wanna increase this weight over time to be a weight that would be appropriate and heavy enough for the patient that you're working with. So that would be for the wrist flexors. And then the last exercise that you could be targeting the medial aspect of the elbow would be an eccentric finger flexion. So where this one, you would be assisting your fingers into flexion and then gradually extending your fingers out. So you could do this with a dumbbell, you could do this with a barbell, but with the dumbbell, it's easy to assist with the other hand.

So you wanna assist the weight up and then lower it down and again, choosing a weight that's appropriate for the patient's fitness level. And then we'll return to the slides there. Okay, so with the heavy slow resistance, like we said, the difference between the protocol that you'd use for heavy slow resistance is that each rep is performed slowly for approximately six seconds total for the eccentric and the concentric phase. So now you're doing both eccentric and concentric movements for about three seconds, each totaling six seconds for the whole exercise. You want to get to the intensity of about 70 to 85% of their one rep max.

So you want the intensity to be high, and you're only doing this two to three times a week. So this is actually mimicking sort of a kind of strength training sort of protocol that you might see in a regular kind of patient population. So if we took these same exercises that we were just talking about, we can modify these for the heavy slow resistance protocol by doing a heavy wrist flexion and extension. So we're doing both the concentric and eccentric phases. We could do full pronation and full supination instead of assisting the weight back up, we would just do the whole motion with the one arm. And then we could take a barbell and do finger curls. So instead of using a

dumbbell to assist the way back up, a barbell would be appropriate and useful because you would wanna be doing both the flexion of your fingers and the extension of your fingers, and it's a heavier load. So those three exercises would be adopted in that way. Okay, and then when we're talking about shoulder management for climbers, we wanna address these kinds of same sort of technique or position oriented issues that come up often with climbers. So talking about the engaged versus disengaged shoulder position is going to be important and we'll get to that in a second. And again, you could just kind of limit their overhung or more than vertical climbing. And then also limit those awkward movements, like we've been saying those gaston movements or that kind of sliding glass door position.

So this is an example of someone that is engaging their shoulders versus disengaging their shoulders. So for the individual on the right, that has that non-engaged shoulder position, it's almost as if they're just dangling there just on their ligaments they're not using their scapular muscles or rotator cuff, they're just dangling and this is very commonly seen in climbers because it takes less effort and less energy, less muscular power and force to dangle with your arms like this. So a lot of climbers will do this actually.

So you want to kind of address these issues. So say you had a climber that you were giving a finger program to for their home exercise, but they were doing it in this manner like you see on the right, they might be setting themselves up for another issue. So you definitely wanna take the time to just look at these problems that they're having potentially that have maybe led to their shoulder problem. Other considerations that you wanna make for rock climbers. So you wanna do some unilateral strengthening. Some closed kinetic chain exercises with three points of contact. And then you wanna do some rotator cuff strengthening with their arms overhead. So you don't wanna kind of get stuck in doing exercises with kind of their arm by their side because climbers very rarely have their arms by their side. So we'll go through some of these videos

here. Go through these two, this would be a great place to start. So if you've got a climber coming in with a shoulder problem, you may wanna start by just doing some weight shifting. So perhaps doing some quadruped shoulder taps where they're weight shifting side to side, putting some weight bearing through that arm with those three points of contact. So that would be a great place to start in sort of an acute or beginning stages of the rehab. And then we'll go to the next one here. I love using kettlebells. It's a great tool to use for climbers because unlike a barbell, like you see with kind of weightlifting or a lot of times CrossFit athletes will use, a kettlebell allows for this unilateral strengthening of the arm and climbers, like we said, do a lot of this unilateral movements that aren't always equal side to side.

So this is kind of the beginning position of like a Turkish get-up where their arm is overhead. Alright, and we'll go back to the slides there. We've got a couple more videos coming up for you guys to see. Okay, so we're gonna put this all together, like I said, to return the patient to their sport and kind of pull this all in. So like we said, you wanna incorporate the full body into upper limb dominant rehab plans. You don't wanna just stick to the body part in question, you really wanna look at their entire body and incorporate their lower body into say a finger program or elbow or shoulder program.

If you feel uncomfortable or not confident giving kind of those technique driven comments to the patient, you wanna collaborate with perhaps a climbing coach or someone at their gym to address these technique problems that they might be having. And then you wanna progress the patient to some kind of dynamic and plyometric upper extremity exercises. Because we all know that with most sports, having all of the strength in the world is great, but if you can not produce that strength in a quick amount of time, you're going to have an issue when you actually perform your sport, so same thing goes with climbing. You could have really strong fingers, but if you can't produce that strength quickly, you're not gonna be able to be successful at your sport.

Okay, so we'll just go through these videos here. So this would be a progression of the shoulder exercise that we just saw. So doing kind of a full Turkish get-up is a great exercise for climbers. The arm is overhead, you're using a unilateral weight and they have to incorporate their whole body throughout this. So they've got some single limb stance considerations, they've got to use their core and it's a great full body exercise with the arm overhead. Next video would be doing sort of a dual kettlebell sit-up. So incorporating the core into the shoulder stability program. So having them do a sit-up with their arms overhead, again, and trying to stabilize the weight. And that would be a great one to do for a climber rehabbing from perhaps a labral tear. And then the next video here. Oh, there we go.

Would be kind of a variation on a traditional plank. So you could do a plank but getting their arms kind of in this overhead position to really mimic the body tension that's required when you're rock climbing, you really need to provide this isometric tension throughout the whole body. So this would be a great way to do that at perhaps more of the late stages of a shoulder stability program. And then another great exercise that would be very sport specific would be doing this isometric pull up position, but adding some alternating leg lifts to mimic sort of the climber perhaps losing their foothold and needing to place their foot back on the hold while they're climbing. So that would be a very climbing specific exercise there.

Okay, and then we'll continue there. Okay, so finally, we want to increase the speed and the dynamic training. So we're gonna progress into this producing the force quickly or more power based exercises for the climber for this return to sport kinda consideration. So there's a couple of different ways that we can do this and we'll get into a couple of videos to demonstrate this. A way that you can kind of produce force quickly using the kettlebell would be to do kind of a single arm kettlebell snatch. That would be a great way to mimic producing the force quickly. You could do assisted pull ups for speed so changing around the intention behind why you're doing the exercise

will provide that sort of increased speed or dynamic training and then quickly loading their fingers on the hangboard. And then upper extremity plyometrics for advanced climbers and we'll show you examples of this here. Okay, so we'll play these two videos here. So the first one, we're doing pull ups for speed. So the individual is trying to do a pull up as fast as possible and because of this, they may need to off weight their body a little bit, depending on their strength. So you could use the same sort of pulley system there that we saw before. Okay, and the next one there. So this would be an example of the climber kind of quickly loading their fingers. So instead of that kind of slow, gradual gentle load, this would be for a more advanced climber, someone that's trying to train power and speed. They're going to, I'm gonna play that one more time, latch onto the hold at the same time that they pick up their feet.

So it's a very quick movement, which will be kind of mimicking the technical ability that it takes to kind of latch on the holds quickly when you're out rock climbing. Okay, and then we'll do the next one. Oh, let me just play that one more time. So this would be an example of an upper extremity plyometric based exercise for a climber. So this would be reserved for an advanced climber.

And upper extremity plyometrics are not as commonly seen as lower extremity plyometrics like you see with most sport athletes doing things like depth jumps. Medicine ball throws sometimes are commonly seen with upper extremity plyometrics, but in order to mimic demands of climbing, this could be an exercise that you, oops, let me just start this back over from the beginning, one more time here. This could be an exercise that you do with a climber to mimic the kind of plyometric demands of the sport. So he's kind of dropping down and then quickly moving upwards on the hold. Okay, and then we'll go to the next slide there. So, we talked about that. Okay, so in summary, so let's just summarize what we just learned here today. Rock climbing is a very technical based sport. It's got a lot of different sub-disciplines to consider. Both acute end overuse or chronic upper extremity injuries are prevalent in climbers. Using

the climber profile as sort of an initial sort of needs analysis before you even dive into the injury that the patient has is gonna be really important to just figure out what kind of climber they are. It's gonna help you to assist in the diagnosis, injury management and progression to these later stage rehab programs, because you're going to be able to really tailor them to the discipline that they participate in. And then assessing climbers on the wall is really important. Like we saw with the climber with the elbow pain that may have had a hip issue, if you don't see them on the wall you may miss those things that you may wanna address. So addressing their technique is really an important consideration to make and may be a huge factor, which would be contributing to their problem.

And that is it, so if anyone has any questions feel free to ask, and I will take some questions. We've got about five minutes left here so feel free to put some questions in the chat box if you have any. Oh, I have a request to play the last video one more time. So I'm just gonna go back. Oh, yeah, and play the plyometric video. So the climber is starting with their hands on what's called a campus board. Oh. We'll just try to replay it one more time. If anyone had any technical issues seeing it, they're dropping down and then they're quickly advancing their limb up.

So it's a quick dropdown, it's kind of simulating sort of a depth jump that you might see in the lower extremity. And I have another question here. How much pain is acceptable when they start to hang? That's a really great question. So when they're starting their initial loading program, we usually tell them that kind of on a pain scale of about two or three out of. Okay, I have another question here. What kind of tape do you recommend for pulley support taping? That would be the H-tape method. So the method where you are putting the tape on the proximal interphalangeal joint and you are strapping it either above or below the knuckle, that would be called H-taping, which would be preferred over the circumferential taping. And let's see. What type of climbing is generally associated with the greatest amount of anaerobic fitness? That

would be bouldering. Bouldering would be associated with that anaerobic fitness, which is that kind of all out quick burst of activity with a full rest period in between. And. Let's see. So Brian asked the question, "When rehabbing the grade one pulley strains "and you say return to full climbing in six weeks, "does that imply tape and climb easy for six weeks?" So that would definitely be a part of the program, taping for all grades of injury would be appropriate. Remember that grade three and four is the only ones that you would wanna use that pulley protection splint, that thermoplastic material. So if a grade one, you could definitely just tape it and then gradually get back into easy climbing and just remember to consider those technique issues that we talked about and really figuring out what the underlying cause of their finger injury is.

So you wanna consider those things while they're getting back to that kind of easy climbing instead of just telling the patient to generally just go back to climbing. Tracy asked the question, "Isn't speed climbing also highly anaerobic?" Yes, that is another one of those sub-disciplines that we didn't really get into, but speed climbing is definitely another example of one of those all our efforts, which is a type of climbing that they will be doing in the Olympics.

So very good question. We didn't really touch on that, but yes, speed climbing would be an anaerobic type of climbing as well. It's not really a type of climbing that's very commonly done in most individuals, it's really just for those Olympic athletes and it's quite a new discipline. So that is definitely an anaerobic climbing style as well. And I have another question. "Which grip type places the most stress?" So that full crimp grip is going to place the most stress where the digit is maximally flexed, the PIP joint is maximally flexed and the distal interphalangeal joint is in hyperextension. That full crimp grip is gonna place the most stress on the annular pulleys. "What exercises would you pick for the climber "that wants to get back to overhung routes?" So one of the exercises that would be ideal to choose, for example, that we saw in the presentation would be where the climber was just hanging on the pull up bar in an

isometric fashion, but doing those alternating leg lifts. So when you're climbing overhead, your feet may kind of come off of the wall and in order to get them back onto the wall, you need to lift up your leg and place your foot. So would be a really specific exercise, those alternating leg lift exercises to get a climber back to doing an overhung route. We have a question from Susan, "Do you use Kinesio tape, "Leukotape or coaches tape?" So like we saw in the presentation, the research is pointing to the H-taping method being more optimal by using Leukotape. So that tape is gonna be a lot stronger, it's gonna actually physically hold that tendon closer to the bone. So that would be the optimal tape to use. A lot of climbers are just using regular athletic tape, which would not be as optimal. And then I have a fun question here, "Where do I like to climb personally?" I live in Las Vegas so I personally climb at Red Rock, which is our climbing area here, so thank you for asking me that . And I'll end with that if Calista wants to come back on.

- [Calista] Alright, wonderful presentation, Jennifer. I know I learned a lot and I'm sure all of you did as well. This is a new area for me, so thank you so much, Jennifer, for sharing your expertise with us today on this topic and I'm sure we'll be seeing clients like this that utilize the rock climbing in their everyday life. So have a great day everyone and thank you again, Jennifer.

- [Jennifer] Thank you.