Bone Stress Injuries in Sportive Young Males
The Search for Differences in Bone Microarchitecture

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Background:

Bone stress injuries (BSI) occur as inability of bone to withstand repetitive loading resulting in a loss of stiffness leading to microstructural damage[1, 2]. Biopsies of hyperintense bone bruise areas of BSI have revealed microfractures of cancellous bone with a concomitant inflammatory reaction[3, 4]. The incidence of BSI is greatest among soldiers and military recruits accounting 3.2 to 5.7 cases per 1000 persons [5-7].

This cross-sectional multicenter study investigated (1) cortical and trabecular bone microstructure as well as volumetric bone mineral density (vBMD) in subjects with a BSI at the proximal tibia, measured by high-resolution peripheral quantitative computed tomography (HR-pQCT) at the distal radius and proximal tibia, (2) areal bone mineral density (aBMD) using dual-energy X-ray absorptiometry (DXA), calcaneal dual X-ray absorptiometry and laser (DXL), and trabecular bone score (TBS), (3) the possible influence of bone turnover markers (BTM) of formation and resorption at the early phase after trauma.

Material and Methods:

Male professional soldiers with a MRI-diagnosed BSI at the proximal tibia after training were included (case group, n=26). Healthy, male age- and weight-matched professional soldiers from the same military companies (control group, n=50) served as controls.

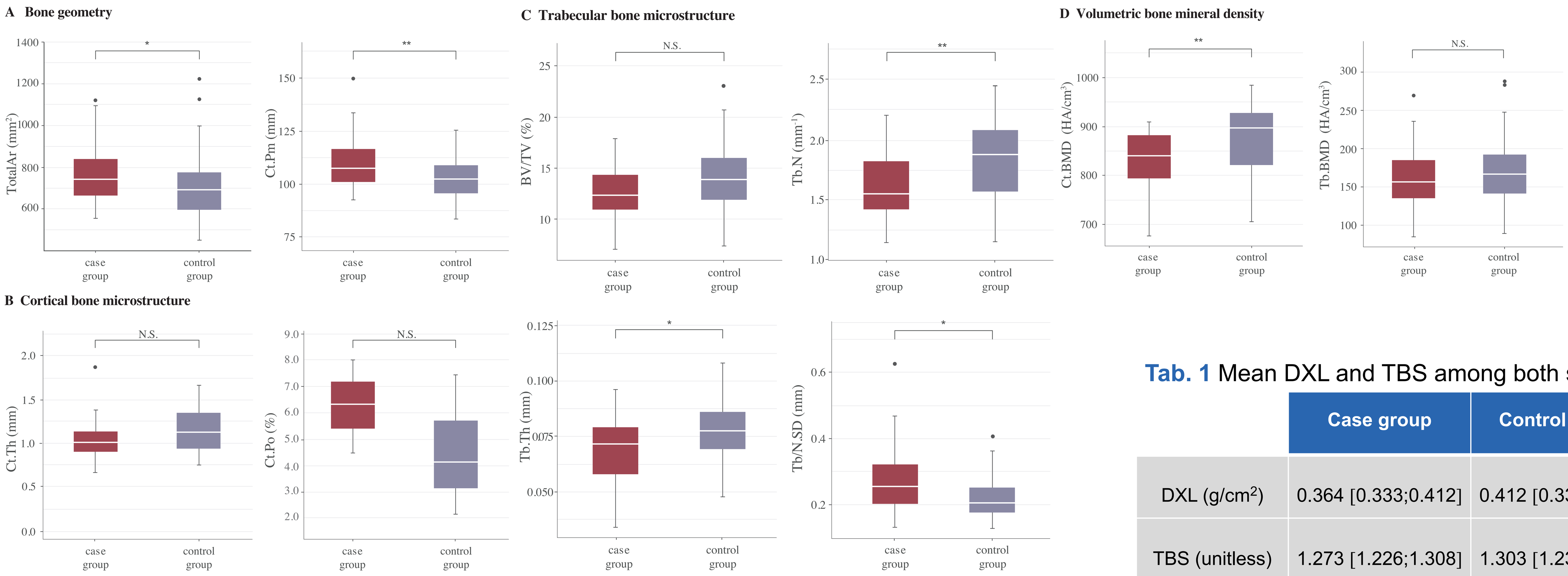
Bone microarchitecture was assessed within three weeks after onset of symptoms. BTM were examined at the time of BMD investigation.

Results:

Differences in bone microarchitecture were observed between both study groups. Bone geometry, cortical bone microstructure, trabecular bone microstructure as well as vBMD at the distal radius and the proximal tibia showed inferior bone microarchitecture in the case group when to the control group (**Fig. 1**). The multivariate logistic regression analysis considered a lower TotalAr at the radius as well as higher values of Tb.N and Tb.Th at the tibia as protective factors for the occurrence of a BSI at the proximal tibia. aBMD assessed by DXA was comparable between both populations. DXL was reduced (p=0.007) in the case group when compared to the control group (**Tab. 1**). Regarding TBS, no differences were found between both study populations (**Tab. 1**).

BTM for bone resorption (Beta-CrossLaps [CTX], sclerostin, and Dicklopf-related protein 1 [DKK-1]) as well as for bone formation (procollagen type 1 amino-terminal propeptide [P1NP]) were significantly higher in the case group when compared to the control group.

Fig. 1 Differences in bone microarchitecture at the proximal tibia assessed by HR-pQCT. N.S. = not significant; * < 0.05, ** < 0.01, *** < 0.001



Tab. 1 Mean DXL and TBS among both study groups

	Case group	Control group	p-value
DXL (g/cm^2)	0.364 [0.333;0.412]	0.412 [0.338;0.497]	**0.007**
TBS (unitless)	1.273 [1.226;1.308]	1.303 [1.237;1.359]	0.097

Conclusions:

This study quantified differences in cortical and trabecular bone microstructure in otherwise healthy individuals. Differences in bone microarchitecture may impair the biomechanical properties by increasing the susceptibility of weight-bearing bone to sustain a stress fracture. Areal DXL at the calcaneus can be considered to provide additional information.

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