Behind Bone Imaging: Part 2

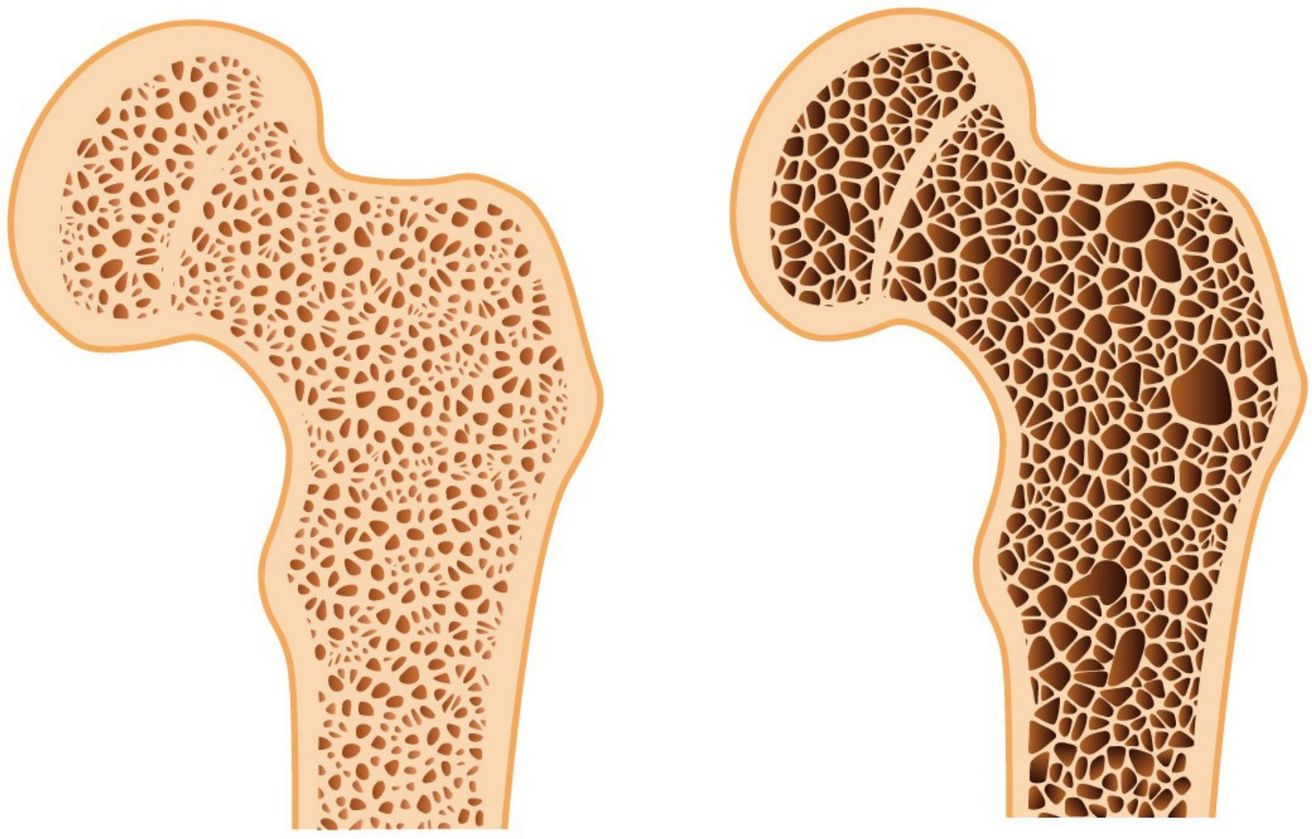
In Part 1 of this series, we compared pQCT and HR-pQCT. Two CT imaging modalities that are becoming increasingly popular in bone & musculoskeletal research.

To recap, pQCT is a low radiation imaging technique that captures images of bone as well as soft tissue, which is important for researchers to better understand how muscle and fat composition affects bone.

HR-pQCT is similarly used to measure bone strength, geometry and mechanical properties, but the higher resolution of the images allows for visualization of minute bone structures

Comparatively, the current clinical standard is to use bone density metrics obtained from a DXA scan for bone health diagnostics.

Aside from density, clinicians are also interested in the structure of a patient's bone. Different patients may have similar bone densities, but if someone has more porous bone they are at an increased risk of fracture in comparison to someone with fewer pores (see figure below).

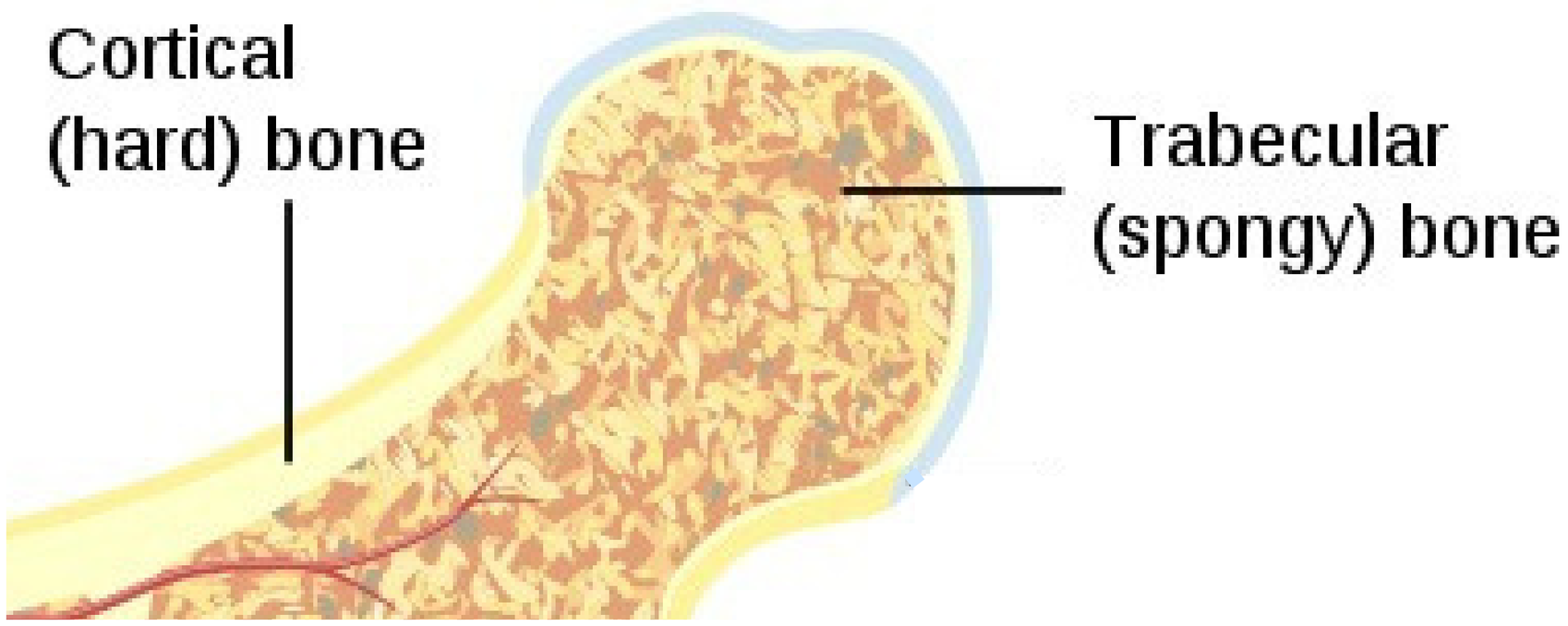


Healthy bone

Osteoporosis

The use of pQCT and HR-pQCT allows researchers to better study the nuances of bone microarchitecture, which provides a greater understanding of the bone strength and quality.

In addition, pQCT and HR-pQCT scans have slightly lower radiation doses than DXA scans. However, DXA is the current standard of care since it is more widespread in care centres and hospitals.



There are 2 types of bone: cortical bone and trabecular bone (see image above).

Cortical bone is known as “hard bone” and is found at the surface of the bone, whereas trabecular bone is “spongy” and found in the center of the bone.

In DXA imaging, it is not possible to visually distinguish cortical and trabecular bone. However, with HR-pQCT researchers can easily study cortical and trabecular bone independently of each other to better understand osteoporotic fractures. This is possible because HR-pQCT produces images with such a high resolution that it can even distinguish trabecular structure, providing further insight into bone architecture at scanned sites.

There are many different research applications using pQCT and HR-pQCT that extend beyond osteoporosis. Some include:

1. Leukemia
2. Crohn’s Disease (CD)
3. HIV

1. Bones of leukemia patients are being studied using these machines to determine the effect of corticosteroid-based medications on bone mass. Recent studies have found that corticosteroid-based medications decrease trabecular bone mineral density.

2. Research has also suggested that pediatric patients with Crohn’s Disease (CD) are at an increased risk for impaired and delayed bone growth due to malnutrition that causes decreased trabecular bone mineral density. Effective CD treatment has been shown to reverse this effect.

3. Another interesting application of HR-pQCT is the investigation of musculoskeletal health in HIV patients. It has been found that those infected tend to have lower cortical bone mineral density, increased diagnosis of osteoporosis, and are at a higher risk of fracture. The reason for weaker bones in those with HIV is multifactorial including due to the virus itself and specific drug regimens.

There are many other ongoing studies that are using HR-pQCT and pQCT to better understand how bone strength and composition is affected by different diseases.

In conclusion of this 2-part series, pQCT and HR-pQCT are imaging techniques used primarily in research to better understand bone structure and strength.

Although it’s unlikely that either modality will become the standard of care for osteoporosis treatment, it has become increasingly popular in the last decade due to the robust visualizations and rich information it provides about bone microarchitecture. pQCT and HR-pQCT imaging are useful tools for researchers as they seek to better understand how bone structure can be affected by genetics, lifestyle, medications, diet and diseases.

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