Results: While there was no significant association between baseline T2 values and the occurrence of a TKR (Table 1), GLCM texture analysis parameters were significantly associated with the occurrence of TKR (Table 2). Specifically, an increase of 1 SD in the mean contrast of cartilage T2 in the lateral femur and lateral tibia was associated with an increased risk of undergoing a TKR (LF: OR 1.500[1.143-1.970] p=0.003, LT: OR 1.348[1.039-1.750] p= 0.025) (Table 2). A similar trend was also seen in the medial femur cartilage compartment. Likewise, an increase in 1 SD in the mean T2 variance in the lateral femoral cartilage compartments was significantly associated with a 50 % increased risk of TKR. (LF: OR 1.51[1.129-2.015] p=0.005) (Table 2).
Conclusions: Our results validate previous findings, which indicate that cartilage degeneration is related with increased cartilage heterogeneity and can be measured using T2 texture parameters. In addition, our findings suggest that mean T2 cartilage measurements cannot effectively evaluate the risk and future need for TKR. However, T2 texture parameters, particularly GLCM contrast, based on T2 maps show promise as a tool to identify individuals predisposed to receiving a TKR in the next for 4 to 7 years.

Table 1
Mean T2 (ms) analysis.

Compartment	T2 (Mean ± SD)		Odds Ratio [95% CI]	p-value
	Controls	Cases		
LF	35.94 ± 3.22	36.65 ± 2.89	1.29 [0.10-1.68]	0.05
LT	28.61 ± 2.92	28.65 ± 2.87	1.01 [0.78-1.30]	0.94
MF	39.69 ± 3.26	39.96 ± 2.44	1.10 [0.85-1.41]	0.47
MT	29.79 ± 2.62	30.30 ± 2.93	1.22 [0.95-1.57]	0.12
ALL	33.38 ± 2.22	33.61 ± 1.99	1.12 [0.87-1.44]	0.36

Table 2
Mean T2 (ms) texture analysis.

Texture analysis	T2 (Mean value) ± SD		Odds Ratio [95% CI]	p-value
	Controls	Cases		
Contrast				
LF	274.90 ± 80.5	301.80 ± 79.30	1.50[1.14-1.97]	0.003
LT	179.70 ± 60.50	200.10 ± 92.10	1.35[1.040-1.75]	0.025
MF	456.0 ± 149.70	481.80 ± 152.70	1.29[0.97-1.70]	0.077
MT	321.60 ± 114.50	336.20 ± 118.10	1.22[0.93-1.59]	0.15
ALL	309.90 ± 88.80	322.30 ± 83.90	1.24[0.94-1.63]	0.13
Variance				
LF	207.20 ± 52.60	226.0 ± 62.10	1.51[1.13-2.02]	0.005
LT	150.80 ± 44.10	157.80 ± 63.60	1.18[0.92-1.53]	0.20
MF	314.30 ± 86.30	325.70 ± 82.0	1.24[0.94-1.63]	0.14
MT	223.80 ± 67.80	230.10 ± 72.90	1.17[0.90-1.52]	0.26
ALL	226.60 ± 54.20	230.50 ± 53.20	1.14[0.87-1.48]	0.35

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BONE TEXTURE ALTERATIONS IN ACTIVE ATHLETES: A KNEE-BASED CROSS-SECTIONAL CASE-CONTROL STUDY

F.W. Roemer †,‡, J. Niu ‡, M. Jarraya ‡, J. Duryea §, J.A. Lynch ‖, A. Guermazi †,‡. † *ASPETAR, Doha, Qatar;* ‡ *Boston Univ. Sch. of Med., Boston, MA, USA;* § *Harvard Med. Sch., Boston, MA, USA;* ‖ *UCSF, San Francisco, CA, USA*

Purpose: It has been shown that trabecular bone structure parameters extracted from radiographs known as fractal signature or bone texture analysis (FSA) is able to predict structural outcomes such as radiographic osteoarthritis progression or clinical endpoints such as total joint replacement. To date most studies investigating bone structure using FSA have focused on osteoarthritic joints in older subjects. Little is known about early disease or about differences between subjects exposed to increased joint loading such as young active athletes compared to non-athletes. Given the repetitive impact of loads to the knee joint in sports like soccer it has to be expected that subchondral bone adaptations as measured by FSA are to be observed. Further it is not known if previous surgery, gender or age has a similar impact on subchondral bone structure.
Aim was to compare horizontal and vertical dimensions of bone texture considering athlete status, gender, previous anterior cruciate ligament surgery and age after combining these features into one single model.
Methods: Methods: 135 consecutive athletes (82% soccer players) 18 to 36 years old and 550 non-athletes aged-matched controls had knee radiography (Lyon-Schuss protocol) for assessment of subacute or chronic knee complaints. Patients with acute trauma or fractures were excluded.
Regions of interest were placed in the subchondral medial and lateral tibial plateaus. The landmarks used were the tibial borders, tibial spine, and cortical plates. Fractal signatures were calculated in the horizontal and vertical dimensions. 19 trabecular images sizes (radii) were applied ranging from 0.9 mm to 2.9 mm. The statistical model used was Yijk = u + athlete + gender + ACLR + agecat + rk + rk2 + rk * athlete + rk2 * athlete + rk * gender + rk2 * gender + rk * ACLR + rk2 * ACLR + rk * agecat + rk2 * agecat+ Pij + eijk with: rk: radius, Pij: the random effect associated with the subject in group and eijk: the random error with the the subject in group. Curve fitting algorithms were applied taking into account all four risk factors in the same model adjusting for each other to assess differences between athletes vs. non athletes, gender, previous ACL surgery and age assessing ROIs in medial and lateral compartments separately.
Results: Included were 685 patients of which 135 were athletes. 556 (81.2%) were male and 60 (8.8%) patients had previous ACL surgery. 133 (19.4%) patients were in the age group 18-22 years, 181 (26.4%) in the range of 23-27, 155 (22.6%) in the range of 28-32 and 216 (31.5%) were between 33 and 36 years old. Mean age was 28.5 years (SD ± 6.5). For the horizontal dimensions significant differences were observed for gender (estimate (E) 0.098 standard error (SE) 0.004, p<.0001), previous ACL surgery (E -0.031, SE 0.006, p<.0001) and the highest age group (E -0.039, SE 0.005, p<.0001). For vertical dimensions, significant differences were shown for athletes (E -0.012, SE 0.004, p<.0001), gender (E 0.056, SE 0.004, p<.0001), and age range from 28-32 years (E -0.028, SE 0.005, p<.0001) (Figure 1).
Conclusions: Trabecular bone structure differs between athletes and non-athletes, in regard to previous ACL surgery, for gender and for higher age. Specific differences observed for horizontal and vertical dimensions of FSA warrant further exploration. FSA is a promising tool to define early subchondral bone alterations in young active subjects. The role of early subchondral bone changes defined by FSA in regard to longitudinal assessment and risk of premature joint degeneration needs to be evaluated further.

Figure 1. Curve fitting across 19 fractal radii for the medial and lateral tibia in the horizontal and vertical dimensions. Comparison between athletes and non-athletes