INTRODUCTION: The Anterior Cruciate Ligament (ACL) injury often leads to instability of the knee joint and chronic injuries to the cartilage and meniscus. The ACL reconstruction is performed to avoid associated injuries and make the knee stable for sports and daily activities. However, the long-term clinical outcomes of ACL surgery shows a large amount of patients with cartilage degenerative changes. A more anatomical reconstruction for the ACL has been described, the double-bundle (DB) ACL reconstruction. This technique has been shown to be superior to restore the knee biomechanics when compared to the conventional single-bundle. However, there are no long-term clinical outcomes using this technique and it is unknown whether the cartilage will undergo to degenerative changes after DB. The purpose of this study is to evaluate the tibiofemoral contact area and pressure after single-bundle (SB) or DB ACL reconstruction. We hypothesized that DB ACL reconstruction better restores the contact area and pressure than SB ACL reconstruction.

METHODS: Eight cadaver knees were used for this study. Four were tested for double-bundle and four for single-bundle ACL reconstruction. Pressure measuring film was inserted between tibia and femur, and subject to 1000N axial load using a uniaxial testing machine. The super-low film was used to assess the contact area, average pressure created in the tibiofemoral joint, and maximum tibiofemoral pressure. We observed contact area and pressure at 0, 15, 30 and 45 degrees. Three conditions were evaluated: 1) intact ACL (Int), 2) double-bundle ACL reconstruction (DB), and 3) single-bundle ACL reconstruction (SB). In order to obtain the data for contact area and pressure the pressure measuring film were scanned after the experiment and the pictures were evaluated by specific software. Statistical analysis was performed using the Repeated Measures Anova. The level of significance was set a priori at p<.05.

RESULTS: DB restored the contact area in the lateral compartment at 0°, 15° of flexion to values close to normal while SB did not. At 30° and 45° neither DB nor SB restored the normal contact area in the lateral compartment (Fig.1). In the medial compartment at 0°, 15°, 30° DB is significant better to SB and restore the contact area close to normal. At 45° there was no difference between DB and SB compared to the normal (Fig.1).

DISCUSSION: ACL DB reconstruction better restore tibiofemoral contact area and pressure when compared to the ACL SB reconstruction. There is a trend to total superiority of DB in the tibiofemoral contact area when compared to the SB. However, in some of circumstances this superiority was not significant. The better performance observed in the contact area was also observed in the pressure measurements, but not as evident as in contact area. A biomechanical study has demonstrated superior restoration of biomechanical properties with DB reconstruction. This better DB biomechanics may be a reason for superior tibiofemoral contact area and pressure. DB reconstruction has a more anatomical approach with not only the reconstruction of the anteromedial bundle (AM), but also posterolateral bundle (PL). It is well known that the PL bundle of the ACL tightens during extension. Interestingly, DB had good performance in all experiments performed at 15° when the PL bundle is becoming tight and may provide additional stability when compared to the SB. The development of arthritis after ACL reconstruction in long-term follow-up is an important topic to be studied. We have observed that DB ACL reconstruction has a superior tibiofemoral contact area and pressure than SB, and it may lead to a better clinical outcome regarding to arthritis development in patients with ACL reconstruction. However, better techniques that allow a less invasive measurement of the joint contact and pressure are needed to elucidate the mechanical influence in the arthritis pathogenesis after ACL tear and reconstruction. Limitations were found in our study, mainly to study flexion angles higher than 45° and also ACL deficient knee. It was causing dislocation of the knee joint. Our technique could detect important difference when compare DB and SB. Our study provides important knowledge about the cartilage contact and pressure after ACL reconstruction and suggests that DB has superior restoration of tibiofemoral contact and pressure than SB reconstruction what may provide a better outcomes in the cartilage preservation after ACL reconstruction.

REFERENCES:
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