

Reconceptualisation of sport and quality of life in young athletes following anterior cruciate ligament reconstruction: understanding the experiences behind the numbers through a prospective mixed-methods study

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ABSTRACT

To explore the theory of response shift in young athletes undergoing anterior cruciate ligament (ACL) reconstruction (ACLR) by investigating athletes' conceptualisation of quality of life (QOL) across time following ACL injury. A mixed-methods study was conducted to understand young athletes' perceived QOL through qualitative investigation of participant perspectives and quantitative self-reported QOL ratings. 20 young athletes were purposively sampled for semi-structured interviews at two timepoints: preoperatively following ACL injury, and 1 year after ACLR. During the interviews, participants also reported their QOL on a visual analogue scale from 0 to 100. Transcripts were coded by two independent researchers. Descriptive quantitative analyses of QOL ratings and thematic analysis of qualitative data were conducted to identify mechanisms of response shift. Self-reported ratings of QOL indicated a recalibration response shift. When recalled preoperative scores were used in place of actual preoperative ratings, improvement in self-reported QOL was larger (median change: 13, range –6 to 62 vs median change: 29, range 5 to 75, respectively). Postoperatively, three processes of reprioritisation related to sport were identified within 16 interviews 1 year after surgery: (1) early transition away from sport as a priority, (2) expected transition away from sport as a priority and (3) sport preserved as a priority. Athletes' perception of overall QOL was influenced by the use of various coping strategies and engagement in self-reflection. QOL does not mean the same things to athletes before and after ACLR, and conceptualisations of QOL are influenced by complex factors. True change in patient-reported outcomes cannot be validly measured if the definitions of constructs are changing. We propose the SPARQ ACL Model of Sport Prioritisation and Athlete Reconceptualisation of Quality of life following ACL injury and reconstruction to help understand these changes.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Traditional quantitative patient-reported outcomes are limited in that they do not provide information as to how patients conceptualise constructs such as quality of life (QOL) across time. The idea that individuals may recalibrate, reprioritise and/or reconceptualise health-related QOL over time describes the phenomenon of response shift.

WHAT THIS STUDY ADDS

⇒ We identified a response shift and a change in what QOL means to young athletes before and after ACL reconstruction. The SPARQ ACL Model of Sport Prioritisation and Athlete Reconceptualisation of Quality of life following ACL injury and reconstruction is proposed and can be used to understand mechanisms of changes in athlete perspectives after ACL injury.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ True change in patient-reported outcomes cannot be validly measured if the definitions of constructs are changing. It is important to acknowledge how individuals' shifting perspectives affect the measurement of such outcomes in research and during recovery in a clinical setting. Clinicians should consider athletes as a whole and within their environmental context when individualising care.

INTRODUCTION

Quality of life (QOL) following anterior cruciate ligament (ACL) reconstruction (ACLR) is a complex, multi-dimensional and ambiguous construct commonly measured using self-reported questionnaires. QOL is likely to mean something different to young active individuals following ACL injury

compared with other patient populations, with additional variation in conceptualisations of QOL within this group. While patient-reported outcome measures (PROMs) can provide useful metrics of progress following ACL injury and surgery, dimensions such as uniqueness, sense-making and personal journeys are often overlooked when solely quantitative outcome scores are used.¹ A review of PROMs for measuring health-related QOL in active youth found that no adequately robust measure existed, mainly due to issues with content validity.² Most PROMs were not developed properly with input from the population of interest,² and PROMs are further limited in their inability to account for changes in how respondents *conceptualise* target constructs across time. If patients' frame of reference for interpreting such measures change across time, a phenomenon known as response shift, outcome measurement may be affected. Therefore, a mixed-methods approach in which patients are able to qualitatively define QOL for themselves is critical to understanding processes of appraising personal QOL over time.

Response shift is a theoretical model used to describe how patient perceptions of health-related QOL are dynamic, often changing across time and circumstances.³ Proposed mechanisms of response shift include (1) recalibration of internal standards, (2) reprioritisation of goals or values and (3) reconceptualisation of constructs.^{3 4} Response shift is thought to occur following a disturbance in health status and has been identified quantitatively in PROMs following various orthopaedic procedures including knee replacement and microfracture.⁵ ACL injuries occur predominantly in young active individuals, whose lifestyle and environment are likely to change over the classic 2-year surgical follow-up period. Therefore, it is reasonable to hypothesise that a response shift may be occurring in the ACL patient population. Qualitative investigations have revealed processes of reprioritisation and reframing following ACL injuries,^{6 7} but the theoretical framework of response shift has not been explicitly applied to this context. Additionally, qualitative studies in this area have been traditionally cross-sectional, making it difficult to truly understand temporal shifts and changes in perspectives.

A common quantitative method for assessing response shift is called the 'then-test'. Using this methodology, participants complete PROMs according to both their current status, and again according to recalled preoperative status at follow-up time points.^{3 8} Therefore, preintervention to postintervention change can be calculated two times: once using preoperative scores done at baseline (typical approach) and once using the recalled preoperative scores (when participants' perspectives and frame of reference are consistent with the postoperative measure). The then-test only explores the recalibration mechanism of response shift and qualitative methods may offer additional insights to explain other causes and individual nuances not captured by PROMs (ie, changes in values, priorities and conceptualisations).³

We have published previous work which describes the common components of QOL defined by this sample of young athletes at the preoperative 'baseline' following ACL injury: sport, social support, health and independence.⁹ The purpose of this follow-up study is to explore the theory of response shift in young athletes undergoing ACLR by investigating the change in or stability of individuals' definition and conceptualisation of QOL across time, using a mixed-methods approach.

METHODS

This study was designed as a mixed-methods study. The qualitative component of the study was designed and conducted using the Consolidated Criteria for Reporting Qualitative Research guidelines.¹⁰ The study was centred around semi-structured interviews with young athletes after ACL injury to uncover personal experiences and incorporate patient voices. Within the interviews, visual analogue scales and then-test methodology were used to investigate self-reported QOL pre- and post-ACLR using descriptive quantitative results. Qualitative data was used to provide context for the quantitative investigation of recalibration response shift and to explore the additional response shift mechanisms of reprioritisation and reconceptualisation.

Methodological orientation and framework

Descriptive qualitative methodology^{11 12} was implemented and framed within the social constructionist worldview, allowing for the acknowledgement that perceptions will differ based on the individual and their context.¹³ We conducted a thematic analysis in which the theoretical framework of response shift was used to help organise and make sense of our findings.

Participants

Patients were purposively recruited through the clinics of three orthopaedic surgeons at a specialist sports medicine clinic in London, Ontario, Canada from September 2021 to February 2022. Individuals were eligible to participate if they were undergoing a primary ACL reconstruction, were 25 years of age or younger, participated in sport, could communicate in English and agreed to be audio recorded. Participants were not eligible if they had experienced a multi-ligament injury or fracture. Patients were approached in person or via email by a member of their circle of care at the sports medicine clinic.

Patient and public involvement

Patients or the public were not involved in the design, conduct, reporting or dissemination plans of our research.

Equity, diversity and inclusion statement

Participants were stratified by sex to balance the number of males and females. Interviews were conducted via videoconferencing at times and locations that were convenient for participants to reduce geographical and socioeconomic barriers to study participation.

Research team

Our author team is composed of four female academic researchers (PhD student HM, MSc student OM and two senior faculty members DMB, FW) and one male orthopaedic surgeon and researcher (AMJG), spanning five clinical and research disciplines (physical therapy (HM), health and rehabilitation sciences (HM, OM), critical qualitative research methods and sociology (FW), clinical epidemiology and biostatistics (DMB) and orthopaedic surgery (AMJG)). HM conducted all interviews. HM and OM conducted coding and thematic analysis with training and guidance from FW. The interviewer (HM) was not known to participants and explained her role and research objectives at the beginning of each interview. Considering positionality, HM and OM come from a biomedical background and initially approached interviews and coding with a relatively clinical lens. HM and OM are both athletes and OM had experienced an ACLR, allowing both members to relate to the athlete participants. Discussion with team members, readings and reflexive journaling was helpful to surface assumptions and integrate multiple perspectives throughout data analysis and interpretation.¹⁴

Data collection

An extensive literature review was conducted prior to developing the semi-structured interview guides. The guides were organised to explore young athletes' perceptions of QOL during the process of recovering from an ACL injury and reconstructive surgery. Pilot interviews were conducted to obtain feedback and make changes related to question clarity, relevance, open-endedness, perceived bias and overall perceptions of the interview guide prior to interviewing eligible participants. Changes were made to the preoperative interview guide to better explain the concept of QOL to participants (adding vignettes and an established definition).⁹ No major changes were made to postoperative interviews as participants were more familiar with the concepts being asked about and the interview format during these follow-up sessions.

Interviews were conducted until the team determined that data sufficiency had been achieved in order to answer the primary research questions.^{15 16} It was determined that data sufficiency had been reached after interview 18, whereby no new themes were being generated by interviews to contribute to overall findings.^{15 16} While each participant provided new data related to their individual experience, overall themes were consistent after 18 interviews. Two further interviews were conducted with consented participants to ensure no new themes were generated.

Preoperatively, participants were asked questions about the definition of their personal QOL, current QOL and how they would describe their perceived QOL anchors (best and worst imaginable QOL). Further description and the preoperative interview guide are available elsewhere.⁹ Postoperative interviews included discussion

around the process of recovery in the year following ACLR, satisfaction with surgery/current outcomes and participants' personal definitions of QOL. To conduct the then-test, participants were asked to rate both their current and preoperative QOL using a visual analogue scale (VAS) from 0 (worst imaginable) to 100 (best imaginable). Then, participants were shown their actual preoperative QOL score from a year earlier and asked to discuss the similarity/discrepancy between ratings. The same process was repeated for the participants' perceived QOL anchors. While the VAS is not a gold standard PROM to measure QOL, it was chosen for easy integration into discussion during interviews including real-time comparisons of preoperative to postoperative scores. Additionally, the purpose of the qualitative component of the study was to allow participants to discuss the complexity of QOL and to define their personal QOL rather than the components or definition being dictated by a previously developed PROM. The VAS allowed participants to quantify QOL within the context in which they had defined it during interviews. Finally, participants were asked whether they thought their (1) standards regarding any component of QOL, (2) priorities or (3) definition/conceptualisation of QOL had changed since their initial injury and interview. The full interview guide is included in online supplemental material 1.

The interviewer (HM) took field notes during interviews and wrote a summary and reflexive journal entry after each interview.^{14 17} Memo notes and reflexive journal entries were continually written by HM and OM throughout research team meetings and thematic analyses. All participants were sent their interview transcripts and asked to provide any comments, clarifications or requests for data modification or removal as part of member checking.¹⁷

Data integration was achieved by using both qualitative and quantitative results to inform the study design and analysis. The a priori mixed-methods analysis plan was to (1) identify recalibration response shift in quantitative scores using the then-test and (2) identify mechanisms of response shift in interviews (asking questions about recalibration, reprioritisation and reconceptualisation). We planned to then review areas of convergence and divergence between the two types of data to gain a more comprehensive understanding of patient-perceived QOL and potential shifts in these perceptions over time.

We used thematic analysis to analyse qualitative interview data through a process of data familiarisation and initial code generation followed by searching for, reviewing, defining and refining themes.¹⁸ Participants were assigned an ID number to maintain confidentiality. Interviews were transcribed by an independent transcriptionist unrelated to the study. NVivo software was used as an organisational tool. Preoperative data analysis was performed inductively by HM and FW.⁹ Postoperative data analysis was performed in two stages by HM and OM. Each postoperative interview was coded four times, in two rounds, by two independent reviewers (HM and OM).

In the first round, transcripts were coded inductively using a descriptive approach.¹⁸ In the second round, a coding framework (online supplemental material 2) was developed and applied based on response shift theory to explore the proposed mechanisms of response shift (recalibration, reprioritisation and reconceptualisation of participants' QOL), the influence of internal (personality, sociodemographics, identity, internal expectations) and external factors (environment, support, external expectations), as well as potential explanations for the mechanisms of response shift (coping strategies, adaptation, comparison, self-reflection, reframing)⁴ (available in online supplemental material 2). The coders met regularly and reflexive thematic analysis^{18 19} was conducted as an iterative process, generating, reviewing and redefining subthemes and overall themes. Quotations are presented to illustrate the constructed themes, with participants identified as follows: (participant number, age, sex (M/F)).

Participants' QOL ratings were quantified by measuring the VAS (length of participant's rating/length of VAS scale \times 100, rounded to the nearest integer) and are presented as descriptive information for non-normally distributed data (median, IQR, range (minimum to maximum)). The following values were calculated for self-reported QOL ratings as per then-test methodology:

Unadjusted change = postoperative–preoperative (typical calculation of change).

Adjusted change = postoperative–recalled preoperative (adjusting for the same frame of reference).

Response shift = preoperative–recalled preoperative (discrepancy in preoperative status, also equivalent to the difference between unadjusted and adjusted change).

RESULTS

Participants

Of the 20 participants interviewed preoperatively, 16 completed 1-year follow-up interviews. Demographics are provided in [table 1](#). The remaining four participants were unresponsive to multiple requests for follow-up interviews. Preoperatively, participants were involved in a variety of sports including soccer, basketball, football, hockey, volleyball, horseback riding and powerlifting ([table 2](#)). One year following injury, 12 of 16 participants (75%) had returned to some level of sport participation. Nine had returned to training for or playing their primary sport and four were participating in a different sport. Participants who completed both preoperative and postoperative interviews included high school students, university students and working young adults. Interviews lasted an average of 31 min (range 23–51 min). No other individuals were present for the follow-up interviews.

Quantitative investigation of QOL and response shift

All 16 patients reported they were satisfied with their surgery, and all participants rated their postoperative QOL $>$ 75 out of 100 (median: 86, IQR: 10, range: 75–98). This was in the context of differing postoperative outcomes including participants who had and had not returned to their primary sport and those who had experienced subsequent injuries and surgeries. Notably, no participants had experienced a graft rupture or contralateral ACL tear at the time of follow-up interviews.

Preoperative (median: 74.5, IQR: 14, range: 13–95), recalled preoperative (median: 55, IQR: 24, range: 0–92) and postoperative QOL scores are shown in [figure 1](#). Preoperative (actual or recalled) QOL ratings were

Table 1 Participant demographics

Participant number	Age (postoperative interview)	Sex	Race	Months from injury to preoperative interview	Months from surgery to postoperative interview
1	23	M	White	15.3	12.3
2	16	F	White	2.4	12.4
4	21	M	White	1.2	12.1
6	22	M	White	2.5	12.6
8	21	M	White	1.8	12.1
9	17	F	White	1.1	12.5
10	15	M	First Nations, Metis or Inuit	1.3	12.4
11	26	M	White	2.3	12.1
12	24	F	White	4.2	12.7
13	17	F	White	4.0	13.0
14	18	M	First Nations, Metis or Inuit	5.2	12.4
15	17	F	White	3.1	13.3
16	17	M	White	3.9	12.2
17	16	F	White	4.7	13.1
18	16	F	Asian	2.8	12.4
20	18	F	White	3.1	13.2

Table 2 Participant level of sport participation, sport and sport prioritisation group, as determined by thematic analysis of interviews with young athletes 1 year after anterior cruciate ligament reconstruction

Participant	Preoperative level and type of sport	Prioritisation group
1	Non-competitive, multiple sports	Early transition
8	Competitive, powerlifting	Early transition
10	Competitive, football	Early transition
11	Non-competitive, soccer	Early transition
13	Competitive, soccer	Early transition
14	Competitive, football	Early transition
16	Competitive, hockey	Early transition
18	Competitive, basketball	Early transition
6	Competitive, football	Expected transition
17	Competitive, hockey	Expected transition
20	Non-competitive, volleyball and horseback riding	Expected transition
2	Competitive, volleyball and hockey	Preserved sport
4	Non-competitive, multiple sports	Preserved sport
9	Competitive, basketball	Preserved sport
12	Competitive, soccer	Preserved sport
15	Competitive, basketball	Preserved sport

Prioritisation groups: early transition=early transition away from sport as a priority (due to ACL injury). Expected transition=expected transition away from sport as a priority (not due to ACL injury). Preserved sport=preserved sport as a priority.

more variable than postoperative QOL ratings. As visualised in figure 2, when recalled preoperative scores were used in place of actual preoperative ratings, the average improvement in self-reported QOL more than doubled (median unadjusted change: 13, IQR: 20, range: -6 to 62 vs median adjusted change: 29, IQR: 24, range: 5 to 75). The median magnitude of response shift in self-reported QOL (difference in actual vs recalled preoperative scores) was 10 points out of 100 (IQR: 26, range: -9 to 61). We investigated these scores within subgroups of participants categorised by sex, sport, age and by groups formed through qualitative analysis discussed in the next section. However, we were unable to identify patterns in the data that would suggest what characteristics participants exhibiting more response shift in QOL scores shared compared with those with very little shift.

Figure 3 provides visualisations of two participant VAS QOL scales, with different representations of response shift. Figure 3A depicts the distribution of scores one might expect: actual and recalled preoperative QOL scores are quite similar, and the magnitude of response shift is small (5 points). For this participant, the change in QOL they perceived and described postoperatively (adjusted change) is similar to what would have been reported numerically with traditional pre-post measures (unadjusted change). In contrast, figure 3B depicts the VAS of a participant who postoperatively perceived and qualitatively described their QOL to have improved since before their surgery (adjusted change shows a 26-point increase). However, this participant's unadjusted pre-post change score would indicate that their QOL worsened

by 5 points compared with preoperative status. Therefore, if this participant had only reported post-op QOL at follow-up and had not been interviewed, the change score (indicating a small worsening of QOL) would not be representative of their subjective experience of improvement (what PROMs are intended to capture).

When asked to reflect on the discrepancies between recalled and actual preoperative numerical QOL scores, participants provided a few explanations for recalling preoperative status as worse than previously reported. Some athletes hypothesised they were trying to stay positive prior to surgery, and therefore inflated their QOL scores without consciously realising it. Others said that only now (postoperatively, having made close to a full recovery) did they comprehend how poor their knee-related QOL was at the preoperative timepoint. This indicates a recalibration and reconceptualisation of the concepts of knee function and QOL. Interviews revealed that participants' process of appraisal of postoperative QOL appeared different from appraisal of preoperative QOL. This concept was explored through a thematic analysis of the qualitative interview data.

Qualitative themes

Published work investigating baseline interviews with these participants identified four commonly held components of perceived QOL: sport, social support, health, and independence.⁹ Second, we identified processes of preoperative reframing of the injury experience that affected young athletes' perceived QOL.⁹

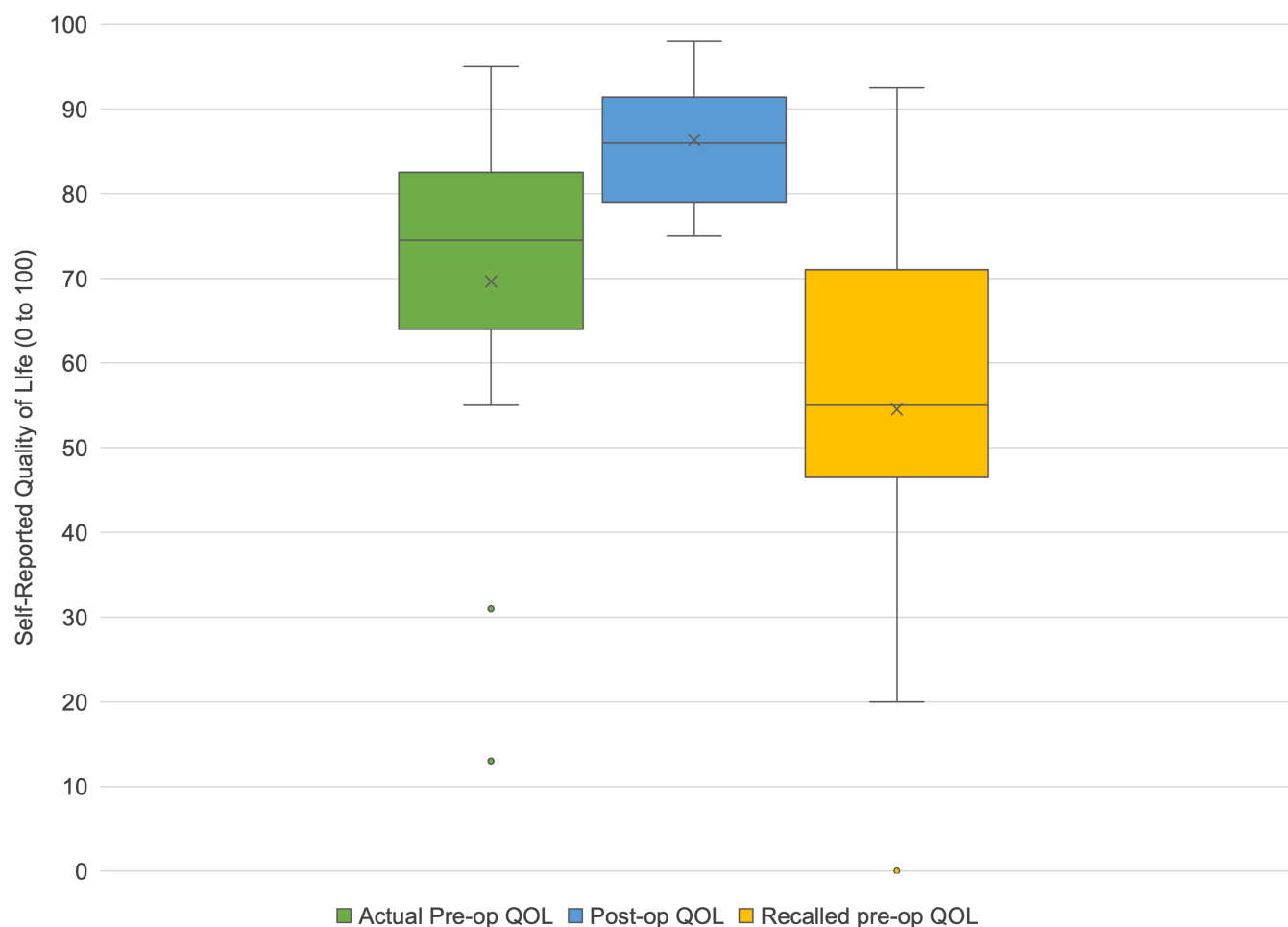


Figure 1 Young athletes' self-reported quality of life scores (0–100 point visual analogue scale). Actual pre-op=preoperative quality of life reported before anterior cruciate ligament reconstruction; post-op QOL=quality of life reported 1 year after surgery; recalled pre-op QOL=preoperative quality of life as reported by patients 1 year after surgery.

One year later, the main themes extracted from post-operative interview data identified that young athletes reconceptualised their personal QOL based on how they:

- ▶ Prioritised sport 1 year after surgery.
- ▶ Used coping strategies and engaged in self-reflection related to their injury.

Sport (re)prioritisation

Every participant listed sport as a major component of their personal QOL preoperatively,⁹ which is logical considering athletes were purposively recruited. Subsequently, the change in patients' conceptualisation of overall QOL appeared dependent on whether they maintained sport as a key priority/component of their life or lowered the importance sport held within their overall QOL. Three different approaches to prioritisation were identified following postoperative interviews, each with a different general storyline related to the prioritisation or focus on sport.

Group 1: early transition away from sport as a priority

The early transition group (8/16 participants) lowered the priority they placed on sport within 1 year following ACLR, and this was described as a direct result of the ACL injury. These participants describe sport as a main priority/defining characteristic of their QOL prior to injury, and how this changed post-injury:

I would say they've [description of quality of life] definitely shifted because before I hurt my knee, physically what I would have considered to be a top quality of life is playing competitive sports ... so it's definitely kind of a lowering of standards of my quality of life and having to raise them in other areas, kind of this jostling between a couple of things and other values and stuff become more important (#1, 22, M) Before my ACL I thought soccer was everything and I did it pretty much since I was 5 and it was non-stop and I finally took a break, well I had to, but I kind of had a breath of fresh air and thought maybe I don't always have to play to still be happy. (#13, 17, F)

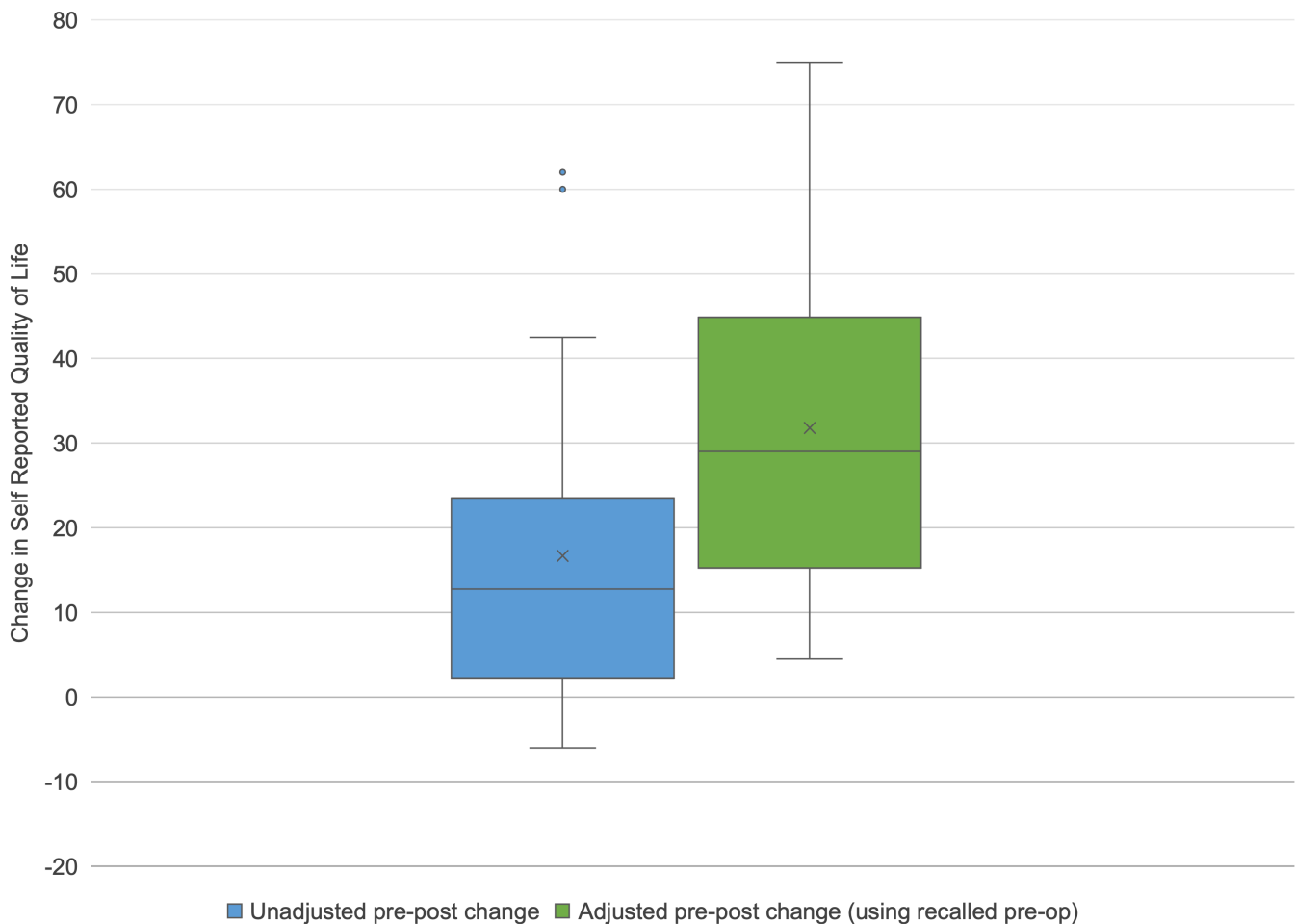


Figure 2 Change in young athletes' self-reported quality of life scores (0–100 point visual analogue scale) from before to 1 year after anterior cruciate ligament reconstruction. Unadjusted change=postoperative–preoperative quality of life scores; adjusted change=postoperative–recalled preoperative quality of life score.

As sport was being given less focus by this group, the school and work components of QOL were often described as being given increased priority. Participants 18 and 14 discuss this reprioritisation and imply they may not have been as concentrated on the future if they had been able to pursue their sport-related plans:

My dream [of] actually making it, you know, for basketball and trying to go to the next level was kind of cut short ... so I was kind of forced to go to plan B, like with my career. (#18, 16, M)

I started focusing on options outside of basketball where I want to go. (#18, 16, M)

I was planning on going to university to play football, but I didn't really get to play that season it's probably better to start focusing on my actual life. So yeah, I would say my plan changed. (#14, 18, M)

Some participants still plan to participate in sports, but their standards related to sport and the intensity of sport held in their definition of QOL has waned, as illustrated by these two participants who were previously playing competitive sports:

My priority before was hockey and getting exposure and playing at a high level ... now honestly just going to university and still playing hockey for sure ... but it's just maybe a little bit more focused on the school side. (#16, 17, M)

Definitely playing [soccer] more for fun, not really serious, but still enjoying it and having fun with this ... not a main priority but something I can do in my pastime. (#13, 17, F)

Group 2: expected transition away from sport as a priority

The next and smallest group (3/16 participants) described a similar pattern to group 1: a lowered amount of focus on sport, with an increased focus on school/work. The difference between groups 1 and 2 is that participants in the expected transition group described the shift away from sport as inevitable based on timing/life and relatively unrelated to their ACL injury.

Participant 20 describes her feelings toward volleyball as a component of her QOL. She had not returned

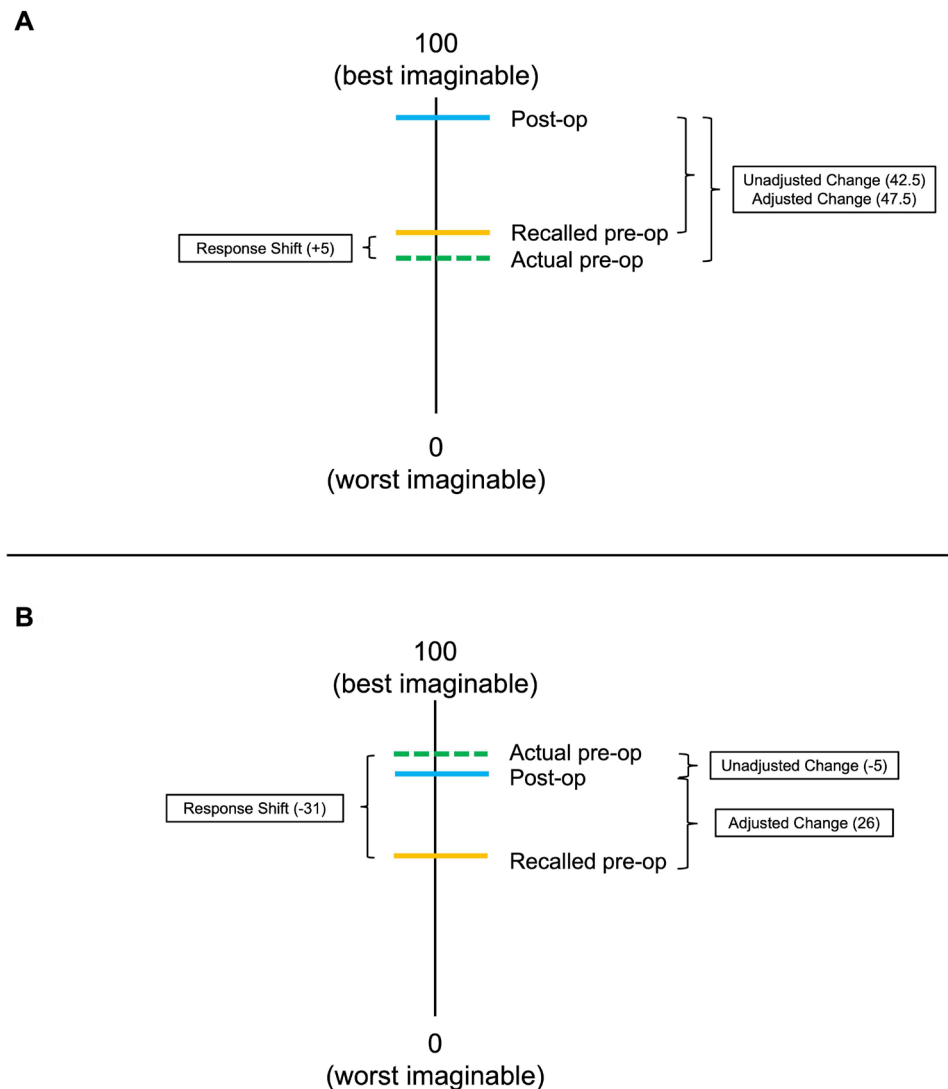


Figure 3 Quality of life visual analogue scale examples. (A) Participant 15; (B) Participant 17.

to playing at the time of her interview but had never planned to play after starting her current undergraduate degree:

I could also say that's [change in priorities] not because of my knee because just like volleyball, not having to play ... I feel that it was going to end sometime anyways (#20, 18, F)

Participant 6 provided insight into how the prioritisation of the components of his QOL affected his mindset after injury:

Even beforehand, like was school always more of a priority than football and that's maybe why it didn't matter as much when you got hurt (#6, 22, M)

Some participants acknowledged that their initial removal from sport was directly linked to the ACL injury, but that at the time of the postoperative interview they likely would not have been playing or focused on sport, simply because of life circumstances and the timing of sport participation:

Yeah, so unfortunately, that season of football when it tore, that was my last season and I don't play anything else competitively speaking so that was kind of it competitively (#6, 22, M)

Next year is my last year of hockey. I won't go anywhere with hockey because I've just played in the school and town my whole life which I love doing ... it's just convenient, so I won't probably go and do anything after. (#17, 16, F)

Group 3: sport preserved as a priority

The third group (5/16 participants) described a maintained or heightened priority around sport. Other components of QOL fluctuated around this core factor. Unlike the participants in the first two groups, participants 15, 12 and 9 described a renewed sense of motivation and focus related to their sport following ACLR, both describing goals to surpass their preoperative level of play:

My competitiveness has really like ramped up and so at the level I'm playing right now, we're a high-level

team but that motor that I have really is like, you can do a little bit more (#15, 17, F)

Sport-wise I still want to get back to the league I was playing in, but they recently announced a women's league probably coming to Canada in the future so that's kind of in the realm of a goal (#12, 24, F)

Of course I'm still aiming for that stuff. Like my goals haven't changed, it's not like before I wanted to play D1 and now I don't. (#9, 17, F)

In response to the ACL injury and initial cessation of sport participation, these athletes talked about adjusting their expectations regarding the timeline to maintain and achieve their sport-related goals.

I might have to take the year to just get back into my body and figure out how things were and then next year use that to reach that goal so it's just lengthening the timeline. (#12, 24, F)

I still want to get back and do the exact same things as what I wanted to beforehand, the expectations of when has changed but what I want to do is the same. (#4, 21, M)

While we had hypotheses regarding more competitive athletes being more likely to maintain sport-related priorities, it was difficult to tease out patterns in this group. A larger sample may be better able to investigate this hypothesis. Table 2 displays participants' preinjury level of sport participation, main sport and the prioritisation group they were categorised as according to our thematic analysis.

Coping strategies and self-reflection

Participants used a wide variety of coping strategies which contributed to their overall conceptualisations of surgical outcome and QOL. The main strategies discussed were maintaining a positive mindset, starting new activities, setting goals and using social supports. The different strategies appeared relatively consistent across participants without clear subgroups emerging.

A few examples of each strategy as described by participants are available in table 3.

Many participants exhibited self-reflection when talking about their recovery, and described lessons learnt or aspects of personal growth over the year since having ACL surgery. Interestingly, the type of reflection seemed to group similarly to the different levels of sport prioritisation discussed earlier.

Participants who lowered their priorities around sport (the early or expected transition away from sport groups) talked about the realisation that *there is more to life than sport*:

I guess before this it was just hockey, hockey, hockey, and maybe there's other things in life right? Even though I still have hockey there are other new things that I can do ... there are other aspects to like I guess, I just found out. (#16, 16, M)

Like it's fun to play football but like I mean like we're all growing up right (#14, 18, M)

I've kind of executed a lot of things that I really wanted to do that I only figured out I wanted to do while having that down time of not being able to do anything. (#8, 21, M)

My perspective has definitely changed because it's just like maybe you don't have to put all your eggs in one basket [referencing sport], maybe spread them out (#16, 6, M)

In contrast, participants who maintained a strong focus on sport, expressed a *new attitude towards sport and/or increased appreciation for sport*:

I still have all those goals, I still want to play for Team Canada again, I want to do all that stuff but it's just that I'm not being brought down by a bad performance. I'm remembering that six months ago I couldn't even play so playing now is just a blessing in itself. (#9, 17, F)

This surgery has made me more appreciative of the resilience of the human body for sure. (#6, 22, M)

Table 3 Coping strategies used by young athletes following anterior cruciate ligament reconstruction with example illustrative quotes

Coping strategy	Example quote
Positive mindset	'I remembered what I couldn't do two days ago and that would push me to keep going because I did see the big progress day to day and that was a big motivator'.
New activities	'I started playing pickleball with my parents and their friends and it's actually a lot of fun'. 'I found a lot of joy in like reading books ... especially in the beginning stages of my recovery where I wasn't really able to do much'.
Setting goals	'At times it did feel kind of frustrating seeing that lack in what you could do before and what you can do now but just putting my goals ahead of myself and reminding myself that a lot of people have gone through it and that was a big help to me personally'. 'I really think a thing that helped me get through was just thinking about the end goal and just looking forward to that'.
Social support	'A lot of people in my sport that I know that have just been cleared or have already gone through it or at kind of a similar point as me so talking to them and realizing that they're feeling the same thing that I was feeling helped a lot just knowing that my struggles weren't just my struggles'. 'I feel like I got a lot more family oriented too. Not that I wasn't ever before but the fact that I feel like I relied on them so heavily, especially the first few months when everything was hard to do'.

I've managed to enjoy the game so much more because I haven't been able to do it so it's just more enjoyable now which is kind of sad that you have to not play for a year before you realize you just like playing in general.

If you can't do something you love for long and you come back to it you're going to love it even more but I think that's changed so the way I see myself playing basketball too like I'm just enjoying playing it and honestly in that I think I'm going to be even better of a player then I was before because when I was constantly worrying about how to perform you don't usually perform very well when you're worried about it. (#9, 17, F)

DISCUSSION

The main message of this work is that QOL does not mean the same thing to athletes before and after ACLR. This has important implications in both clinical and research settings. We used descriptive qualitative methodology longitudinally (preoperative and postoperative) to identify potential mechanisms of response shift, reflected in cross-sectional quantitative scores. When participants used a VAS to rate perceived QOL based on their personal definitions of the construct, perceived improvements tended to be larger when recalled preoperative scores completed at follow-up were used rather than the actual preoperative scores completed a year prior. In postoperative interviews, athletes were organised into three groups based on the importance sport played in individual definitions of QOL from preoperative to postoperative. The 'early transition away sport from sport as a priority' group lowered sport as a priority and tended to focus on school or work, describing this as a direct result of their ACL injury. The 'expected transition away from sport as a priority' group similarly reduced focus on sport while increasing school or work as priorities, but ascribed this change more to timing and life plans rather than their ACL injury. The 'sport preserved as a priority' group maintained or elevated the importance of sport as a key contributor to overall QOL. These postoperative findings built on our first study which identified processes of reframing the injury experiences following ACL injury prior to surgical intervention. In the preoperative period, we identified that athletes' self-reported QOL prior to surgery was influenced by whether they shifted focus to the unaffected aspects or negatively affected aspects of QOL following ACL injury.⁹

Presence of response shift was supported by the then-test method of assessing QOL scores. Participants tended to recall their preoperative QOL as much worse than they had rated it during the preoperative interviews, meaning positive recalibration was identified: participants' change in QOL (preoperative to postoperative) was larger when the recalled preoperative scores were used. The adjusted change score is calculated from two scores completed at the same time, with participants in the same frame of reference for appraising their QOL and may therefore

better reflect perceived change. If patients are perceiving a greater improvement in self-reported outcomes than what is reflected in traditional pre-post change scores, it is possible that change/mean treatment effects are being underestimated or misclassified in some contexts.^{5 20}

While the overall presence of response shift was mirrored in both qualitative and quantitative results, the sport (re) prioritisation identified qualitatively did not seem to drive the response shift measured quantitatively in this study. This process and others could be identified as being correlated/predictive in a quantitative study with a larger sample size.

The finding of positive recalibration response shift (overestimation of preoperative disability) has also been reported in studies investigating patient-reported pain and function following total knee arthroplasty^{21–23} and autologous conditioned serum injection²⁴ for knee osteoarthritis. In a qualitative then-test study with patients before and after radiotherapy treatment for cancer, participants often provided a different description of pretreatment function during the postoperative recall interview than they did prior to treatment.²⁵ The authors suggested that future studies present patients with their previous (baseline) scores and be given a chance to comment on them to provide insight into response strategies.²⁵ We added this step to the current study and questioned participants about discrepancies between their recalled and actual pre-operative QOL ratings.

Theoretical model development: the SPARQ ACL Model

Based on the longitudinal qualitative data collected prior to ACLR⁹ and 1 year after surgery, we propose the SPARQ ACL Model (the Sport Prioritisation and Athlete Reconceptualisation of Quality of life after ACL Injury Model). This model represents athletes' conceptualisation of QOL following ACL injury and reconstruction (figure 4). The model consists of two key components from our studies: (1) preoperative framing of the injury experience and (2) postoperative prioritisation of sport within the individuals' global perception of their QOL, and is supported by descriptive quantitative measures of athletes' self-reported QOL. Additionally, we identified that the processes outlined within the model are likely influenced by individual coping strategies and self-reflection, and external factors such as opportunity and environment.

The presence and influence of response shift in patient-reported outcome measurement is a growing field of research but has not been investigated in our population of interest: athletes recovering from ACL injuries.^{6 7} Employing a coding framework based on established response shift theory (online supplemental material 2) improved our ability to make sense of participant experiences across time. Specifically, codes related to the mechanisms of response shift and explanations for these mechanisms allowed us to construct themes that contextualised the detection of response shift in a new patient population, culminating in the SPARQ-ACL

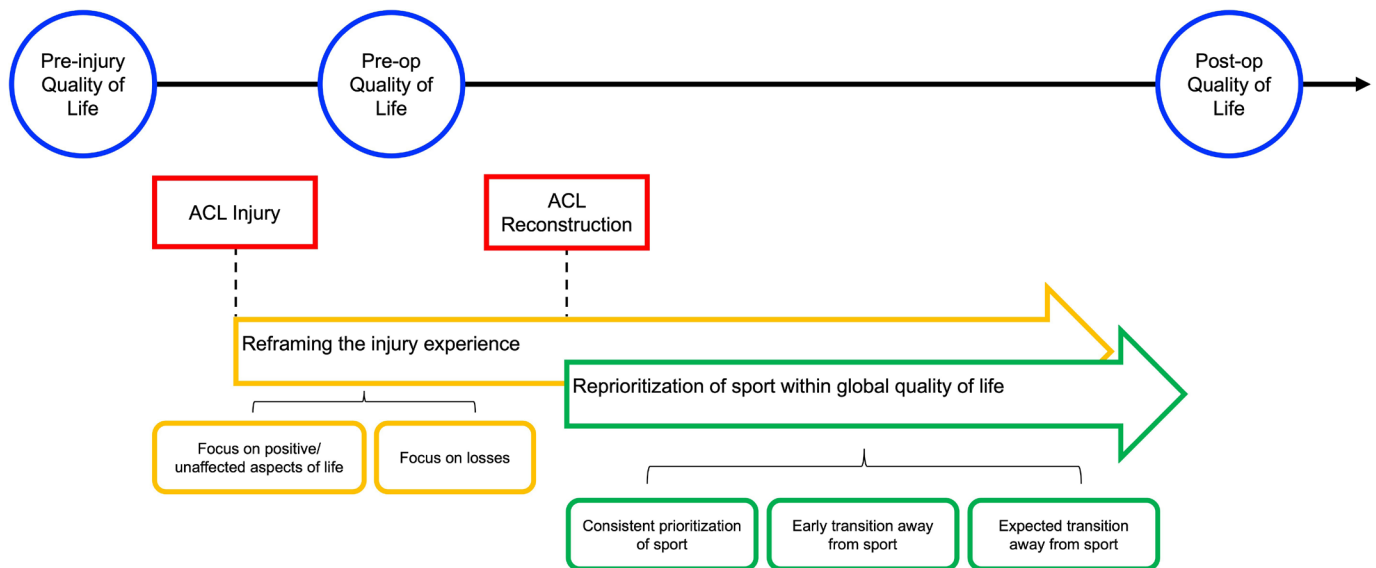


Figure 4 The SPARQ ACL Model. SPARQ-ACL Model: Sport Prioritisation and Athlete Reconceptualisation of Quality of Life after ACL injury Model. The model describes (re)conceptualisation of quality of life and (re)prioritisation of sport across time following anterior cruciate ligament injury and surgery in young athletes, based on preoperative and 1-year postoperative interviews with 20 participants. QOL, quality of life.

Model which includes multiple aspects of response shift theory.

Despite similar ratings of postoperative QOL reported by participants, each athlete verbalised a unique process of conceptualising their life in the context of recovery from ACL injury. Qualitative exploration helps fill an identified gap in response shift research as to understanding the variability in response shift.²⁶ Our experience speaking with patients supports the theory that QOL appraisal is an individual experience, influenced by multiple factors thought to be correlated with QOL including personal circumstances, stressful events, progression or recovery of impairments, and individual criteria used to evaluate QOL.²⁷ Our findings support response shift theory in suggesting that mechanisms of recalibration, reprioritisation and reconceptualisation may help explain why individual perceptions of health-related QOL change across time following a health-related event.⁴ Our findings and proposed model are further supported by previous work suggesting processes of reframing and reprioritisation occurring after ACL injury.^{6,7} Similarly, patients interviewed regarding their health-related QOL following stem cell transplant described changing values and internal standards.²⁸ Furthermore, these participants described similar strategies to manage threats to QOL as our participants: optimism, social support and goal setting in addition to social comparison and changing expectations.²⁸ In an orthopaedic setting, interviewed patients reported successful outcomes following total knee arthroplasty despite ongoing pain and functional limitations.²⁹ The authors proposed response shift as one explanation for this, theorising that patients had adapted to and rationalised their new health state, therefore reconceptualising the success of their outcome in an attempt to understand it.²⁹

The changes and variability in how sport was positioned within athletes' perception of overall QOL mirrors what has been discussed in the literature surrounding athletic identity. Studies of patients following ACLR have shown that self-reported athletic identity decreases significantly across rehabilitation, specifically in the year following surgery.^{30,31} Brewer *et al* identified a greater reduction in athletic identity for athletes with slower recoveries after ACL injury and propose that a lowering of athletic identity may have a self-protective mechanism for athletes who are faced with difficult recoveries, physical performance below their expectations and potential disappointments.³¹ The narratives provided by our interviewees could be interpreted as aligning with previous studies, given that most participants (about three-quarters) decreased their athletic identity. However, we avoided these labels as they did not sufficiently capture what participants were describing, and athletic identity was never mentioned explicitly. Other studies suggest that an increased athletic identity is associated with favourable responses such as improved coping to stressors, returning to preoperative levels of sport and reduced kinesiophobia.^{30,31} These findings are limited to quantitative self-report outcomes, and our qualitative investigation indicated that many if not all participants who decreased their emphasis on sport were coping quite well with high levels of perceived QOL and self-reflection indicating personal growth.

Clinical and research implications

While this study is exploratory and further research is required to support the theories presented here, we have used this work to create three key messages that will be beneficial to clinicians and clinical researchers who work with young athletes following ACL injury.

- Be cognisant of changes over time:

A primary finding of this novel longitudinal qualitative work is that the meaning young athletes assign to their injury and different aspects of QOL changes over time. Importantly, participants' description of QOL changed from preoperative to postoperative, and the changes identified were not homogenous across all athletes. Therefore, the temporal aspect of outcome appraisal (respondents' perception of their symptoms, function, QOL, etc) is critical to consider. Our interviews provided evidence that patients are not always answering postoperative questions in the same frame of reference as they were preoperatively and this must be considered when evaluating pre-post comparisons. Specifically, patient priorities may change over time. Effective shared decision-making relies on healthcare professionals accurately understanding patient priorities, which they do not always achieve.³² In ACLR, we showed that surgeons tend to prioritise clinical outcomes while patients prioritise functional outcomes.³³ The fact that priorities may fluctuate once established adds another layer of complexity in clinical decision making. Understanding temporal patient experiences will allow for better interpretation of outcomes and may inform individualised treatment strategies.

► Consider the context:

Athletes will experience different levels of loss surrounding sports following ACL injury. This appeared to be based more on their personal life context and the meaning they ascribe to sport in their life, rather than the experience of injury itself. Personal context may therefore be valuable to understanding why one individual's QOL is more greatly affected than others following the same injury. As such, we believe that it is important to make a distinction between experiencing a larger loss and being a poor copier or experiencing a smaller loss and being a positive copier. As an illustrative example imagine two patients: A—a professional soccer player who experiences significant difficulty dealing with their ACL injury and B—a university student who plays golf recreationally with friends in the summer does quite well following ACLR. Quantitatively, it may be determined that patient A is not a copier because their postoperative QOL score is quite low, and that patient B is a super copier as their QOL score is quite high. To combat this fallacy, clinicians should understand what sport means to each patient and the context sport is placed in for them (identity, external pressures, etc).

► Use mixed methods:

While PROMs are important tools for evaluating group-level outcomes, they provide a single snapshot in time, do not provide context and assume invariance of the construct being measured across time. These pitfalls are highlighted in the current study and outlined in the previous two points. Qualitative investigations can help overcome the limitations and enhance the findings of quantitative methodologies.

Curry and colleagues outline key research aims that may be best suited to qualitative methods: investigating complex phenomena (ie, changing patient perspectives), generating a comprehensive understanding of a problem (ie, why do only some athletes return to sport after ACLR), developing good measurement processes or instruments (ie, ACL injury specific PROMs), and studying underrepresented populations (ie, patients of low socioeconomic status following ACL injury).³⁴ Increased use of qualitative inquiry may help explain mechanisms and nuances in ACLR outcomes that we traditionally attach numbers to. Triangulation of quantitative and qualitative evidence helps ensure the validity and reliability of research conclusions.³⁵ In a clinical context, healthcare practitioners should be comfortable with using qualitative-based research as part of evidence-based practice.³⁶

Limitations

The ideas and theory presented from the current study cannot be generalised to all young athletes undergoing ACL reconstruction. Our sample was limited in diversity considering participants were recruited from a specialist clinic, were predominantly white, spoke English and had access to technology to participate in videoconferencing for interviews. We did not purposively sample or stratify by type of sport/activity level or age, factors which may affect recovery and QOL. The composition of the sample likely represents the population of young athletes seen at the study clinic but may not be representative of populations seen at other institutions.

Additionally, we did not have any participants who reported an objectively poor QOL rating 1-year post-ACLR (lowest score was 75 out of 100). No participants in our sample had experienced a graft rupture or contralateral ACL injury at the time of their follow-up interview. It is likely that this significant adverse event would greatly affect the responses participants would provide to questions about their recovery, satisfaction and QOL. With patients being recruited prior to ACLR, we were not able to identify those who would experience an adverse knee- or life-related event that would lower their QOL. A future study using purposive sampling of individuals who experienced poor outcomes or low QOL would be helpful to better understand factors related to that patient experience.

There are limitations in our use of a single-item VAS to measure QOL, which is inherently a multi-dimensional construct. However, this measure may be more feasible for clinicians to use as an adjunct to subjective assessment and discussion with patients during clinical care. Additionally, the small sample size of this study limits our ability to conduct analyses beyond descriptives and to draw any conclusions about subgroups associated with the magnitude of response shift. Quantitative investigation of recalibration response shift should be investigated in a larger sample using common PROMs for patients

after ACL injury that include multiple dimensions and constructs related to ACLR outcomes.

We would like to understand whether there are factors that may be associated with or predict the magnitude of changing conceptualisation (response shift). In the current study, no specific factors including coping strategies, how athletes prioritised sport, preoperative or postoperative QOL scores, level of sport, nor sex appeared linked to this concept. Larger prospective studies are needed to investigate this question.

CONCLUSION

QOL does not mean the same things to athletes before and after ACLR. Young athletes exhibited multiple divergent conceptualisations of QOL following ACLR, influenced by complex factors. True change in patient-reported outcomes across time cannot be validly measured if the definitions of constructs are changing. It is important to acknowledge how individuals' shifting perspectives affect the measurement of such outcomes in research and during recovery in a clinical setting. Using the longitudinal qualitative data, supported by descriptive quantitative data, we propose the SPARQ ACL Model of Sport Prioritisation and Athlete Reconceptualisation of Quality of life following ACL injury and reconstruction to help understand these changes.

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