Ankle Reconstruction

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Running Head: ANKLE RECONSTRUCTION

INJURY PATHOMECHANICS:

The Lateral Collateral ligaments are made up of three different types of ligaments, the anterior talofibular ligament(ATFL), the calcaneofibular and the posterior talofibular ligament. The ATFL is the most commonly injured ligament and is the ligament that is most likely going to need an ankle reconstruction surgery. The ATFL's main function is to limit the anterior displacement of the talus and also plantar flexion in the ankle. On average, the ATFL is 10mm long and around 6-10mm wide. The calcaneofibular ligament is 20mm long and has around a 6-8mm width. The main function of the calcaneofibular ligament is to link the talocrural joint and the subtalor joint together. The insertion point of the ligament is on the lateral aspect of the calcaneus and is the main reason why the talcrural joint has flexion and extension movements. The calcaneofibular ligament also aides with some subtalar movements. The posterior talofibular ligament (PTFL) main purpose is to provide a supplementary role to the ankle and also is very important to limit posterior translation of the talus. The PTFL is also the strongest ligaments in the ankle and is very important for ankle stability. (Golano, Vega, de Leeuw, Malagelda, Manzanares, Gotzens, Niek van Dijk, 2010)

The Medial collateral ligaments(MCL) is made up of the deltoid ligament. The deltoid ligament is made up of two layers which consists of the deep and superficial layers. The MCL is a multifascicular ligament, which originates from the medial malleolus and inserts in different bones of the foot like the talus, calcaneus, and navicular bone. The anatomy of the MCL is also made up of three different ligaments that are always seen in the ankle anatomy. Those are the tibiospring ligament, tibionavicular ligament, and deep posterior tibiotalar ligament. However, there are some ligaments that may or may not be present in the anatomy of the MCL, and those

are the posterior tibiotalar ligament, tibiocalcaneal ligament, and deep anterior tibiotalar ligament. The MCL ligament of the ankle is also mostly covered by tendons all the way down into the bony insertions of the foot. (Golano, Vega, de Leeuw, Malagelda, Manzanares, Gotzens, Niek van Dijk, 2010)

The peroneal muscle group consists of two muscles, peroneus brevis and the peroneus longus. Peroneus brevis originates on the lower two thirds of the lateral shaft of the fibula and inserts on the tuberosity of the base of the 5th metatarsal. The main purpose of the peroneus brevis is to maintain concavity of the sole during the toe off phase of walking, as well as evert the foot and limit inversion. The peroneus longus originates on the upper two thirds of the lateral shaft of the fibula and inserts on the plantar aspect of the base of the first metatarsal and medial cuneiform. It will also help with the toe off phase of walking and also aid with eversion and plantar flexing the foot. (Saladin, 2014). The peroneal muscle group is also "integral to the control of supination of the rearfoot and protection against lateral ankle sprains" (Hertel, 2002).

The calf muscle group consists of the soleus and gastrocnemius. The gastrocnemius has two heads, lateral and medial. The lateral head originates on the posterior surface of the lateral condyle of the femur and the medial head originates on the posterior surface of the femur above the medial condyle. The insertion of the gastrocnemius is on the posterior calcaneus via the calcaneal tendon. The main function of the gastrocnemius is to plantar flex the ankle and also aide in walking, jumping and running. The origin of the soleus is on the proximal half of the posterior surface of the tibia along the soleal line and inserts on the posterior calcaneus via the calcaneal tendon. The soleus function is also to plantar flex the ankle and steadies the ankle while standing. (Saladin, 2014)

The anterior tibialis originates on the upper half of the lateral shaft of the tibia and the interosseous membrane and inserts on the inferomedial aspect of the medial cuneiform and the base of the first metatarsal. Main function is to dorsiflex the ankle and also invert the foot. Also supports the medial longitudinal arch and resist backward tipping of the body at the ankle (Saladin, 2014). The Anterior tibialis also plays a major role "to the dynamic stability of the lateral ankle complex by contracting eccentrically during the supination of the rearfoot" (Hertel, 2002). To be more specific this muscle "slows down the plantarflexion component of supination to prevent injury to the lateral ligaments" (Hertel, 2002)

The origin of the posterior tibialis is on the upper half of the posterior shaft of the tibia, and it inserts on the tuberosity of navicular bone and all tarsal bones and spring ligament. The main function is to invert the foot. It is also one of the strongest muscle that acts on plantarflexion. Another main function of the posterior tibialis is to pronate the foot while walking, running, etc. (Saladin, 2014)

Achilles tendon main function is to attach the soleus muscle to the calcaneus bone. The tendon is the strongest in the body is able to withstand the strongest forces on the body. It is very important to the ankle to make sure it can withstand the forces of daily activities and sport specific activities. (Saladin, 2014)

There are a lot of bones that complete the ankle and really help stabilize the ankle. Beginning with the tibia, it is the primary weight-bearer for the leg. The tibia also forms the rough of the ankle mortise. The tibia follows down into the medial malleolus which forms the medial border of the ankle mortise therefore, it provides an attachment site for the deltoid ligament. Numerous

muscles of the ankle, foot, and toes also originate on the anterolateral and posterior shaft of the tibia. (Starkey, Brown, 2015)

The fibula is a long, thin bone that runs next to the tibia. The fibulas main purpose is to provide lateral stability to the ankle mortise. Other functions of the tibia consist of acting as an attachment site and an origin site for ankle muscles. The fibula also serves as a site for ligamentous attachment and a pulley to increase the efficiency of the muscles that run posterior to it. The fibula only bears weight around 12% of the total body weight. (Starkey, Brown, 2015)

The talus is the interface between the leg and the foot. The anterior portion of the talus is broader than the posterior portion of the talus. The medial and lateral portion of the talus articulate with both the medial and lateral malleolus. The superior portion of the talus creates a concave surface which then leads to a snug articulation with the convex surface of the tibia. The inferior portion of the talus articulates with the calcaneus, which then creates the subtalar joint. (Starkey, Brown, 2015)

The talocrural is articulated by the talus, tibia, and fibula. The joint is only a closed-fitting articulation when it is in the closed pack position while in dorsiflexion. The one degree of movement that the talocrural joint performs is dorsiflexion and plantarflexion. (Starkey, Brown, 2015)

The subtalar joint is a uniaxial, synovial, gliding joint that provides one degree of motion. That motion is pronation and supination of the ankle. (Starkey, Brown, 2015)

When there is an ankle sprain there will be an antalgic gait with a shortened stance phase on the involved side. The ankle will also rest in a slight plantarflexion and the ability for the patient to have balance on the one foot will be very limited. (Starkey, Brown, 2015)

Running Head: ANKLE RECONSTRUCTION

ETIOLOGY:

Most of the injuries that are involved with ankle reconstruction are acute ankle sprains or the constant repetition of acute ankle sprains. An ankle sprain would consist of any tearing of the ligaments involved with the ankle. The ligament that is usually impaired first, on the lateral side, is the ATFL, then the CFL and then lastly the PTFL. If the PTFL is ruptured it can be associated with ankle dislocations, medial malleolar fractures, lateral malleolar avulsion or spiral fractures, and talar neck or medial compression fractures (Safran, Benedetti, Bartolozzi, Mandelbaum, 1999). Some of the common risk factors of why there are many inversion ankle sprains are "slower running speed, less cardiorespiratory endurance, less general balance, less movement coordination, decreased dorsiflexion range of motion, decreased dorsiflexion muscle strength, and decreased reaction time of the tibialis anterior and gastrocnemius muscles" (Willems, Witvrouw, Delbaere, Mahieu, Bourdeaudhuij, Clercq, 2005). Some other risk factors for ankle sprains are "females are at a greater risk of ankle sprains than males in general because they have been shown to have greater ligamentous laxity in the ankle, as well as tarsal coalitions" (Shakked, Karnovsky, Drakos). Any sport that involves jumping is also a huge risk factor for spraining ankles.

There also can be eversion ankle sprains that deal with the deltoid ligament. Some of the main reasons on why there are more lateral ankle sprains rather than medial ankle sprains are due to the fact that "lateral malleolus projects more distally than the medial malleolus producing less bony obstruction to inversion than eversion" (Safran, Benedetti, Bartolozzi, Mandelbaum, 1999). Another reason why lateral ankle sprains are more common is because the deltoid ligament is much stronger than the ATFL and all of the ligaments in the lateral ligament complex. Most

lateral ankle sprains occur from increased supination and inversion of the ankle with some external rotation of the tibia on the fixed foot (Safran, Benedetti, Bartolozzi, Mandelbaum, 1999). For a lateral ankle sprain the most common occurrence of pain will be on the sinus tarsi, which is where the ATFL is palpated, and on or around the lateral malleolus (Starkey, Brown, 2015).

ASSESMENT/EVALULATION:

For a lateral ankle sprain, the most common occurrence of pain will be on the sinus tarsi, which is where the ATFL is palpated, and on or around the lateral malleolus (Starkey, Brown, 2015). When the injury first happens, patients may hear a “pop” or a “snap”. If a patient has a history of ankle sprains, they are more likely to sprain their ankle again and it will become more and more common. If the patient usually gets ankle sprains, it is due to decreased proprioceptive ability, decreased strength, and lack of coordination from the first time they sprained their ankle. (Starkey, Brown, 2015)

Swelling will be found around the lateral joint capsule, which could spread down into the dorsum of the foot and over the sinus tarsi(ATFL). Also, depending on how bad the sprain is there could be ecchymosis around the lateral malleolus. Along with observing the ankle itself, you must also observe the gait of the patient and make sure the patient is able to walk fully on the ankle. (Starkey, Brown, 2015)

While palpating the patient, they may be tender to palpate along the sinus tarsi and pain will be elicited along the involved ligaments. Crepitus felt at the site of the origin and insertion may be indication of an avulsion fracture.

The anterior drawer test is commonly used to diagnosis a lateral ankle sprain, and is considered the gold standard special test for the ATFL. A positive test indicates a sprain of the ATFL and the associated capsule. There will be laxity of the talus and it will slide anteriorly from the ankle mortise. Used mainly to evaluate lateral ankle sprains of the ATFL. Sensitivity= .86, specificity=.74. (Starkey, Brown, 2015)

The inversion (talar tilt) stress test is a positive test if there is extreme laxity and if the talus tilts or gaps excessively compared to the uninjured side. This test implicates there could be a possible sprain of the calcaneofibular ligament as well as involvement of the ATFL and PTFL. Sensitivity=.96, specificity=.64-.68. (Starkey, Brown, 2015)

Eversion (talar tilt) stress test is a positive test if there is extreme laxity of the talus when tilted to the side compared to the uninjured side. This test will implicate that there is a sprain of the deltoid ligament or a tib-fib sprain. (Starkey, Brown, 2015)

Kleiger test is a test for the deltoid ligament pathology, and there would be medial joint pain as well as, the examiner may feel a displacement of the talus away from the medial malleolus. Sensitivity=.54, specificity= .96. (Starkey, Brown, 2015)

A grade 1 sprain is a mild ankle sprain. There will be microscopic tearing of the ligament fibers and there will be mild tenderness and swelling of the ankle. (Starkey, Brown, 2015).

A grade 2 sprain is a moderate ankle sprain. There will be partial tearing of the ligament and there will be moderate swelling and moderate tenderness around the involved ligament. (Starkey, Brown, 2015)

A grade 3 sprain is a severe ankle sprain. There will be a complete tear of the ligament and extreme swelling and tenderness around the involved ligament. Usually a grade 3 tear may be more likely to receive ankle repair/reconstruction surgery. (Starkey, Brown, 2015)

There are many different theories on when surgery should be required with ankle sprains. Severe grade 3 ankle sprains will require ankle reconstruction surgery because the ligaments will be severely damaged and will not be able to heal with conservative treatment. Another reason to get surgery is if the patient has a common history of spraining their ankle. If the patient is always spraining their ankle, then the ligaments are very loose which will then require surgery. If you have chronic instable ankles due to either hindfoot varus, plantarflexion of the first ray, midfoot cavus, and general looseness due to Ehlers Danlos and conservative treatment is not working than surgery will be recommended(www.hopkinsmedicine.org).

An MRI is the gold standard imaging for detecting lateral ankle sprains. There are many studies that are done that show how effective this imaging really is. One study shows that there is "74% sensitivity and 100% specificity of MRI to detect lateral collateral ligament disruption after acute ankle injury" (Kaminski, Hertel, Amendola, Docherty, Dolan, Hopkins, Nussbaum, Poppy, Richie, 2013). Another study shows that there is "100% sensitivity and 50% specificity that detect for tears of the ATFL and 92% sensitivity and 100% specificity to detect tears of the CFL" (Kaminski, Hertel, Amendola, Docherty, Dolan, Hopkins, Nussbaum, Poppy, Richie, 2013). MRI's are used to specifically find out which ligament is injured. For a tear of the ATFL a dye will be placed with the MRI and you will be able to see if there is a tear or not. Using the extravasation of the dye is very common and seen in grade 2 and grade 3 sprains. Another common reason that MRI is being used for ankle sprains is for chronic ankle sprains. The MRI is

able to identify the thickening of the capsular with ligamentous injuries. (Golano, Vega, de Leeuw, Malagelda, Manzanares, Gotzens, Niek van Dijk, 2010)

Stress radiography has been used to test for instability of the lateral ligaments of the ankle, however the reliability of this test has been question greatly. “Radiographic measurements of anterior drawer and talar tilt tests show low sensitivity (50% and 36%, respectively) but high specificity (100%)” (Kaminski, Hertel, Amendola, Docherty, Dolan, Hopkins, Nussbaum, Poppy, Richie, 2013). There was also a study done about “stress radiography to diagnose ligamentous rupture after acute ankle sprain concluded that anterior drawer and talar tilt stress radiographs are not reliable enough to make the diagnosis of ligament rupture, regardless of whether mechanical devices or local anesthesia is used” (Kaminski, Hertel, Amendola, Docherty, Dolan, Hopkins, Nussbaum, Poppy, Richie, 2013).

An X-ray can be taken to rule out any possible fractures that may have occurred from the acute sprain. Most common fractured bone from an ankle sprain would be the lateral malleolus.

CONSERVATIVE MANAGEMENT OF INJURY:

Rest, ice, compression and elevation (RICE) is the most common and conservative treatment for an acute ankle sprain. Along with RICE patients can take NSAIDS so it will decrease pain and increase function of the ankle. Another way to treat the ankle conservatively is functional rehab. This can consist of ankle stabilization and weight bearing exercises. Trying to increase early mobilization will be beneficial for the healing process as a whole. After functional rehab, you can progress to therapeutic rehab which is in plan to restore ROM, strength and sensorimotor function. Strength and muscle activation would be the last step and the purpose behind that is to increase the strengthen of the ankle evertors, invertors, plantarflexors. All the muscles around the

ankle need to be strengthen so the ankle can return to full strength and daily activity or sports activity. (Kaminski, Hertel, Amendola, Docherty, Dolan, Hopkins, Nussbaum, Poppy, Richie, 2013)

Conservative treatment should always be the first option rather than surgery. However, if rehabilitation fails than surgery should be done. One study examined the rehabilitation of chronic instability and found that "50% of patients with chronic instability benefited from a structured rehab program" (Ajis, Maffulli, 2006). However, patients with mechanical instability were less likely to benefit than someone who has a functional instability. Rehab for conservative management would follow the same as a soft tissue injury, by using the RICE principles. Peroneal strengthening, proprioceptive training, lateral heel wedges, bracing and strapping are all involved in the rehab process. Rehab could also last about 2-3 months. It will consist of two phases: functional and prophylactic. In the functional phase, all exercises should be pain free as well as being weight bearing and multidirectional. The prophylactic phase should involve strengthening of all the ankle muscles, and be multipledirectional. The exercises should be performed in plantarflexion and inversion with the joint being progressively stressed. (Ajiis, Maffulli, 2006)

SURGICAL MANAGEMENT OF INJURY:

If the patient has chronic ankle sprains and is constantly re-injuring the ankle then an ankle reconstruction surgery may be necessary. There can either be a complete ankle reconstruction surgery or there can be an ankle repair surgery. If the ankle is not able to be repaired with a simple surgery than the reconstruction surgery will take its place. Ankle reconstruction surgery follows the guidelines of taking either the semitendinosus or gracilis and

using those muscles to reconstruct the ligaments in the ankle. First part of the surgery is to drill holes in the correct diameters at the insertion sites of the ATFL and the CFL on the talus and calcaneus. Then, “bone tunnels will be created in the fibula at the anatomic origins of the ATFL and CFL and drilled to intersect with one another at the posterior aspect of the fibula to allow passage of the graft from the ATFL tunnel into the CFL tunnel” (Matheny, Johnson, Liechti, Clanton, 2016). The graft is then replaced with a screw in the talar drill hole and goes through the ATFL fibular bone tunnel. The graft was then screwed down to secure the ATFL portion of the graft. “The graft was next passed through the CFL tunnel, then tensioned and secured to the calcaneal drill hole with another tenodesis screw to reconstruct the CFL” (Matheny, Johnson, Liechti, Clanton, 2016). The whole graft process is performed in plant flexion and neutral inversion and eversion for the ATFL. For the CFL it is placed in slight dorsiflexion and neutral inversion and eversion. Once the whole process is over the ankle is tested to make sure there is enough stability. (Matheny, Johnson, Liechti, Clanton, 2016)

Patients post-op will be in a splint for 7-10 days and after that will be on a walking boot. After reconstructive surgery, inversion and plantarflexion exercises will be prescribed. “6 weeks after surgery, therapy consisted of restoration of allowable range of motion, eccentric exercises for the muscle groups in the surgical leg, strengthening of dorsiflexion and eversion musculature, swelling control and soft tissue massage, gait training in a walking boot, and well leg and open chain strengthening of both sides” (Matheny, Johnson, Liechti, Clanton, 2016). Six weeks post-op, there is ROM allowed in all directions and working on the gait without the boot is now permitted. Post-op after 6 weeks is trying to progress with balance, proprioception, and closed kinetic chain exercises. After 8-10 weeks, the boot could completely come off, and the patient

could return to sport training as long as strength, balance, proprioception and gait were all within normal limits.

FUNCTIONAL PROGRESSION TIMELINE:

The healing process for a lateral ankle sprain begins with the inflammatory response. The inflammatory response is divided into three stages. The first stage is vasodilation of the injured area, then phagocytosis of the injured area, and then after those steps are done there is reconstruction and repair of the injured area. The inflammatory phase lasts around 3-4 days. The early proliferative phase lasts 4-10 days and is the start of the repair process, which consists of new blood vessels being formed and connective tissue. After that there is the late proliferative phase which lasts 11 days to three weeks and this is when the strength of the tissue is increased. Lastly, the maturation phase (3-8 weeks) and this is when everything is healed and the complete new tissue and fibers are laid down (Loveridge, 2002). The healing process post-op for an ankle reconstruction can vary from anywhere from 14-16 weeks long.

The main long-term goals for this specific surgery is to increase lateral stability of the ankle in 14-16 weeks. Surgical option is usually only required if the patients have chronic ankle sprains and have very unstable ankles. So, the long-term goal from the surgery is to make sure that the ankle is stable and able to withstand a greater force. Short term goals would be to solve the problem of acute ankle injuries. Also, short term goals would be to decrease the swelling and increase the ROM by 6 weeks.

Every surgery is different and may have different protocols, but the most common is placing the patient in a well-padded splint after the surgery with the foot in neutral and slight eversion. After that, the patient will come back for another visit 10-14 days later. Taking aspirin

and telling the patient to move their toes was required to do for 14 days to reduce venous stasis. After that, the patient is placed in a walking boot for the next two weeks. After that, the next two weeks protected and progressive weight bearing. Weeks 4-6 the patient is required to wear an ankle brace and begins range of motion exercises. Weeks 6-8 proprioception and strength training begins, and at the end of week 8 plyometric exercises will be started, and it will continue to week 12. Week 12, the patient will begin running and performing functional activities. In Week 16, more sports specific activities exercises will be implemented. (Li, Killie, Guerrero, Busconi, 2009)

The Karlsson score is a scale developed that can be used for both the examiner and the patient. Its purpose is to evaluate the ankle joint function. It works with points with different signs and symptoms. The 8 signs are instability, pain, stiffness, swelling, any symptoms with climbing, running, and work activities. A score of 95 on the Karlsson score would put the patient in the excellent category. The range of 80-95 is acceptable but, 79 and below is not acceptable at all. Using this scale is a good way to engage the patient and help the clinician with their rehab plan. (Li, Killie, Guerrero, Busconi, 2009)

Two other patient outcomes that were very common for ankle sprains are the Lower Extremity Functional Scale(LEFS) and the Numeric Pain Rating Scale(NPRS). The LEFS would ask numerous questions about the function of the ankle. They would ask questions about daily living and about sport activities. The LEFS will then add up all the numbers; you can answer any number 1-4. One is the most pain and then four is no pain at all. Then all the numbers are added up, and the total number is the score received. Eighty is the highest score, and is what every

patient should strive for upon returning to activity. The NPRS is a just a pain scale ranging from 0-10. Ten being the worst pain ever and zero being no pain at all.

PHYSICAL REHABILITAINS AND THERAPEUTIC EXERCISE:

During each stage of rehabilitation, there are certain goals that need to be focused on. For the first phase of rehab, the main goal is to protect the ankle after post-surgery. Phase one lasts from surgery all the way 6 weeks post-op. Protection of the ankle right after surgery is very important and is needed to make sure the ankle fully heals before it is active. Phase two begins six weeks after surgery. There are a couple of rehabilitation goals for phase two. First goals are to continue to protect the ankle and the repair, the second goals are to "achieve 75% percent of full active range of motion" (Sherry, 2014), the third goal is to get leg enough length strength to transition to weight-bearing, and the last goal is to try and get the patient to "wean out of the boot and into an ankle brace" (Sherry,2014). Phase three begins after all of phase one and two criteria is met. It begins around weeks ten and twelve after surgery. There are a few goals that also come in phase three. They consist of full "active range of motion in weight bearing and non-weight bearing positions, 5/5 strength in the peroneals in neutral and plantarflexion positions, 5/5 strength in all hip muscles, and normal gait mechanics" (Sherry, 2014). Lastly, phase four starts once phase three is complete. Phase four usually starts around 14-16 weeks post-op. The goals that phase three starts with getting the patient to begin "higher velocity movements in directions that are specific to the patients sport, no apprehension or instability while performing high intense exercises, improving core and hip strength to make sure there is no compensation for the ankle" (Sherry, 2014), and finally cardiovascular endurance to get the patient ready for their sport. (Sherry, 2014)

Phase one for rehab, there aren't too many exercises that the patient can be perform this early on in the recovery stage. The main precautions for phase one exercise are non- weight bearing until the first visit with the surgeon. After the first visit with the surgeon and depending on how that goes the patient will then go about on touchdown weight bearing (TDWB) in a boot or a cast. There should no range of motion exercises that should be implemented in the first phase. However, depending on the type of surgery or repair there may be different protocols for every surgeon. The specific therapeutic exercises that are implemented are four-way straight leg raises for 3 sets of 10. The purpose of the leg raises is to strengthen the hip muscles, since you cannot move the ankle at all. This exercise is trying to limit the amount of atrophy in the hip. Full arc quad sets 3x10 are the next exercises in the rehab plan. The purpose of this is to also strengthen the surrounding muscles since any ankle motion is not allowed in this phase of the rehabilitation process. Abdominal isometrics, which consists of hanging straight leg raises, glute bridge hold, and glute bridges are the next exercises that need to be performed to make sure the core is being activated. Two sets of thirty second planks are also in the plan to improve core strength. (Sherry, 2014)

During phase two, there is an increased workload since the patient can now start to work on range of motion of the ankle. However, there are some precautions that consist of no inversion or eversion motions to help protect the repair of the ankle. As well as progressive and graduated return to weight-bearing, there has to be a progression to it and the patient must be worked into weight bearing. The patient will start with active and active assistive range of motion in plantarflexion and dorsiflexion. Exercises will include tracing the alphabet twice to improve the range of motion, and towel curls only going from front to back for 3 sets of 10. For

active and assistive range of toe mobility, the patient will perform toe extension, flexion, and abduction motions 3x10. This is to regain all the ROM in the foot and toe motions, so the gait is not effected. The therapeutic exercises they will perform are isometric strengthening in neutral plantarflexion and dorsiflexion only. For plantarflexion, they can put their foot against the wall and plantarflex for a 5-8 second hold for 3 sets of 10. For dorsiflexion, they can put a pillow between there foot and push down and hold for 5-8 seconds for 3 sets of 10 seconds. This will help increase the muscle strengthening and will help when the patient begins to walk. They will also work on a balance progression with only double leg stance on a stable floor. Balancing for 2 sets of 30 seconds on a hard wood floor eyes open first and then progress to eyes closed. Balance will help with the patient's proprioception and will help increase muscle strength. Next there will be standing 4-way straight leg raises for 3x10 to improve hip strength and regain the strength lost during surgery. 2x30 seconds planks will also be involved to maintain core stabilization for gait purposes. (Sherry, 2014)

Phase three now begins once all of phase one and two criteria is met. The precautions that go into this phase three of the rehab process involve no jumping, hopping or any sports. Also, there must be a brace worn all the time outside therapy to ensure that the ankle is being protected at all times. Now, the patient will move on to an ankle strengthening progression. That can look something along the lines of towel curls with weights in all directions 3x10, marble pickups twice, 4-way ankle 3x10, ankle pumps with weights 3x10. All these exercises are meant to strengthen the ankle to make sure it can withstand the forces of daily activities and sports related activities. Balance progression will go from double leg on a stable surface to a double leg on an unstable surface. They can perform DL balance on either a foam pad, trampoline, or BOSU for 2

sets of 30 seconds starting with eyes open and progressing to eyes closed. After that is achieved, the balance progression will go from DL balance on unstable surfaces to single leg balance exercises on stable surfaces. That will be balancing on a hard wood floor for 2 sets of 30 seconds first with eyes open and then progressing to eyes closed. The balance progression is to improve proprioception and strength in the ankle. Gait exercise will also be a new exercise that will be implemented in the rehab. Gait exercise will consist of forward march twice, backward march twice, side stepping twice, backward stepping twice, hip circle walks twice. This will help with improving the gait and making sure there is no gait deficiency upon return to daily life/sport. Stretching of the calf and peroneal will also be involved to make sure the muscles are loose and not tight as well as, to ensure that full range of motion is being regained. (Sherry, 2014)

Phase four also begins once phase three criteria is met. The main precautions for all of the exercises in phase four is to make sure you progress the patient gradually by increasing velocity and progressing from known to unanticipated movements. The first exercise that will be performed are impact control exercises that start with 2 feet to 2 feet and progress to 1 foot to another and 1 foot to the same foot. This will help with the agility and coordination of the ankle. One exercises for 2 feet to 2 feet will be double leg hops, forward/back and side to side, for 3 x30secs. Then progress to single leg hops to the other foot, forward/back and side to side, for 3x30secs, and then progress to single leg hops from 1 foot to the same foot, forward/back and side to side, for 3x30secs. Movement control exercise will consist of low velocity single plane and then will progress to high velocity multiplane. Movement control exercises will help with coordination, balance, and agility. Start with the slide board for 3x10 and the progress lateral left to right hopping 3x30secs and then to plyometric exercises. Some plyometric box exercises will

be jump over side to side, alternate jumps right side to front to left side, and lateral high jumps, all for 3x30seconds. Balance progression will go from single leg stable balance to single leg unstable balance. It will be the same as before working with the foam pad progressing from eyes open to eyes closed. After that, sport specific activities will be implemented to help with strength and control. Also, sport specific exercises will be used for hip and core strengthening to help with gait and muscle imbalances. (Sherry, 2014)

Return to play criteria can be determined by many different factors. However, it all is in the clinician's hands. There are many different ways to go about how to get the athlete to return to play. Many different patient outcomes are used to see how the patient is progressing through the rehab. Some of those consist of "Foot and ankle disability index, Foot and ankle ability measure (FAAM), Lower Extremity Function Score(LEFS), and the Sports Ankle Rating System" (Richie, Izadi, 2015). All of these patient outcomes calculate a score "that can be used to quantify functional disability after an ankle sprain" (Richie, Izardi, 2015). The most commonly used outcome is the Sports Ankle Rating System. This test uses a "patient-based questionnaire that evaluates the impact that an ankle injury has on the quality of life of the patient" (Richie, Izardi, 2015). The part of the "questionnaires evaluating symptoms, activities of daily living, and lifestyle have proved to be the most valid and useful in podiatric practice" (Richie, Izardi, 2015). The second part of the outcome is a "Clinical Rating Score, which is provided by both patient and clinician administered in sections" (Richie, Izardi, 2015). When the patient fills out the form, it will ask scales that deal with "pain, swelling, stiffness, giving-way, and function" (Richie, Izardi, 2015). As well as asking questions about daily life and activities, "the Sports Ankle Rating System uses the Single Assessment Numeric Evaluation" (Richie, Izardi, 2015) In the

questionnaire they are asked the question of "On a scale of 0 to 100, how would you rate your ankle's function with 100 being normal?" (Richie, Izardi, 2015). If the total rating of this scale is in the rage of 90%-100% then the athlete may be able to return to play.

There are many different functional tests used to also see if the patient is ready to return to play. Some of the very common functional tests that must be performed are "single leg hops for distance, shuttle run, side hop, and up and down hops" (Richie, Izardi, 2015). The main decided factor is that the when performing these activities and these functional test the clinicians have to compare the test bilaterally and make sure the injured ankle "has achieve at least an 80% performance level" (Richie, Izardi, 2015). Another very popular return to play test is the Star Excursion Balance Test. This test "measurers strength, ROM, proprioception, and neuromuscular control" (Richie, Izardi, 2105). The Star Excursion Balance Test is performed by having the patient stand in the center of 8 different directions of tape. Then have the patient balance on one leg and with the other leg reach out and touch one of the 8 directions multiple times.

There are many different progressions for return to play but, the most effective progression has multiple tests that really ensures that patient is ready to return to play. This progression will look similar to this, "1. Retro jog 2. Side shuffles 3. Carioca 4. Bilateral bounding (A-P then lateral) 5. Run 6. Unilateral quadrant jumps 7. Jog-sprint-jog 8. Sprint-jog 9. Sprint-stop 10. Figure eights 11. Unilateral bounding (A-P then lateral) 12. 45-degree cuts 13. Single-leg hop test for time and distance8 14. Multiple Hop Test4 15. 90-degree cuts 16. Shuttle run test" (McKenzie, 2010). This whole progression goes through it all and will really ensure that the patient has full strength, ROM, agility, and coordination. Some other return to play criteria will consist of "multiplane activities, regain full cardiovascular and muscular endurance, strength

≥85% limb symmetry through functional testing, no apprehension-with high level activity and with any high-level direction changes" (McKenzie, 2010)

CONCLUSION:

Surgery is never going to be the first recommended route for chronic unstable ankles. Conservative treatment will always out way surgery to start with. However, if conservative treatment is not effective after six months surgical interventions should become on option in repairing the ankle. There has been a high success rate with the different ankle repair surgeries for example Brostrom repair had an 80% success rate, Gould modification had an 85-90% success rate and the Brostom-Gould Technique had an 89% success rate and is considered the gold standard for ankle repair/reconstruction. (Shakked, Karnovsky, Drakos, 2017). Overall, ankle reconstruction surgery will be beneficial in the end, but if you can fix the problem by preforming conservative treatment then there is no need to get surgery. Surgery is going to be effective and will help, but it is for certain people only and not everyone needs surgery. In conclusion, ankle reconstruction is a great tool to use, but clinicians should not be reliant on it and should really use their clinical skills of rehabilitation before sending the patient for surgery.

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