

The anterior cruciate ligament (ACL) of the knee joint plays an important role, which is generally well known. Reconstruction of the ACL after injury is among the most common orthopedic procedures. This study focuses on the biomechanical aspects of reconstruction techniques, with an emphasis on evaluating the dynamic loading of materials most commonly used for this purpose. Another possible application includes revision surgeries of previous ACL reconstructions. Single and multiple strands of the *m. gracilis* and *m. semitendinosus* tendons (i.e., hamstrings) were subjected to uniform tension, simulating conditions used in ACL reconstruction. Cadaver tissue samples were biomechanically tested and compared with the native anterior cruciate ligament (ACL) and the substitute graft from the patellar ligament (Bone–Patellar Tendon–Bone, BPTB).

### **Materials and Methods**

Fresh-frozen samples were used for this study. They were prepared identically for testing, mounted in the measuring system, and subjected to the same testing procedures. Experimental grafts were obtained in pairs from 21 knee joints. Measurements were carried out at room temperature (21°C) after 24 hours of thawing at 4°C. The first part of the study focused on measuring the material properties (the native ACL, patellar tendon graft, and individual hamstring tendons), such as strength, maximum stress, maximum load, and elongation under maximum load. In the second part, doubled strands of the *m. semitendinosus* and *m. gracilis* tendons (STG) were used. The final part involved measurement and evaluation of quadrupled STG strands.

Measurements were based on the drop-weight testing method using a laser Doppler vibrometer, which served as the primary sensor for detecting dynamic movement between the gripping clamps. This method was compared with measurements taken using a piezoelectric acceleration sensor.