# Mechanics can explain slow healing of stress-fractures in elderly patients

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In the last decade, a growing number of elderly patients have suffered from a peculiar injury where a small slip or stumble suddenly cause a fracture in the mid-shaft of the thigh bone. These fractures start as cracks on the bone surface that grow over time and eventually cause a complete fracture. The initial crack is very similar to stress-fractures otherwise most commonly found in top athletes. In case of the elderly patients, doctors have found the fractures to be associated with drugs used to decrease the risk for osteoporotic fractures with the unfortunate effect of adding a small risk for stress-fractures. One problem with these fractures is that the healing process is slow and painful, even if the injury is discovered early. The aim of this project was to understand the underlying reason for the slow healing.

Bone healing is a gradual process starting with formation of soft tissue that stepwise matures into cartilage and eventually bone. Each step requires a more mechanically stable environment. Only very small deformations are allowed for bone formation to occur. This project used a mathematical 3D model of a thigh bone based on patient CT data that describes the geometry of the bone with the crack (figure 1). The model was combined with a detailed model of the crack based on images of a biopsy drilled out from the crack site. Loads corresponding to normal walk was applied to the bone model to see how much the crack deformed and what tissue formation that was possible inside the crack.

Our results suggests that bone formation only occurs in less than 5% of the crack volume, the rest of the crack is too deformed and unstable to heal. This is in agreement with what is seen in the lab when looking at the biopsy tissue. There are signs of healing around the crack but no living cells inside the crack.

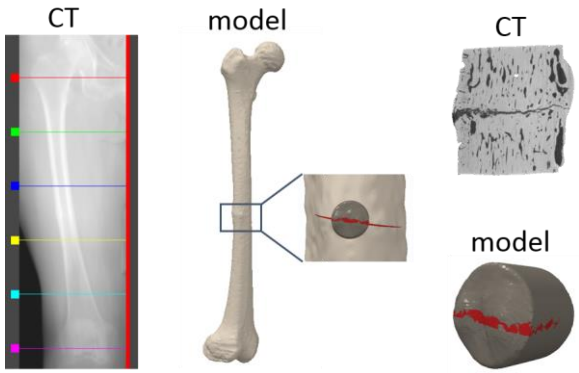


Figure 1: Medical images of the thigh bone, the biopsy and the corresponding models.