Two-year Follow-up of Fracture Healing in the Distal Radius in Post-menopausal Women Using HR-pQCT

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Introduction

High resolution peripheral computed tomography (HR-pQCT) in combination with finite element analysis (FEA) is a promising tool to assess the healing process of distal radius fractures [1,2]. In a recently published pilot study, 18 fractures were scanned by HR-pQCT up to 12 weeks post-fracture [1]. We here present the changes in bone parameters at the fracture side during a two-year follow-up period, compared to the same region at the contra-lateral radius.

Subjects and Methods

- Post-menopausal women with a stable distal radius fracture (n=18)
- HR-pQCT of fracture at 1-2 (baseline), 3-4, 6-8, 12 weeks and >2 years post-fracture, and of the same region at the contra-lateral radius at >2 years post-fracture (Figure 1)
- Bone density and micro-architectural analysis
- Stiffness in compression, torsion and bending using µFEA
- Comparison of fracture side to the contra-lateral side using a linear mixed-effect model

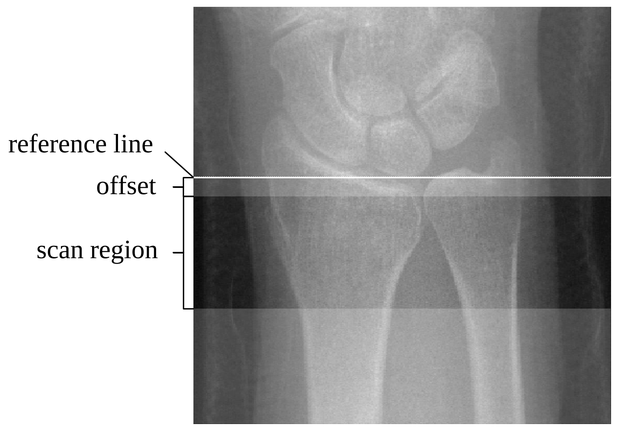

Figure 1 Scan region at the fracture and contra-lateral side in HR-pQCT. To cover the fracture, a variable offset and a scan length of 18 mm was used in each patient.

Results (1)

Fracture gap and longitudinal changes can be observed very accurately on the high resolution 2D-slices. At the two-year follow-up visit the cortical fracture gaps were completely restored in all patients, but some deterioration has occurred in the trabecular region (Figure 2).

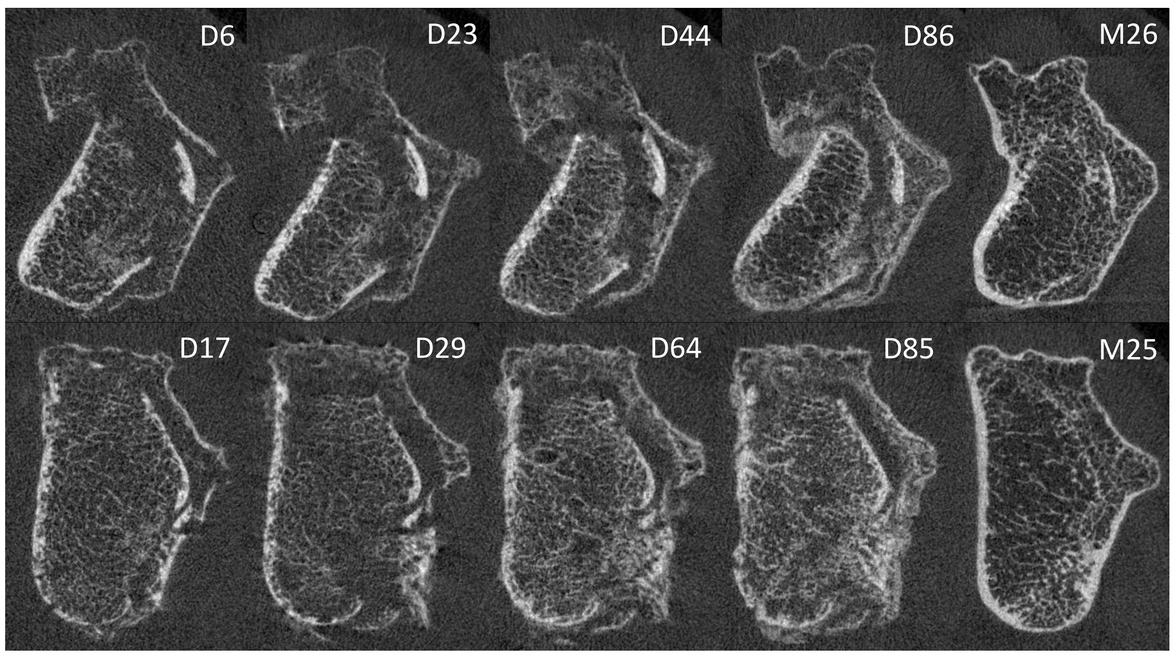

Figure 2 Two representative examples of healing distal radius fractures assessed by HR-pQCT over a two-year follow-up period.

Results (2)

The initial lower cortical density became comparable to the contra-lateral radius, while cortical thickness became higher (+20%, p=0.047). Trabecular density, number and thickness at fracture side were initially higher. While trabecular density and number decreased and became comparable to the contra-lateral radius, trabecular thickness remained higher at >2-year post-fracture (+52%, p<0.001). As a result, the initial lower torsional and bending stiffness became higher at the fracture side than at the contra-lateral radius after >2 years (+31%, p=0.016; and +29%, p=0.030, respectively), see Figure 3.

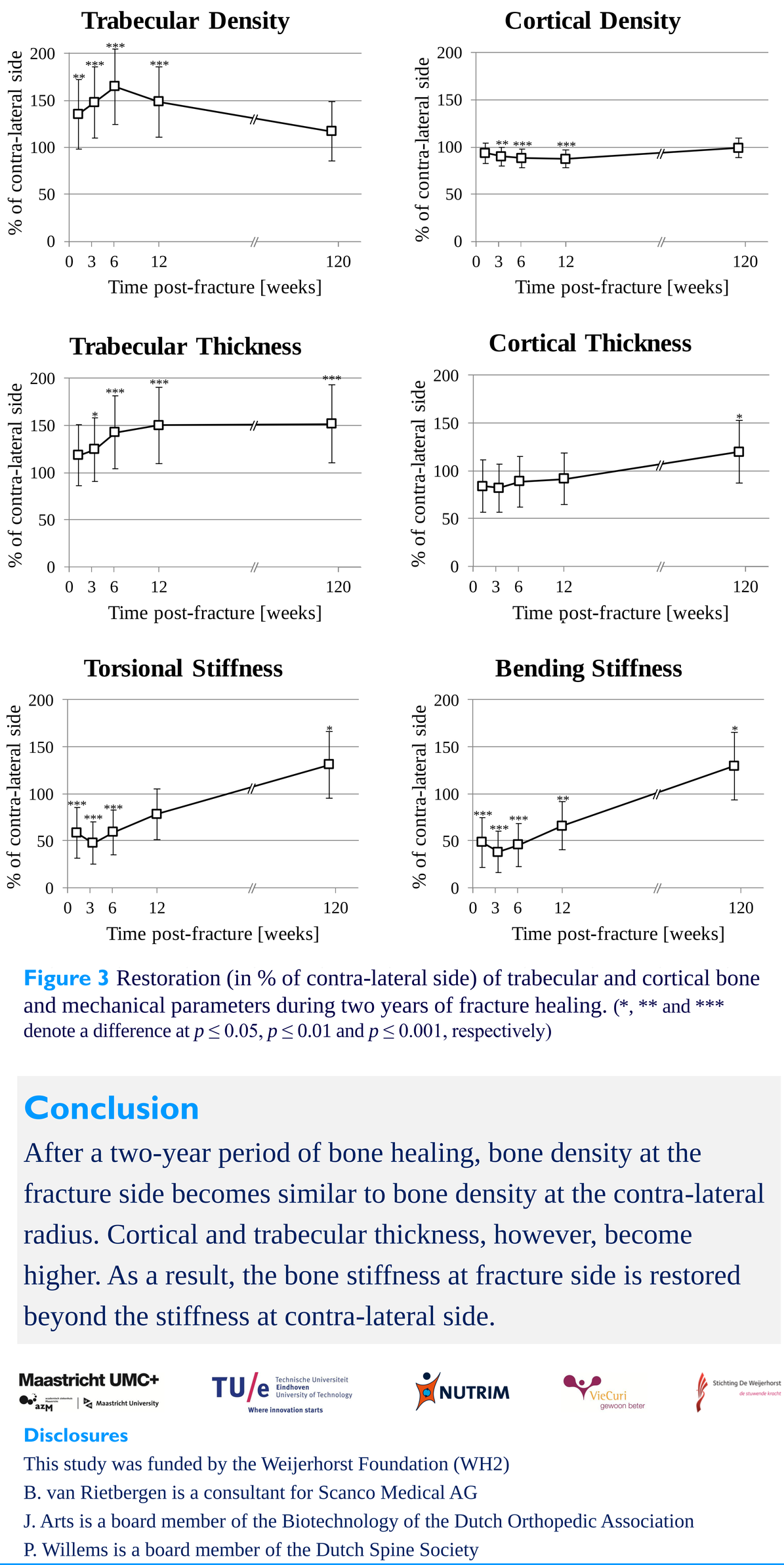

Figure 3 Restoration (in % of contra-lateral side) of trabecular and cortical bone and mechanical parameters during two years of fracture healing. (*, ** and *** denote a difference at $p \leq 0.05$, $p \leq 0.01$ and $p \leq 0.001$, respectively)

Conclusion

After a two-year period of bone healing, bone density at the fracture side becomes similar to bone density at the contra-lateral radius. Cortical and trabecular thickness, however, become higher. As a result, the bone stiffness at fracture side is restored beyond the stiffness at contra-lateral side.

References

1. De Jong et al., "*Assessment of the healing process of distal radius fractures by high resolution peripheral quantitative computed tomography*" Bone vol.64, pp.65-74, 2014
2. Meyer et al., *"Early Changes in Bone Density, Microarchitectural, Bone Resorption and Inflammation Predict Clinical Outcome…",* JBMR vol.29, pp.2065-2037, 2014

Disclosures

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J. Arts is a board member of the Biotechnology of the Dutch Orthopedic Association
P. Willems is a board member of the Dutch Spine Society

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