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RUPTURE OF THE ANTERIOR CRUCIATE LIGAMENT: WHICH BEST EXERCISE FOR RECOSTRUCTION

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Abstract: OBJECTIVE: To carry out a literature review on rupture of the Anterior Cruciate Ligament and the main types of graft for reconstruction. METHODS: Retrospective literature review study analyzing clinical data from 2015 to 2023. They were used for research on websites such as SCIELO, LILACS and GOOGLE ACADEMICO. RESULTS: Autografts are widely used for ACL because they prevent good long-term return to sports results without the risk of graft destruction. However, the morbidity caused by autograft harvest and long recovery may affect the prognosis. Allografts are another option for ACLR, which is technically easier and not associated with additional local physician morbidity. However, they are associated with special sterilization techniques, potential risk of infection, delayed healing, and higher rates of graft rupture. In the 1980s, synthetic ligaments were used in the ACL residency to treat ACL injuries. However, these ligaments are associated with high rates of failure and reactive synovitis. CONCLUSION: Discover major limitations in the current evidence base. All of the planned controlled studies we included only compared BPTB grafts with artificial ligaments, and only 1 to 3 studies were included for each type of artificial graft. It was difficult to thoroughly compare BPTB exercises with specific types of artificial ligaments. Most importantly, the average age of all patients included in the literature was less than 32 years, which made it impossible to evaluate the effectiveness of BPTB and artificial ligament exercises in the elderly. Furthermore, comparison of the efficacy of other autogenous tendons or allogeneic tendons with artificial ligaments was not possible in the included studies.
Keywords: LCA; Reconstruction, Graft.

INTRODUCTION

Anterior cruciate ligament (ACL) reconstruction techniques have been improved over the past 10 years, but graft failure is not uncommon: 0.7–10% (JANNSSEN RP ET AL 2011; MENETREY ET AL 2012). Successful ACL reconstruction requires understanding several factors: anatomical placement of the graft, mechanical properties of the selected graft tissue, mechanical behavior and fixation strength of fixation materials, as well as the biological processes that occur during remodeling, maturation and graft incorporation. They directly influence the mechanical properties of the knee joint after ACL reconstruction and therefore determine the rehabilitation and time course until normal knee joint function can be expected (DAI C. ET AL 2016)

Although substantial research efforts have been published on various aspects of ACL reconstruction, there is limited knowledge on the biology of the human ACL graft (JOYCE CD. ET AL 2015; WANG HD. ET AL 2018). Graft healing after ACL reconstruction occurs in two different locations: intratunnel graft incorporation and intra-articular graft remodeling, often referred to as "ligamentization" (Parsons JL, Coen SE, Bekker S. 2021)

This article presents current knowledge on intra-articular remodeling of ACL grafts with a special focus on human hamstring autografts. In many countries, the incidence of injuries during anterior cruciate ligament (ACL) reconstruction has been steadily increasing. Furthermore, the ACL injury rate in women remains 3 to 6 times that of men and has not changed in over 20 years. Once an ACL injury is diagnosed, the gold standard surgical procedure for ACL injury treatment is performed. In ACLR, the use of different grafts can result in different results, which is why the selection of grafts by the surgeon is very important. There are three main types of grafts for ACLR: autografts, allografts and synthetic grafts (BECK NA ET AL 2017; Mascarenhas R, MacDonald PB. 2008).

Autografts are widely used for ACL because they provide good long-term return to sports results without the risk of graft rejection. However, the morbidity caused by autograft harvest and long recovery may affect the prognosis. Allografts are another option for ACLR, which is technically easier and is not associated with additional donor site morbidity. However, they are associated with special sterilization techniques, potential risk of infection, delayed healing, and higher rates of graft rupture. In the 1980s, synthetic ligaments were being used in ACL reconstruction to treat ACL injuries. However, these ligaments are associated with high rates of failure and reactive synovitis (CLAES S. ET. AL 2011; GOHIL S. ET. AL 2017; GRANA WA. ET. AL 2004).

Numerous systematic reviews have compared autografts versus allografts. Joyce et al. (2016) showed no difference after ACL reconstruction with non-irradiated BPTB and soft tissue allografts. Wang et al. (2018) reported that the hamstring tendon is superior to allografts in terms of subjective assessments and knee stability, but inferior in terms of hypoesthesia. Prodromos et al. (2017) showed that compared to autografts, allografts were associated with significantly less normal stability. Mariscalco et al. (2014) showed no significant differences in autografts and allografts. However, only a few systematic reviews and meta-analyses have attempted to determine the superiority of autografts or synthetic grafts. Furthermore, the studies evaluated included non-randomized studies, of low quality and with small samples. A meta-analysis of data from currently available studies and quantitative synthesis of their results can provide clarity (JIA ZY ET AL 2017).

The aim of this review article was to compare autografts and synthetic grafts in terms of postoperative knee stability and function. The primary outcomes were the pivot shift test, Lachman test and instrumented laxity. Secondary outcomes were IKDC grades and complications. The authors hypothesized that autografts are superior to synthetic grafts in terms of pivot shift test, Lachman test, instrumented laxity, IKDC grades, and complications.

METHOD

This is a narrative review of the literature, which aims to describe the characteristics of the main types of grafts for anterior cruciate ligament reconstruction and which is the best option, from a theoretical point of view, through materials that have already been published on the subject. topic in question, through analysis and interpretation of the literature. The inclusion criteria were: articles in Portuguese and English; published between 2015 and 2023 and which addressed the themes proposed for this research, review-type studies made available in full. The exclusion criteria were: duplicate articles, available in abstract form, which did not directly address the proposal studied and which did not meet the other inclusion criteria.

The review was carried out from June to September 2023, through searches in the databases Virtual Health Library (VHL), Latin American and Caribbean Literature in Health Sciences (LILACS), National Institutes of Health's Library of Medicine (PubMed) and Scientific Electronic Library Online (SciELO). The following descriptors were used: "ACL rupture", "ACL grafts", "ACL treatment", in order to find articles relevant to the topic covered. After the selection criteria, 5 articles remained that were subjected to thorough reading for data collection. The results were presented in a descriptive way, divided into thematic categories addressing: describing the subtitles or points that were mentioned in the discussion.

RESULTS AND DISCUSSION

Studies reported that football, team handball and other sporting activities were the main causes of injuries. The significant age in the included studies ranged from 23.4 to 31.7 years and there were no differences in age or sex distribution among the seven studies. Five studies used the Lachman test. Five studies reported complications. Four studies used the pivot shift test [24–27, 30] and four studies reported IKDC scores (ELVEOS MM. ET. AL 2018; ENGSTRON ET. AL 1993; GRØNTVEDT T, ENGEBRETSEN L 1995; PETERSON L. ET. AL 2020).

Five studies reported pivot shift test results. A total of 397 patients were included in both groups. In the Leeds-Keio graft subgroup, poor data showed that the BPTB group had a lower rate of positive pivot shift than the Leeds-Keio graft (OR=0.04; 95% CI 0.00, 0.31). However, in the subgroup of the poly (urethane urea) augmentation device (Artelon), the BPTB graft group showed no significant difference compared to the synthetic group (OR=1.05; 95% CI 0.51; 2.19). In the Kennedy ligament augmentation device subgroup, compared with BPTB grafts, artificial grafts had poor results (OR= 0.30; 95% CI 0.11, 0.82; p=0.02; I2=75 %). Likewise, BPTB grafts had better results than synthetic grafts (OR=0.47; 95% CI 0.28, 0.78; p=0.001, I2=77%). The test for differences between subgroups showed high heterogeneity (I2=0.81).

There were 215 patients who used patellar tendons and 192 patients who used synthetics. In the Leeds-Keio graft subgroup, poor data showed less Lachman test positivity in the BPTB group (OR=0.09; 95% CI 0.01; 0.76). Similarly, in the Kennedy ligament augmentation device subgroup, compared

to BPTB grafts, artificial grafts had worse outcomes (OR = 0.06; 95% CI 0.01, 0.42; p = 0.24; I2 = 28%). On the other hand, the poly (urea urethane) augmentation device (Artelon) showed no significant difference compared to the BPTB group (OR = 0.85; 95% CI 0.47, 1.54). Collectively, the 215 patients in the BPTB group showed a lower Lachman test positivity rate compared to the 192 patients in the synthetic graft group (OR = 0.49; 95% CI 0.29; 0.80; p = 0. 02; I2 = 71). The test for subgroup differences indicated the presence of heterogeneity (79.4%).

Four studies that included 342 patients (183 patients treated with patellar tendons and 159 patients treated with patellar tendons) reported instrumented laxity (>3 mm). In the Kennedy ligament augmentation device subgroup, data showed no significant difference between the BPTB group and the synthetic group (OR=0.52, 95% CI 0.24, 1.13; I2=71%). Similarly, the poly (urethane urea) augmentation device (Artelon) group showed no significant difference compared to the BPTB group (OR=1.01; 95% CI 0.53, 1.91). Collectively, the 183 patients in the BPTB group showed no significant difference compared to the 159 patients in the synthetic graft group (OR = 0.77; 95% CI 0.47, 1.26; p=0.02; I2=63%). The test for subgroup differences indicated the presence of heterogeneity (40.5%).

Three studies that included 292 patients (154 patients treated with patellar tendons and 138 patients treated with synthetics) reported IKDC grades. One study was excluded due to different types of data (NAU T. ET AL 2022). In the Leeds-Keio graft subgroup, data showed better IKDC scores in the BPTB group than in the synthetic graft group (OR=0.30; 95% CI 0.12; 0.78). In the poly (urethane urea) augmentation device (Artelon) subgroup, pooled data for artificial grafts showed no significant difference from those for BPTB grafts (OR = 0.53; 95% CI 0.28, 1.02). On the other hand, 176 patients in the BPTB group had better IKDC scores than 164 patients in the synthetic graft group (OR=0.44; 95% CI 0.26; 0.75; p=0.53; I2= 0). No heterogeneity for subgroup differences was found.

Five studies that included 380 patients (205 patients treated with patellar tendons and 1,175 patients treated with synthetics) reported complications. In the Leeds-Keio graft subgroup, three studies showed no significant difference between the two groups (OR=0.50; 95% CI 0.19; 1.33). Likewise, in the Ligament Advancement Reinforcement System (LARS) subgroup, the synthetic graft group showed no significant difference with the BPTB group (OR=1.50; 95% CI 0.12, 18.13). In the subgroup of the poly (urethane urea) augmentation device (Artelon), compared with BPTB grafts, artificial grafts had worse results (OR=0.49; 95% CI 0.28; 0.86). Collectively, 205 patients in the BPTB group had superior results compared to 175 patients in the synthetic graft group (OR = 0.49; 95% CI 0.28; 0.86; p = 0.61; I2 = 0%). No heterogeneity was found according to the test for subgroup differences.

In this review, the most important finding was that BPTB grafts were associated with better pivot shift results, Lachman test results and IKDC grades, and fewer complications than synthetic grafts.

In this study, we found that in the pivot test (OR=0.47; 95% CI 0.28; 0.78) and the Lachman test (OR=0.49; 95% CI 0.29; 0.80), BPTB grafts were associated with better outcomes than synthetic grafts. The Kennedy ligament augmentation device (Kennedy LAD) and Leeds-Keio grafts were also associated with worse outcomes on the pivot test and Lachman test, which is similar to the findings of a previous study (Jia et al. 2017). JIA ET AL (2017) showed that the Kennedy LAD and Leeds-Keio grafts had worse results

in terms of instrumented laxity, but our study found that there was no difference between the two groups (OR = 0.77; 95% CI 0.47, 1.26). This result may be due to the inclusion of the study with longer follow-up of the same patients. In contrast, Sun et al. found less laxity instrumented with a Ligament Augmentation and Reconstruction System (LARS). Scores from the IKDC, a widely used tool to assess knee function and pathology, were better for BPTB grafts than for previous generation synthetic grafts (OR = 0.30; 95% CI 0.12; 0,78), and this result was supported by Jia et al. After surgery, complications are a major problem that needs to be addressed. In this study, the Leeds-Keio graft (OR = 0.50; 95% CI 019, 1.33) and the Kennedy LAD subgroups (OR = 1.50, 95% CI 0.12, 18.13) showed no differences significant complications between the two groups. However, the overall results show that autogenous tendons remain the preferred option (OR=0.49; 95% CI 0.28, 0.86) due to the polyaugmentation device. No Sol et al. study, autografts had a higher rate of complications than LARSs, which may indicate an improvement in the new artificial ligaments compared to previous generation ligaments (SUN J ET AL 2020).

Artificial grafts became popular for ACL reconstruction in the 1980s. They provide greater strength and stability and decrease donor site morbidity and the risk of disease transmission. Second-generation artificial ligaments include longitudinal and transverse fibers to promote fibroblastic growth as scaffolds, but still cause wear and debris. A LARS is a non-absorbable polyethylene terephthalate graft. It is a third-generation synthetic ligament and attempts to provide a mesh for repair and avoid the complications of reactive synovitis (YAMAMOTO H ET AL 1992; VENTURA A ET AL 2010; TRIEB K. ET AL 2004). As one of the commonly used artificial ligaments, its clinical efficacy has been affirmed. A multicenter study reported by Gao et al. found that LARS used in the acute and chronic phases had good results with a low rate of complications. Bugelli et al. found that a total of 31.25% of the included patients were able to resume their lifestyle prior to the injury, and the subjective assessment showed good/excellent results (BUGELLI G ET AL 2018; CHEN T ET AL 2017). A 10-year longitudinal study reported that primary ACLR using synthetics yielded satisfactory results. In 2018, Parchi et al. found that for elderly patients, the use of a LARS ligament may be a safe and appropriate option and allow for rapid postoperative recovery. In 2019, it was reported that ACLR was associated with good knee function scores, a high rate of return to sport, and low re-rupture rates. Tsai et al. reported that knee stability improved immediately after ACLR with LARS. Su et al. reported no statistically significant differences between allografts, 4-strand hamstring tendon autografts, and LARSs in terms of clinical outcomes after ACLR (SU M ET AL 2021).

CONCLUSION

This review indicates that for adults BPTB (patellar tendon bone, bone) grafts are more favorable than synthetic grafts in ALCR in terms of knee stability, function and complication rates. The high-quality evidence of these results is similar to that in the previous version of this review, as no new randomized trials were performed. However, the conclusions of this review do not apply to older populations because no elderly people were included in these studies. For people with ACLR; For adults, BPTB grafts are associated with better knee function, degree of stability, and complications than the synthetic graft. For doctors; BPTB is still the "gold standard" for ACLR and provides better knee stability, function, and complication rates than synthetic grafts in adults. For policymakers;

BPTB is an effective autograft, compared to synthetics, for adults with ACLR. We found major limitations in the current evidence base. All of the randomized controlled trials we included only compared BPTB grafts with artificial ligaments, and only 1 to 3 studies were included for each type of artificial graft. It was difficult to thoroughly compare BPTB grafts with specific types of artificial ligaments. Most importantly, the average age of all patients included in the literature was less than 32 years, which made it impossible to evaluate the effectiveness of BPTB grafts and artificial ligaments in the elderly. Furthermore, comparison of the efficacy of other autogenous tendons or allogeneic tendons with artificial ligaments was not possible in the included studies. We suggest the following research guidelines to help future discussions in this area; Elderly patients undergoing ACLR and reconstruction of other knee joint ligaments need to be considered; Interventions need to consider other autologous tendons; Comparisons need to consider the latest generation of ligaments in the clinic; Outcomes must include subjective scores of function, quality of life, re-rupture, and return to activity or sport; Final follow-up time must be 2 years or more; Reporting of randomized trials must follow the Consolidated Standards of Reporting Trials (CONSORT) Guidelines.

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