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2	Title Page
3	
4	The effect of meniscal pathology and management with ACL reconstruction on patient-
5	reported outcomes, strength, and jump performance ten months post-surgery
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17	Running Title: Meniscal intervention with ACLR
18	

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35	The effect of meniscal pathology and management with ACL reconstruction on patient-
36	reported outcomes, strength, and jump performance ten months post-surgery
37	
38	Laura Byrne ¹ , Enda King PT, PHD, ^{1, 2} , Ciaran Mc Fadden ^{1, 2} , Mark Jackson ¹ , Ray Moran ¹ ,
39	Katherine Daniels PHD ^{1, 3, 4}
40	
41	Background
42	The purpose of this study was to examine the differences in patient-reported outcome
43	measures, isokinetic strength, plyometric ability and ability to meet return to play criteria ten
44	months after anterior cruciate ligament (ACL) reconstruction surgery between those who
45	underwent meniscectomy, those who underwent meniscal repair and those with no meniscal
46	intervention alongside ACL reconstruction surgery.
47	
48	Methods
49	Three hundred and thirteen athletes with clinically and radiologically confirmed ACL
50	ruptures were included in this study. Participants were grouped according to their intra-
51	operative procedures (isolated ACL reconstruction surgery n=155, ACL reconstruction
52	surgery with meniscectomy n=128, ACL reconstruction surgery with meniscal repair n=30).
53	Participants completed patient-reported outcome measures questionnaires (Marx Activity
54	Rating Scale, the ACL Return to Sport after Injury and the International Knee Documentation
55	Committee Score) and completed a battery of objective functional testing including isokinetic

- 56 dynamometry and jump performance testing (countermovement jump and drop jump)
- 57 between 9 and 11 months after surgery.

- 60 No significant between-group differences were identified in any metric relating to patient-
- for reported outcome measures (p = .611), strength and jump measures (p = .411) or the ability to
- 62 achieve symmetry-based return to play criteria (p = .575).

63

64	Conclusions

- 65 Clinically, these results suggest that concomitant meniscal surgery has no significant effects
- on patient-reported outcome measures, strength and jump metrics at the return to play stage
- 67 post-operatively and can inform the pre-operative counselling of those awaiting ACL
- 68 reconstruction surgery with likely meniscal intervention.

69

- 70 Keywords: Anterior Cruciate Ligament, Anterior Cruciate Ligament Reconstruction,
- 71 Isokinetic Dynamometry, Countermovement Jump, Return to Play

72

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76 <u>1.1 Introduction</u>

77 Anterior cruciate ligament (ACL) injury is the most common orthopaedic knee ligament injury and primarily affects young, active individuals [1]. ACL tears can result in impaired 78 79 function of the knee and affect quality of life [2] and surgical ACL reconstruction (ACLR) is commonly used to restore stability to the knee [2-4]. ACL injuries usually occur during 80 activities that involve pivoting, twisting and multidirectional movement [1] and can occur 81 82 with concomitant damage to other structures of the knee [5, 6], most frequently the menisci [6-8]. The role of the menisci is to distribute load and to protect the articular cartilage from 83 excessive axial, rotational and shearing forces [9, 10]. Injured menisci can be either left in 84 situ, partially or wholly resected (meniscectomy) or repaired using sutures [11]. Management 85 of concomitant meniscal injuries varies depending on the type and location of the injury [11, 86 12]. Increased efforts are being made to repair menisci where appropriate, in light of the 87 increased risk of knee osteoarthritis (OA) following meniscectomy [13-15]. However, 88 meniscectomy is still 2-3 times more prevalent than meniscal repair [16]. 89

90

Given how commonly meniscal injury occurs alongside ACL rupture [6] it is important to 91 92 understand the impact meniscal intervention has on outcomes after ACL reconstruction and the ability of participants to return to sport. Long-term investigations have demonstrated a 93 94 significantly increased risk of OA in patients after meniscectomy and partial meniscectomy 95 relative to those who have not undergone meniscal intervention [13, 15]. Outcomes after meniscal repair yield high success rates in both adults and adolescents, making it an attractive 96 97 option to protect the long-term health of the knee [15, 17, 18]. However the decision to perform a meniscal repair is influenced by many factors [19] and post-operative 98 99 rehabilitation protocols vary in relation to restricted range of motion through bracing and

100	restricted weightbearing [20, 21]. The long-term impact of meniscal intervention alongside
101	ACLR is well investigated with respect to osteoarthritis, however the effect on the patients'
102	short term outcomes and ability to meet a return to play criteria is unclear.

104 Return to play after ACL reconstruction is a decision made by various stakeholders in the 105 management of an athlete after ACLR. At present, the best evidence suggests that achieving 106 >90% symmetry in quadriceps and hamstring strength, >90% symmetry in plyometric ability 107 alongside optimising neuromuscular function before returning to play, combined with increased time from surgery reduces risk of further knee injury [22-24]. Isokinetic 108 109 dynamometry has been shown to be a reliable and valid measure of quadriceps and hamstring strength [25] and has been previously reported in a post-ACLR population to measure the 110 recovery of strength in the ACLR limb and quantify between-limb asymmetries [4, 26]. Jump 111 112 testing, for example, countermovement jump (CMJ) and drop jump (DJ) testing are important measures of reactive and explosive strength [27], both of which are qualities needed for 113 multidirectional sports [28, 29]. In addition to this, previous research in patients after ACLR 114 115 demonstrate biomechanical differences in how jumping tasks are executed alongside performance asymmetries between limbs on single leg jumping tasks [24, 30]. The single-leg 116 CMJ has been identified as the most sensitive and valid jump test for assessing restoration of 117 normal function after ACLR [30]. 118

119

Previous research has yielded mixed results with respect to how these measures are affected
by meniscal intervention. Patient-reported outcome measures (PROMs) are an important tool
in monitoring the progress of rehabilitation and readiness to return to play. When comparing

short term subjective findings after isolated ACLR, ACLR with partial meniscectomy and 123 ACLR with meniscal repair, studies have shown equivocal subjective results at 2 years for 124 125 meniscectomy with ACLR and isolated ACLR [31]. However, patients who underwent meniscal repair with ACLR demonstrated poorer short term results when compared to ACLR 126 with meniscectomy and isolated ACLR in relation to subscales of the Knee Injury and 127 Osteoarthritis Outcomes Score (KOOS) across a range of timescales from 6 months to 2 years 128 129 [31-33]. Functional tests including isokinetic dynamometry, isometric strength and hopping tasks have demonstrated no significant differences between patients after isolated ACLR, 130 131 ACLR with meniscectomy and ACLR with meniscal repair across timescales of 6 months to 2 years though methods have been heterogenous [4, 26, 34]. 132

133

Findings to date have thus provided mixed conclusions on how PROMs, strength and 134 135 functional testing is affected by meniscal pathology in the short term, and there are no studies incorporating a testing battery that assesses all of the qualities needed to return to playing a 136 multidirectional sport at a return to play stage. Results from previous studies are also difficult 137 138 to compare due to the variety of methodologies, time-points and metrics used. It is therefore unclear how meniscal intervention affects rehabilitation post ACLR and whether it hinders 139 the athlete's ability to meet return to play criteria. This information is important for clinicians 140 and patients alike, enabling clinicians to provide informed education on the expected short-141 term prognosis of the various meniscal procedures, particularly for athletes aiming to return 142 143 to sport, and allowing for accurate expectation management post-operatively. A combination of the above measures would assess the fundamental subjective qualities, objective qualities 144 and functional outcomes needed to return to play, reducing the risk of further knee injury [22-145 24], so a testing battery that incorporates all of these measures and provides a comparison 146

147 across those who underwent an isolated ACLR, ACLR with meniscectomy and ACLR with148 meniscal repair is needed.

149

150	The aim of this study was to investigate PROMs, isokinetic strength, plyometric ability and
151	the ability to meet return to play criteria 9-11 months after surgery across patients who
152	underwent meniscectomy, meniscal repair and no meniscal intervention at the time of ACLR.
153	We hypothesised that subjective and objective outcomes would be lower among those who
154	underwent ACLR with meniscal repair compared to those who underwent ACLR with
155	meniscectomy or an isolated ACLR.
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157

158 **<u>1.2 Methods</u>**

159 **1.2.1 Participants**

160 This study was a level II cohort study involving 313 participants from a single institution.

161 ACL injury was confirmed clinically and on MRI at the Sports Surgery Clinic, Dublin,

162 Ireland. Participants included were male, multidirectional athletes between the ages of 16-35

163 years undergoing primary ACL reconstruction with a bone-patella tendon-bone autograft.

164 Multi-directional sports require frequent and consistent sagittal plane movement and running

- as well as lateral shuffling, cutting and jumping [11]. The primary sports included in this
- study were Gaelic football (52%), soccer (18%), hurling (16%) and rugby (14%).

Participants were only eligible for to participate in this study if they underwent testing 9-11
months after ACLR as part of a standardised return to play assessment protocol.

169

Surgery was carried out using arthroscopic and surgical techniques: bone–patellar tendon–
bone (BPTB) autografts, with graft and tunnel placement within anatomic footprints and with
graft selection guided by case history and surgeon preference. Allograft-based surgical
reconstructions were not included in this study. BPTB grafts were secured with metal
interference screws (Softsilk; Smith & Nephew). Routine arthroscopy was performed and coexisting pathology and managed at the discretion of the surgeon. All intraoperative data were
recorded at the time of surgery in an ACL registry.

177

178 Exclusion criteria were revision ACL surgery and multi ligament reconstruction. Participants undergoing partial meniscectomy or repair of both compartments were included and were 179 placed in the appropriate meniscectomy and repair groups .Those who underwent a 180 meniscectomy in one compartment of the knee but also underwent meniscal repair in the 181 other compartment (n=2) were also excluded from the study. Participants were divided into 3 182 groups: ACLR with meniscal repair (n=30), ACLR with partial meniscectomy (n=128) and a 183 control group who had an isolated ACLR (n=155). A breakdown of the meniscal tears in the 184 meniscectomy and meniscal repair groups is provided. (Table 1). The control group also 185 186 included those with meniscal tears that were deemed stable by the surgeon and left in situ (medial meniscal tears left in situ n=26, lateral meniscus tears left in situ n=43). 187

Post-operatively, participants were given two elbow crutches, advised to weight bear astolerated for two weeks, and provided with rehabilitation guidelines. Given the geographical

- spread of participants, rehabilitation was led by local clinicians and therapists in the majority
- 191 of cases. Informed written consent was obtained prior to study enrolment. Ethical approval
- 192 was granted by the hospital ethics committee and this trial was registered with
- 193 <u>https://clinicaltrials.gov/</u> (NCT02771548).
- 194 *Table 1. Breakdown of meniscal injuries into meniscectomy and repair groups*

	Meniscectomy	Meniscal repair
Management of medial and	16 medial	16 medial
lateral meniscal tears	114 lateral	17 lateral
Location of tear	64 posterior	26 posterior
	62 middle	6 middle
	9 anterior	2 anterior
Type of tear	64 cleavage tears	26 cleavage tears
	62 beak tears	6 beak tears
	9 bucket tears	2 bucket tears

196

197 **1.2.2 Testing procedures**

198 Testing took place 9-11 months after ACLR surgery. Prior to all testing, participants

199 completed a standardised warm up consisting of a two-minute jog, five bodyweight squats

and five double-legged countermovement jumps. Exercise familiarisation was then completed

201 prior to data collection for each movement task, in the form of two submaximal repetitions.

202 The testing protocol comprised single-leg counter-movement jumps (SLCMJ), followed by

single leg drop jumps (SLDJ) from a 20cm box. During SLCMJ testing, patients were asked

to keep their hands on their iliac crests and jump as high as they could, with the knees fully-

205 extended during the flight phase. During SLDJ testing, participants were instructed to drop

off the box and jump as high in the air as possible whilst also minimizing ground contact

time, keeping their hands on their iliac crests. Three valid (apparent maximal effort and full 207 foot contact on force plate) attempts were recorded from each leg. The non-operated side was 208 tested first for each task. Participants then completed additional jumping and change of 209 direction exercises as part of a clinical assessment and broader study [24, 36]. Prior to testing, 210 retroreflective markers (14 mm diameter) were placed at bony landmarks on the lower limbs, 211 pelvis, and trunk as per a modified Vicon Plug-in-Gait (Vicon Motion Systems, Oxon, UK) 212 213 marker set [37]. Data were recorded with an 8-camera motion analysis system (Bonita-B10; Vicon Motion Systems) at 200 Hz synchronized (Vicon Nexus 1.8) with two force platforms 214 215 (BP400600; AMTI, MA, USA) sampling at a frequency of 1000 Hz.

216

Participants then completed isokinetic dynamometry knee strength testing (Cybex NORM, 217 Computer Sports Medicine Inc., MA, USA). This consisted of concentric knee extension and 218 flexion torque, assessed at an angular velocity of 60°/s through the range 0-100 degrees knee 219 flexion. Participants completed a total of 3 sets of 5 repetitions of knee flexion and extension. 220 The first set was used as a warmup of increasing effort from 60-90%, finishing with 1 attempt 221 222 at maximal effort. Participants then completed 2 sets of maximal flexion and extension repetitions with a 60-second rest period between each set. The non-operated limb was tested 223 first. 224

225

Three validated PROM questionnaires, completed on the same day as the physical testing,
were used to assess subjective knee function. The measures chosen were the Marx Activity
Rating Scale, the Anterior Cruciate Ligament Return to Sport after Injury (ACL-RSI) and the
International Knee Documentation Committee Score (IKDC).

231 **1.2.3 Data processing**

Marker trajectory and ground reaction force (GRF) data were filtered using a low-pass 232 fourth-order zero-lag Butterworth filter with a cut-off frequency of 15 Hz [38]. The position 233 234 of the centre of mass (COM) was calculated on a frame-by-frame basis from segment 235 kinematics and anthropometric properties (Vicon Nexus 2.7) Jump height was calculated from the vertical displacement of the COM from the instant of take-off to its maximum 236 237 height during the flight phase. Contact time was calculated using a GRF threshold of 20 N. For the two jumping tasks, the mean of the three collected trials on each leg was used for 238 further analysis. The isokinetic dynamometry set with the highest gravity-corrected knee 239 extensor peak torque and coefficient of variation <0.1 was selected for analysis [39]. Peak 240 torques relative to body mass during knee extension and flexion were extracted from this set. 241

242

The Limb Symmetry Index (LSI) was used to quantify symmetry between the operated and non-operated limb for all analysed variables. LSI was calculated by taking the test score of the operated limb, dividing by the non-operated limb, and multiplying by 100 to obtain a percentage difference between limbs:

247

248
$$LSI = \frac{Operated \ limb}{Nonoperated \ limb} \times 100$$

249

251 **1.2.4 Statistical Analysis**

All statistical analyses were performed using JASP version 0.12.2 for Windows. Descriptive 252 statistics are reported as mean +/- standard deviation. No significant between group 253 254 differences were seen in age (p = .623), bodyweight (p = .188) and time from surgery to testing (p = .067). One-way ANOVA was used to identify between-group differences in 255 isokinetic strength metrics and jump performance metrics. Between-group differences in 256 257 PROMS were analysed using the Kruskal-Wallis test due to the non-parametric nature of the data. Both LSI and results from the operated limb were analysed. Significance was accepted 258 at $\alpha = 0.05$ and effect size was calculated as eta-squared. Results were interpreted using the 259 following thresholds: ES > 0.1 = small; ES > 0.25 = moderate; ES > 0.37 = large [40, 41]. 260 Chi-squared goodness of fit testing was used to identify the proportion of each group that met 261 the overall return to play criteria to ascertain whether meniscal intervention influenced the 262 participants' ability to meet these criteria. Return to play criteria were defined as >90% inter-263 limb symmetry in objective measures (Grindem et al., 2016): knee extensor peak torque, knee 264 flexor peak torque, SLCMJ height, and SLDJ height and SLDJ contact time. This was also 265 266 broken down to assess whether meniscal intervention influenced the participants' ability to meet return to play criteria in strength and jump performance outcome measures separately. 267 268 To determine the magnitude of difference between each individual meniscal intervention group and the control group, and between meniscal intervention groups, effect size (ES) was 269 calculated using Cohen's d. The results were interpreted using the following thresholds: ES >270 .1 = trivial ES > 0.2 = small; ES > 0.5 = moderate; ES > 0.8 = large [42].271

272

274 <u>**1.3 Results</u>**</u>

There were no significant between-group differences in age, body mass or time from surgery

to testing (Table 2).

Table 2. Descriptive statistics-mean, standard deviation

Group	Ν	Age (years)	Body Mass	Time from	
			(kg)	surgery to	
				testing (weeks)	
Control	155	23.33 +/- 5.0	81.41 +/- 9.5	43.15 +/- 2.3	
Meniscectomy	128	22 +/- 5.4	82.71 +/- 12.6	42.65 +/- 2.3	
Repair	30	23.75 +/- 5.6	85.1 +/- 9.3	42.28 +/- 2.6	

2	o	1
2	0	т

- 283 There were no statistically significant between-group differences were identified for any
- 284 PROM, strength or jump performance outcome metric (Table 3).

	Control	Meniscectomy	Repair	р	n ²
	Median (IQR)	Median (IQR)	Median (IQR)		
MARX SCORE	12.00 (4.00)	12.00 (3.00)	12.00 (2.00)	.181	.011
IKDC SCORE	85.42 (10.42)	85.42 (12.50)	84.38 (13.80)	.749	.002
ACL RSI	75.38 (24.17)	80.00 (25.00)	82.50 (19.38)	.310	.008

290 Table 4. Strength and jump performance metrics

Control	Meniscectomy	Repair	р	n ²
Mean	Mean (SD)	Mean		
(SD)		(SD)		

EXTENSOR LSI	83.5	82.6 (13.6)	85	.691	.002
	(14.6)		(14.3)		
FLEXOR LSI	100.2	97.6 (15.1)	98.2	.271	.008
	(13.08)		(11.4)		
SLCMJ LSI	85.9	85.1 (11.3)	84.5	.810	.001
	(16.2)		(10.9)		
SLDJ JH LSI	79.7	80.6 (14.3)	77.8	.708	.002
	(19.3)		(12.7)		
SLDJ CT LSI	105.2	106.6 (12.5)	107 (.4)	.576	.004
	(13.2)				
EXTENSOR	186.5	179.8 (38.1)	188.3	.269	.008
STRENGTH	(39.1)		(32.3)		
OPERATED SIDE					
FLEXORSTRENGTH	128.2	125.4 (27.5)	128.7	.612	.003
OPERATED SIDE	(24.8)		(21.4)		
SLCMJ OPERATED	12.3	12.5 (3)	12.3	.780	.002
SIDE	(3.2)		(2.5)		
SLDJ JH OPERATED	11.3	12 (3.2)	11.6	.276	.008
SIDE	(3.3)		(2.5)		
SLDJ CT	.38 (.11)	.37 (.09)	.39 (.1)	.465	.005
OPERATED SIDE					

SLCMJ LSI-Single leg countermovement jump limb symmetry index, SLDJ JH LSI-Single
leg drop jump jump height limb symmetry index, SLDJ CT LSI-Single leg drop jump contact
time limb symmetry index

297

298 1.3.1 Return to play criteria

Of the 313 participants in the study, 3% of participants achieved >90% symmetry in all metrics tested, therefore meeting the return to play criteria, 27% achieved >90% symmetry in all isokinetic strength metrics and 10% achieved >90% symmetry in jump metrics (Table 4). The proportion of athletes achieving the return to play criteria for all metrics, strength metrics and jump metrics did not differ between the three groups (p = .611, p = .411, p = .575).

304 Table 5. Return to play criteria achievement

	Total % of participants	Control	Meniscectomy	Repair
Achieved >90%	3	5	4	0
symmetry in all				
metrics				
Achieved >90%	27	40	32	11
symmetry in				
isokinetic				
strength				
measures				

Achieved >90% 10		18	11	2
symmetry in				
jump metrics				

306

307

308 <u>**1.4 Discussion**</u>

This study examined the differences in PROMs, isokinetic strength and plyometric ability between those who underwent ACL reconstruction with and without two different forms of meniscal intervention. We hypothesised that subjective and objective outcomes would be lower in the ACLR with meniscal repair group compared to the ACLR with meniscectomy and isolated ACLR groups but this hypothesis was not supported by our findings.

314

315 **1.4.1 PROMS**

The results indicated similar levels of perceived impairment and patient confidence in the ability to return to play across the three groups. Previous literature has suggested that patients with isolated ACLR and ACLR with meniscectomy display equivocal PROM scores two years post-operatively [31]. These results have been replicated in this study at the earlier stage of 9-11 months, around the time of return to play. It is reported that removal of meniscal tissue increases the risk of OA in the long-term [43], however the results of this study suggest that short term outcomes are not different regardless of surgical management.

Our findings do not correspond with those of previous studies reporting that patients who 323 have undergone ACLR with meniscal repair demonstrate poorer PROM scores at 6 months, 1 324 year and 2 years post-operatively relative to their counterparts who undergo isolated ACLR 325 or ACLR with partial meniscectomy [32, 33]. This could be attributed to the heterogeneity in 326 the reported rehabilitation programmes and more conservative approach to early post-327 operative management in comparison with that experienced by our study's participants; 328 329 Svantesson, Cristiani, Senorski, Forssblad, Samuelsson, Stålman [32] used a hinged brace with restricted range of motion in the early post-operative period, [4] prescribed partial 330 331 weight-bearing for four weeks to all participants and the rehabilitation guidelines in LaPrade, Dornan, Granan, LaPrade, Engebretsen [33] are not described. The rehabilitation guidelines 332 provided in the current study were to weight bear as tolerated for two weeks with elbow 333 crutches and a protocol provided to their physiotherapist. There was no use of bracing post-334 operatively. The difference in PROM results between our meniscal repair cohort and the 335 cohorts in the aforementioned studies may thus be attributed to a rehabilitation protocol that 336 allowed unrestricted knee range of motion and encouraged a normal gait pattern, which is 337 thought to cause compression of some meniscal tear types and promote healing of the repair 338 [44-46]. It is important to note that the current study focuses on post-operative PROMs and 339 doesn't provide analysis on pre-operative PROMs. The lack of preoperative PROMs is a 340 limitation to this study as it does not allow for analysis of changes in score from the 341 preoperative state that may have found differences in the degree of improvement 342 postoperatively among the three groups. 343

344

345 **1.4.2 Strength and jump testing**

The results of this study suggest that there are no significant differences in knee strength, SLCMJ height, SLDJ height and SLDJ contact time between those who underwent an ACLR, ACLR with meniscectomy and ACLR with meniscal repair 9-11 months after surgery. There were also no significant between-group differences in LSI for strength or jump performance, and no between-group differences in the ability to achieve >90% symmetry return to play criteria across jump and strength metrics.

352 In this study, <3% of participants met 90% symmetry across the variables tested, however previous research has shown performance deficits persist beyond 9 months post-operatively 353 across many variables [24, 36, 39, 47, 48]. Variables often tested include strength [47, 48], 354 jump performance [24] and biomechanics [36, 39] and in all three areas, patients post-ACLR 355 underperform compared to their non-ACLR counterparts. The causes of this are likely to be 356 multi-factorial and could be attributed to both physical and psychological readiness [49] to 357 return to play but also the timepoint at which our participants were tested. There is some 358 evidence to suggest that differences in limb symmetry index reduce 1 year post-ACLR [50] 359 but this study tested participants at 9-11 months post-operatively. However, this study 360 361 demonstrates that the presence of these deficits is not related to meniscal intervention intraoperatively but does add to the literature highlighting the persistence of deficits in strength 362 363 and performance metrics post-operatively.

364

The results of this study are also in line with those of previous studies comparing patients who underwent isolated ACLR vs those who underwent ACLR with meniscal intervention. Both Lepley, Wojtys, Palmieri-Smith [26] and Øiestad, Holm, Engebretsen, Risberg [4] found no significant difference in quadriceps strength as measured by isokinetic dynamometry at 6 months, 1 year and 2 years post-operatively. Similarly, [Øiestad, Holm,

Engebretsen, Risberg [4]] reported no significant differences in jump hop and stair hop test 370 scores between those who underwent ACLR with and without meniscal intervention. 371 However, the current study is the first to investigate both strength and a variety of single leg 372 jump metrics across patients with isolated ACLR, ACLR with meniscal repair and ACLR 373 with meniscectomy at the key return to play timepoint of ten months post-operatively. 374 Meniscectomy results in a change to the biomechanical loading of the knee joint [51-53] and 375 376 the removal of shock-absorbing cartilage [54]. Despite this significant interruption to the structure of the joint, our study shows it has no impact on participants' ability to achieve 377 378 between-limb strength and jump score symmetry at this stage after ACLR.

379

380 **1.4.3 Clinical implications**

The clinical implications of this study revolve around preoperative counselling and 381 382 expectation management for patients undergoing ACLR with concomitant meniscal 383 intervention. It is well accepted that ACLR with meniscectomy results in a higher risk of OA in long-term studies [15, 43], however these differences are not evident in subjective or 384 objective outcomes in the first post-operative year [4, 31]. Sarraj, Coughlin, Solow, Ekhtiari, 385 386 Simunovic, Krych, MacDonald, Ayeni [31] demonstrated favourable outcomes in the meniscectomy cohort relative to the meniscal repair cohort at two years, however this effect 387 is reversed at four years when results favour the meniscal repair group in terms of 388 arthrometric data and IKDC scores. Our results also highlight that early range of motion and 389 weightbearing post-operatively may negate the poorer PROM scores and functional outcomes 390 391 seen in previous studies [32, 34]. This study suggests that concomitant meniscal surgery has no significant effects on PROMs, strength and jump metrics at the return to play stage post-392 393 operatively. These findings suggest that clinicians and patients can be counselled to expect to

achieve similar levels of recovery of strength and jump performance and PROMs in the shortterm after ACLR, regardless of meniscal intervention.

396

397

398 1.5 Conclusion

This study reports a range of outcomes after isolated ACLR, ACLR with meniscectomy and ACLR with meniscal repair in multi-directional athletes ready to return to play. We show that concomitant meniscal intervention with ACLR has no significant effect on PROMs, strength scores and jump scores at 9 months post-operatively. Clinically, these results can inform the pre-operative counselling of those awaiting ACLR with likely meniscal intervention.

404

405

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