

# Bilateral cogwheel grooves observed on lateral condyles of femur and patellar articular surfaces: a cadaveric case report

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## SUMMARY

The knee joint comprises the articulation of the femur and tibia, the femorotibial joint, and articulation between the femur and patella, the patellofemoral joint. In non-pathological anatomy, the articular surfaces of the femur, tibia, and patella are smooth, allowing for fluid motion of all joints associated with the knee. The bilateral knees of a cadaver were dissected and analyzed due to the presence of bilateral longitudinal, parallel cogwheel grooves on the lateral femoral condyles and dorsal surface of the patella. The evenly organized grooves are an odd occurrence, especially since very few cases have been reported. Termed Cogwheel grooves, they are grossly visible longitudinal grooves on femoral condyles and the articular surface of patellae that interlock together. Health practitioners should be aware of the potential presence of cogwheel grooves in the knees. In knees with cogwheel grooves, the knee motion may initially appear appropriate with flexion or extension of the knee; however, restriction could be expected when lateral movement of the patella is facilitated. Depending on the depth of the cogwheel grooves, patients may be diagnosed with a hypomobile patellae, as the only way to likely manipulate the patellae laterally or medial-

ly would be to distract the patella to disengage the grooves prior to lateral or medial movement.

**Key words:** Cogwheel grooves – Patellofemoral joint – Osteoarthritis – Cadaver – Knees

## INTRODUCTION

The patellofemoral and femorotibial joints assist in establishing the functional foundation for the lower extremity through the formation of unique pulleys and levers (Bandovic et al., 2021; Brennan et al., 2002; Bump and Lewis, 2023; Flandry and Hommel, 2011). In normal anatomy, the hyaline cartilage-lined articular surfaces of the femur and patella should be smooth (Brennan et al., 2002), allowing for fluid motion of the femorotibial and patellofemoral joints. These joints must articulate smoothly and seamlessly, as the lower extremity is typically exposed to constant compressive forces and complex movements (Bump and Lewis, 2023).

The presence of bilateral longitudinal, parallel, and evenly organized ridges on lateral femoral condyles and articular surface of patellae is an abnormal occurrence, only noted in literature once (Rogers and Dieppe, 1993). In the report, these

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**Fig. 1.-** Gross image of left knee looking from distal to proximal demonstrating the observed cogwheel grooves of the lateral femoral condyle.



**Fig. 2.-** Gross image of left knee looking from proximal to distal displaying the relationship between the cogwheel grooves on the lateral femoral condyle and articular surface of patella.

ridges were reported with varying depths and peak-to-peak distances, but when the articulating surfaces of the femur and patellae were approximated, they matched up, giving a cogwheel appearance (Rogers and Dieppe, 1993). The purpose of this case report is to describe the abnormal occurrence of bilateral longitudinal ridges, or cogwheel grooves (as described in Rogers and Dieppe article), found in the knees of a cadaver.

## MATERIALS AND METHODS

The bilateral knees of a 98-year-old female cadaver used in a university anatomy course were analyzed. The past medical history of the donor was unobtainable and the rights of the donor were protected. To secure an appropriate view of the patellofemoral joints and obtain measurements of the internal aspects of bilateral knees, the quadriceps tendons were severed, and the patellae were reflected inferiorly. Both femoral heads were then dislocated to measure femoral length in millimeters from the head of the femur to the distal end of the medial condyle. Tibias were also measured bilaterally from the tibial plateau to the plafond

of the tibia. These measurements were completed to determine if there was a difference in femur length between sides. Photos of the bilateral femoral condyles and the articular surfaces of patellae were taken (Figs. 1-3), and radiographs of the left patellofemoral joint were completed (Figs. 4-6) to show the cogwheel grooves.

## RESULTS

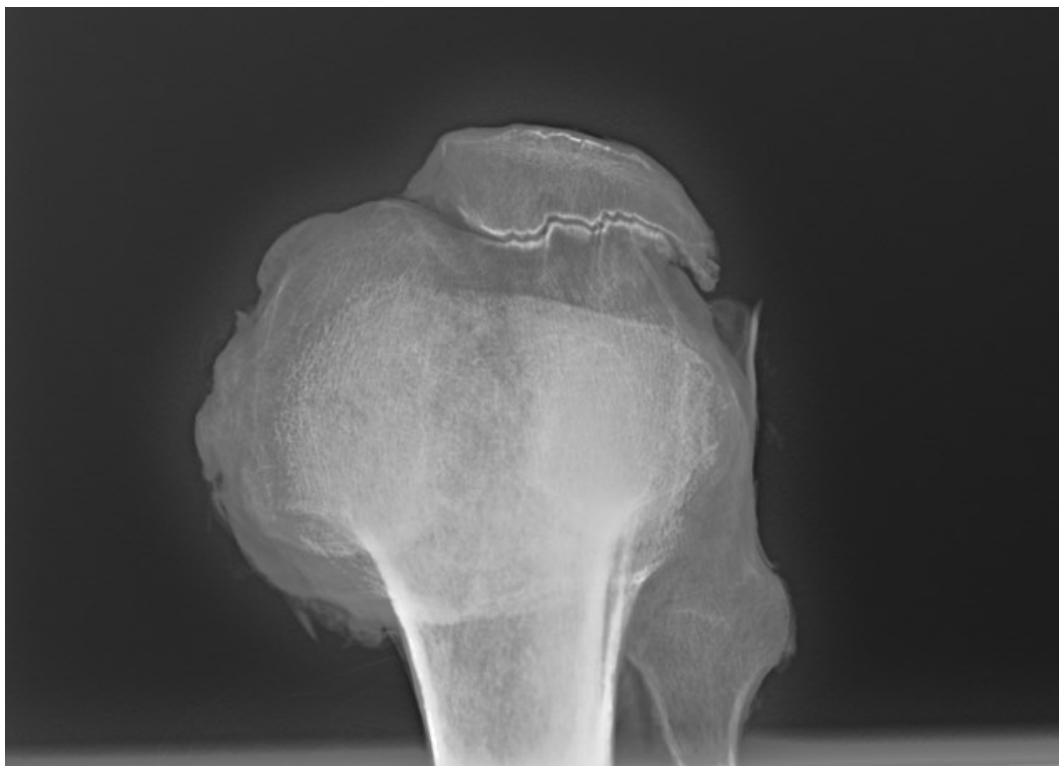
Cogwheel grooves were observed bilaterally on the lateral femoral condyles and the articular surface of the patellae (Figs. 1-6). No ridges or grooves were seen within the hip or talocrural joints. A slight bilateral genu valgum was apparent upon inspection of the cadaver in the supine position. The right femur length was 423 mm, and the left femur length was 419 mm; however, left hip replacement was present. The right tibial length was 345 mm, and the left tibial length was 343 mm. The cogwheel grooves were well isolated to the lateral femoral condyle and the near entirety of the articular surface of the patellae bilaterally (Figs. 1-2). The grooves also were more prominent within the left knee than the right knee.



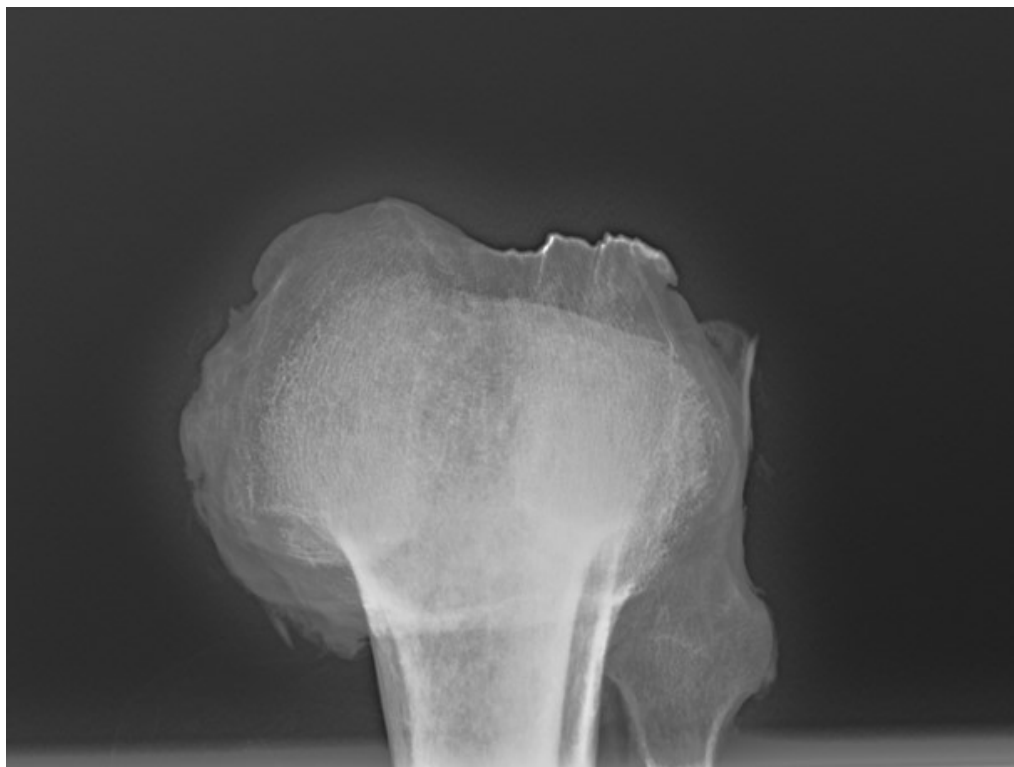
**Fig. 3.-** Gross image of the articular surface of the left patella demonstrating the observed cogwheel grooves.



**Fig. 4.-** Anterior/Posterior radiographic image of the left lower extremity.



**Fig. 5.-** Radiographic image of the left knee displaying the cogwheel grooves observed on the lateral femoral condyle and articular surface of patella.



**Fig. 6.-** Radiographic image of the left knee with the patella removed demonstrating the cogwheel grooves observed on the lateral femoral condyle.

## DISCUSSION

The absence of reports and literature to support the occurrence of bilateral longitudinal grooves on lateral femoral condyles and articular surfaces of patellae may be the result of underreporting or the rare occurrence of cogwheel grooves (Rogers and Dieppe, 1993). Potential etiologies that should be considered include, but are not limited to, osteoarthritis and patellofemoral syndrome (Brennan et al., 2002; Bump and Lewis, 2023).

The grooves observed in the cadaver on the lateral femoral condyles and patellae could be due to a primarily isolated genu valgum or secondary to weakened musculature (Bump and Lewis, 2023). It is plausible that an increased Q-angle and resultant increased contact of the patellae on the lateral femoral condyles over time could potentially result in advanced osteoarthritis (Eckenrode et al., 2018; Flury et al., 2020). Additionally, the biomechanical effects of the left hip replacement may have contributed to the more pronounced ridges observed on the left lateral femoral condyle and patella. However, these cannot positively be linked. In this case, it cannot be ascertained whether the cogwheel grooves are the result of

pathological sequelae or secondary to aging or both. Future studies should focus on correlating medical history and demographic information to cases of cogwheel grooves found in knees. This case report may offer clinicians documentation of this presentation of cogwheel grooves.

## ACKNOWLEDGEMENTS

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