Identification of Patellar Tendinopathy Risk Factors Combined with Ultrasonography

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BACKGROUND AND PURPOSE

- Patellar tendinopathy (PT) is a common overuse injury that can impose functional limitations for 2-3 years or more[1,2]
    - PT affects up to 22% of athletes, primarily those participating in sports that involve repetitive jumping[2]
- Anterior knee pain, tenderness to palpation, and increased pain with knee extension characterize PT[2,3]
- Risk factors include elevated BMI and waist-to-hip ratio, female gender, muscle weakness, and lack of flexibility[1,2,3]
- Ultrasound (US) can be used to diagnose PT and to identify athletes who may be at risk for its development[3,4]
    - Presence of a hypoechoic region and increased neovascularization are indicators of an abnormal tendon[3,4,5]
- Little evidence exists to support a method for predicting the likelihood that a given athlete will develop PT[1]
- The purpose of this study was to compare factors that differentiate college athletes with a history of PT from matched control participants, which could improve methods for assessment and therapeutic management

PARTICIPANT CHARACTERISTICS

	Age	Sport	Height (cm)	Mass (kg)	BMI
Case 1	19	Volleyball	177.8	72.1	22.8
Control 1	20	Volleyball	172.5	67.2	22.6
Case 2	22	Basketball	167.1	64.7	23.2
Control 2	18	Basketball	170.2	68.2	23.5
Case 3	18	Volleyball	177.3	70.7	22.5
Control 3	20	Volleyball	172.7	69.6	23.3
Case 4	19	Basketball	177.8	77.0	24.4
Control 4	21	Basketball	182.9	87.0	26.0
Case 5	21	Basketball	167.6	60.0	21.4
Control 5	19	Basketball	168.1	59.2	21.0

Table 1

Factor	Cut Point	Odds Ratio	Sensitivity	Specificity
WHR	≥0.82	6.0	80%	60%
MMOI	≥215	6.0	60%	80%
HeR cm^2	≥0.06	16.0	80%	80%

METHODS

- 5 female Division I college athletes with PT matched as closely as possible to 5 female control athletes without PT
- Anthropometric measurements: height, mass, waist circumference, and hip circumference
    - Waist-to-hip ratio (WHR) and estimated mass moment of inertia (MMOI) were calculated
- Additional measurements: sit-reach distance, quadriceps strength, and foot-width index (FWI)
    - Quadriceps strength measured using a hand-held dynamometer
- Visual analog scale (VAS) used to assess level of pain over patellar tendon during jumping activities
    - To what extent have you experienced pain right below the kneecap that has impacted your ability to perform jumping activities within the last year? (0= Never 3=Rarely 5= Sometimes 8= Often 10= Constantly)
        - Operational definition of PT: VAS score ≥6
- Gray-scale (GS) and color-Doppler (CD) US images of symptomatic or control-dominant patellar tendon
    - Hypoechoic regions (HeR) and areas of neovascularization identified (Figures 1 and 2)
        - Cross-sectional Area (CSA) of HeRs were measured
- Receiver operating characteristic (ROC) analysis established cut-points to dichotomize potential predictors of PT
    - 2 x 2 cross-tabulation analyses used to identify strength of associations for potential predictors (odds ratios)
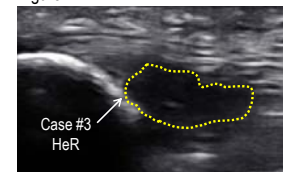- Prediction models developed for discrimination of cases from controls

Figure 1

Control #1

Figure 2

Case #3 HeR

Table 2

High WHR and/or High MMOI		
# Factors +	Case	Control
≥1	5	2
0	0	3

+ LR = 2.23 - LR = 0.15
OR = 15.00* (90% CI = 0.86 – 263.17)
*0.5 added to avoid division by 0

Table 3

Large HeR CSA		
cm^2	Case	Control
≥0.06	4	1
<0.06	1	4

+ LR = 4.00 - LR = 0.25
OR = 16.00 (90% CI = 1.19 – 215.58)

RESULTS

- HeR CSA, WHR, and MMOI were the strongest factors that discriminated cases from controls (Table 1)
    - 100% of cases (5/5) demonstrated either high WHR (≥0.82) or high MMOI (≥215), or both factors (Table 2)
    - 80% of cases (4/5) exhibited a large HeR (≥0.06) (Tables 3 and 4)
        - Only 1 control (#2) exhibited a HeR, which was substantially smaller than that for any of the cases
    - 40% of cases (2/5) were positive for all 3 factors
- BMI, FWI, sit-reach distance, and quadriceps strength failed to provide any substantial discriminative power
- No CD-US image demonstrated evidence of neovascularization

Table 4

Control	VAS	HeR cm^2	Case	VAS	HeR cm^2
1	0	0.00	1	8	0.21
2	0	0.11	2	8	0.33
3	2	0.00	3	8	0.40
4	5	0.00	4	8	0.44
5	0	0.00	5	6	0.00

CLINICAL RELEVANCE OF FINDINGS

- HeR CSA appears to be the strongest indicator of the existence of PT
    - 80% of cases demonstrated HeR CSA >0.20 and 80% of controls had no evidence of any HeR (Table
- WHR (≥0.82) and MMOI (≥215) also demonstrated a strong association with PT
    - Athletes with either one or both factors positive had 15x greater odds to be a case rather than a control
- Screening that identifies athletes who have high WHR and/or high MMOI may be used to guide follow-up with US
    - If US is unavailable, anthropometric screening and VAS score may have value for identification of PT risk
- Pre-participation screening, with or without US, may identify athletes who are at high risk for development of PT
    - Preventive strategies may include body fat reduction, monitoring of activity volume, and eccentric exercise

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