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In end-stage knee osteoarthritis the subchondral bone microstructure of the tibial plateau is correlated to that of the distal femur

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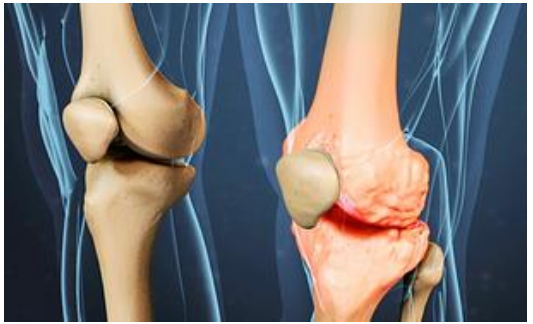
Problem statement

Healthy knee Osteoarthritis knee



- Osteoarthritis (OA) is the most prevalent chronic joint disease; major cause of disability; major socio-economic impact.
- OA is a multifactorial disease affecting the entire joint.
- The precise role of subchondral bone in the onset and development of OA is unknown.
- Unknown whether subchondral bone at both sides of the joint are affected.

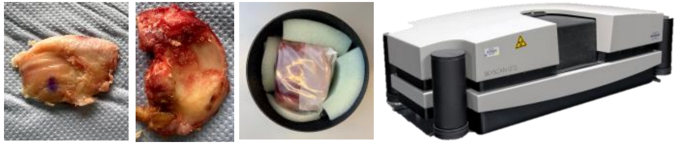
Aim:

Quantify bone microstructure in the tibial plateau and distal femur in end-stage OA.

Methods

Step1

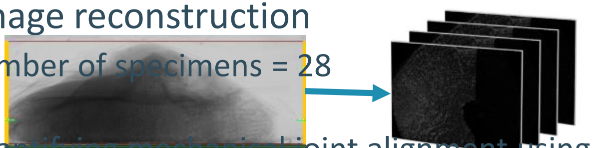
Specimen preparation and micro-CT scanning



- Tibial plateaus and femoral condyle cuts from total knee arthroplasty
- Number of specimens = 28
- Quantifying mechanical joint alignment using radiographic data
- All patients have medial deviation >15mm, defined as varus
- Micro-CT scanning at the pixel size of 20 µm

Step2

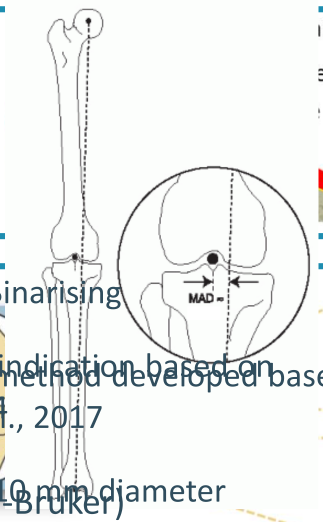
Image reconstruction

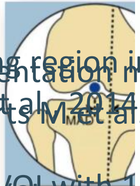


- NRecon software (Skyscan-Bruker)

Step3

Segmentation





…r bone (STB)

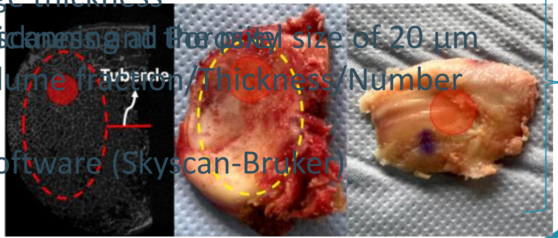
…e plate (SBP)

- Segmentation method developed based on Roberts M et al., 2017
- CTAn (Skyscan-Bruker)

Step4

VOI's definition

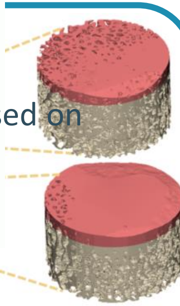
- Load bearing region indication based on Adouni M et al., 2014
- Cylindrical VOI with 10 mm diameter



Step5

3D Analysis

- Filtration and Binarising
- Cartilage thickness
- SBP Thickness and Porosity
- STB Volume fraction/Thickness/Number
- CTAn software (Skyscan-Bruker)



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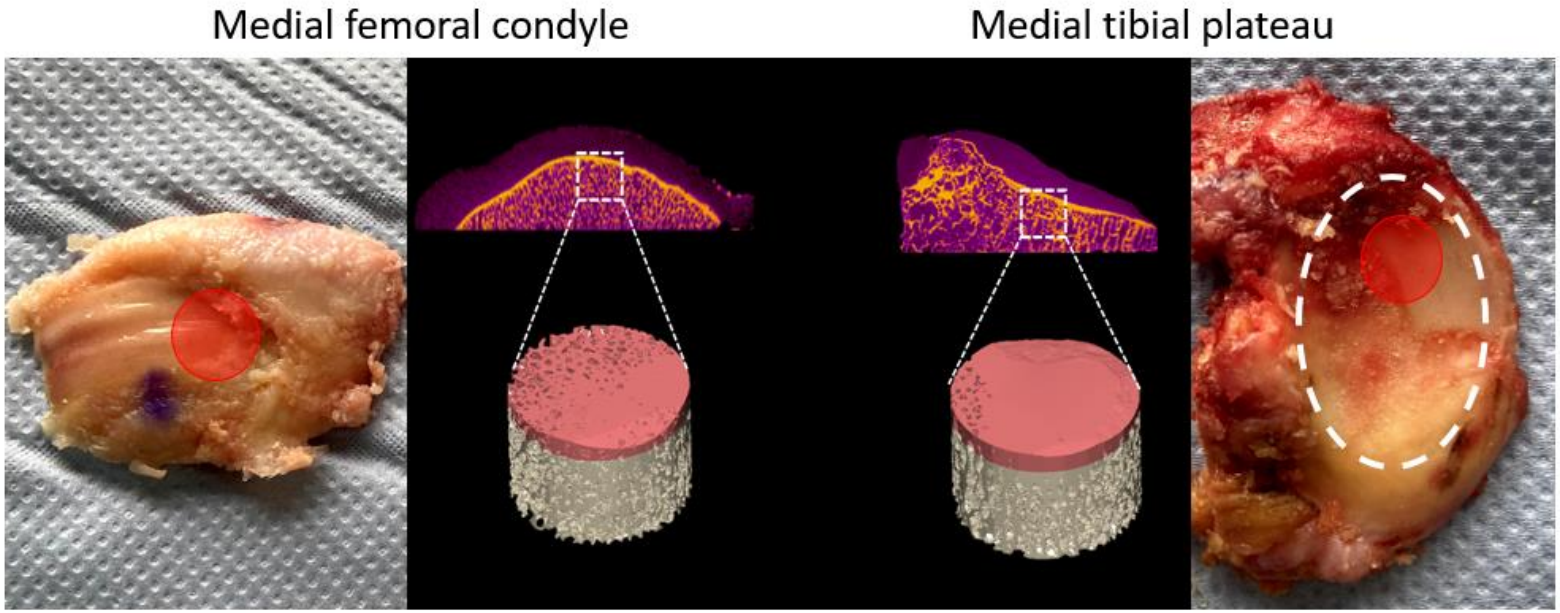
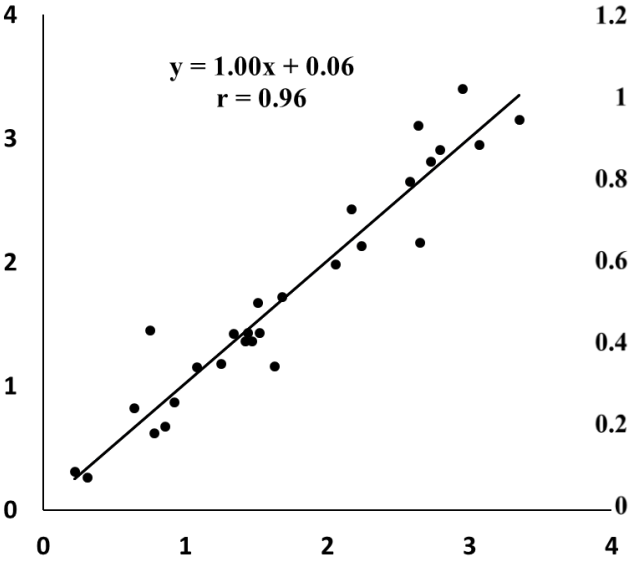
Association between Femoral condyle & Tibial plateau

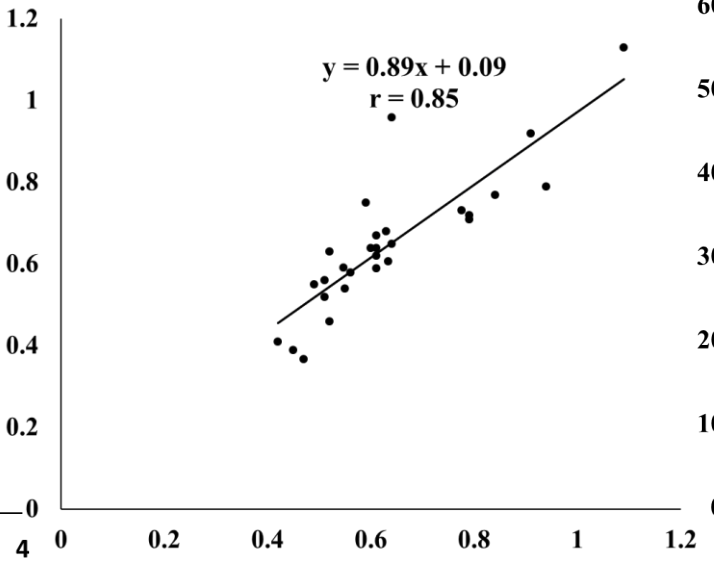


Association between Femoral condyle & Tibial plateau

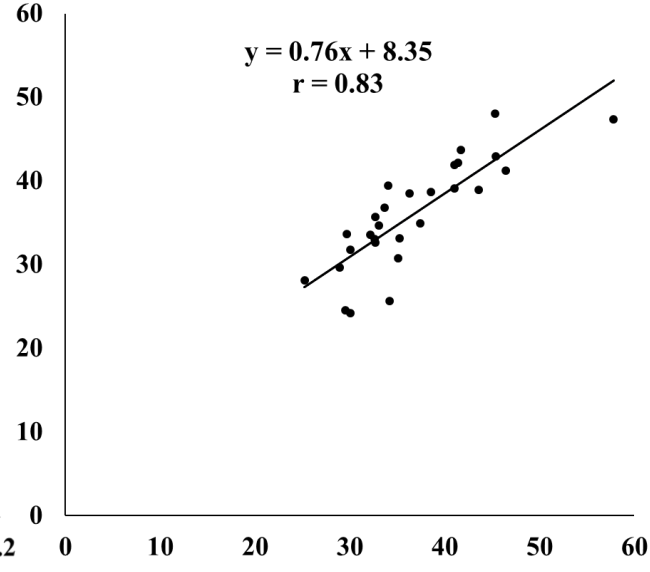
Cartilage thickness [mm]



Subchondral bone plate thickness [mm]



BV/TV [%]



Femur (vertical axes) and tibia (horizontal axes)

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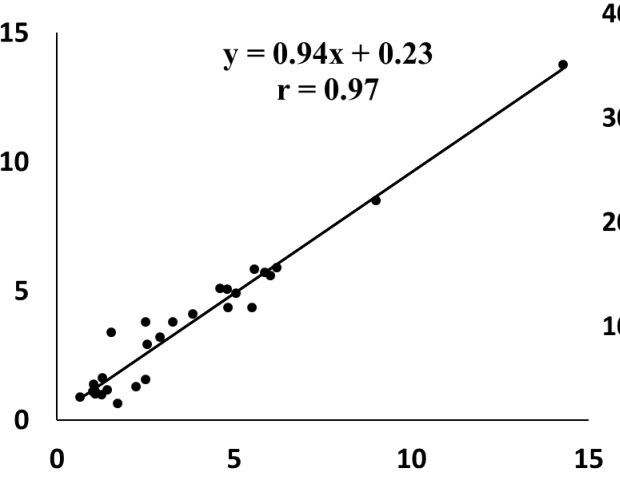
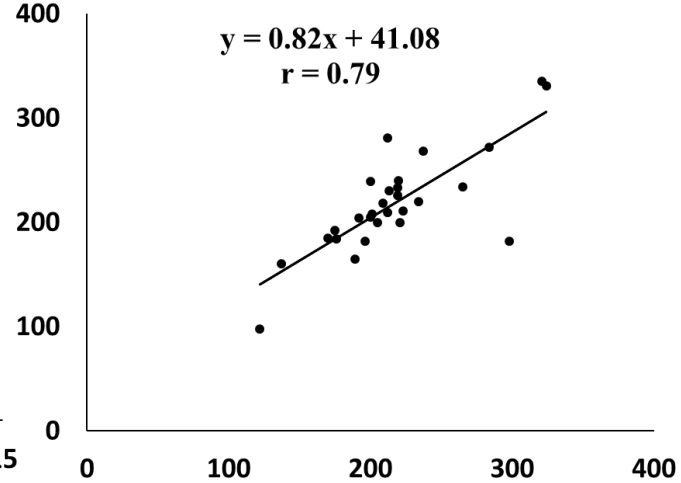
Association between Femoral condyle & Tibial plateau

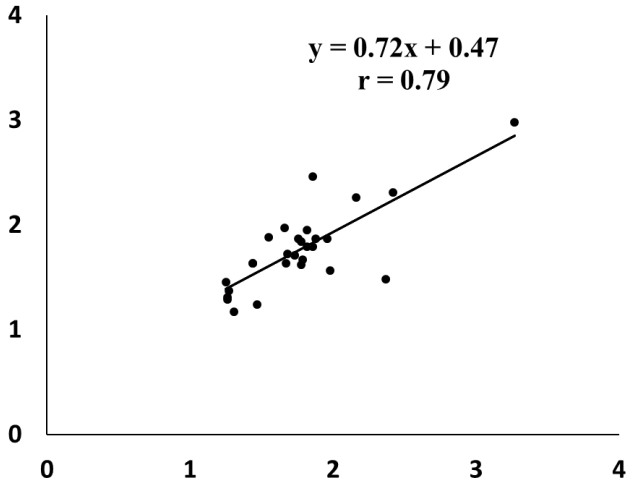
Subchondral bone plate porosity [%]



Trabecular thickness [µm]



Trabecular number [1/mm]



Femur (vertical axes) and tibia (horizontal axes)

Discussion

- Correlation between tibial plateau and femoral condyle in OA from mechanical point of view is unknown
- Association between osteoarthritis severity and bone matrix changes in both locations is lacking
- We investigated only medial condyle of tibial plateau in varus cases

Conclusion

- We found strong associations between subchondral bone microstructure in the proximal tibia and distal femur in knees with end-stage OA.

- These findings suggest that bone microarchitecture reflects a response to local mechanical factors in the joint.

Thank you for your attention!

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