# Stress Fractures in an Athlete with Primary Amenorrhea after Onset of Menarche at Age Twenty-Two: A Case Report

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## Introduction

The female athlete triad consists of low energy availability, low bone mineral density, and menstrual irregularities. Low energy availability may be due to food restriction and/or excessive energy expenditure. Menstrual irregularities may consist of primary or secondary amenorrhea. In primary amenorrhea, the patient does not get her period by fifteen or sixteen years old. In secondary amenorrhea, the patient had menarche but missed three or more periods in a row. Low bone mineral density in premenopausal females can be defined as a Z-score between -1.0 and -2.0 but a Z-score of less than -1.0 in athletes is concerning because athletes usually have higher bone mineral densities than the general population1. The female athlete triad is difficult to treat due to multiple factors affecting the patient, such as pressure to succeed and to be thin, but the main goal of treatment is to have adequate caloric intake to improve bone mineral density and resolve menstrual irregularities. If not treated, the female athlete triad can lead to serious complications, such as osteoporosis, fractures, infertility, and cardiac arrhythmias[1]. On the other hand, with proper guidance and treatment, patients can resume regular menstrual cycles and possibly improve low bone mineral density.

## Case Report

A twenty-two-year-old female cross country athlete presented to the training room clinic with primary amenorrhea. She was originally from Canada and had multiple work-ups for primary amenorrhea when she was fifteen, nineteen, and twenty-one years old but still did not reach menarche. Patient had always been slender, with her BMI around 16 kg/m$^2$, so she did not think much of her weight. Her mother and grandmother were also slender but they had menarche around fifteen years old. When the patient was in Canada, she had a pelvic exam and ultrasound, which showed cysts on the left ovary but otherwise normal. She was told that she may not have her period because she has polycystic ovaries. She had labs done that showed normal LH, FSH, anterior pituitary labs, TSH, and prolactin. She had low estradiol, progesterone, and serum testosterone.

After graduating high school, the patient attended a U.S. NCAA Division I University on a cross-country scholarship. At this University, she had another work-up that included labs, pelvic ultrasound, and DEXA scan, which showed osteopenia. After two years at this University, she transferred to another U.S. NCAA Division I University, where she again had a work-up for amenorrhea. In addition to these work-ups, the patient also did not have a withdrawal bleed with Provera. After the multiple work-ups, she was diagnosed with hypothalamic primary amenorrhea. She was encouraged to gain weight; however, the patient did not feel that she had been adequately instructed on how she should gain weight. She was offered oral contraceptive pills but the patient thought this was an "unnatural" way to get her periods so did not start the oral contraceptive pills.

The patient transferred to the University of New Mexico for her last year of eligibility as a graduate student. At this time, she did not have any stress fractures but did have stress reactions. Her history and presentation were not consistent with disordered eating but the patient was slender with a BMI around 17 kg/m$^2$. Her physical exam showed temperature of 97.6 degrees Fahrenheit and blood pressure of 97/61 mmHg. Her general exam showed a slender patient, in no acute distress. Her extremities showed mottling of both hands and feet with coolness. The rest of her physical exam was normal. At the University of New Mexico, she had repeat labs done and a DEXA scan. Her vitamin D 25-OH was 26, FSH was 9.5, and LH was 12.1. The DEXA scan results showed osteoporosis of the lumbar spine.

A meeting was held with the patient, one of the team physicians, her coach, and the sports nutritionist. They discussed that the results from the labs and her past work-ups suggest the diagnosis of hypothalamic primary amenorrhea due to the stress of running and low body weight. They came up with the goals to begin menarche naturally and attain better bone health by decreasing overall mileage and advancing diet. If she did not gain weight, exogenous estrogen was going to be considered. She was placed on Vitamin D3 1000 mg and Calcium 1200-1500 mg per day. Patient met with the nutritionist regularly and added about 800 calories to her daily intake. Since the nutritionist understood that the patient did not want to

feel heavy or weighed down because she is a runner, the nutritionist added a little protein, such as an egg to breakfast, and more calories, such as dried fruits and nuts, to her post-practice meals. The patient had gradual weight gain, about one to two pounds per week. After seeing the nutritionist for three and a half weeks, the patient had her first period. At the time of menarche, she was 47.4 kilograms, which placed her BMI at 18 kg/m$^2$.

The patient's first period lasted for four to five days. She also had associated cramping and acne. Patient became sexually active and requested to be started on oral contraceptive pills. During this time, the patient felt that she has improved stamina and workout recovery. She completed a 10 K run with a personal best. The patient had her second menses about twenty-six days after her first menses and at this time, she was 50.0 kilograms.

Unfortunately, approximately one month after she got her first period, the patient noticed right groin and buttock pain. The pain was sharp and worse with bearing weight on the right leg, bending over, internal rotation, and prolonged sitting. She did not have any injuries that started this pain. She was initially thought to have tight piriformis and hamstrings and was given Celebrex, as well as treatment with the athletic trainers. Her running volume was also decreased. The pain persisted with even limited running so after repeat evaluation, pelvic x-rays were ordered that showed a right ischial tuberosity stress fracture (Figure 1).

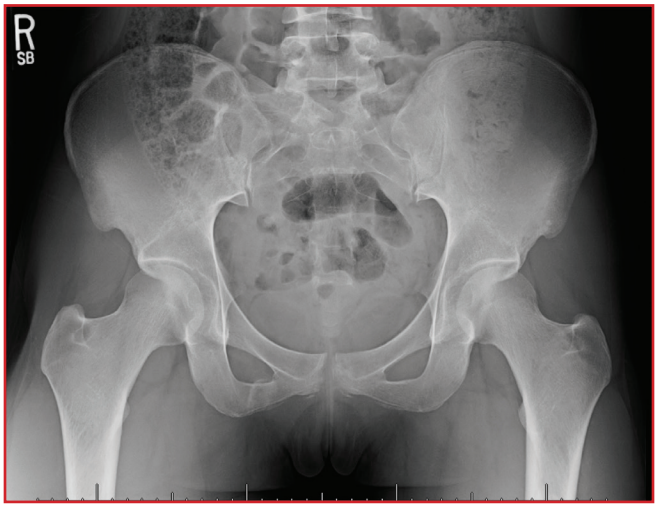


Figure 1: Right ischial tuberosity stress fracture. Incidental note of skeletal immaturity in this 23-year-old female (persistent apophyses along the bilateral iliac crests and ischial tuberosities).

Patient was instructed to rest completely from running, but was allowed pain free cross training. Three weeks later, a repeat x-ray showed healing right ischial fracture and she was progressed to zero gravity or underwater treadmill running as tolerates. Patient started running on dry land again without pain after about 6 weeks from her stress fracture diagnosis.

A little over a month after she returned to dry land running, the patient noticed pain in her right ischium and inguinal area, worse after her runs. An MRI of her pelvis was done and showed a new right superior pubic ramus and left inferior pubic ramus fracture, as well as incompletely healed (delayed healing) of the right inferior pubic ramus fracture (Figure 2). The MRI also showed an incidental finding of proximal left femoral bone lesion (Figure 3).

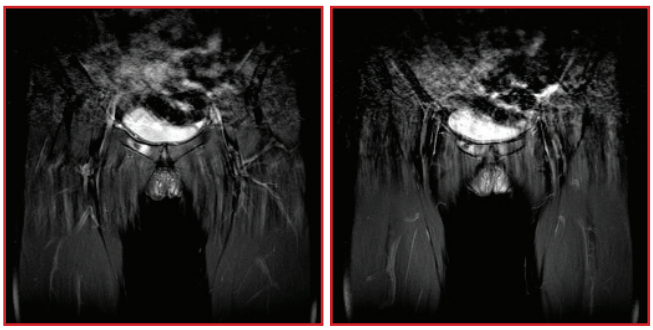

Figure 2: MRI showing new right superior pubic ramus and left inferior pubic ramus fractures. Incompletely healed (delayed healing given the intervening time) right inferior pubic ramus fracture.

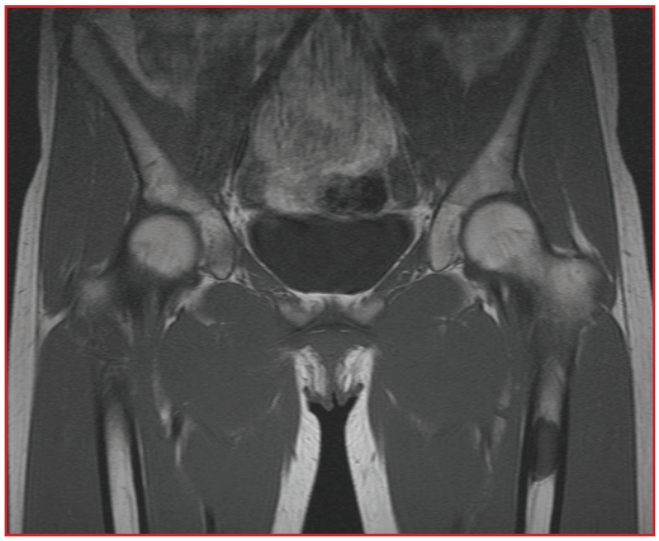

Figure 3: Incidental proximal left femoral bone lesion with very nonaggressive features.

The patient was seen by an Orthopedic Oncologist who felt the incidental femoral lesion was most likely due to fibrodysplasia and would monitor with another x-ray in 3 months. The patient was again instructed to rest and refrain from running. She was placed on crutches for a short period of time but then progressed to activity that did not cause any symptoms. She did not have pain with walking or using a stationary bike. Patient progressed her time on the stationary bike and started swimming more since this did not cause exacerbation of her pain. She was still not able to run due to pain. She had follow-up x-rays of her pelvis that showed bone healing but persistent fracture lines, indicating delayed bone healing (Figure 4). She currently is not able to run so is cross training with biking and swimming.

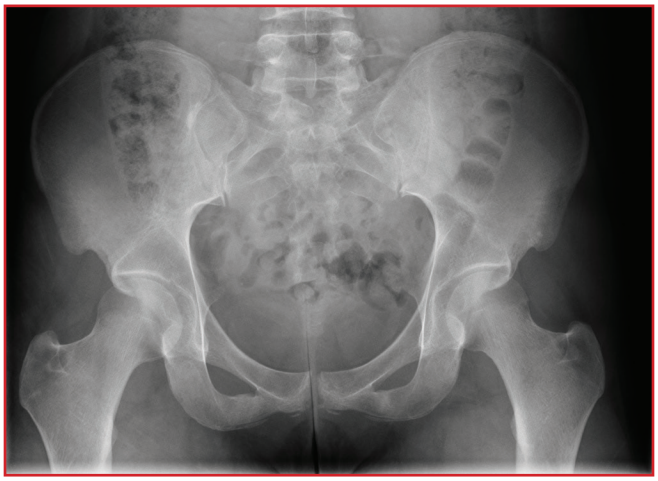

Figure 4: Follow up x-ray showing healing right obturator ring and left inferior pubic ramus fractures, unchanged in alignment

## Discussion

The patient met criteria for the female athlete triad with low energy availability, low bone mineral density, and menstrual irregularities[1,2]; however, she was able to reach menarche in a little more than three weeks of having a positive caloric intake. Indeed, optimal treatment for the female athlete triad is to resolve low energy availability,[1,2] which this patient had accomplished. Multiple studies have shown that weight gain in anorexic patients can restore menses, which also leads to improvements in bone mineral density.[2,3] As with this patient, the treatment plans should consider the patient goals, unique diet and training, and any coexisting conditions. The primary goal should be to restore or normalize body weight; however, this may be more difficult if disordered eating is present, which was not the case in this patient. An increase in energy availability can affect metabolic hormones within days to weeks and menstrual function can resume in months,[2] but this may not be the same with restoring low bone mineral density.

Although normal menses may resume, restoring bone health can take longer. In this case, the patient increased her energy availability and started having normal menses but had three stress fractures after she reached menarche. Indeed, irregular menstrual cycles and low bone mineral density are associated with increased risk for stress fractures.[2] In a study done by Nattiv et al on NCAA track and field and cross-country athletes, female athletes with oligomenorrhea and amenorrhea had higher grade bone stress injuries and significantly lower bone mass4. The bone loss with the female athlete triad is likely due to energy deficient related factors and estrogen deficiency.[1,2] Lower estradiol levels can reduce calcium absorption, increase bone resorption, and suppress bone formation.[4] Therefore, both nutritional and hormonal recovery needs to be addressed to restore bone health.[1-3] The patient started her periods by increasing energy availability but her bone mineral density had already been affected and there is no clear timeline when or if her bone mineral density will improve.[1,3] Osteoporosis may be partially irreversible despite resumption of menses, oral contraceptives, and calcium.[5] One article suggested that osteoporosis may be irreparable after three years of amenorrhea.[6] Patients with amenorrhea may lose 2-3% of bone mass per year if not treated.[3]

After females regain their periods, improvements in bone mineral density can occur slowly, sometimes taking years, if possible.[2] Studies have shown that increases in bone mineral density of 2-3% per year have been seen with weight gain in patients who were anorexic1. Since patients may have low bone mineral density for a prolonged period of time, providers should also assess calcium and vitamin D states.[1,2] Patients should have at least 1,200 to 1,500 mg of Calcium per day and 400 to 800 IU of Vitamin D per day.[1,5,6] Weight bearing exercises may also help with bone strength; however, high impact activities in patients with low bone mineral densities may result in fractures.[2] Studies have shown that stress fractures occur more frequently in physically active women who have menstrual irregularities and low bone mineral density.[1] Pharmacological treatment may be considered if patients fail one year of non-pharmacologic treatment or if they have new fractures; however, there is no clear guidelines for pharmacological treatment in premenopausal women.[2] Bisphosphonates should not be used in premenopausal women with functional hypothalamic amenorrhea because of unproven efficacy in women of child-bearing age and bisphosphonates can reside in bone for years, potentially harming a fetus in the future1. Estrogen administration may be considered for those who are older than sixteen years old and have failed non-pharmacological treatment, but there is also mixed evidence for using oral contraceptives to increase bone mineral density.[1,2,5,6]

Prevention and early intervention is vital to treating the female athlete triad and reducing the risk of stress fractures. This patient may not have had stress fractures if she had reached menarche at a normal time. DEXA scans should be considered if patients have one or more high risk triad factors: history of diagnosed eating disorder; BMI 17.5 kg/m$^2$ or less, less than 85% estimated weight, or recent weight loss of 10% or more in one month; menarche at sixteen years old or later; current or history of less than six menses over twelve months; two prior stress fractures or stress reactions, one high risk stress fracture or stress reaction, or low energy non-traumatic fracture; and prior Z-score less than -2.0. DEXA scan should also be considered if patients have two or more moderate triad risk factors: current or history of disordered eating for six months or more; BMI between 17.5 and 18.5 kg/m$^2$, less than 90% estimated weight, or recent weight loss of 5-10% in one month; menarche between fifteen and sixteen years old; current

history of six to eight menses over twelve months; one prior stress fracture or stress reaction; prior Z-score between -1.0 and -2.0. Any athlete with a history of one or more non-peripheral or two or more peripheral long bone traumatic fractures should be considered for DEXA if they have one or more moderate or high risk triad factors. A consensus statement recommended follow up DEXA scanning should be obtained when there are expected changes in bone mineral density Z-scores. Studies have shown that increases in bone mineral density in anorexic women were associated with weight gain and resumption of menses but those who did not resume regular menses had continued declines in bone mineral densities.[2]

Initially, this patient was being evaluated for primary amenorrhea and her current bone mineral density was not known. She had reported a past DEXA that showed osteopenia. This patient was allowed to continue to train and compete; however, at that time, there were no clear recommendations as to when an athlete with the female athlete triad should be restricted from training. A recent consensus statement made recommendations for return to play after the first (San Francisco) and second (Indianapolis) International Consensus Meetings on the Female Athlete Triad took place (Figures 5 and 6). According to these recommendations, the patient would have had a high enough score that would have placed her at high risk and restricted her from training and competition.[2] Although there were no clear recommendations at the time the patient was initially evaluated, these recent recommendations can be used to screen for the female athlete triad, especially at pre-participation exams. Nevertheless, this case demonstrates that females are able to resume normal menstrual cycles by restoring their energy availability but the benefits on bone health may take longer.

## References


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| Risk Factors | Magnitude of risk | | |
|---|---|---|---|
| | Low Risk = 0 points each | Moderate Risk = 1 point each | High Risk = 2 points each |
| **Low EA with or without DE/ED** | ○ No dietary restrictions | ○ Some dietary restriction; current/past history of DE | ○ Meets DSM-V criteria for ED |
| **Low BMI** | ○ BMI ≥ 18.5 or ≥ 90% EW or weight stable | ○ BMI 17.5-18.5 or < 90% EW or 5-10% weight loss/month | ○ BMI ≤ 17.5 or < 85% EW or ≥ 10% weight loss/month |
| **Delayed Menarche** | ○ Menarche < 15 years | ○ Menarche 15-16 years | ○ Menarche ≥ 16 years |
| **Oligomenorrhea/Amenorrhea** | ○ >9 menses in 12 months | ○ 6-9 menses in 12 months | ○ < 6 menses in 12 months |
| **Low BMD** | ○ Z-score ≥ -1.0 | ○ Z-score -1.0 - -2.0 | ○ Z-score ≤ -2.0 |
| **Stress Reaction/Fracture** | ○ None | ○ 1 | ○ ≥ 2; ≥ 1 high risk or of trabecular bone sites |
| **Cumulative risk (total each column, then add for total score)** | ___ points + | ___ points + | ___ points = ___ Total Score |

Figure 5: Cumulative risk assessment from the Female Athlete Triad Coalition Consensus statement

| | Cumulative Risk Score | Low Risk | Moderate Risk | High Risk |
|---|---|---|---|---|
| **Full Clearance** | 0-1 points | ○ | | |
| **Provisional/Limited clearance** | 2-5 points | | ○ Provisional Clearance<br>○ Limited Clearance | |
| **Restricted from Training and Competition** | ≥ 6 points | | | ○ Restricted from Training/competition—Provisional<br>○ Disqualified |

Figure 6: Clearance and return to play guidelines from the Female Athlete Triad Coalition Consensus statement