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Current perspectives of New Zealand physiotherapists on rehabilitation and return to sport following anterior cruciate ligament reconstruction: A survey☆

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ABSTRACT

Objective: To investigate the clinical beliefs and practices of New Zealand physiotherapists regarding pre- and post-surgical rehabilitation and return to sport (RTS) criteria following anterior cruciate ligament reconstruction (ACLR).
Design: Online cross-sectional survey.
Methods: A survey was adapted from a previously published survey and disseminated to New Zealand physiotherapists who were considered more likely to be involved in post-ACLR rehabilitation.
Results: The number of completed surveys was 318. Most physiotherapists (85%) preferred to first consult patients within 14 days of ACLR. In the first six weeks following ACLR, 89% of physiotherapists see patients at least once per week. Between 3- and 6-months post-ACLR, 76% of physiotherapists see patients at least once a fortnight. Pre-operative rehabilitation and post-operative rehabilitation exceeding six months are considered essential or important to patient outcomes by over 95% of physiotherapists. While 63% of physiotherapists support RTS 9–12 months after ACLR, 11% permit RTS within 6–9 months of surgery. Common RTS considerations include functional capacity, movement quality during functional tasks, time from ACLR, and knee strength.
Conclusion: The survey revealed variability in the beliefs and practices of NZ physiotherapists regarding post-ACLR rehabilitation, and these beliefs and practices are at times inconsistent with best practice recommendations.

1. Introduction

Injury to the anterior cruciate ligament (ACL) of the knee typically occurs during sporting activities involving cutting, landing, and pivoting movements (Renström, 2013). Management of an ACL injury usually follows one of two pathways: 1) post-injury rehabilitation, followed by early surgical ACL reconstruction (ACLR) and post-surgical rehabilitation, or 2) post-injury rehabilitation, with the option of delayed ACLR if clinically indicated (Beynnon, Johnson, Abate, Fleming, & Nichols, 2005). The goals of ACLR are to facilitate a safe and sustainable return to pre-injury activities and prevent secondary knee changes such as osteoarthritis, although recent research does not support these outcomes for a significant number of patients (Ardern, Taylor, Feller, & Webster, 2014; Harris et al., 2014). Despite no clear benefit of surgical over conservative management (Frobell et al., 2013; Wellsandt, Failla, Axe, & Snyder-Mackler, 2018), annual rates of ACLR in certain populations have increased by up to 40% in recent years (Abram, Price, Judge, & Beard, 2019; Herzog et al., 2018; Zbrojkiewicz, Vertullo, & Grayson, 2018).

Independent of the treatment pathway chosen following ACL injury, rehabilitation is a critical factor that can influence short- and long-term patient outcomes (van Melick et al., 2016). Rehabilitation for ACLR includes pre-operative rehabilitation, followed by criterion-based post-operative rehabilitation, and a graduated return to pre-injury activities (Grindem, Wellsandt, Failla, Snyder-Mackler, & Risberg, 2018). Pre-ACLR rehabilitation aims to eliminate any knee joint effusion, restore range of motion, and improve quadriceps strength (Filbay & Grindem, 2019; van Melick et al.,

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2016). The goals of post-ACLR rehabilitation are to restore neuromuscular function and modify any pre-injury risk factors that may increase the risk of subsequent ACL injury (Adams, Logerstedt, Hunter-Giordano, Axe, & Snyder-Mackler, 2012). While the effectiveness of rehabilitation following ACLR is well accepted (Lobb, Tumilty, & Claydon, 2012), there remains little consensus as to the optimal components of the rehabilitation program (Meredith et al., 2020). While clinical practice guidelines for post-ACL rehabilitation do exist, their usefulness in clinical practice may be limited due to low external validity (Andrade, Pereira, van Cingel, Staal, & Espregueira-Mendes, 2019).

The annual incidence of ACLR in New Zealand (NZ) has increased by 58% since 2005 (Sutherland, Clatworthy, Fulcher, Chang, & Young, 2019), and the annual cost of ACLR surgeries in NZ exceeds $25 million dollars (ACC, 2018a). Physiotherapists are key health professionals who manage pre- and post-ACLR rehabilitation (Filbay & Grindem, 2019); particularly so in the NZ context, where private practice-based physiotherapists oversee the significant majority of pre- and post-ACLR rehabilitation (Fausett, Wilkins, Reid, Larmer, & Potts, 2019). However, due to an underutilisation of physiotherapy services following surgery, patients undergoing ACLR in NZ may not be receiving an appropriate dosage of rehabilitation (Fausett et al., 2019).

There is considerable variability amongst therapists in beliefs and clinical practices regarding ACLR rehabilitation, including activity and exercise progression, knee strength testing, return to sport (RTS) timeframes, and frequency of treatment (Dingenen et al., 2021; Ebert et al., 2018; Greenberg, Greenberg, Albaugh, Storey, & Ganley, 2018). Although physiotherapists are the main providers of post-ACLR rehabilitation in NZ (ACC, 2018b), the beliefs and practices of NZ physiotherapists regarding rehabilitation following ACLR are currently unknown. Therefore, the aim of the current study was to investigate practice beliefs of NZ physiotherapists regarding pre- and post-surgical rehabilitation and RTS criteria following ACLR.

2. Methods

An online survey consisting of 14 questions was utilised to survey NZ physiotherapists. The survey was adapted from a previously published survey of Australian therapists involved in ACLR rehabilitation (Ebert et al., 2018), with permission to replicate the survey granted by the lead author. The survey questions and possible responses are shown in Table 1. There were two minor changes to the original survey. Question three regarding which state/territory the provider practiced in was removed, as this was not applicable to the NZ population. In the original survey, participants could select as many options as applicable for questions 14 and 15. For technical reasons, participants could only select one option for those questions in the current survey (questions 13 and 14 in the current study). All other questions in the current survey were duplicated from the original study.

The survey was available for completion via an online platform (SurveyMonkey) between April 23rd, 2020 and June 31st, 2020. The survey was anonymous, which was clearly stated in the information section, with no personal participant data collected. Participants were required to self-identify as NZ registered physiotherapists with an up-to-date annual practicing certificate who were currently treating, or had previously treated, a patient who had undergone ACLR. If a participant did not self-identify with the above criteria, they were not granted access to the survey. No data was collected from participants regarding demographics, number of years practicing, qualifications, or location of practice.

An email invitation to complete the survey was sent to members of two Special Interest sub-groups of Physiotherapy New Zealand – New Zealand Manipulative Physiotherapists Association (NZMPA) and Sport and Exercise Physiotherapy New Zealand (SEPNZ). Members of these groups were considered more likely to be, or have been, actively involved in the treatment of patients who had undergone ACLR. During the survey period, the survey was also promoted within the NZMPA and SEPNZ groups on a social media platform (Facebook) to increase survey exposure. In an effort to maximise response rates, participants had the option of entering a draw to win a gift card following completion of the survey.

After survey closure, group and individual responses were exported to Microsoft Excel format for examination. A descriptive analysis of the data was performed using SPSS (IBM SPSS Statistics V.26), with the number and percentage of respondents for each answer option calculated. Respondents could select an 'other (please specify)' option for questions 4, 5, 12, 13, and 14. Individual responses for each 'other (please specify)' option were analysed, and if considered appropriate, the response was removed from the 'other (please specify)' option and included in the most suitable answer option for that question.

3. Results

The number of completed surveys was 318, with all questions answered by all respondents. At the time the survey was available for completion, there were 192 members of NZMPA and 890 members of SEPNZ, for an estimated response rate of 29.3% (318/1082). The number of responses and percentages for each question are presented in Table 1. Almost 93% respondents identified their area of expertise as treating all musculoskeletal conditions, with over 90% of respondents treating 20 or less ACLR patients per year.

While 57% of respondents wished to see their patient within a week of ACLR, 28.4% of respondents preferred to wait until 7–14 days after surgery (Table 1). Within the first six weeks of ACLR, over 91% of respondents would see their patients 1–2 times per week. Between 3- and 6-months post-ACLR, 76.2% of respondents would see patients in the clinic at least once per fortnight, with over 20% preferring less frequent visits and a focus on home or gym-based exercises.

Almost all respondents consider rehabilitation essential or important to overall outcome from ACLR at all time points surveyed (Table 1). Between six weeks and three months was the period when the most respondents considered rehabilitation 'essential' (86.8%), compared to six months post-ACLR onwards when the least respondents considered rehabilitation 'essential' (45.3%).

Providing the patient had made satisfactory progress and displayed adequate physical capacity, 63.2% of respondents permitted RTS 9–12 months after ACLR (Table 1). Almost a quarter of respondents (24.2%) would wait 12–18 months after ACLR before supporting RTS, whereas 11% would allow RTS within 6–9 months of surgery. Functional capacity (98.1%), lower limb/trunk mechanics during functional tasks (92.5%), knee strength (90.3%), psychological readiness (89.3%), and time from surgery (75.2%) were the factors most commonly considered before permitting a patient to RTS after ACLR (Table 1).

To evaluate knee strength, 36.2% of respondents estimate strength via other means eg hop tests, while an equal number of respondents use manual muscle testing (MMT) or hand held dynamometry (HDD) (16%) (Table 1). Only 24.5% of respondents use gym-based repetition maximum (RM) testing i.e. 1-10 RM for squat, deadlift, single leg press, knee extension/hamstring curl machine, to assess knee strength when considering RTS. Although respondents could select only one option for question 13 regarding knee strength, the total number of responses for that question exceeds the total number of respondents. The reason for this discrepancy is a large number of respondents selected 'other

Table 1
Questions and responses (n, %) for each item from the anonymous survey.

Q1 What is your primary area of expertise for the purpose of this survey?		
All musculoskeletal conditions	295	93.0%
Primarily lower limb	9	2.8%
Primarily upper limb	2	0.6%
Other sub-specialty, but I still see some ACLR patients	11	3.5%
Other (please specify)	1	0.3%
Q2 Approximately, how many ACLR patients would you see per year?		
1-5	166	52.4%
6-20	131	41.3%
21-50	18	5.7%
>51	3	0.9%
Q3 At what post-operative time-point do you encourage your patient to be seen by you after their ACLR surgery?		
Within the first 1–4 days after surgery.	48	15.1%
Within the first 7 days after surgery.	133	41.9%
Between 1 and 2 weeks after surgery.	90	28.4%
After being cleared by their surgeon.	46	14.5%
When they feel ready to start, though I do not recommend a specific (or ideal) time.	1	0.3%
Q4 How often would you like to see your ACLR patient for supervised rehabilitation, within the first 6 weeks post-surgery?		
Twice per week.	160	50.3%
Once per week.	122	38.3%
Once every two weeks.	9	2.8%
Less frequently if possible, with a focus on home-based exercises and periodic review.	5	2.5%
Other (please specify)		
•Dependent on patients progress, engagement, pre-injury activity level, financial status.	10	3.1%
•1–2 x week.	9	2.8%
•3 x week.	3	0.9%
Q5 Between 3 and 6 months post-surgery, how often would you like to see your ACLR patient within your practice?		
Twice per week.	26	8.2%
Once per week.	88	27.7%
Once every two weeks.	128	40.3%
Less frequently if possible, with a focus on home-based exercises and periodic review.	65	20.4%
Other (please specify)		
•Dependent on patients progress.	6	1.9%
•Every 1–2 weeks.	3	0.9%
Q6 How important do you think 'pre-operative rehabilitation' is to post-operative patient outcome?		
Essential	199	62.8%
Important	116	36.9%
Not important	1	0.3%
No view or opinion	2	0.6%
Q7 How important do you think 'post-operative rehabilitation' is to overall patient outcome within the first 6 weeks post-surgery?		
Essential	247	77.9%
Important	70	22.1%
Not important	1	0.3%
No view or opinion	0	0%
Q8 How important do you think 'post-operative rehabilitation' is to overall patient outcome within 6 weeks to 3 months post-surgery?		
Essential	276	86.8%
Important	41	12.9%
Not important	1	0.3%
No view or opinion	0	0%
Q9 How important do you think 'post-operative rehabilitation' is to overall patient outcome within 3–6 months post-surgery?		
Essential	230	72.3%
Important	83	26.1%
Not important	3	0.9%
No view or opinion	2	0.6%
Q10 How important do you think 'post-operative rehabilitation' is to overall patient outcome from 6 months post-surgery onwards?		
Essential	144	45.3%
Important	157	49.4%
Not important	13	4.1%
No view or opinion	4	1.3%
Q11 Providing you are satisfied with their progress and physical capacity, what time do you typically permit a patient to return to sport (including rugby/league, soccer, netball, touch rugby etc.)?		
6–9 months.	35	11.0%
9–12 months.	201	63.2%
12–18 months.	77	24.2%
≥18 months.	4	1.3%
I tell them they should not return to higher demand sports (e.g. rugby/league, soccer, netball).	1	0.3%
Q12 Given the aforementioned high demand sports, what factors do you personally consider before 'clearing' a patient to return to their sport? (Check all that apply)		
Time from surgery.	239	75.2%
Age of the patient.	141	44.3%
Knee Range of Movement and/or Laxity.	225	70.8%
Patient-reported Outcome Questionnaires.	167	52.5%
Psychological readiness (e.g. confidence, anxiety).	284	89.3%
Knee Strength.	287	90.3%
Functional capacity (e.g. jump and/or hop tests).	312	98.1%
Lower limb and trunk mechanics during jumping/landing task.	294	92.5%

Table 1 (*continued*)

Side-to-side differences in muscular size (i.e. thigh girth).	163	51.3%
Other (please specify)		
•Return to Sport tests/Sport specific tasks.	30	9.4%
•Proprioception/Agility.	8	2.5%
•Cardiovascular fitness.	4	1.3%
•Surgeon clearance.	3	0.9%
•Symptoms eg pain, swelling.	3	0.9%
Q13 If you consider 'knee strength' to be important prior to clearing a patient to return to their sport, how do you evaluate this?		
I use manual muscle testing methods.	51	16.0%
I use hand held dynamometry.	51	16.0%
I use an isokinetic dynamometer.	20	6.3%
I extrapolate/estimate knee strength from other measures such as hop capacity.	115	36.2%
I feel strength is important, but do not have access to necessary equipment (and/or do not feel manual testing methods are accurate enough) so I refer on to someone who can provide this evaluation for me.	24	7.6%
I do not consider these tests that important.	5	1.6%
Other (please specify)		
•Gym based/Repetition Maximum testing.	78	24.5%
Q14 If you consider 'lower limb functional capacity' to be important prior to clearing a patient to return to their sport, how do you evaluate this?		
Star excursion and/or Y-balance test.	12	3.8%
Single limb vertical hop.	5	1.6%
Single limb hop for distance.	20	6.3%
6m timed hop test.	2	0.6%
Triple hop for distance.	16	5.0%
Triple crossover hop for distance.	8	2.5%
A hop test battery (including ≥2 of the 6m timed and single, triple hop and triple crossover hops for distance).	214	67.3%
I do not consider these tests that important.	3	0.9%
Other (please specify)		
•Combination of all the above.	27	8.5%
•Sport specific tasks.	9	2.8%
•Passive range of movement.	2	0.6%

Abbreviations: ACLR = anterior cruciate ligament reconstruction.

(please specify)' and recorded multiple methods of assessing knee strength in their response. Accordingly, and where possible, responses from the 'other (please specify)' option were added to the appropriate answer totals for question 13. To evaluate lower limb functional capacity, 67.3% of respondents use a hop test battery, 16% use only one hop test, and 3.8% use the star excursion balance test (SEBT) and/or Y-balance test (YBT) (Table 1).

4. Discussion

The aim of this study was to gain insights into the current beliefs and practices of NZ physiotherapists regarding rehabilitation and RTS following ACLR. We estimated a survey response rate of 29.3%. Previous surveys of therapists working with ACLR patients have been unable to calculate a response rate (Dingenen et al., 2021; Ebert et al., 2018; Greenberg et al., 2018); however, a recent online survey involving NZ physiotherapists reported a response rate of approximately 10% (Reid et al., 2020).

Successful rehabilitation following ACLR is challenging and should be performed by a clinician with experience in post-ACLR rehabilitation (Buckthorpe, 2019; Filbay & Grindem, 2019). Only 47.6% of respondents in the current study report treating more than six ACLR patients per year, which is less than Australian (74%) and United States (US) therapists (66.7%) (Ebert et al., 2018; Greenberg et al., 2018). Australia has higher rates of ACLR compared to NZ (Zbrojkiewicz et al., 2018), which could contribute to the higher patient numbers in that country. Although rates of ACLR in NZ are now similar to the US (Sutherland et al., 2019), this has not yet translated into NZ physiotherapists treating similar numbers of ACLR patients. Over 90% of respondents indicated they treat all musculoskeletal conditions, suggesting few NZ physiotherapists are specialists, which may further limit clinician experience in ACL rehabilitation.

Post-ACLR rehabilitation should commence immediately following surgery (Filbay & Grindem, 2019; van Melick et al., 2016). Only 57% of respondents in the current survey would see patients in the week following ACLR, which is consistent with Australian (53%) and Flemish (62%) therapists (Dingenen et al., 2021; Ebert et al., 2018). The reasons why a significant percentage of therapists across multiple populations do not commence rehabilitation within the first week of ACLR require further investigation, but could include surgeons not endorsing rehabilitation in the first week following surgery (Feller, Cooper, & Webster, 2002).

Almost 90% of respondents in the current study would see their patient 6–12 times within the first six weeks, and over 77% would see patients 6–24 times between three and six months, which are higher percentages than Australian therapists (82.1% and 58.7%) for the respective time periods (Ebert et al., 2018). It is not clear how frequent respondents would see their patients between six weeks and three months, or from six months onwards, as these periods were not surveyed. Therefore, the majority of respondents in the current survey would see their patients at least 12–36 times within the first six months of ACLR, which is similar to the number of physiotherapy treatments currently suggested following ACLR (Adams et al., 2012; Filbay & Grindem, 2019).

Physiotherapist-led rehabilitation prior to ACLR, and 9–12 months of structured rehabilitation post-ACLR, can optimise patient outcomes (Alshewaier, Yeowell, & Fatoye, 2017; van Melick et al., 2016). Almost all respondents in the current study considered pre-operative rehabilitation essential or important to overall outcome following ACLR – a belief shared by Australian therapists (Ebert et al., 2018). At least 94% of respondents considered rehabilitation essential or important to patient outcomes up to and exceeding six months post-surgery, again similar to Australian therapists (Ebert et al., 2018), but greater than US and Flemish therapists (Dingenen et al., 2021; Greenberg et al., 2018).

Our results suggest NZ physiotherapists are aware of the dosage (quantity and duration) of physiotherapy treatment necessary to achieve optimal patient outcomes – an awareness that does not seem to translate into clinical practice. A recent study showed patients undergoing ACLR in NZ receive an average of 8–12 physiotherapy treatments over an average duration of approximately five months following surgery (Fausett et al., 2019). As such, there is a large discrepancy between the dosage of treatment physiotherapists in NZ believe they are providing following ACLR, and the dosage of physiotherapy treatment actually being provided. ACL rehabilitation in NZ is almost exclusively funded by the Accident Compensation Corporation (ACC) – a government entity that administers a public insurance scheme funding medical treatment and providing compensation following accidents (Flood, 2000). Up until 2019, ACC placed limits on the number of physiotherapy treatments providers could deliver without first seeking prior approval – a barrier that could result in patients receiving a lesser quantity or duration of physiotherapy treatment following ACLR (Fausett et al., 2019). Other possible barriers to receiving the optimal dosage of physiotherapy treatment following ACLR could include economic constraints, decreased patient motivation to complete rehabilitation, decreased patient understanding of rehabilitation requirements, and a lack of surgeon endorsement of rehabilitation (Cailliez et al., 2012; Ebert et al., 2018; Ebert et al., 2018; Fausett et al., 2019). It should be noted the optimal dosage of physiotherapy treatment following ACLR is yet to be established (van Melick et al., 2016; Walker, Hing, & Lorimer, 2020). The overall dosage of physiotherapy treatment following ACLR will be dependent on the treatment plan, with adjustments made according to the progress of the individual patient (Filbay & Grindem, 2019; Wilk & Arrigo, 2017).

A RTS within nine months following ACLR is associated with an increased risk of re-injury (Beischer et al., 2020; Grindem, Snyder-Mackler, Moksnes, Engebretsen, & Risberg, 2016). Over 87% of respondents in the current study reported waiting at least nine months after ACLR before supporting a RTS, which is higher than Australian (77%), Flemish (73%), US (45%) and Brazilian (22% recommend $\geq$8 months) therapists (Aquino et al., 2020; Dingenen et al., 2021; Ebert et al., 2018; Greenberg et al., 2018). Only 11% of respondents would support a RTS between 6 and 9 months, which is less than Australian (22%), Flemish (25%), and US (38%) therapists (Dingenen et al., 2021; Ebert et al., 2018; Greenberg et al., 2018). Supervised rehabilitation after ACLR that exceeds 6 months is associated with increased knee strength, improved functional capacity, and greater limb symmetry (Ebert, Edwards, et al., 2018; Edwards et al., 2018; Królikowska, Sikorski, Czamara, & Reichert, 2018) – factors that also decrease the risk of graft rupture and increase the likelihood of a successful RTS (Kyritsis, Bahr, Landreau, Miladi, & Witvrouw, 2016; Meredith et al., 2020). Although criterion-based measures are now recommended over time-based measures following ACLR (Adams et al., 2012), time from surgery and duration of rehabilitation likely influence patient outcomes. Our results indicate the majority of NZ physiotherapists endorse a RTS timeframe consistent with current evidence, while also being more aware of the importance of 'time from surgery' when considering RTS following ACLR than overseas counterparts.

Physical capacity, movement quality, psychological readiness, and biological healing are factors recommended to consider when evaluating a patient for RTS following ACLR (Filbay & Grindem, 2019; van Melick et al., 2016). The factors NZ physiotherapists consider when evaluating a patient for RTS align with current recommendations, and are also consistent with factors considered by Australian, Flemish, and Brazilian therapists (Aquino et al., 2020; Dingenen et al., 2021; Ebert et al., 2018). Successful RTS following ACLR includes achieving the pre-injury level of activity, as defined by the same type, frequency, intensity and quality of performance (Meredith et al., 2020). A multidisciplinary team, including the physiotherapist, should be involved in any RTS decision (Meredith et al., 2020). However, NZ physiotherapists may not be actively involved in patient management at the time of RTS, as the duration of physiotherapy treatment in NZ after ACLR does not often extend to the time-point where patients are potentially contemplating a RTS (Fausett et al., 2019).

Just over one third of respondents report estimating knee strength from functional measures such as hop capacity, which is less than Australian therapists (48.9%) (Ebert et al., 2018). Caution should be used when using hop tests in this way, as results from functional tests do not always correlate with objective measures of knee strength (Toole et al., 2017), leading to a possible overestimation of knee strength. Manual muscle testing (MMT) and hand held dynamometry (HDD) were also commonly reported methods to evaluate knee strength – consistent with US therapists (Greenberg et al., 2018) but less often than Australian therapists (Ebert et al., 2018). MMT and HDD require little resource, which likely contributes to their popularity, although their accuracy may be less than other methods (Bohannon, 2005; Sinacore et al., 2017). The reliability of gym-based repetition maximum (RM) tests are similar to MMT and HDD (Sinacore et al., 2017). However, only one in four respondents in the current study report using gym-based RM testing to evaluate knee strength – a similar number to US therapists (Greenberg et al., 2018). Isokinetic evaluation of knee strength remains the gold standard but utilisation of this by NZ and Australian therapists is low, likely due to cost and availability (Ebert et al., 2018). Overall, the methods reportedly used by the majority of NZ physiotherapists to evaluate knee strength after ACLR could lead to an inaccurate assessment of strength. An incorrect estimation of knee strength could lead to an insufficient rehabilitation stimulus to promote functional improvement, the prescription of rehabilitation exercises that exceed the patients true functional ability, or a premature return to pre-injury activities (Beischer, Senorski, Thomeé, Samuelsson, & Thomeé, 2018; Filbay & Grindem, 2019). Given the positive relationship between knee strength and patient outcomes following ACLR (Arhos et al., 2020; Cristiani et al., 2020), there appears considerable scope for improvement in the assessment of knee strength by NZ physiotherapists.

Approximately 75% of respondents in the current study reported using a hop test battery to evaluate lower limb functional capacity for RTS, which compares favourably to Australian (84.3%) and US therapists (79.4%) (Ebert et al., 2018; Greenberg et al., 2018). Hop tests are commonly used in the clinic setting, as they are relatively easy to administer, and produce valid, reliable results (Reinke et al., 2011). A hop test battery should be utilised when considering a RTS following ACLR (Ardern et al., 2016; van Melick et al., 2016), and greater performance during hop tests can be associated with improved patient outcomes (Edwards et al., 2018; Kyritsis et al., 2016). Measuring only quantitative performance during hop tests maybe insufficient to fully assess knee function after ACLR (Kotsifaki, Korakakis, Whiteley, Van Rossom, & Jonkers, 2020; Nagai, Schilaty, Laskowski, & Hewett, 2020). A 'quality' assessment of movement performance during hop tests is recommended (Davies, Myer, & Read, 2020), as meeting RTS criterion on a quality measure is associated with a lower second ACL injury rate (van Melick et al., 2021). Of note is the 25% of respondents in the current study who report not using a hop test battery. Using only one hop test to asses lower limb functional capacity could result in a sub-optimal assessment of physical performance and compromise RTS, as no single hop test can consistently predict RTS or risk of re-injury (Davies et al., 2020).

Only 12.3% of respondents report using the star excursion balance test (SEBT) and/or Y-balance test (YBT) to assess functional

capacity when considering RTS following ACLR, compared to 62.8% and 48.8% of Australian and US therapists respectively (Ebert et al., 2018; Greenberg et al., 2018). As performance on the SEBT in ACLR patients at the time of RTS has been shown to be worse compared to uninjured controls (Clagg, Paterno, Hewett, & Schmitt, 2015), increased utilisation of balance tests by NZ physiotherapists when evaluating lower limb function may be indicated. The reasons for the low utilisation of balance tests by NZ physiotherapists compared to overseas counterparts are not entirely clear. In contrast to the original survey of Ebert et al., respondents were limited to one selection for the question regarding methods to assess lower limb functional capacity. Therefore, the low reported usage of balance tests may be an underestimation, as more respondents could have selected hop tests as they considered these more important, despite in fact using balance tests to asses functional capacity.

5. Limitations

A number of limitations with the current study can be identified. Despite all NZMPA and SEPNZ members being notified of the survey, the estimated response rate was approximately 30%. A low survey response rate can introduce bias and compromise the validity of the results. Due to unrestricted access to the survey via social media, we cannot exclude the possibility NZ physiotherapists who are non-members of NZMPA or SEPNZ completed the survey, although this is unlikely to be a significant number. Although there are over 4000 registered physiotherapists in NZ, we limited promotion of the survey to specific groups of physiotherapists in NZ, which potentially constrained both the number and diversity of responses. In the current study, respondents were restricted to NZ registered physiotherapists, but in the original study the survey was sent to members of the Australian Physiotherapy Association and Exercise and Sport Science Australia, as members of both groups are involved in delivering post-ACLR rehabilitation (Ebert et al., 2018). Different training between the professions and diverse practice beliefs between the study populations could have contributed to discrepancies between the results. It is possible some respondents in the current study answered questions from a 'what is *best* clinical practice' perspective, rather than 'what is *actual* clinical practice' perspective, which could explain some of the variability in the results. No data was collected regarding participant demographics and practice variables (number of years practicing, qualifications, location of practice etc), and the absence of such information may limit the overall generalisability of the results. Participant anonymity is required for ethical approval; however, the lack of a participant specific log-in could, in theory, permit multiple responses from the same participant. Although SurveyMonkey will not allow the survey to be completed on multiple occasions from the same computer and internet browser, it is not possible to say whether participants accessed the survey multiple times via different internet browsers.

6. Conclusion

Results of this survey revealed variability amongst NZ physiotherapists regarding rehabilitation and RTS practices and beliefs following ACLR. The need for pre-and post-ACLR rehabilitation is well recognised amongst physiotherapists, and although the majority of respondents report practice beliefs consistent with current recommendations, it is not clear if those beliefs are consistent with clinical practice. The commencement of post-ACLR rehabilitation and frequency of patient visits is varied, with multiple factors likely influencing the overall dosage of physiotherapy treatment. Areas for future research include exploring discrepancies between therapist beliefs regarding ACLR rehabilitation and objective treatment data, investigating barriers to delays in commencing rehabilitation following ACLR, increasing the usability of clinical practice guidelines, and improving access to appropriate methods to assess knee strength and RTS testing following ACLR.

Ethics statement

Ethical approval for this research was obtained from the Auckland University of Technology Ethics Committee (AUTEC); approval number 20/106.

Declaration of competing interest

None.

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