doi: 10.4085/1062-6050-0618.20

Positive reframing: An important but underutilized coping strategy in youth athletes undergoing sports-related knee surgery

Joshua S Everhart, MD MPH1; Alex C DiBartola, MD, MPH1; Christian Blough BS1; Steven E Schiele, MS2; Kristie M Harris, PhD2; Charles F Emery, PhD2; David C Flanigan, MD1

1Sports Medicine, Ohio State University Department of Orthopaedics
2Psychology, Ohio State University

Short title: Positive reframing for sports injuries

Disclosures: The authors received no funding for this study and report no conflicts of interest.

This project was approved by the Biomedical Institutional Research Board of The Ohio State University.

Correspondence:

David C. Flanigan, MD
Sports Medicine Research Institute
The Ohio State University Wexner Medical Center
2835 Fred Taylor Dr, Columbus, OH 43202
Phone: (614) 293-3600
Fax: (614) 293-2910
david.flanigan@osumc.edu

Readers should keep in mind that the in-production articles posted in this section may undergo changes in the content and presentation before they appear in forthcoming issues. We recommend regular visits to the site to ensure access to the most current version of the article. Please contact the JAT office (jat@slu.edu) with any questions.
Positive reframing: An important but underutilized coping strategy in athletes undergoing sports-related knee surgery

Abstract

Context: It is unknown how specific coping strategies are associated with the short-term outcomes among athletes following knee surgery.

Objective: 1) To determine whether specific coping strategies are associated with satisfaction, return to sport, self-reported knee function, or kinesiophobia following sports-related knee surgery. 2) To determine whether these associations vary by age, sex, or surgical procedure.

Study design: Case series.

Methods: Athletes (n=184 total; n=104 men, n=80 women; n=38 age <20 years, n=35 age 20-25, n=36 age 26-31, n=36 age 32-40, n=39 age >40) who underwent outpatient knee surgery were enrolled from a single center. Utilization of specific coping strategies (self-distraction, use of emotional or instrumental support, venting, positive reframing, and acceptance) was assessed pre-operatively with the Brief-COPE inventory. Relationship between coping strategies and post-operative satisfaction, return to sport, International Knee Documentation Committee-subjective (IKDC-S) and Tampa Scale for Kinesiophobia scores at median 10.7 months follow-up were determined with consideration for age, sex, and surgical procedure.
Results: Return to prior level of sport was 72%, and satisfaction was 86%. Most coping strategies had age-specific utilization rates; positive reframing was utilized least frequently in ages <20 years. Satisfaction increased with greater positive reframing among ages <20 years and decreased with greater self-distraction among men. Return to sport was higher with greater positive reframing in ages <32 years. No coping strategies predicted IKDC-S scores. Greater positive reframing correlated with lower kinesiophobia in ages <20 years. Greater instrumental support correlated with lower kinesiophobia in ages >40 years. No other coping strategies were associated with outcomes. Surgical procedure was not related to association between coping strategies and outcomes.

Conclusion: Coping strategies have age-specific associations with outcomes after knee surgery in athletes. Positive reframing is infrequently utilized in younger athletes. Greater use of positive reframing in this group may improve satisfaction, return to sport, and lower fear of re-injury.

Key terms: knee injury; coping strategies; knee surgery; sports psychology; youth athletes
Key points:

- Among injured athletes requiring knee surgery, reported coping strategies varied by age and sex.
- Young athletes under age 20 years are less likely than older athletes to report use of positive reframing as a coping strategy.
- Young athletes that do report higher use of positive reframing as a coping strategy tend to have higher satisfaction rates, higher rates of return to sport, and lower levels of kinesiophobia (fear of re-injury) after surgery.
There is a growing body of evidence that psychological factors can significantly affect rehabilitation quality and outcomes after sports related knee surgeries. Absence from sport due to injury can be associated with significant psychological distress, and the specific stressors experienced by injured athletes vary among individuals and can change throughout the recovery process. Additionally, multiple psychological factors have been identified that have been described to decreased chance of return to sport. Webster et al. found that psychological readiness for surgery predicts return to sport. Forsdyke et al. documented the various coping strategies that athletes use in the recovery from injury and an athlete’s return to sport.

Following sports-related injuries, younger athletes are at risk for psychological distress. The growing trend of single sport specialization at a young age may be associated with younger athletes development of a heightened athletic identity. This is often a positive, as it promotes self-confidence and growth, but research has demonstrated an association with increased psychosocial stress following sport injury, as the athlete is removed from their team and sport that they identify with; this increased stress has been demonstrated to limit recovery. This is not often the case in older athletes, as most identify with something other than a sport, or have more developed social networks. Sports injury can also be associated with depression. These depressive symptoms have been studied and shown to be correlated with the time elapsed after injury and gender. Alternatively, the impact of a sport injury on older patients can be associated with stress distinct from youth athletes, as many injuries can require extended time away from work. Time away from work and the cost of medical care is associated with significant financial stress for adult patients.
Associations between specific psychological factors and sports related knee surgery outcomes have been documented\textsuperscript{4,11}. Coping strategies among athletes can vary by age\textsuperscript{12} as well as by gender\textsuperscript{13}, and the productiveness of specific coping strategies varies depending on the specific stressor or problem encountered\textsuperscript{14}. Additionally, the coping strategies used can vary throughout the different stages of recovery, with negative feelings dominating soon after injury\textsuperscript{2}. Among adolescents, there are significant individual differences in coping strategies when confronted with a stressful situation\textsuperscript{15}, and youth athletes appear more likely to use maladaptive coping strategies such as behavioral disengagement and less likely to utilize positive reframing, planning and acceptance than older athletes\textsuperscript{12}. Additionally, there are sex differences in coping with stress\textsuperscript{16,17}, including among competitive athletes\textsuperscript{17}. For instance, women score higher on emotional and avoidance coping styles and lower on rational and detachment coping when compared to their male counterparts\textsuperscript{17}.

The purpose of the current study are: 1) to determine whether specific coping strategies are associated with satisfaction, return to sport, self-reported knee function, or kinesiophobia (fear of re-injury) following sports-related knee surgery, and 2) to determine whether these associations vary by age group, sex, or surgical procedure. We hypothesize that there will be age and sex specific differences in coping strategies as well as the association between these strategies and outcomes. Specifically, we hypothesize that younger patients will report using lower levels of instrumental support and positive reframing. We also hypothesize that the relationship between coping strategies and outcomes will not be associated with a specific surgical procedure performed.

Methods
After institutional review board approval, patients who underwent sports-related knee surgery were enrolled from a single university hospital-based sports medicine center between 2014 and 2016. Consent was obtained for all study participants prior to inclusion in the study and assent to participate as obtained from minors (under the age of 18) and consent was obtained for their parents. Inclusion criteria were age over 14 years, regular participation in sporting activity at least 3 days per week prior to their injury, and presence of knee pathology requiring surgical treatment. At time of enrollment for surgery, patients were consented to complete an online self-administered psychological assessment. A cohort of 224 patients completed enrollment, but a total of 40 patients were excluded: 35 did not identify as regularly participating in sporting activities, and 5 did not complete the coping scale as part of the pre-operative survey. Of the 184 remaining patients, follow-up was obtained on 82% (n=151/184) at median 10.7 months (interquartile range: 18.8, 3.6). The minimum length of follow-up was dependent upon the surgical procedure: for knee arthroscopy with debridement or partial meniscectomy the minimum length of follow up was 3 months and for all other surgeries the minimum length of follow-up was 6 months.

The primary procedures performed included arthroscopy with debridement or meniscectomy (n=65, 35%), anterior cruciate ligament reconstruction (n=62, 34%), cartilage restoration (microfracture, osteochondral allograft, or autologous chondrocyte implantation [n=34, 18%]), isolated meniscus repair (n=17, 9%) or other tendon/ligament repair (n=6, 3%). All patients participated in published and guided, procedure specific, post-operative rehabilitation programs that were supervised by a physical therapist and physician.

An a priori power analysis was performed, and the sample size per age group was determined to be adequate to detect a 0.6 point difference in self-reported frequency of use of
coping strategies with 80% power and alpha = 0.05. No minimum clinically important difference in COPE (Coping Orientation to Problems Experienced) scores is established for athletes, however the current study’s 0.6 point difference is less than half of the standard deviation for coping strategies as assessed by the brief COPE inventory in a large (n=550) study of athletes\textsuperscript{12}, indicating that the present studies patient population is adequate to detect a relatively small difference (as compared to other studies).

The preoperative survey was available in online format through a secure personalized hyperlink provided via electronic mail to each patient. A paper format was also made available though no patients elected to fill out the paper survey. International Knee Documentation Committee subjective scores (IKDC-S)\textsuperscript{18} and Tampa Scale for Kinesiophobia (TSK-11 item)\textsuperscript{19} were assessed before surgery (during the time between the pre-operative appointment and the day of surgery) and again at median 10.7 months after surgery.

Coping strategies were assessed with the brief COPE inventory (Brief-COPE)\textsuperscript{20}. The Brief-COPE is a 28-item questionnaire that instructs the reader to consider how frequently he/she utilizes specific coping strategies to deal with stress or difficult situation. For the purpose of this study the prompt was modified to specify “ways you’ve been coping with the stress in your life since you found out you were going to have to have this operation.” Each statement is rated on a 4-point Likert scale from 1 (I haven’t been doing this at all) to 4 (I’ve been doing this at a lot). The Brief-COPE measures 14 distinct dimensions of coping, though for the current study only 6 were utilized: self-distraction, venting, acceptance, positive reframing, use of emotional support, and use of instrumental support. These 6 subscales were selected based on prior age or sex-specific associations with specific coping strategies identified in athletes.\textsuperscript{12,13,15,17} Self-distraction involves ignoring the stressor and focusing on unrelated thoughts or tasks. Venting
entails focusing on the stressor in conversations with others. Acceptance entails that the person accepts the reality of a stressful situation in an attempt to deal with the situation. Positive reframing involves focusing on ways that a stressor may actually be positive or beneficial. Use of emotional support entails seeking emotional support from others to cope with a perceived stressor. Use of instrumental support entails physical reliance on others for tasks such as transportation. Scores for each coping strategy in the Brief-COPE inventory range from 2 to 8, with higher scores indicating greater self-reported use of the coping strategy. The Brief-COPE has adequate internal consistency reliability (Cronbach’s alpha 0.71–0.96), test-retest reliability and concurrent validity.20,21

Patient reported satisfaction was determined by the following question on follow-up evaluation: in regard to the outcome of your surgery, would you say that you are very satisfied, somewhat satisfied, neutral, somewhat dissatisfied, or very dissatisfied? Satisfaction was defined as a response of “very satisfied” or “somewhat satisfied,” and dissatisfaction was defined as a response of “neutral,” “somewhat dissatisfied,” or “very dissatisfied.” Return to sport was defined as confirmation by the athlete that he or she had returned to their prior pre-injury activity of choice at the time of the satisfaction survey. The IKDC-S survey was re-administered at the time of the satisfaction survey.

Statistical analysis

Descriptive statistics were first generated for the entire sample and with stratification by sex or age group (<20 years, 20-25 years, 26-31 years, 32-40 years, and >40 years). Baseline differences in categorical variables were assessed by Chi-square test and differences in continuous variables were assessed by one-way ANOVA with post-hoc testing of between group differences. The odds of return to prior level of sport or post-operative satisfaction by specific
coping strategies were assessed by logistic regression with results reported as Odds Ratio (OR) and 95% confidence intervals (CI). The association between coping strategies and continuous outcomes (IKDC-S and kinesiophobia scores) was assessed via linear regression. These tests were performed before and after stratification by age or sex. Surgical procedure and length of follow-up were included as interaction terms in all tests and was found to be non-significant in all cases (p>0.25).

**Results**

Return to prior level of sport was reported as 72% with similar rates between sexes but higher rates with increasing age (50% under age 20, 90% over age 40; p<0.001) (Table 1). The age-specific return to sport rates correspond to age specific differences in surgical procedure, with greater rates of arthroscopy with debridement or meniscectomy among older patients (75% among patients age >40 years) and greater rates of repair or reconstructive procedures among younger patients (65% among patients age <20 years) (p<0.001). Reported satisfaction was 86% overall with higher rates over age 40 (100%) versus under 40 (83%) (p=0.004) and no difference between sexes. There were no age- or sex-specific differences in post-operative IKDC or kinesiophobia scores.

**Age and sex differences in self-reported coping strategies**

All reported coping strategies other than venting and acceptance had age-specific utilization rates (p<0.05) (Table 2). After stratifying by age group, reported utilization of specific coping strategies was unrelated to the planned surgical procedure (p>0.25, all comparisons). Positive reframing was reported to be used less frequently among youth athletes (age <20) (mean 3.9/8 ± 1.1, max 6/8) compared to ≥20 years (mean 4.6/8 ± 0.9, max 8/8) (p=0.001). Among the investigated coping strategies, self-distraction was reported to be used more frequently among
men (men 5.7/8 ± 1.4 versus women 5.3/8 ± 1.4; p=0.03); no other significant sex-specific trends were identified.

Coping strategies as a predictor of satisfaction

Positive reframing was associated with a higher likelihood satisfaction for athletes <20 years (per point increase in positive reframing score: OR 6.21 CI 1.29, 11.5 p=0.02) but no association in other age groups (Table 3). Self-distraction was associated with lower likelihood of satisfaction in men (per point increased use of self-distraction, OR 0.53 CI 0.30, 0.89 p=0.02). No other coping strategies were associated with satisfaction in the entire sample or after stratification by age group or patient sex (Table 3). The surgical procedure and length of follow-up did not have an association with the relationship between coping strategies and satisfaction (p>0.25, all interaction terms).

Coping strategies as a predictor of return to sport

Reported use of positive reframing was associated with higher rates of return to prior level of sport among athletes in the <20, 21-25, and 26-31 age groups (per point increase in satisfaction in ages <32 years; OR 2.36 CI 1.12, 5.10; p=0.009) but not the 32-40 or >40 age groups (Table 3). The association between reported use of positive reframing and return to sport did not vary by sex. No other coping strategies were predictive of return to sport for the entire sample or after stratification by age group or sex (Table 3). The surgical procedure and length of follow-up did not have an statistically significant relationship with coping strategies and return to sport (p>0.25, all interaction terms).

Coping strategies as a predictor of IKDC-subjective score
No reported use of a coping strategy was found to be predictive of IKDC-subjective scores at a follow-up (Table 3). No association was found for the entire sample, after stratification by age group or sex, or with consideration for surgical procedure or length of follow-up.

Coping strategies as a predictor of post-operative kinesiophobia

Athletes under age 20 who reported employing greater positive reframing had lower kinesiophobia scores at follow up (per 1 point increase positive reframing, mean 2.9 point decrease kinesiophobia score; \( r=-0.53, p=0.02 \)) as did athletes over 40 that used greater instrumental support (per point increase instrumental support, mean 2.0 point decrease kinesiophobia score; \( r=-0.48, p=0.01 \)) (Table 3). No sex-specific associations between reported use of a specific coping strategies and post-operative kinesiophobia were identified. No other coping strategies were found to be predictive of post-operative kinesiophobia (Table 3). Surgical procedure and length of follow-up did not have an association with the relationship between coping strategies and post-operative kinesiophobia (\( p>0.25 \), all interaction terms).

Discussion

In the current study we identified age and sex specific differences in coping strategies utilized among athletes undergoing sports-related knee surgery. Positive reframing is an infrequently coping strategy among youth athletes that undergo sports related knee surgery. The beneficial associations between of positive reframing and satisfaction and return to sport in youth athletes were present regardless of surgical procedure. Additionally, athletes over age 40 who used greater instrumental support (physical reliance on others for tasks such as transportation) had less post-operative kinesiophobia, whereas male patients that used greater self-distraction had lower ratings of satisfaction after knee surgery. These findings provide an interesting starting
point for potential interventional strategies early in the recovery process to emphasize helpful coping skills and improve surgical outcomes.

Previous studies have shown that youth athletes encounter different psychological stressors following injury than adults\(^8\) and that youth athletes appear more likely to use maladaptive coping strategies such as behavioral disengagement and less likely to utilize positive reframing, planning, and acceptance than older athletes\(^12\). The current study confirms that youth athletes tend to use positive reframing infrequently, though this is also the age group in which positive reframing has the greatest association with clinically relevant surgical outcomes including return to sport, post-operative satisfaction, and degree of post-rehabilitation kinesiophobia (fear of pain or recurrent injury during movement) (Table 3). Positive reframing has been shown to positively affect many aspects of life, improving metrics both psychologically and physiologically after negative stressors\(^22\). Salim et al. found that in a study of 206 injured athletes who had recently returned to sport, positive reframing was found to significantly mediate the relationship between hardiness and perceived stress-related growth\(^23\). Positive reframing has also been found to be helpful if used during earlier phases of rehabilitation from sport injury\(^6\).

There are established interventions designed to encourage helpful coping methods that can be applied to the injured youth athlete. Cognitive behavioral therapy or resilience training has been shown to improve coping strategies and reduce psychological distress in college students\(^24\). Injured athletes can have a negative stigma surrounding perceived psychological assistance; this should be minimized if possible as it can negatively impact the benefit received from intervention\(^25\). Athletic trainers may have a key role in providing guided intervention\(^26\) as well as sports psychologists who are well trained to provide cognitive behavioral therapy to enhance helpful coping mechanisms and address performance issues with return to sport\(^27\). The
comfort level of athletic trainers with sports psychology specialists was associated with the rate of referral for intervention\textsuperscript{26}, and is something that could be targeted to increased interventions in the future. A multidisciplinary intervention to address performance and coping issues in injured athletes can improve outcomes\textsuperscript{28}.

A significant sporting injury in older patients is associated with distinct stressors in youth athletes, including time away from work and financial stressors\textsuperscript{10}. Greater use of instrumental support (physical assistance from others for tasks) was uniquely associated with higher activity levels and lower rates of kinesiophobia only in athletes over age 40 in comparison to other age groups. In the current study, patients reported lesser use of instrumental support with increased age (Table 2). This may be secondary to a general decreased reliance on others for physical assistance in adulthood with the exception of elderly patients who substantially benefit from regular instrumental support to improve general health-related quality of life\textsuperscript{29}. On the contrary, younger athletes seem to rely on others for support during the post-operative period and when injured. Patients over age 40, who are normally self-sufficient regarding physical task completion, could be encouraged to more actively seek greater assistance from others to help with transportation and activities of daily living following knee surgery, in a similar fashion to their younger counterparts. This is distinct from the intervention proposed for youth athletes based on the current study findings, which is primarily a psychological intervention.

\textit{Limitations}

There are several limitations to the current study. First, the study follow-up period ranged from 3-21 months. This high range may allow for some athletes early on in the post-operative period to be satisfied initially, whereas if they later experienced a setback, they may end up being not satisfied had they been followed longer. In addition, our findings may not apply to very
young (<14 years) patients or patients over age 60. The distribution of knee procedures by age 
group represented in the current study is typical of an orthopaedic sports medicine practice in the 
United States. Furthermore, return to play depends on a wide array of parameters, many of which 
were unmeasured or not analyzed in this study and include variables such as time from surgery, 
muscle strength, age, and many others. In addition, the present study includes athletes from a 
wide array of age ranges, each of which may have age specific motivations for return to sport; 
motivations that were not captured by the current analysis. Pre-operative and post-operative 
activity level scales such as Tegner activity levels were not routinely assessed for this cohort, 
making meaningful understanding of specific activity levels difficult.

The utilization rates of coping strategies were unrelated to the planned procedure in the 
current study; however, the sample size is not adequately powered to determine whether the 
strength of association between coping strategies and outcomes are affected by the planned 
procedure. Though we identify an association between specific coping strategies and outcomes 
after surgery, it is unclear whether “coaching” toward greater use of potentially beneficial coping 
strategies would change outcomes. Sports-psychologist referral may be warranted, as cognitive 
behavioral therapy can be used to enhance helpful coping mechanisms and been shown to 
address performance issues with rehabilitation and return to sport in athletes. Cultural and 
language differences could affect wording and interpretation of the item content of the 
psychological instruments used in this study, and further validation will need to be performed 
before use in a region outside of the United States or in a non-English format.

Coping strategies have age-specific associations with outcomes for athletes who undergo 
knee surgery. Positive reframing is an infrequently used coping strategy in younger athletes, but 
greater use of positive reframing in this age group may improve satisfaction, return to sport, and
lower fear of re-injury. Self-distraction may lower satisfaction after surgery among men, and
older athletes with greater use of instrumental sport have lower fear of re-injury after surgery.

References

1. Ardern CL, Taylor NF, Feller JA, Webster KE. A systematic review of the psychological
   factors associated with returning to sport following injury. *Br J Sports Med.* 2013;47(17):1120-1126.

2. Clement D, Arvinen-Barrow M, Fetty T. Psychosocial responses during different phases
   of sport-injury rehabilitation: a qualitative study. *J Athl Train.* 2015;50(1):95-104.

3. Evans L, Wadey R, Hanton S, Mitchell I. Stressors experienced by injured athletes. *J
   Sports Sci.* 2012;30(9):917-927.

4. Walker N, Thatcher J, Lavallee D. Psychological responses to injury in competitive sport:
   a critical review. *J R Soc Promot Health.* 2007;127(4):174-180.

5. Webster KE, Nagelli CV, Hewett TE, Feller JA. Factors Associated With Psychological
   Readiness to Return to Sport After Anterior Cruciate Ligament Reconstruction Surgery.
   *Am J Sports Med.* 2018;46(7):1545-1550.

6. Forsdyke D, Smith A, Jones M, Gledhill A. Psychosocial factors associated with
   outcomes of sports injury rehabilitation in competitive athletes: a mixed studies
   systematic review. *Br J Sports Med.* 2016;50(9):537-544.

7. Padaki AS, Noticewala MS, Levine WN, Ahmad CS, Popkin MK, Popkin CA.
   Prevalence of Posttraumatic Stress Disorder Symptoms Among Young Athletes After
Anterior Cruciate Ligament Rupture. *Orthop J Sports Med.* 2018;6(7):2325967118787159.

8. Nippert AH, Smith AM. Psychologic stress related to injury and impact on sport performance. *Phys Med Rehabil Clin N Am.* 2008;19(2):399-418, x.

9. Appaneal RN, Levine BR, Perna FM, Roh JL. Measuring postinjury depression among male and female competitive athletes. *J Sport Exerc Psychol.* 2009;31(1):60-76.

10. Gabbe BJ, Slaney JS, Gosling CM, et al. Financial and employment impacts of serious injury: a qualitative study. *Injury.* 2014;45(9):1445-1451.

11. Everhart JS, Best TM, Flanigan DC. Psychological predictors of anterior cruciate ligament reconstruction outcomes: a systematic review. *Knee Surg Sports Traumatol Arthrosc.* 2015;23(3):752-762.

12. Dias CS, Cruz JFA, Fonseca AM. Coping strategies, multidimensional competitive anxiety and cognitive threat appraisal: Differences across sex, age and type of sport. *Serbian J Sport Sci.* 2010;4(1):23-31.

13. Crocker PR, Graham TR. Coping by competitive athletes with performance stress: Gender differences and relationships with affect. *Sport Psychologist.* 1995;9(3):325-338.

14. Stephenson E, King D, DeLongis A. Coping process. *Stress: Concepts, Cognition, Emotion, and Behavior.* Waltham, MA: Academic Press; 2016:359-364.

15. Copeland EP, Hess RS. Differences in young adolescents' coping strategies based on gender and ethnicity. *J Early Adolesc.* 1995;15(2):203-219.

16. Ptacek JT, Smith RE, Dodge KL. Gender differences in coping with stress: When stressor and appraisals do not differ. *Pers Soc Psychol Bull.* 1994;20(4):421-430.
17. Matud MP. Gender differences in stress and coping styles. *Personality and individual differences.* 2004;37(7):1401-1415.

18. Irrgang JJ, Anderson AF, Boland AL, et al. Development and validation of the international knee documentation committee subjective knee form. *Am J Sports Med.* 2001;29(5):600-613.

19. Woby SR, Roach NK, Urmston M, Watson PJ. Psychometric properties of the TSK-11: a shortened version of the Tampa Scale for Kinesiophobia. *Pain.* 2005;117(1-2):137-144.

20. Carver CS. You want to measure coping but your protocol's too long: consider the brief COPE. *Int J Behav Med.* 1997;4(1):92-100.

21. Tuncay T, Musabak I, Gok DE, Kutlu M. The relationship between anxiety, coping strategies and characteristics of patients with diabetes. *Health Qual Life Outcomes.* 2008;6(1):1-9.

22. Tugade MM, Fredrickson BL, Barrett LF. Psychological resilience and positive emotional granularity: examining the benefits of positive emotions on coping and health. *J Pers.* 2004;72(6):1161-1190.

23. Salim J, Wadey R, Diss C. Examining the relationship between hardiness and perceived stress-related growth in a sport injury context. *J Psychol Sport Exercise.* 2015;19:10-17.

24. Steinhardt M, Dolbier C. Evaluation of a resilience intervention to enhance coping strategies and protective factors and decrease symptomatology. *J Am Coll Health.* 2008;56(4):445-453.

25. Arvinen-Barrow M, Massey WV, Hemmings B. Role of sport medicine professionals in addressing psychosocial aspects of sport-injury rehabilitation: professional athletes' views. *J Athl Train.* 2014;49(6):764-772.
26. Clement D, Shannon VR. Injured athletes' perceptions about social support. *J Sport Rehabil.* 2011;20(4):457-470.

27. Podlog L, Dimmock J, Miller J. A review of return to sport concerns following injury rehabilitation: practitioner strategies for enhancing recovery outcomes. *Phys Ther Sport.* 2011;12(1):36-42.

28. Arvinen-Barrow M, Walker N. *The psychology of sport injury and rehabilitation.* New York, NY: Routledge; 2013.

29. CDC. Social support and health-related quality of life among older adults--Missouri, 2000. *Morb Mortal Wkly Rep.* 2005;54(17):433-437.

30. Whelan JP, Mahoney MJ, Meyers AW. Performance enhancement in sport: A cognitive behavioral domain. *Behav Ther.* 1991;22(3):307-327.
|                                | All athletes (n=184) | Sex-specific results | Age group-specific results |
|--------------------------------|----------------------|----------------------|----------------------------|
|                                | All athletes         | Sex-specific results | Age 20-25 (n=35) | Age 26-31 (n=36) | Age 32-40 (n=36) | Age >40 (n=39) | P-value       |
| Age (years)                    | 31.1 SD 12.7         | 31.8 SD 12.9         | 30.2 SD 12.4       | 16.8 SD 1.9      | 22.9 SD 1.7     | 28.1 SD 1.9   | 35.8 SD 2.7   | 50.8 SD 7.7   | <0.001        |
| Male                           | 57%                  | 47%                  | 51%               | 53%              | 58%             | 59%             | 59%            | 59%            | 0.90          |
| Female                         | 43%                  | NA                   | NA                | NA               | NA              | NA              | NA             | NA             |               |
| Soft tissue repair or          | 64%                  | 65%                  | 64%               | 88%              | 92%             | 76%             | 60%            | 25%            | <0.001        |
| reconstruction*                | 36%                  | 35%                  | 36%               | 12%              | 8%              | 24%             | 40%            | 75%            |               |
| Arthroscopy with debridement or| 40.8 SD 16.0         | 39.4 SD 16.1         | 42.8 SD 14.8      | 43.3 SD 15.5     | 44.3 SD 18.6    | 37.5 SD 13.1   | 39.6 SD 16.1   | 37.6 SD 15.3   | 0.11          |
| meniscectomy*                  | Pre-operative IKDC-subjective score | Pre-operative kinesiophobia score (TSK-11) | 24.4 SD 5.9 | 22.3 SD 5.1 | 24.4 SD 6.1 | 24.6 SD 7.0 | 25.0 SD 5.1 | 25.3 SD 7.0 | 24.1 SD 5.1 | 0.63          |
|                                 |                       |                      |                   |                   | 24.5 SD 5.5 | 24.6 SD 5.1 | 24.6 SD 5.1 | 24.6 SD 5.1 | 24.6 SD 5.1 | 0.99          |
|                                | 0.95                 | 0.99                 | 0.99              | 0.99             | 0.99           | 0.99           | 0.99           | 0.99           | 0.99          |
| Satisfaction                   | 86%                  | 87%                  | 84%               | 87%              | 83%             | 77%             | 84%            | 100%           | 0.02          |
| Return to prior level of sport | 72%                  | 50%                  | 66%               | 50%              | 56%             | 61%             | 88%            | 96%            | <0.001        |
| Post-operative IKDC-subjective score | 60.0 SD 13.9         | 60.0 SD 15.8         | 59.6 SD 18.8      | 66.6 SD 12.3     | 63.9 SD 10.9    | 57.2 SD 13.5   | 60.0 SD 11.8   | 56.4 SD 15.2   | 0.13          |
|                                 | 0.99                 | 0.99                 | 0.99              | 0.99             | 0.99           | 0.99           | 0.99           | 0.99           | 0.99          |
| Post-operative kinesiophobia score (TSK-11) | 21.4 SD 5.8 | 22.2 SD 6.0 | 21.6 SD 6.5 | 20.0 SD 5.4 | 23.1 SD 6.0 | 20.2 SD 5.3 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
|                                 | 0.58                 | 0.58                 | 0.58              | 0.58             | 0.58           | 0.58           | 0.58           | 0.58           | 0.58          |

SD: Standard Deviation; NA: Not Applicable. *The primary procedures performed included arthroscopy with debridement or meniscectomy (35%), anterior cruciate ligament reconstruction (33%), cartilage restoration (microfracture, osteochondral allograft, or autologous chondrocyte implantation (18%), isolated meniscus repair (9%) or other tendon/ligament repair (3%).
Table 2. Coping strategy utilization by sex and age group

|                         | All athletes | Sex-specific results | Age group-specific results | p-value |
|-------------------------|--------------|----------------------|---------------------------|---------|
|                         | All         | Men                  | Women                     |         |
|                         | athletes    |                      |                           |         |
| Self-distraction        | 5.5 SD 1.4  | 5.7 SD 1.4           | 5.3 SD 1.4                | 0.03    |
|                         |             |                      |                           |         |
| Use of emotional support| 5.7 SD 1.5  | 5.8 SD 1.5           | 5.6 SD 1.4                | 0.48    |
|                         |             |                      |                           |         |
| Use of instrumental support| 3.9 SD 1.2 | 3.9 SD 1.2           | 4.0 SD 1.2                | 0.39    |
|                         |             |                      |                           |         |
| Venting                | 5.3 SD 1.5  | 5.1 SD 1.5           | 5.5 SD 1.5                | 0.07    |
| Positive reframing     | 4.4 SD 1.0  | 4.5 SD 1.0           | 4.3 SD 1.0                | 0.21    |
| Acceptance             | 3.5 SD 1.4  | 3.3 SD 1.5           | 3.6 SD 1.4                | 0.16    |

*Brief COPE subscale scores are reported on a 2-8 point scale. Higher values indicate more frequent self-reported utilization of the coping strategy。

**SD: Standard Deviation
Table 3. Summary of associations of coping strategies with outcomes after surgery

| Coping Strategy                  | Satisfaction | Return to prior level of sport | Self-reported knee symptoms (IKDC-S) | Kinesiophobia (fear of re-injury) |
|----------------------------------|--------------|---------------------------------|-------------------------------------|-----------------------------------|
| Positive reframing               | Positive (age <20)<sup>1</sup> | Positive (age <32)<sup>3</sup> | No assoc. | Negative (age<20)<sup>4</sup> |
| Self-distraction                 | Negative (men)<sup>2</sup> | No assoc. | No assoc. | No assoc. |
| Use of instrumental support      | No assoc. | No assoc. | No assoc. | Negative (age>40)<sup>5</sup> |
| Use of emotional support         | No assoc. | No assoc. | No assoc. | No assoc. |
| Venting                          | No assoc. | No assoc. | No assoc. | No assoc. |
| Acceptance                       | No assoc. | No assoc. | No assoc. | No assoc. |

No assoc. = no association

1 Per 1 point increase in Brief COPE positive reframing score, Odds Ratio for satisfaction 6.21 (95% Confidence Interval 1.29, 11.5 p=0.02)
2 Per 1 point increase in Brief COPE self-distraction score, Odds Ratio for satisfaction 0.53 (95% Confidence Interval 0.30, 0.89; p=0.02)
3 Per 1 point increase in Brief COPE positive reframing score, Odds Ratio for return to sport 2.36 (95% Confidence Interval 1.12, 5.10; p=0.009)
4 Per 1 point increase in Brief COPE positive reframing score, mean 2.9 point decrease in kinesiophobia score (lower score represents less kinesiophobia) (r=-0.53, p=0.02).
5 Per 1 point increase in Brief COPE use of instrumental support score, mean 2.0 point decrease in kinesiophobia score (lower score represents less kinesiophobia) (r=-0.48, p=0.01).