What causes stress fractures?

Bones, like a steel girder, can under repetitive loading eventually fatigue and develop cracks. In the case of bones, this condition can be accelerated by inadequate support of the bones by the surrounding soft tissues, i.e., the muscles. These cracks lead to local pain and tenderness in the bone. Therefore, maintaining both ideal muscle strength and balance is the best way to avoid developing a stress fracture. Stress fractures occur most frequently in the shinbone (tibia), the foot (metatarsal) and the hip (femur or pelvis). Stress fractures occur in the foot bones in about 60 percent of cases and in the tibia or shinbone in 25 percent. Upper extremity injuries have also been reported but are extremely rare. Bones are the skeletal structures that provide anchors or attachments for the muscles, ligaments and tendons so that they can exert force in order to generate movement. The bones also receive their strength from proper use of the adjacent muscles—so any situation where there is muscle weakness, anatomical conditions or malalignment can lead to weakening of the bones, which may lead to fractures. Maintaining bone health through proper nutrition is obvious. Adequate calcium and vitamin D are required. Beware of the “female athlete triad”—amenorrhea, anorexia and osteoporosis! This is a leading cause for the higher incidence of stress fractures in women.

The typical scenario of a runner who is developing a stress fracture often begins with the non-diagnostic complaint of “my leg/foot/hip, etc., hurts after my long run.” Symptoms of a stress fracture can mimic those of shin splints, particularly early on in the condition. With continued running the pain will progressively worsen. Initially, the pain improves with rest and avoidance of running. However, until the fracture heals completely, the pain remains or may even get worse. Eventually there is pain in the involved area with even simple movements such as walking slowly. If the bone affected is easily felt with your hand there might be tenderness to touching it. There may be swelling in the area and the skin overlying the bone may seem warm. Eventually, especially if untreated, a stress fracture can lead to a complete break in the bone thereby not even allowing you to stand without severe pain.

If you suspect you may have a stress fracture, the wisest thing to do is to curtail your running for a week or two. Running up until the point of pain is probably a practical suggestion for any injury. However, persistent pain is often the most important signal that something is amiss. The usual remedies of rest, ice and training modifications should always be tried first. Pain that does not go away and when there is also local bony tenderness should alert the runner to the possibility of an underlying stress fracture and you should visit your doctor.

A useful self-test that can also suggest you may be dealing with a stress fracture is the one-legged hop test. With most stress fractures, you are unable to hop repetitively on that leg without pain.

With a typical history of the above, I would then proceed to further investigations. Once you have tried non-medical approaches (physiotherapy) and the problem has not been rectified then you need to find out if there is another remote cause for the pain. Following a thorough local physical examination, more invasive and expensive tests may be needed. Conventional or plain x-rays are the standard test to assess bony integrity and assure that there are no gross bony injuries, deformities or other conditions. (Figure 1). Some may argue that plain x-rays are probably not necessary and proceed directly to a bone scan. However, it may take several weeks to schedule a bone scan whereas a plain x-ray is available immediately at a relatively low cost. If the plain x-ray is positive and discloses some pathology then treatment can be undertaken immediately. If the plain x-ray is not diagnostic then further investigations such as a bone scan or even MRI (Magnet Resonance Imaging) may be needed.
Imaging) can later be done (Figure 2).

If any of the tests confirm a stress fracture then immediate weight restrictions are required. Notice I didn’t say “complete non-weight bearing.” Some degree of weight training, bearing or limb loading is required for speedier healing of the bone. Bone responds to weight bearing by producing or laying down more bone in the healing process. Generally some degree of weight restrictions coupled with graduated weight increase and weight bearing with the addition of external support (splints, braces, etc.) should be done. This could also encompass aqua-therapy and other forms of supervised physical activity. Selective cross training is an excellent way to stay in shape without causing further injuries to your bone. I also want to emphasize that a proper diet is essential for complete and speedy bone healing. Adequate protein and vitamin intake is required for bone and soft tissue healing. Most stress fractures are healed in 6–8 weeks. Graduated return to training and running is then possible.

**PROGNOSIS**

One of the complications of a stress fracture is the development of a complete fracture where the bone breaks right through. (Figure 3). This has the same implications for a fracture occurring from a severe single event trauma (e.g., skiing and fracturing your tibia). That can be devastating and may require 6–12 months of treatment with no running. The time to heal for a stress fracture takes longer than a usual fracture to heal; the reason being that with repetitive overloading as the cause, the blood supply and hence the healing ability of the bone is compromised. Hence the importance of treating stress fractures early and adequately before they become complete fractures. Most stress fractures respond to an aggressive approach of restricted weight bearing with alternative activities to maintain general fitness but allowing some weight transmission through the injured bone. This is best conducted under the supervision of a trainer or therapist who can monitor your activity and gradually increase your extremity usage according to your recovery trend.

**Causes of Stress Fractures:**
- “Female Athlete Triad”
- Training Errors
  - Too much
  - Too soon
  - Too quickly
- Anatomical Factors - Malalignment
- Muscle Weakness or Imbalance

**Figure 1.**
An x-ray of a shinbone that shows no signs of a stress fracture.
Figure 2.
A bone scan showing “hot” spots indicating an area of stress fracture. (Black areas).

Figure 3.
The same athlete as in Figure 1 but now showing a complete fracture.