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### Underloading, not overloading, of the patellofemoral joint increases the risk of early osteoarthritis after ACL reconstruction

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**Background:** Approximately 50% of adolescents and young adults who rupture their anterior cruciate ligament (ACL) develop osteoarthritis within 10 years. While most reports of osteoarthritis after ACL injury focus on the tibiofemoral joint, patellofemoral osteoarthritis is common and strongly associated with symptoms and impaired function. The mechanisms underpinning the development of patellofemoral osteoarthritis after ACL injury are unknown but may relate to altered joint loading. This study aimed to determine if altered patellofemoral loading is associated with the presence and/or worsening of early patellofemoral osteoarthritis following ACL reconstruction (ACLR).

**Methods:** Forty-six participants (30 men, age 27±5 years, BMI 24.5±3.1 kg.m<sup>-2</sup>) were randomly selected from a cohort of 111 consecutively recruited patients with primary hamstring-tendon ACLR and completed magnetic resonance imaging (MRI) and biomechanics testing of their index knee 1-year post-ACLR. Biomechanics testing involved recording trunk and lower-limb movement with a 12-camera 3D motion analysis system and ground reaction force data during the landing phase of a standardised forward hop. These data were input into a musculoskeletal model to calculate patellofemoral joint contact forces normalised to body weight. Follow-up MRI was completed on 32 participants 5-years post-ACLR. Early patellofemoral osteoarthritis was defined as the presence of a patellofemoral cartilage lesion by an experienced musculoskeletal radiologist. Generalised linear models (Poisson) assessed the relationship between patellofemoral joint loading and prevalent early patellofemoral osteoarthritis at 1-year and worsening patellofemoral osteoarthritis between 1- and 5-years adjusting for sex and age.

**Results:** At 1-year following ACLR, 14 (30%) participants had early patellofemoral osteoarthritis. Those with a lower peak patellofemoral joint contact force were more likely to have early patellofemoral osteoarthritis (prevalence ratio: 1.37, 95%CI 1.02-1.85). Of the 32 participants with 5-year follow-up data, 9 (28%) displayed worsening patellofemoral osteoarthritis. A lower peak patellofemoral joint contact force at 1-year increased the risk of worsening patellofemoral osteoarthritis (risk ratio: 1.54, 95%CI 1.13-2.11).

**Discussion:** Young adults following ACLR who underload their patellofemoral joint during a hopping task are at high risk of early patellofemoral osteoarthritis onset and progression within the first 5-years after ACLR. For every one unit (i.e., body weight) decrease in peak patellofemoral joint contact force, the risk of incident or progressive early patellofemoral osteoarthritis increases ~50%. These findings challenge traditional thinking that joint overloading drives post-traumatic osteoarthritis and provides new targets for osteoarthritis prevention.

**Conflict of interest statement:** My co-authors and I acknowledge that we have no conflict of interest of relevance to this abstract.

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### What is the relationship between imaging-defined intra-articular features and cartilage defects in young adult football players?

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**Introduction:** While hip osteoarthritis is a disease of the whole synovial joint, cartilage defects are considered a hallmark feature. A high proportion of young adult football players have hip cartilage defects. However, the role that other intra-articular features play in the pathogenesis of cartilage defects in football players remains unknown. This study had two aims: 1) examine the relationship between imaging-defined intra-articular features (labral tears, bone marrow edema pattern, subchondral cysts, effusion-synovitis and ligamentum teres tears) and cartilage defects (presence and severity) in football players; 2) investigate if the relationship between imaging-defined intra-articular features and cartilage defects is stronger in football players with hip/groin pain

**Methods:** 182 semi-elite football (soccer/Australian football) players (288 hips; 50% soccer; age:26yrs; height:1.79m; weight:78kg; 20% women) with hip/groin pain (>6 months of pain and +ve flexion-adduction-internal-rotation test) and 55 semi-elite control football players (110 control hips; 55% soccer; age:26yrs; height:1.79m; weight:79kg; 25% women) without hip/groin pain underwent 3-tesla MRI. Cartilage defects, labral tears, bone marrow edema pattern (BMPE), subchondral cysts, effusion-synovitis and ligamentum teres tears were scored semi-quantitatively. Logistic and negative binomial regression with generalised estimating equations were used to determine whether intra-articular features were associated with presence and severity of cartilage defects.

**Results:** Hips with minor (OR 1.8, 95%CI 1.2,2.9) and severe (OR 5.1, 95%CI 2.5,10.3) labral tears had a higher prevalence of cartilage defects than hips without. Only hips with severe labral tears (IRR 2.1, 95%CI 1.4,3.2) had higher (greater severity) cartilage defects scores than hips without. Hips with BMPE or subchondral cysts had a higher prevalence (OR 7.7, 95%CI 3.1,20.0) and more severe (IRR 1.8 95%CI 1.4,2.3) cartilage defects than hips without. Effusion synovitis was not associated with a higher prevalence or greater severity of cartilage defects. For ligamentum teres tears only, a significant feature by symptoms interaction was present. Symptomatic football players without a ligamentum teres tear had a greater severity of cartilage defects when compared to those with symptoms and ligamentum teres tears.

**Discussion:** Labral tears, BMPE and subchondral cysts were associated with the presence and severity of cartilage defects in active adult football players. Effusion-synovitis was not associated with cartilage defects. With the exception of ligamentum teres tears, the relationship between imaging-defined intra-articular features and cartilage defects was no stronger in football players with hip/groin pain when compared to those without.

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