Risk Factors for Anterior Cruciate Ligament Graft Failure in Elite Athletes: An Analysis of 342 Professional Athletes with a Mean Follow Up of 100 Months from the SANTI Study Group

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INTRODUCTION:

Anterior cruciate ligament (ACL) injuries are among the most common knee injuries sustained in elite sport and athletes generally undergo ACL reconstruction (ACLR) to facilitate their return to sport. Despite advances in ACL reconstruction surgical techniques, rehabilitation protocols and return-to-play criteria, ACL graft rupture is still a career-threatening event for elite athletes. There is a growing body of literature on lateral extra-articular procedures (LEAPs), in particular, the anterolateral ligament (ALL) of the knee. Clinical studies have demonstrated significant advantages of combining an ACLR with a LEAP including reducing ACL graft rupture rates, protecting medial meniscal repairs, and improving outcomes in high risk groups including chronic ACL injuries and patients with hyperlaxity.

Multiple studies have reported predictors for ACLR failure including age, activity level, graft size, graft choice, increased posterior tibial slope, and meniscal deficiency. However, no studies are specific to professional athletes and include the addition of a LEAP. The purpose of this study was to determine the risk factors for graft failure in professional athletes undergoing ACLR. It was hypothesized that athletes who underwent combined ACLR with a LEAP would experience significantly lower rates of graft rupture in comparison to those who underwent isolated ACLR.

METHODS:

Professional athletes who underwent primary ACLR with a minimum follow up of 2 years were identified from the SANTI database. Athletes who underwent primary ACLR using autograft by the senior author (BSC) between January 2003 and January 2020 with a minimum follow up of 2 years were considered for study inclusion. Patients were excluded if they underwent major concomitant procedures, including multiligament reconstruction surgery or osteotomy. Patient notes were reviewed to determine if they had sustained a further ipsilateral knee injury, contralateral knee injury, or had undergone any reoperations or complications after the index procedure. Return to play was determined by identifying if the athlete had played at least one match or participated in one event at the preinjury level or higher following ACLR. Key demographics and additional secondary surgery were also documented.

RESULTS:

A total of 420 professional athletes underwent ACLR during the study eligibility period. After application of the exclusion criteria, 342 athletes were identified as eligible for final inclusion with a mean follow up of 100.2 +/- 51.9 months (range, 24 - 215 months).

In total, 324/342 professional athletes returned to sport (94.7%). Thirty-one graft failures (9.1%) were reported, all requiring revision surgery due to symptomatic instability. The rate of graft failure was significantly higher when ACLR was not combined with a LEAP (15.5% vs. 6.0%, p = 0.0105) and in younger athletes (13.8% vs. 6.6%, p = 0.0290). (Figures 1 and 2).

A multivariate analysis was performed using the Cox model and demonstrated that athletes undergoing an isolated ACLR were at >2-fold risk of ACL graft rupture (Hazard Ratio (HR) = 2.678 (1.173;4.837), p = 0.0164) when compared to a combined ACLR with a LEAP. Additionally, athletes aged 21 or younger were also at >2-fold risk of graft failure (HR = 2.381 (1.313;5.463), p = 0.0068). Gender, sport, and graft type were not found to be significant risk factors.

Secondary surgery on the ipsilateral knee took place in 62 athletes (18.1%). Additionally, 42 athletes (13.2%) had a subsequent ACL rupture of the contralateral knee of which 30 patients (13.8%) had underwent combined ACLR and LEAP and 12 patients (12.0%) had underwent isolated ACLR.

DISCUSSION AND CONCLUSION:

The main finding of this study was that professional athletes who underwent isolated ACLR had a >2-fold higher graft failure rate than when ACLR was combined with a LEAP. Additionally, athletes aged 21 or younger also had a >2-fold higher graft failure rate when compared to older athletes. To the knowledge of the authors, this is the first study to specifically analyze risk factors for ACL graft failure in elite athletes of all sports including the addition of a LEAP.

Undeniably, there has been an increased incidence of ACLR combined with a LEAP, supported by the growing body of literature on the prevalence of injuries to the ALL and its role in rotational control of the knee.

Subsequent ACL rupture in the contralateral knee following the index surgery is as equally damaging as a graft failure in an athlete. The rate of subsequent contralateral knee injury was 13.2% in our cohort of professional athletes with no significant differences in athletes who underwent combined ACLR with a LEAP when compared to an isolated ACLR (13.8% vs. 12.0%). Comparing the contralateral rupture rate to the graft rupture rate gives us an understanding of the population being treated and is related to the type of sport and level of sport they are participating in. The 13.2% contralateral rupture rate following the index surgery in our study is similar to the graft rupture rate of 15.5% in the isolated

ACL group whereas the addition of a LEAP more than halved the graft rupture rate to 6% which is significantly better than the natural risk. It is therefore fundamental to compare the rate of graft rupture with the rate of contralateral rupture.
In conclusion, professional athletes undergoing isolated ACLR and aged 21 or younger are at >2-fold risk of graft failure. Orthopaedic surgeons treating elite athletes should combine an ACLR with a LEAP to improve ACL graft survivorship.