Complete Achilles Tendon Rupture in a 22 Year Old Cheerleader: A Case Report

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Abstract This case follows a 22 year old female collegiate cheerleader who was diagnosed with an acute Achilles tendon rupture immediately after performing a routine stunt. The athlete was a “flyer” on a university cheer team who was performing normal tumbling routines in practice and had no known previous history of Achilles tendon injury. Achilles tendon ruptures (ATR) are more commonly associated with middle-aged men who are participating in sporadic physical activity with little stretching or warm up. Other factors that will be discussed relevant to this case include tendonosis preceding ATR and how the menstrual cycle might be linked to ligamentous structure injury in females.

Keywords Achilles Tendon Rupture, Tendonosis, Menstrual Cycle

1. Introduction

Besides commonly occurring in middle-aged individuals known as “weekend warriors”[1], Achilles tendon ruptures (ATR) are an uncommon injury. When they do occur, they are described as a “gunshot”[1] felt posteriorly to the ankle mortise. Some patients that have experienced this injury refer to the injury incident as feeling as if someone has kicked them in their lower calf muscle. This perceived sensation is indicative of the extreme amount of eccentric stress placed on the gastrocnemius when the ankle is moved into dorsiflexion during full weight bearing (FWB). Injury occurs when the individual’s lower leg muscles (specifically the gastrocnemius and soleus) are not properly stretched, warmed up, or capable of sustaining extreme stress that are placed upon them during increasing activity. A physically fit collegiate athlete would not qualify as a common candidate for this classification of injury. Collegiate cheerleaders and gymnasts would be classified as extremely low risk to sustain an ATR due to their age, flexibility and muscular strength[2].

2. Case Report

On September 5, 2008, a 22-year-old female cheerleader was attempting a pass during her tumbling routine in practice. The mechanism of injury was jumping vertically to perform a back handspring with extreme eccentric loading of the a back handspring with extreme eccentric loading of the gastrocnemius followed by a forceful concentric contraction for lift off. During her pass, the athlete reported feeling as if a teammate had “tripped” her immediately before attempting to jump. At that same moment, the athlete felt and heard a loud “pop” in her left ankle. The athlete landed on her side because normal jumping height was not reached and she was trying to avoid the pain she would most definitely experience upon landing. After she landed, minimal pain was experienced, but she immediately felt nauseated as she sat up quickly and saw her left foot limp. The teammate that assisted her stated that the athlete had a green shade evident on her face and seemed confused immediately post injury. The athlete reported feeling nauseated, light-headed, dizzy, had tunnel vision, muffled hearing, and developed a cold sweat.

The athlete was transported to the athletic training room by teammates where a staff certified athletic trainer performed an orthopedic assessment and evaluation of her injury. He palpated an obvious drop off deformity in the distal third of the Achilles tendon with no swelling or ecchymosis present. He found a positive Thompson test and no neurovascular compromise. He also measured active plantar flexion via a manual muscle test for a 0/5 grade. This is a clear diagnosis for an ATR[3].

Post evaluation, many other possible contributors to the cheerleader’s ruptured tendon was discovered. The athlete reported having a dull pain in her left Achilles tendon prior to that day, described as general “soreness behind her left ankle.” During the previous three weeks leading up to the injury, this athlete had been learning how to ride a skateboard, pushing off with only her left foot. She did not think much of it, therefore did not mention it to the certified athletic trainer performing the initial evaluation. Later, it was...
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hypothesized that the dull pain she had been experiencing previous to her injury was tendonosis in her left Achilles tendon. She also reported feeling tired and sick prior to that day’s practice. Upon further investigation, it was found that the injury occurred on a spring floor. This surface, as opposed to padded mats rolled out over the gym floor that were normally used for cheer team practice, would have an increased resilience or “spring” to it. It was also discovered that October 6, 2008 only one month post injury, was the third day of the athlete’s usual five day menstrual cycle. She reported that of the five days, the third day is usually the worst for symptoms of menstruating. This indicates that in the same time frame of her injury, she had been in her menstrual cycle.

3. Surgical Procedure

The athlete received a left, open ATR repair by a foot and ankle surgeon at a local surgery center within a few days of the initial injury. She received a popliteal block anesthetic procedure in a prone position. During the procedure, she was awake, but reported feeling “goofy.” She was brought back to the operating room and placed prone on the cart. A calf tourniquet was applied as well as standard surgical preparation and drape, followed by a posteromedial incision that was made over the distal third of the Achilles tendon. A sharp dissection was made through subcutaneous structures down to the peritendon. The ruptured tendon ends were identified and exposed. A Krackow whipstitch procedure, described by Krackow et al.[4],[5], was placed in the end of each tendon, utilizing No. 2 Ethibond. This approach left two strands of Ethibond available for tying at the repair site centrally within the ruptured area. The first strand was initially placed at the approximated tension and held with a smooth needle driver without definitively tying the knot. Then, both knees were brought up into a flexed position and the second strand was tensioned so that the plantar flexion of both ankles was similar. The other knot was tensioned appropriately. The sutures were crossed from knot-to-knot to avoid any unraveling. A paratendon type repair with 0-Vicryl was performed. A tendinous repair with 0-Vicryl and paratendon repair with 2-0 Vicryl was done for subcutaneous tissues and staples for the skin incision. The initial incision was then stapled together for wound closure and the staples were to be removed when the athlete was taken out of the cast. The athlete was then placed in a gravity equines splint/cast and taken to recovery in a stable condition. There were no complications during surgery. She received Vicodin for the first three days post-operation, followed by the daily recommended dosage of ibuprofen for a month after. She was given crutches and received gait training a couple of days after surgery to use during her initial recovery while casted. She was instructed to begin rehabilitation when her cast was removed.

4. Rehabilitation

Post cast removal the athlete continued to utilize crutches and wore a removable ankle brace on her left leg. The swelling that followed surgery was discovered to be minimal when the cast was removed (see Figure 1).

There were no signs of surgical defect as she moved from a non-weight bearing (NWB) cast with crutches four weeks post surgery to partial weight bearing (PWB) in an ankle brace[5]. Partial weight bearing continued to improve and the athlete progressed off the crutches completely after about a week post hard cast removal. The athlete did report intermittent episodes of a “pins and needles” sensation in her left foot and Achilles tendon while regaining full weight bearing function as well as while performing active great toe extension exercises during the initial rehabilitation phase.

Rehabilitation focused heavily on regaining full weight bearing function without pain or an antalgic (limping) gait pattern. Regaining normal active range of motion (ROM) was also a focal point of daily rehabilitation and treatment. As ROM progressed light isotonic strengthening exercises, both FWB and NWB, were added into the protocol. Multiple isotonic nautilus machines and devices were implemented as the athlete’s strength and ROM allowed.

Pool workouts were also utilized, but not as heavily as functional FWB strengthening exercises. Once a week for a month, she performed 3 sets of 15 double leg jumps in a 72% non-weight bearing environment with the water up to her chest. The athlete reported that it was hard to land on her foot even when jumping in the water for a few weeks. In the pool she also performed toe walks to improve gastrocnemius strengthening and swam for 5-10 minutes to work on functional ability, range of motion, and strengthening.

5. Discussion
In this case study of an ATR, the history, mechanism of injury, signs and symptoms, diagnosis, surgical repair, and rehabilitation has been presented. A 22-year old female collegiate cheerleader ruptured her Achilles tendon during a tumbling pass on a spring floor. She had a surgical repair and then standard rehabilitation until return to competition. All of the post-injury examinations and progressions have been normal, but this case study is unique in its abnormalities around and during the time of injury. This ATR etiology is unknown. Many different factors have been discovered, post-initial evaluation, and will be further investigated to find a possible determinant as the main cause of the injury. Because of this case’s distinct and atypical nature, additional investigation into possible cause or combination of causes is necessary.

ATRs typically occur in older, untrained individuals known as “weekend warriors”[1]. The average age and gender for ATRs to happen is in “males around age 40-50”[6],[7],[8]. The frequency of acute Achilles tendon ruptures has been estimated to be between 7 and 13/100,000 per year[9]. Most all research shows that men are more likely to suffer an ATR than women even when there is no Achilles tendinopathy prior to an ATR[10]. Recent studies performed on a much younger population show that Achilles tendinopathy is rare in younger individuals[11]. Up to 75% of acute injuries to the Achilles tendon can be attributed to sports related activity regardless of the age of the injured[12]. It can be assumed that remaining active later in life can potentially predispose individuals to an acute Achilles tendon rupture.

The athlete presented in this case study varies from the norm in gender and age; she further breaks the mold as she is physically fit, flexible, and quite a bit younger that the typical patient that experiences this type of injury. The average return to functional weight-bearing activity, such as running, after an Achilles tendon surgical repair is around 28 weeks[2]. The athlete in this case study had an extremely fast recovery. Her rehabilitation, recovery, and return to participation in stunting as a cheerleader was only 14 weeks. Because of the rarity of ATR’s in young, active females, other factors predisposing this athlete to her injury should be considered. This specific injury transpired when the athlete jumped to do a back handspring during a tumbling pass. Ruptures of the Achilles tendon normally occur on the eccentric phase stretching the tendon[13]. However, this athlete's ATR was just the opposite due to its occurrence during the concentric contraction.

Flexibility is a factor to consider when assessing any musculoskeletal injury. However, multiple theories exist to the benefits or disadvantages of hyper flexibility. Some research concludes hyper flexibility can be detrimental due to overstretching muscle fibers that promote weakening of the structure, or it can be beneficial because range of motion is increased[9]. The evidence for either theory is theoretically and clinically does not prove any one theory on hyper flexibility. Findings and research have been inconsistent; therefore, in assessing this athlete, flexibility was simply measured to have on record. The athlete was measured using the traditional and reliable sit and reach test[14]. Her flexibility was measured post-rehabilitation and measured from 25.5 – 27 inches during five separate trials, which is in the 99th percentile according to the American College of Sports Medicine[15].

Before this injury occurred, it was unknown to the certified athletic trainer that the athlete was experiencing pain in her Achilles tendon. It was hypothesized that the pain stemmed from learning how to skateboard three weeks prior to injury. The beginning of tendonosis was the suggested diagnosis preceding the injury, which would cause structural weakness to the tendon subjecting it to a higher chance of strain[16]. De Mos et al. did a study on Achilles tendonosis and the changes in biochemical composition and turnover rates[7]. The study compared various differences in biochemical composition of a healthy tendon and an affected one. Collagen, the main building block of many functional tissues, produces a matrix in muscle and tendon maturation; however, biochemically, the high collagen matrix turnover rate actually can degenerate the Achilles tendon before making it stronger[3]. It is theorized that the athlete in this case study could have been in this weakened state of early tendonosis when the ATR happened.

Mild tendinopathy negatively affects the histological ontogenesis of tendons. This athlete could have begun the early stages of mild Achilles tendinosis that led to her ATR, yet, there are still factors to study surrounding the time of injury. Upon further investigation of the athlete’s injury, it was discovered she was currently in the middle of her menstrual cycle. During the menstrual cycle, there are many hormones released; estrogen, progesterone, and relaxin are three common hormone concentrations that fluctuate during this time[17]. The amount of research on Anterior Cruciate Ligament (ACL) sprains and hormones is growing, lending evidence to support that hormones are directly related to the third degree ACL sprain[14],[17],[18]. It has been speculated that women have a greater ACL laxity and injuries in the knee than men due to the presence of increased hormones at the peak of menstruation periods. However, since this particular injury, ATR, happened directly in the middle of the menstrual cycle, it is proposed that there is also a correlation between the menstrual cycle, specifically the increased amounts of hormones released, and general soft tissue injuries not specific to ligaments. Tendon fibers have hormone-specific receptors; two of these hormone receptors are specific to estrogen and progesterone[14],[19]; hence there is an actual physiological link between the two. Increased estrogen and estradiol concentrations, seen in hormone fluctuation during menstruation, are shown to inhibit tendon-healing processes, like fibroblast proliferation and collagen synthesis[20]. A study by Miller, Hansen, Olesen, Schwarz, Babraj, Smith, Rennie, and Kjaer shows the tendon collagen fractional synthesis rate (FSR) is lower in women than in men[17]. This means that women, due to hormone levels, have a slower collagen FSR, which may contribute to a lower rate of
tissue repair prolonging the tendon in a weakened state. These results show a specific sex-based difference in the healing or recovery process of collagen, specifically in the tendons[21]. This healing process inhibited structurally weakens the tendon, predisposing it to injury.

An increase in hormone concentrations, seen in a menstruating female, is directly linked to affecting ligament laxity and tendon healing; however there is also an indirect link that could have lead to her ATR. While ligaments are the structural support to joints in the body, tendons and musculature around the joint also help support. These hormones cause laxity of the ligaments, decreasing stability, causing more stress and forces to be exerted on surrounding structures[14]. Knee stability is compromised due to lax ligaments during menstruation and joint play is increased[14],[17],[18]. This principle of instability can be applied to all the joints in the body. Even a slight change in a joint can add a greater than expected strain on the surrounding structures. Both of these factors transfer the responsibility of stability to the secondary supports, the musculotendinous junction, which is not adequately prepared to handle this surge of force[22].

Another facet of potential cause that was not explored was the nutritional aspect of the injury. Since proper nutrition can play a vital role in the function of muscles and bones, it would be an aspect worthy of further investigation. As far as was observed, there was no reason to question eating habits or suspect malnutrition as a primary or auxiliary factor in the etiology in the injury.

Based on the research mentioned above, it leaves a moderate to strong probability that having both tendonosis and hyper flexibility prior to injury, the bodily effects of menstruation is what significantly factored into the increase in ligament laxity, decrease in collagen synthesis, and ultimate overload to the Achilles tendon resulting in a rupture. With this specific case, it appears that though the athlete had many other predisposing factors to an ATR, the most abnormal aspect is the fact that she was menstruating at the time of injury. While this is a generalization in this case, further research must be collected to support this argument of menstruation affecting all soft tissue, not just ligaments. All of the factors in her examination however can lead to this injury. There is rarely one factor responsible but usually a combination of considerations that go into an injury as severe as an ATR.

6. Conclusions

Although it is rare, this injury can happen to young athletes in peak physical shape. Proper evaluation and assessment, referral for surgery and rehabilitation is necessary for proper functional return to play. There were many factors preceding the injury in this case that could have combined to promote this type of injury: tendonosis, increased hormonal level from menstruation, and a change in practice surfaces. Further research on osteonecrosis and the effects of exercise on the development of this condition would be beneficial as well.

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REFERENCES


