

The association between Infrapatellar fat pad volume and knee pain scores in non-overweight postmenopausal women

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INTRODUCTION

- Previous research has shown the Infrapatellar fat pad (IPFP) to have a pro-inflammatory effect:
 - Adipocytes secrete cytokines (interleukins) and growth factors.
 - Cytokines such as leptin are increased in women with knee-OA but not in men with OA
- Small sensory-nerves present in IPFP are a potential pain mechanism.
 - Found to have high rates of Substance P neuropeptides that cause vasodilation to recruit more immune cells

OBJECTIVES

- 1) Determine the effect of larger IPFP volume/area and knee pain for postmenopausal women
- 2) Better understand IPFP's role in OA by limiting total body fat as a contributor
- 3) Develop a method to segment IPFP volume directly from existent knee MRI and CT

METHODS

- Sample of postmenopausal women (N=43, Age = 50-85) with variable knee pain that are non-overweight (BMI <25 kg/m²).
- Knee Osteoarthritis and Outcome score (KOOS) and Intermittent and Constant Osteoarthritis Pain (ICOAP) questionnaires used as validated assessments of knee pain.
- Physical functioning tests: 30 second chair-stand test, 9 step stair-climb test and 30m walk test.
- IPFP segmented in 10 contiguous 3mm thick slices of a SAG view PD-weighted MR series using Slice-o-matic.
- IPFP also segmented from 4 transaxial slices 2.3mm thick of a peripheral quantitative CT (pQCT), positioned using a coronal scout view on XCT 5.20C Analysis: 2% (of femoral length) proximal to the distal medial and lateral condyles, 1% (of tibia length) distal to proximal medial and lateral plateau
- Cross-sectional areas combined to form volume. Volume also interpolated by Slice-o-matic's algorithm. pQCT areas were added up to create a total area but each compartment was analyzed separate to pinpoint pain.

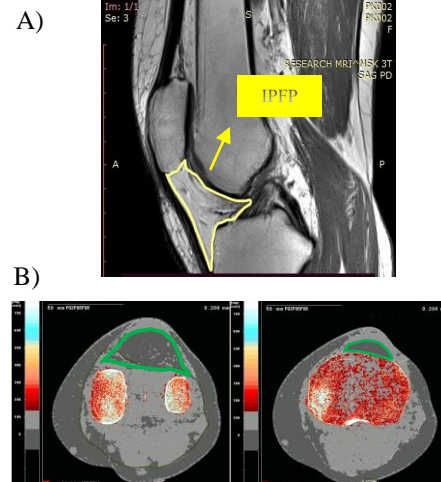


Figure 1: Segmentations from MRI outlined in yellow (A) and pQCT outlined in green (B) isolating the IPFP.

Table 1: Participant IPFP area and volume characteristic from pQCT and MRI scans. A lower KOOS score or a higher ICOAP score indicate more painful responses. M= medial, L= lateral, F= femoral, T = tibial

Variable	N	Mean	SD	Min	Max
Age (years)	51	61.16	8.82	50.00	83.00
BMI (kg/m ²)	51	22.47	3.20	14.44	29.32
Intermittent ICOAP (score)	49	20	21	0	75
Constant ICOAP (score)	50	11	21	0	85
KOOS PAIN (score)	50	81	16	42	100
KOOS Activities of Daily Living (score)	50	90	13	41	100
KOOS Quality of Life (score)	50	65	27	13	100
pQCT					
Total IPFP Area (cm ²)	49	19.98	4.06	12.48	28.82
MF IPFP Area (cm ²)	49	7.31	1.72	3.41	11.30
LF IPFP Area (cm ²)	49	6.47	1.80	2.53	11.40
MT IPFP Area (cm ²)	49	2.56	1.01	0.39	4.63
LT IPFP Area (cm ²)	49	3.64	1.10	0.68	6.25
MRI					
Volume calculated (cm ³)	43	13.91	3.05	7.65	22.86
Volume interpolated (cm ³)	43	16.57	3.65	9.06	27.26

Table 2: Significant associations between MRI IPFP volumes and ICOAP. Bolded P-values are <0.05.

IPFP volume method (Exposure)	Pain Questionnaire (Outcome)	Estimate (score)	95% CI Limits	SE	P-value	MCID (cm ³)
Volume (MR) calculated (cm ³)	ICOAP Intermittent	1.8	0.2 3.4	0.8	0.029	10.3
Volume (MR) interpolated by Slice-o-matic (cm ³)	ICOAP Intermittent	1.5	0.2 2.8	0.7	0.023	12.3

Table 3: Significant associations between pQCT IPFP area and KOOS. Bolded P-values are <0.05.

IPFP volume method (Exposure)	Pain Questionnaire (Outcome)	Estimate (score)	95% CI Limits	SE	P-value	MCID (cm ²)
IPFP Area at Medial Tibial Plateau (cm ²)	KOOS Pain	-4.7	-9.1 -0.4	2.2	0.034	0.5
IPFP Area at Medial Tibial Plateau (cm ²)	KOOS ADL	-3.6	-7.0 -0.2	1.7	0.039	-
IPFP Area at Medial Tibial Plateau (cm ²)	KOOS QoL	-7.3	-13.8 -0.8	3.2	0.029	1.1

STATISTICAL ANALYSIS

- General linear models used to examine the relationship between IPFP volume/areas and ICOAP/KOOS or physical function test. Age, BMI, and Pain Medications were used as covariates.
- Analysis performed using SAS 9.4.

RESULTS

- A 1cm³ higher MR IPFP volume related to a 1.8 and 1.5 point higher score for intermittent knee pain meaning more pain (P-values 0.034, 0.039, 0.029, respectively). An IPFP volume increase of 10.3cm³ from volume calculated and 12.3cm³ from volume interpolated is needed to exceed MCID in ICOAP score.
- A 1cm² larger pQCT IPFP area in the medial tibial condyle was associated with a 4.7 point lower KOOS score in knee pain, 3.6 lower daily activity and 7.3 lower quality of life (P-values 0.034, 0.039, 0.029, respectively). An IPFP MT area increase of 0.5cm² and 1.1cm² is needed to exceed MCID of KOOS pain and QoL, respectively.
- There was no association between IPFP volume and physical function tests.

CONCLUSION

- A higher IPFP volume/area correlates with worse knee pain scores. A larger volume may reflect more inflammation, therefore contributing more pain.
- No association between volume/area of either imaging and physical function tests therefore IPFP may not affect knee function.

ACKNOWLEDGEMENT

This project was made possibly by a CIHR grant **PJT-156274**, Joint Department of Medical Imaging in the University Health Network and Dr. Andy Kin On Wong's MSK Imaging and Epidemiology Lab.

