Original Research

Autograft Choice and Jumping Performance After Anterior Cruciate Ligament Reconstruction

A Comparative Study on Professional Athletes

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Background: The extensor apparatus of the knee is of paramount importance in generating the torque needed for a countermovement jump (CMJ), especially in jumping athletes. In anterior cruciate ligament reconstruction (ACLR) procedures, graft harvesting from the extensor apparatus may dramatically affect extensor strength and jumping performance.

Hypothesis: The focused jump training of professional jumping athletes would increase the likelihood of restoring jumping performance after ACLR, despite the graft choice (autologous bone-patellar tendon-bone [BPTB] or hamstring [HS] tendon).

Study Design: Cohort study; Level of evidence, 3.

Methods: A retrospective evaluation of prospectively collected data was carried out. Only professional athletes were included, and all surgical procedures were performed by a single experienced surgeon. Data collection considered the type of surgery, sports activity, and functional evaluation at 3 months after surgery. From the functional evaluation, data on single-leg hop (SLH) test, triple hop (TH) test, and CMJ were extracted. Limb symmetry index (LSI) for maximal voluntary isometric contraction of the quadriceps and for each of the jumping tests was calculated. Multiple analysis of covariance (ANCOVA) models were used to assess mean differences among groups for the LSI in CMJ, SLH, and TH and estimate the effect of confounders.

Results: From a subsequent series of 208 athletes, 44 professional athletes were included for data collection. Of these, 26 were male and 18 were female. A jumping sport (basketball, volleyball) was played by 17 athletes, while a running sport (soccer, judo, rugby, tennis, ski) was performed by 27 athletes. The mean time from injury to surgery was 17.8 ± 14.5 days. At 90 days from surgery, the overall mean LSI for CMJ was 85.3% ± 8.9%, for SLH was 92.2% ± 6.4%, and for TH was 90.8% ± 6.1%. When ANCOVA was fitted using the interaction term with BPTB autograft and jumping sport, a nonsignificant effect on LSI for CMJ (P = .56), SLH (P = .72), and TH (P = .98) was observed.

Conclusion: The results of the present investigation on professional athletes showed that no difference occurred within the study cohort in overall jumping performance between jumping and running athletes undergoing ACLR either with BPTB or with HS tendon grafts. Although some evidence suggests that quadriceps strength may be dramatically affected by the harvesting of BPTB, the overall performance of the jump was not compromised.

Keywords: knee; anterior cruciate ligament reconstruction; graft choice; jumping performance; professional athlete

Anterior cruciate ligament (ACL) reconstruction (ACLR) is the most common surgical procedure in the athletic population, aiming at restoring normal knee joint stability and limb biomechanics for a full return to sports activities.[18] The recovery of symmetrical quadriceps and hamstring (HS) strength is regarded as a key factor after ACLR. It has been hypothesized that the postoperative asymmetries in the extensor strength may contribute to the impairment of jumping performance,[23] although the individual landing strategy and psychological protective attitude on symmetrical loading may also play a relevant role in asymmetries in jumping tasks.[11,12] However, there

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is discordance regarding the effect of the graft (patellar tendon or quadruple-strand semitendinosus and gracilis) on the outcome of such tests.[15,22] Contrasting results have been reported in randomized studies comparing the 2 autografts at postoperative follow-up.[26,31,37] Great debate exists in the literature concerning the choice of the graft used for reconstruction, with guidelines and expert opinions evolving over the years, especially concerning selected populations of athletes involved in different sports activities.[23,24,27] In a specific jumping activity such as basketball or volleyball, some surgeons prefer to harvest HS tendons because the use of bone-patellar tendon-bone (BPTB) would impair the functional recovery of the extensor apparatus and the restoration of limb symmetry in extensor strength.[6,23,31] Jumping performance in athletes has been found to be affected by ACLR, depending on the graft choice, with a more relevant limb asymmetry of the extensor strength for up to 4 months after the surgery using BPTB; however, results were limited to hop tests and did not involve the countermovement jump (CMJ).[23]

The jump is considered a multifaceted task, involving both concentric and eccentric force generation in phases of propulsion and landing, allowing the simultaneous evaluation of different features of muscular power and strength. Agility and balance are 2 complementary abilities involved in landing and multiple jumping. Several tests involving jumping and/or landing ability that simulate athletic activities are useful in assessing agility, balance, and neuromuscular control for a thorough evaluation. Hop tests such as the single-leg hop (SLH) and the triple hop (TH) are often used in ACLR postoperative evaluation and are reliable in assessing the multifaceted features of jumping, including agility and balance.[2,9,38] However, the CMJ represents a complete evaluation of jumping performance, as this task allows the thorough and simultaneous assessment of strength, power, and concentric and eccentric force components.[13,23] It has been reported that the knee joint accounts for 33% to 49% of total positive work generated during a CMJ.[36] Thus, acknowledging the major role of the knee in jumping performance, the postoperative condition of the knee could be relevant to the interlimb symmetry of such tasks. Biomechanical studies have also suggested that the performance of the CMJ is mainly dependent on the magnitude and rate of development of muscular moments and power.[36] As extensor muscular strength is the most relevant feature that could be affected by autograft harvesting,[31] the CMJ should always be considered in a comprehensive assessment of jumping performance and can be affected by muscular condition at the site of harvesting.

Moreover, to the best of our knowledge, no previous studies have compared the 2 autografts on the jumping ability in a selected population of professional athletes involved in jumping tasks (volleyball, basketball) to investigate the role of the specific preinjury activity and training in influencing the postoperative ability to recover the jumping action. Because the jumping activity involves neuromuscular control, we hypothesized that the specific ability and the focused preinjury training of professional jumping athletes and their peculiar fitness increase the likelihood of restoring the jumping performance after ACLR, despite the graft choice (autologous BPTB or HS).

To confirm or reject this hypothesis, a comparative study involving jumping versus nonjumping professional athletes was set up and aimed to assess the following at a short follow-up duration: (1) differences in the postoperative limb symmetry index (LSI) of CMJ, SLH, and TH tasks among jumping and nonjumping athletes and (2) the specific effect of graft type and of extension strength on LSI in CMJ, SLH, and TH tasks.

METHODS

Ethical Considerations

The retrospective data collection for the present study was approved by the institutional review board of Villa Stuart Sport Clinic, Rome, Italy, and was carried out in accordance with the Declaration of Helsinki. All patients signed an informed consent to personal data handling for research purposes before undergoing surgical procedures.

Inclusion and Exclusion Criteria

Inclusion criteria were the following: professional athletes (8-10 on Tegner scale), both jumping and nonjumping; ACL reconstruction with BPTB or HS tendon autograft; age range of 16 to 40 years; complete functional evaluation including extension strength; CMJ at 90 and 180 days and SLH and TH performed at 180 days after surgery; and no prehabilitation program performed before surgery. No limitation was made for patients undergoing surgery for acute or chronic injury. Exclusion criteria were the following: ACL retear or revision surgery, concurrent bilateral ACL injury or contralateral ACL surgery, and presence of multiligament tears or associated lesions that required partial weightbearing for the first postoperative month.

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Ethical approval for this study was obtained from Casa di Cura Villa Stuart (Professionisti_OSS_2022).

Study Design and Setting

This study is a retrospective factorial analysis of patients who underwent ACLR at a single institution (Villa Stuart Sport Clinic FIFA Medical Centre of Excellence) between 2016 and 2021. First, from the entire cohort of eligible patients, a group of patients performing jumping sports was identified. A matched group (for age and Tegner level) was then included from those performing a nonjumping sport. Subgroups were identified based on the type of autograft used (patellar tendon or HS tendon). These categories (graft and jumping sport) were considered main factors of analysis.

Surgical Procedures

All procedures were performed by the same surgeon, with special expertise in arthroscopic knee surgery on professional athletes (P.P.M.). The central third of the patellar tendon with 2 bone blocks was harvested (diameter, 9-10 mm). The bone defects were bone grafted and the defect in the patellar tendon and paratenon was closed with 3 stitches of absorbable suture. The harvesting of HS tendon was carried out through an oblique incision over the pes anserinus, using a semicircular tendon stripper. The femoral tunnel was drilled using a transtibial technique in all cases. All grafts were fixed using a suspensory device at the femur and an absorbable interference screw at the tibia. For the rehabilitation, all the athletes were followed by the physical therapist of their team, under indications of the surgeon.

Outcome Measurements

All participants were evaluated at the same location by the same examiner (J.R.). Recorded data for each patient included demographic information such as age, sex, body weight, body mass index (BMI), time from the injury to the intervention, type of practiced sport, side of ACLR, and graft type. Limb dominance was determined by asking the participants with which limb they would prefer to kick a ball. The patients were divided into 2 groups, according to practiced sport: jumping (J group) and nonjumping (NJ group). Patients were evaluated 90 ± 5 days postoperatively. After 5 minutes of warming up and 2 minutes of stretching, patients were asked to perform maximal voluntary isometric contraction (MVIC) test for extensor strength, CMJ, SLH and TH. All tests were performed with adequate resting between tasks to minimize fatigue effects. For all tests, each leg was individually tested, and asymmetries were measured using the LSI, by applying the following formula:

$$\frac{Output_{\ operated\ limb}}{Output_{\ healthy\ limb}} \times 100$$

Maximal Voluntary Isometric Contraction

The patient was comfortably seated at a leg-extension machine (Technogym) and was instructed to try to extend the knee against a resistance locked with the knee at 30° of flexion.

After ≥1 practice trials, the patient was asked to perform the task, and MVICs were measured and registered. The patient was also instructed to stop the task for any complaint concerning pain or discomfort when performing contraction. Both legs were individually tested, with the noninjured test first and ACLR leg second.

SLH and TH Tests

The patient was instructed to stand on 1 leg with toes positioned on a mark on the floor and to perform 1 forward jump (for SLH test) or 3 forward jumps (for TH test), landing as far as possible on the same foot without balance adjustments or compensatory hops and maintaining position without losing balance. A new mark on the floor was made at the toe and heel where the participant landed. The distance in centimeters was measured from the toe in the starting position to the heel where the patient landed. For TH, the total distance spanned with 3 hops was measured and registered. After practicing the task 3 times, the patient was asked to perform the task and measures were registered. Both legs were individually tested, with the noninjured leg first and ACLR leg second.

CMJ Test

Patients were asked to stand upright with their hands at their waist, to avoid interference of the upper limbs. They were asked to rapidly flex on their knees as for a squat-loading movement and then jump to the maximal height with no interruption. Three CMJs were performed, alternating them with a 1-minute rest, and the best of the 3 was registered as the final output. Ground-reaction force (GRF; in newtons) was measured using two 6-component force platforms (100-Hz sampling frequency; model 9281 B; KISTLER), positioned below each foot. A raw GRF value for each limb was reported by the dedicated platform software, and LSI was calculated using the formula.

Data Extraction

Data from medical records of operated patients were collected by the authors after verifying the postoperative diagnosis and selection criteria. All data were pseudonymized and managed through Microsoft Excel (Microsoft Office for Mac, Version 2021; Microsoft Corp) and with STATA (Version 18 for Mac; Stata Corp).

Statistical Analysis

Descriptive statistics were used for participants' descriptive data. Summary statistics for continuous variables were reported as mean and standard deviation, for discrete variables as median and interquartile range, and dichotomous variables as raw frequency and rate. For continuous variables, the Shapiro-Wilk test and kernel density estimation were used to check normal distribution. Normally distributed variables were compared between groups using an unpaired Student *t* test. Nonnormally distributed and discrete variables were compared through the Wilcoxon Mann-Whitney *U* test. Multiple analysis of covariance (ANCOVA) models were used to analyze differences between group means, basing on confounders, using LSI in CMJ, SLH, and TH as dependent variables. An interaction term using graft and jumping sport as main factors was created and used as the main covariate. For a clearer description of results and to validate ANCOVA findings, an intergroup comparison was also performed using an unpaired Student *t* test, utilizing subgroups based on graft choice and type of sport. The sample size was considered appropriate, based on existing literature.[23] A post hoc power calculation was carried out considering the Cohen *d* for the CMJ LSI difference between graft groups: a power of 0.7 was obtained (Cohen $d = 0.76$; critical $T = 2$; $\alpha = .05$). The significance threshold was set at $P = .05$, as per convention. All statistical analyses were performed using STATA 17 (Version 17, Stata Corp., Texas, USA).

RESULTS

Study Population

Of 208 professional athletes who underwent ACLR between 2016 and 2021, 44 were included in this study, including 26 male and 18 female athletes. A flow diagram for patient selection process is shown in Figure 1. This population included 17 (38.6%) athletes in the J group (volleyball, n = 9; beach volleyball, n = 2; basketball, n = 6) and 27 (61.4%) in the NJ group (football, n = 20; rugby, n = 3; judo, n = 1; tennis, n = 1; gymnastics, n = 1; ski, n = 1). Nineteen (43.2%) participants had left-leg surgery, and 25 (56.8%) had right-leg surgery. BPTB graft was used in 28 (63.3%) athletes and HS tendon graft in 16 (36.4%). Patients were divided based on the practiced sport (J or NJ group), and BMI and age were compared to verify the homogeneity of the subgroups. The mean time from injury to surgery was 17.8 ± 14.5 days. Demographic data are summarized in Table 1.

Functional Performance

Differences between the operated and the healthy limb for extensor strength, CMJ, SLH, and TH were evaluated. The LSI for MVIC after surgery showed no significant difference between groups, as did LSI for CMJ, SLH, and TH (Table 2).

Effect of Confounders on Functional Performance

ANCOVA models were fit to investigate the effect of graft choice (BPTB or HS) on the LSI for CMJ, SLH, and TH in both sports groups. Multiple confounders were introduced in the model to check for the effect of descriptive variables: LSI for MVIC, sex, BMI, and acute or nonacute

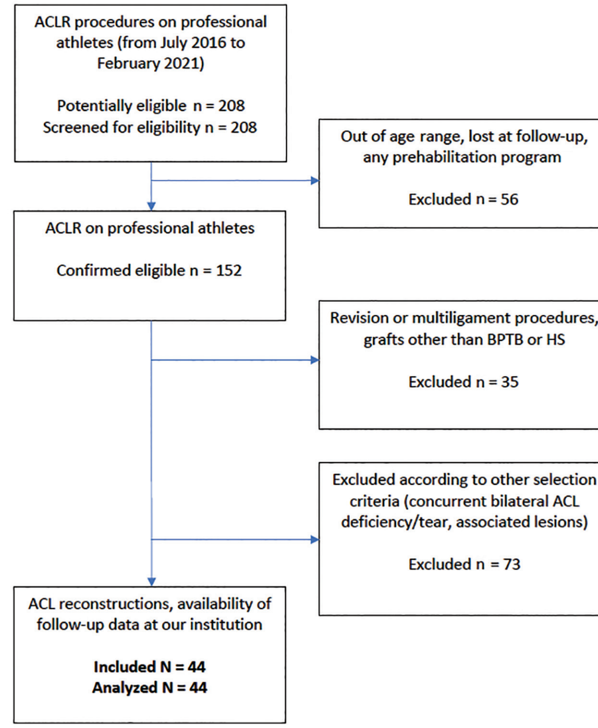

Figure 1. Flow diagram for the study population selection process. ACL, anterior cruciate ligament; ACLR, ACL reconstruction; BPTB, bone–patellar tendon–bone; HS, hamstring.

surgery (15-day cutoff). No factor was found to have a statistically significant effect on the difference in LSI between the J and NJ groups in determining LSI for CMJ. The interaction term between BPTB autograft and jumping sport had a nonsignificant effect on LSI for CMJ ($P = .56$). Similarly, LSI for SLH and TH tests was found to be independent of all factors, including the interaction between BPTB autograft and jumping sport (SLH, $P = .72$; TH, $P = .98$). Effects of confounding factors on jumping tasks are summarized in Table 3. To further clarify our results, subgroup individual comparisons have been summarized in Tables 4 and 5.

DISCUSSION

Results of our investigation showed that the LSI for isometric extensor muscular strength and for jumping performance (CMJ, SLH, and TH) after surgery did not significantly differ between jumping and nonjumping athletes, without any interaction or effect from graft (BPTB vs HS). It has been reported that ACLR using the BPTB graft leads to a knee extensor strength inferior to ACLR using HS, for as long as 6 to 9 months.[8,21] Extensor strength deficit is linked to altered jumping performance, especially in the first postoperative months.[23] Therefore, it would be reasonable to prefer HS tendon graft in athletes involved in jumping sports. However, outcomes from this study showed that the jumping performance was comparable

TABLE 1
Summary Statistics[a]

	J Group	NJ Group	P^b
Sex, M/F	3/14	23/4	<.001
Age, y	23.6 ± 5.9	23.5 ± 4.9	.93
BMI	22.8 ± 2.4	23.7 ± 3.4	.35
Operated side, R/L	6/11	19/8	.02
Graft, BPTB/HS	9/8	19/8	.25
Time from injury to surgery, acute/nonacute	16/1	20/7	.10

[a]Values are presented as mean ± SD or No.; BMI, body mass index; BPTB, bone–patellar tendon–bone; F, female; HS, hamstring; J, jumping; L, left; M, male; NJ, nonjumping; R, right.
[b]Pretest intergroup comparison for homogeneity.

TABLE 2
Functional Evaluation (Limb Symmetry Index)[a]

	Overall	J Group	NJ Group	P^b
MVIC, %	83.8 ± 17.3	84.1 ± 26.3	83.6 ± 12.2	.95
CMJ, %	85.3 ± 8.9	85.2 ± 11.4	85.4 ± 7.9	.94
SLH, %	92.2 ± 6.4	94.1 ± 6.9	91.6 ± 6.4	.51
TH, %	90.8 ± 6.1	91.8 ± 5.5	90.5 ± 6.7	.77

[a]Values are presented as mean ± SD. CMJ, countermovement jump; J, jumping; MVIC, maximal voluntary isometric contraction; NJ, nonjumping; SLH, single-leg hop; TH, triple hop.
[b]Unpaired Student t test.

TABLE 3
Effects of Graft and Other Confounders on Jumping Task Difference (LSI)[a]

	CMJ		SLH		TH	
	R^2 = 0.14		R^2 = 0.55		R^2 = 0.56	
Variable	F^b	P^b	F	P	F	P
Jumping sport	<0.01	.94	1.55	.25	1.0	.37
BPTB	1.12	.30	4.16	.08	0.56	.50
Jumping sport and BPTB[c]	0.29	.60	0.14	.72	0.01	.98
MVIC (LSI)	0.29	.59	0.22	.65	1.18	.34
Age	0.03	.87	0.26	.63	0.52	.51
Male sex	0.08	.78	3.71	.09	–	–
BMI	0.02	.89	0.02	.89	2.48	.19
Early ACLR	1.24	.28	4.82	.06	0.02	.89
Overall regression model	0.4	.91	1.21	.40	0.86	.59

[a]ACLR, anterior cruciate ligament reconstruction; BMI, body mass index; BPTB, bone–patellar tendon–bone; CMJ, countermovement jump; LSI, limb symmetry index; MVIC, maximal voluntary isometric contraction; SLH, single-leg hop; TH, triple hop.
[b]Multiple analysis of covariance models using the index hop test as dependent variable. Dashes in table cells indicate missing values, due to small subgroups for which model could not return coefficient.
[c]Interaction term.

between jumping and nonjumping athletes, and not influenced by the graft, in patients who underwent ACLR with BPTB. Our outcomes partially differ from those in the currently available literature. It is well known that the initial knee extensor strength deficit in patients who underwent ACLR with BPTB compared with HS usually resolves by the first postoperative year.[8,10,21] Recent studies by Costley et al[5] and by Miles et al[23] investigating the

TABLE 4
Intergroup Comparison of Functional Performance: Jumping Sport Then Graft (LSI)[a]

	J			NJ		
	BPTB	HS	P^b	BPTB	HS	P^b
MVIC, %	84.3 ± 36.7	83.9 ± 14.3	.98	82.4 ± 11.6	89.2 ± 14.7	.33
CMJ, %	80.7 ± 9	88.8 ± 12.8	.33	85.2 ± 8.1	87.7 ± 7.9	.68
SLH, %	90.1 ± 9.5	97.3 ± 3.8	.47	n.a.	n.a.	–
TH, %	n.a.	n.a.	–	n.a.	n.a.	–

[a]Values are presented as mean ± SD. BPTB, bone–patellar tendon–bone; CMJ, countermovement jump; HS, hamstring; J, jumping; LSI, limb symmetry index; MVIC, maximal voluntary isometric contraction; n.a., not available, subgroup too small to achieve comparison (dashes in table cells indicate p values not available); NJ, nonjumping; SLH, single-leg hop; TH, triple hop.
[b]Unpaired Student *t* test.

TABLE 5
Intergroup Comparison of Functional Performance: Graft Then Jumping Sport (LSI)[a]

	BPTB			HS		
	J	NJ	P^b	J	NJ	P^b
MVIC, %	84.3 ± 6.7	82.4 ± 11.6	.85	84 ± 14.3	89.2 ± 14.8	.61
CMJ, %	80.7 ± 9.1	85.2 ± 8.1	.34	88.8 ± 12.8	87.7 ± 7.9	.92
SLH, %	90.9 ± 9.5	91.8 ± 6.6	.87	n.a.	n.a.	–
TH, %	88.8 ± 2.7	90.5 ± 6.6	.75	n.a.	n.a.	–

[a]Values are presented as mean ± SD. BPTB, bone–patellar tendon–bone; CMJ, countermovement jump; HS, hamstring; J, jumping; LSI, limb symmetry index; MVIC, maximal voluntary isometric contraction; n.a., not available, subgroup too small to achieve comparison (dashes in table cells indicate p values not available); NJ, nonjumping; SLH, single-leg hop; TH, triple hop.
[b]Unpaired Student *t* test.

vertical jump performance after ACLR showed that athletes with BPTB demonstrated greater impulse asymmetries than athletes with HS specifically during the eccentric[5,23] and concentric[23] phases of the CMJ. In the current study, phase-specific impulses from CMJ were not analyzed; therefore, this difference in the methodology precludes direct comparisons. Nevertheless, there are 2 main explanations for the different outcomes between those 2 studies and ours. First, contrary to our study, authors from both studies reported that the BPTB cohort demonstrated a greater knee extensor strength asymmetry than the HS cohort at the time of jumping performance testing. This could have negatively influenced the CMJ performance in patients with BPTB. In addition, our cohort was composed exclusively of professional athletes, involved either in jumping or nonjumping sports. On the contrary, Costley et al included amateur athletes and Miles et al included multidirectional field sport athletes without specifying the level of activity. It is our opinion that the specific training (in jumping sports) and the professional level of activity to which patients were exposed before the injury could have had a strong influence in promoting a prompt recovery in terms of muscular strength and in terms of performance. Central and peripheral neural changes and muscular morphological and functional alterations arise rapidly after an ACL tear and can persist even at the time of return to sports.[32] However, there is increasing evidence showing that postoperative recovery is influenced by the preoperative neuromuscular status,[32] and many studies have confirmed that preoperative muscular condition influences the postoperative muscle recovery.[7,14,16,20,28,29,33,35] As none of the patients included had performed a dedicated prehabilitation protocol, sport-specific training was the only muscular conditioning considered. Based on this evidence, we can speculate that 2 features of our patient population composed exclusively of professional athletes contributed to our peculiar outcomes: preoperative high-level physical condition given by intense and sport-specific training and a short injury-to-surgery interval, with a high percentage (82%) of patients undergoing early ACLR.

We found a higher LSI in both groups (jumping and nonjumping) in SLH and TH tests (mean, >90% for both tests) compared with CMJ and MVIC (mean, <90%), but this can be expected given that interlimb symmetry in hop distance is achieved more rapidly than in isometric extension strength.[1,25] This is in line with the current available literature; in fact, it is well-reported that quadriceps weakness can persist for a long time after surgery[4] while having achieved symmetry in jumping test performance.[25] These findings suggest reconsidering the return-to-sports criteria and avoiding relying solely on hop test performance.[17] The higher chance of achieving limb symmetry in hop tests can be explained by 2 factors. First, patients who underwent ACLR compensated for their quadriceps weakness with greater hip extensor strength during the propulsion phase.[3,34] Second, the symmetry can be masked by the recently proposed "crossover" phenomena, by which neural and peripheral deficits are transferred to the uninjured limb, affecting its strength and functional performance and attenuating interlimb differences.[5,19]

Moreover, it was noticeable that, independently from the sports group and other covariates, a higher LSI for SLH was found to be associated with BPTB graft, though at limits for statistical significance ($F = 5.04$; $P = .05$, see Table 3). It has been demonstrated that the knee accounts only for the 12% of the total lower limb work in the concentric (propulsive) phase of a horizontal hop (against 30% to 50% of contribution in CMJ).[36] Analyzing the propulsion phase of a horizontal jump, the hip and the ankle are more involved than the knee, and there is a higher contribution of the lateral HS and of the soleus muscles in patients with ACLR versus healthy controls.[17] Considering patients who underwent ACLR with BPTB show only knee extension impairments compared with patients with HS who show both knee extension and knee flexion strength impairment,[30] it can be expected that patients with BPTB can perform better in horizontal jumps with superior interlimb symmetry compared with patients with HS.

Clinical relevance of the present outcomes should be found in the decision-making process when choosing the best graft for a professional athlete. As results showed, no relevant impact of BPTB harvesting was detected on the overall jumping performance, assessed before clearance for RTP, especially for jumping-trained athletes.

Limitations and Strengths

There are limitations in this study that should be considered. First, MVIC and hop tests were performed at a very early postoperative time point (3 months). This is due to the difficulties of following up with professional athletes for a longer time and because our population comes from different countries, thus generally dropping out from follow-up after that time point. In addition, concerning the CMJ test, a phase-specific analysis of impulses from CMJ was not performed, limiting direct comparison with the most recent studies reporting on the same subject. Moreover, the lack of a known effect size for jumping assessment in professional athletes prevented the prospective calculation of an appropriate sample size. However, these data may be of help in defining an effect size to be used in future research on the topic, including larger cohorts. Last, there was the retrospective nature and the lack of a control group of healthy athletes for comparison.

However, there are also strengths: the patient population, based on homogeneous professional athletes and the multivariate ANCOVA to assess for influences from multiple variables on outcomes.

CONCLUSION

The preliminary findings of the current study showed a similar postoperative recovery of the overall jumping performance in the study cohort, independently from graft choice and type of sport activity. Therefore, BPTB autograft may be considered for ACLR also in jumping athletes, without the risk of inferior outcomes compared with HS. Further prospective studies with longer follow-up will be useful in validating these findings in a larger population of athletes.

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