Training the muscle between the ears: Psychological Readiness to Return to Sport After ACL Reconstruction

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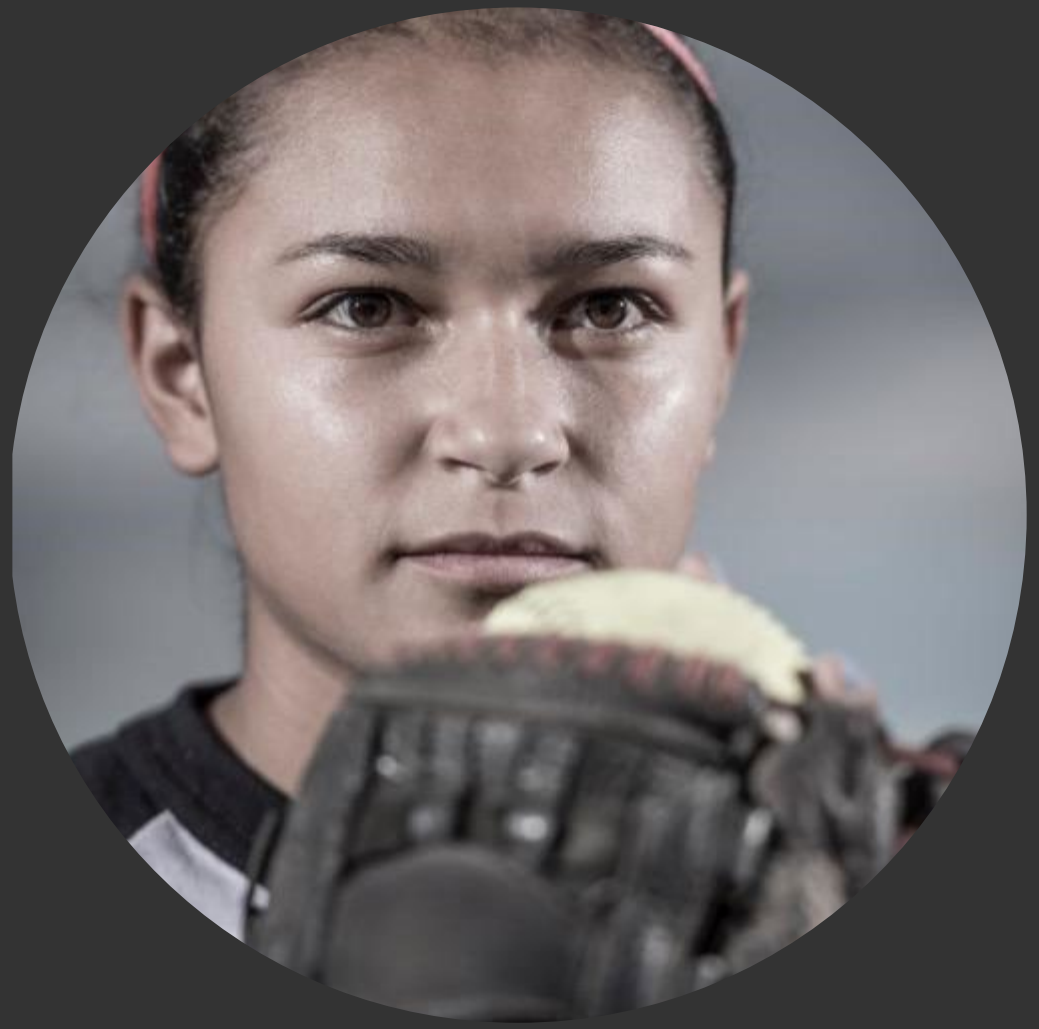
Objectives

- Understand the importance to assess psychological readiness in the athlete following injury
- Describe assessment tools used to assess psychological readiness throughout ACL rehab
- Understand and provide examples of different psychological skill training techniques to implement at each phase of rehab
- Discuss the benefits of addressing the psychological aspect of return to sport throughout the rehabilitative process to train the whole patient for optimal outcomes.



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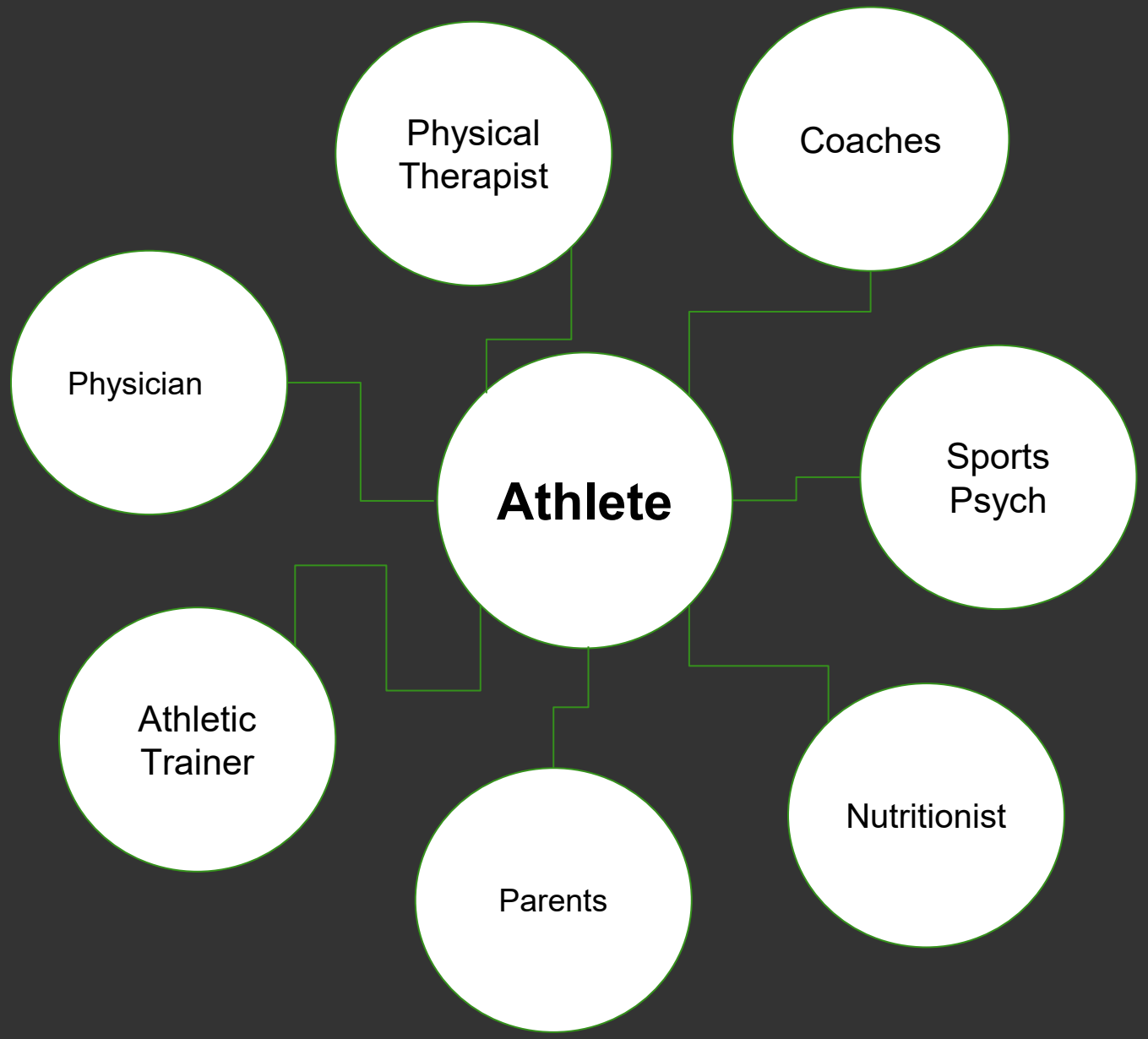
The Sports Medicine Team



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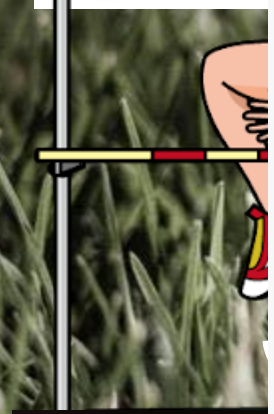

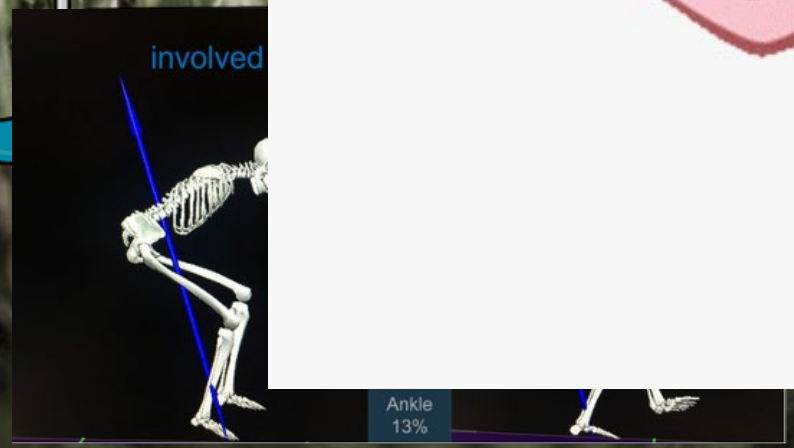

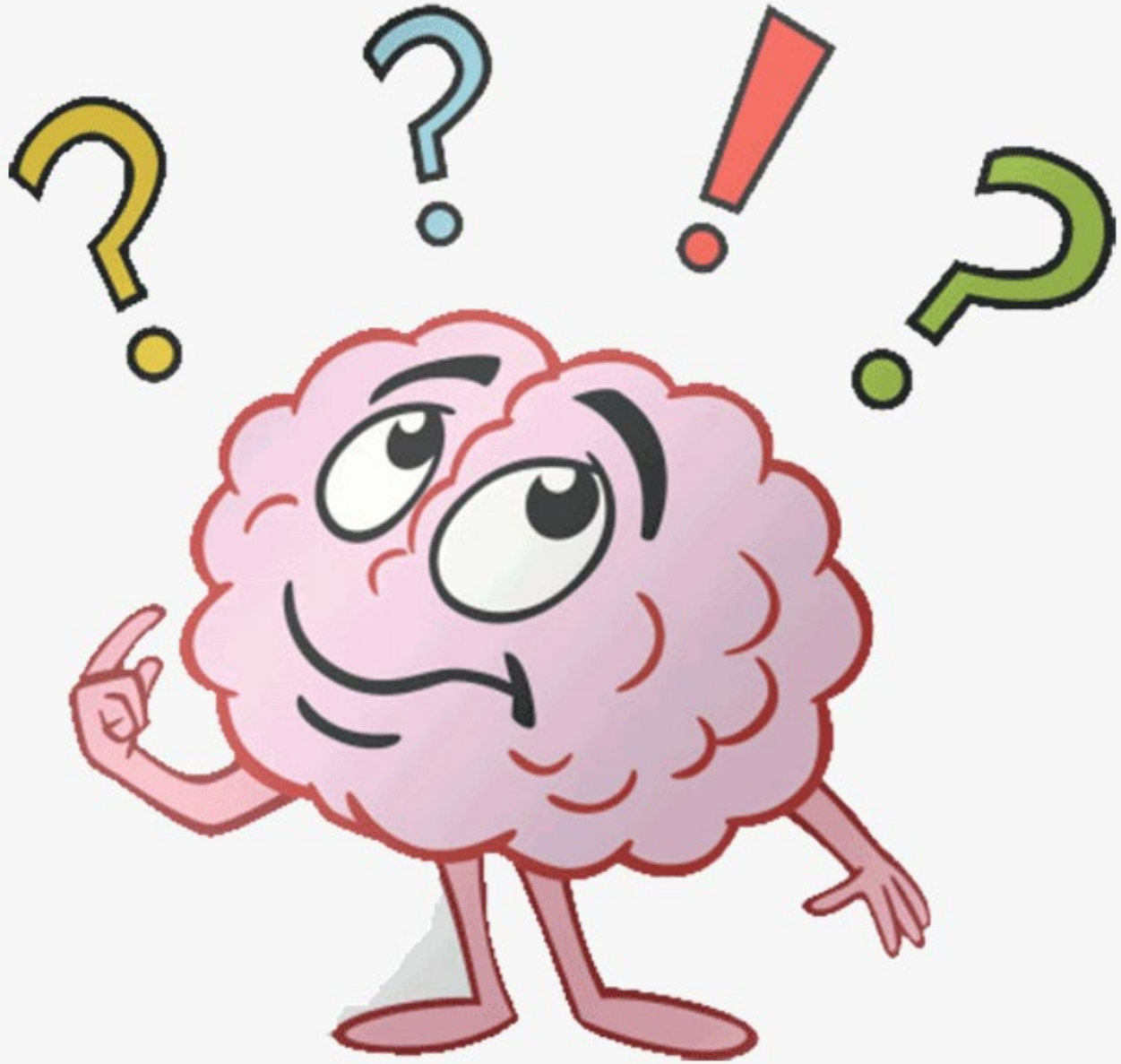

Nwachuku, 2019

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What is Psychological Readiness?

Overarching Components (Podlog, et al., 2015)

- Confidence in returning to sport
- Realistic expectations of one's sporting capabilities
- Motivation to regain previous performance standards

Confidence Components (Kunnen, et al., 2020)

- *Belief in one's rehabilitation program*
- *Confidence and trust in rehabilitation professionals*
- A belief in one's formerly injured body part was fully healed
- Efficacy in one's performance capabilities

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THE FEARFUL ATHLETE

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What is kinesiophobia?

- Fear of movement (Kori, 1990)
  - Defined as an “excessive, irrational and debilitating fear to carry out a physical movement, due to a feeling of vulnerability to a painful injury or reinjury”
  - Alters how people move and causes adjustments in the motor behavior (Karos, 2017)

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Role of fear in rehab

- Furman et al::
  - “Limitations to the current ACL protocols may be that they rely heavily on musculoskeletal rehabilitation and that they have limited emphasis on neurological rehabilitation.”
  - “When athletes have been cleared to return to sport, fear tends to be the most common reason for their decision to not return to play.”
- Clement et al:
  - “...a certain number of psychological factors such as personality, cognition, feelings, and behaviors influence the results of rehabilitation after sport injuries”
- Baez et al:
  - “Psychological factors, specifically injury-related fear and self-efficacy, were associated more significantly than functional outcomes with return to sport and physical activity levels.”

Furman, 2018; Clement, 2015;
Baez, 2019;

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Role of fear in rehab

- Ann et al “The adverse effects of fear on neuromuscular control may indicate that psychological interventions should be incorporated with neuromuscular-control exercise programs after ACL injury.”
- Trigsted reported greater fear of reinjury (higher TSK-11 score) is related to stiffened jump-landing biomechanics
- Hsu et al “63% of athletes returned to preinjury level, and fear of reinjury is the most frequently cited reason for reduction in sports participation. However, over 85% of athletes achieved clinically satisfactory outcomes in terms of knee laxity, muscle strength, and single-leg hop distance”
- Paterno and Norte et al reported that patients with high fear were more likely to have strength deficits and poorer SL hop performance
- Further, Paterno reported higher fear increases risk of second ACL tear
  - Patients with TSK-11 score of 19 or greater, were 13 times more likely to suffer second ACL tear

Ann, 2019
Trigsted, 2018
Hsu, 2017
Paterno, 2018
Norte, 2019

ACL and Beyond…

- Psychological factors account for 64% of reasons patients did not RTS after ACLR (Nwachukwu, 2019)
  - Fear of reinjury most commonly reported, but resilience, self motivation and loss of interest were also reported
- Hip-RSI has been found to discriminate between patients with successful RTS and those who did not
  - Indicating psychological readiness is a factor post hip arthroscopy (Worner, 2021)
- SIRSI (Shoulder Instability RSI): valid measure of psychological readiness to RTS, whether instability is managed surgically or conservatively (Georormetta, 2018)

Across Athlete Considerations

UCL vs ACL mechanism of injury (Chen, et al., 2022)

- Nontraumatic, repetitive vs traumatic, acute
- Yet both result in high fear of reinjury scores and decreased RTP
- Among reasons athletes did not RTP following UCL injuries, 40.4% were due to psychological factors

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Variable Injuries, Rehab and RTP Timelines…

- And consistent psychological factors impacting athletes across age and ability levels
- But why?
    1. Athletes are unaware of how their bodies will respond to returning to competition
    2. Fearful that they will not achieve their previous athletic goals
    3. Worried they have wasted time in rehabilitation

(Chen, et al., 2022)

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THE OVERLY CONFIDENT ATHLETE

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What about the overly confident athlete?

- The opposite scenario: low fear and high self-efficacy (ie confidence) is actually correlated with increased risk of injury
    - More exposure to high risk activities
    - Less acceptance of strength and neuromuscular control deficits
    - Poor understanding of the risks involved with returning to sport too early
    - PT may be less likely to truly evaluate important RTS objective measures
        - Clearance prior to being ready
    - Harder for the PT to delay return to sport
- How do we address this?
    - Choose psychological assessment (TSK-11, ACL-RSI, Knee Self Efficacy Scale)
    - Regular assessment of fear and self-efficacy
    - Improved adherence to RTS decision making criteria

Lentz, 2018

Psychological, social and contextual domains

- Important to acknowledge these factors and not view them as less important than physical factors
- Assess early and monitor throughout rehab as needs change from acute to return to sport phase
- Develop strong therapeutic alliance and engage athlete in care
- Focus on the individual to achieve success

Truong, 2020

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Psychological Domain Themes

- Barriers to progress
  - Fear, frustration, anxiety, knee/sport confidence, motivation, psychological readiness
  - Early recognition of negative emotions is important for recovery
- Active coping
  - Athletes want to understand injury and diagnosis, manage emotion, deal with athletic identity loss
  - Providing coping strategies associated with greater motivation, resilient behaviour and adherence to rehab
- Independence
  - Allow athletes to develop independence and have control over their rehab
  - Promoting self-motivation, confidence, self-efficacy and autonomy around RTS decisions positively influence rehab and RTS outcomes
- Recovery expectations
  - Set realistic timelines and expectations for the rehab process and ultimately RTS
  - Expectations are influences by medical team, role models, teammates, coaches, prior beliefs

Truong, 2020

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Social Domain Themes

- Social support
  - Educational and emotional support has positive effect on recovery expectation, negative emotions, and risk appraisal
  - “It takes a village”. Support needed starts with family/friend and shifts towards needing support from PT’s, coaches and medical staff when nearing RTS
  - Consider injury role model
- Engagement in care
  - Athletes value being engaged in their care through strategies such as goal setting
  - Strong therapeutic alliance where the athlete’s goals and values where respected lead to positive rehab experience and improved thrush in healthcare provider
  - Maintain open communication between the healthcare provider and coaches

Truong, 2020

Contextual Domain Themes

- Environmental influences
  - Environments that promote autonomy-supported behaviors are associated with better compliance, more independence and self-motivation
  - Important to address situation factors (eg. lack of time or equipment)
  - Make rehab fun and challenging - athletes like a muscle burn!
- Sport culture
  - “No pain, no gain”. Hyper-masculine culture of sport validates enduring pain and downplaying injuries
  - Social pressure from peers and risk-taking culture in sports contributes to athletes considering premature RTS

Truong, 2020

Let's Pause for a Moment

Return to Sport s/p ACL:

- Elite athletes: 83-90%
- Non-elite: ~60%

Non-return to sports/decreased physical activity can lead to:

- low quality of life scores
- increased body weight
- depression
- isolation from friends and teammates

(Mahood, et al. 2020)

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ASSESSMENT TOOLS

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Psychological Assessment Tools

Kinesiophobia	Self-Efficacy	Psychological Readiness	Anxiety/Depression	Mood States
▪ TSK ▪ TSK-11	▪ K-SES ▪ PSEQ ▪ GSE	▪ ACL-RSI ▪ I-PRRS	▪ QIDS ▪ PHQ2 ▪ PHQ9 ▪ HADS	▪ ERAIQ ▪ POMS ▪ ISP ▪ PROMIS ▪ SRLC

TSK-11

- Shortened version of the Tampa Scale of Kinesiophobia
- Assesses pain-related fear of movement/reinjury
- Scores 11-44, higher score indicates greater fear or movement/reinjury
- Score of 17 or higher indicates patients with greater fear following ACLR (Paterno, 2018)

Tampa Scale for Kinesiophobia
(Miller , Kori and Todd 1991)

1 = strongly disagree
2 = disagree
3 = agree
4 = strongly agree

1. I'm afraid that I might injury myself if I exercise	1	2	3	4
2. If I were to try to overcome it, my pain would increase	1	2	3	4
3. My body is telling me I have something dangerously wrong	1	2	3	4
4. My pain would probably be relieved if I were to exercise	1	2	3	4
5. People aren't taking my medical condition seriously enough	1	2	3	4
6. My accident has put my body at risk for the rest of my life	1	2	3	4
7. Pain always means I have injured my body	1	2	3	4
8. Just because something aggravates my pain does not mean it is dangerous	1	2	3	4
9. I am afraid that I might injure myself accidentally	1	2	3	4
10. Simply being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my pain from worsening	1	2	3	4
11. I wouldn't have this much pain if there weren't something potentially dangerous going on in my body	1	2	3	4
12. Although my condition is painful, I would be better off if I were physically active	1	2	3	4
13. Pain lets me know when to stop exercising so that I don't injure myself	1	2	3	4
14. It's really not safe for a person with a condition like mine to be physically active	1	2	3	4
15. I can't do all the things normal people do because it's too easy for me to get injured	1	2	3	4
16. Even though something is causing me a lot of pain, I don't think it's actually dangerous	1	2	3	4
17. No one should have to exercise when he/she is in pain	1	2	3	4

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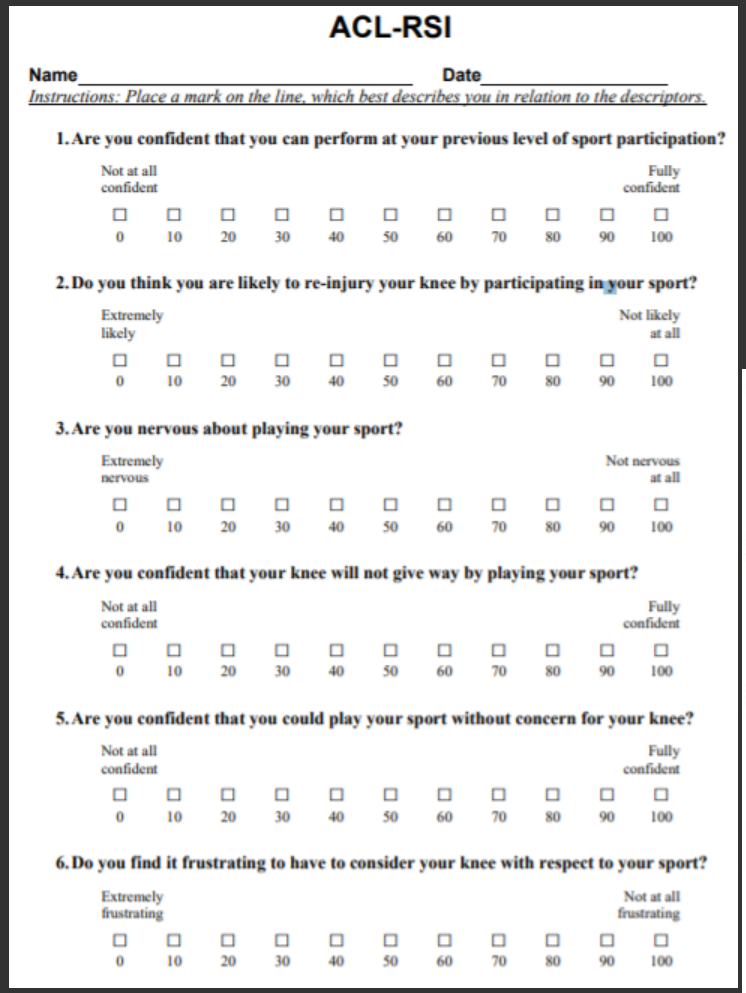
ACL-RSI

- ACL-Return to Sport After Injury Scale
  - 12 item scale
- Assesses emotion, confidence in performance and risk appraisal
- Higher scores indicate more likely to return to sport
  - 56 at 4 months
  - 65 at 7 months
  - 72 at 12 months
- Evidence to support higher scores correlate with improved performance on hop testing (Hart, 2020)



ACL-RSI

Name_____ **Date**_____

Instructions: Place a mark on the line, which best describes you in relation to the descriptors.

1. Are you confident that you can perform at your previous level of sport participation?

Not at all confident — Fully confident

☐ 0 ☐ 10 ☐ 20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ 80 ☐ 90 ☐ 100

2. Do you think you are likely to re-injury your knee by participating in your sport?

Extremely likely — Not likely at all

☐ 0 ☐ 10 ☐ 20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ 80 ☐ 90 ☐ 100

3. Are you nervous about playing your sport?

Extremely nervous — Not nervous at all

☐ 0 ☐ 10 ☐ 20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ 80 ☐ 90 ☐ 100

4. Are you confident that your knee will not give way by playing your sport?

Not at all confident — Fully confident

☐ 0 ☐ 10 ☐ 20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ 80 ☐ 90 ☐ 100

5. Are you confident that you could play your sport without concern for your knee?

Not at all confident — Fully confident

☐ 0 ☐ 10 ☐ 20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ 80 ☐ 90 ☐ 100

6. Do you find it frustrating to have to consider your knee with respect to your sport?

Extremely frustrating — Not at all frustrating

☐ 0 ☐ 10 ☐ 20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ 80 ☐ 90 ☐ 100

7. Are you fearful of re-injuring your knee by playing your sport?

Extremely fearful — No fear at all

☐ 0 ☐ 10 ☐ 20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ 80 ☐ 90 ☐ 100

8. Are you confident about your knee holding up under pressure?

Not at all confident — Fully confident

☐ 0 ☐ 10 ☐ 20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ 80 ☐ 90 ☐ 100

9. Are you afraid of accidentally injuring your knee by playing your sport?

Extremely afraid — Not at all afraid

☐ 0 ☐ 10 ☐ 20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ 80 ☐ 90 ☐ 100

10. Do thoughts of having to go through surgery and rehabilitation prevent you fro playing your sport?

All of the time — None of the time

☐ 0 ☐ 10 ☐ 20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ 80 ☐ 90 ☐ 100

11. Are you confident about your ability to perform well at your sport?

Not at all confident — Fully confident

☐ 0 ☐ 10 ☐ 20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ 80 ☐ 90 ☐ 100

12. Do you feel relaxed about playing your sport?

Not at all relaxed — Fully relaxed

☐ 0 ☐ 10 ☐ 20 ☐ 30 ☐ 40 ☐ 50 ☐ 60 ☐ 70 ☐ 80 ☐ 90 ☐ 100

Meirbachtol, 2018

Assessing Your Athlete's Confidence

Shoulder Instability-Return to Sport After Injury Scale (SIRSI)

- 12 items
- Higher scores indicate a more positive psychological response

Injury-Psychological Readiness to Return to Sport (I-PRRS)

- 10 items
- Higher scores indicate a more positive psychological response

Ankle Ligament Reconstruction Return to Sport after Injury Scale (ALR-RSI)

- 12 items
- Higher scores indicate a more positive psychological response

Hip-Return to Sport After Injury (Hip-RSI)

- 6 items, scored 0-100
- Higher scores indicate a more positive psychological response

(Podlog, 2022)

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Measuring Confidence…continued

Psychological Readiness of Injured Athlete to Return to Sport: Questionnaire for Injured Soccer Players (PRIA-RS)

- 10 items
- Higher score indicates a more positive psychological response

Re-Injury Anxiety Inventory (RIAI)

- Total of 28 items
- 15 items on the rehabilitation phase
- 13 items on the re-entry phase

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Pain Coping Measure (PCM)

- 7 item questionnaire designed to measure the degree to which respondents utilize emotion-based or problem-based pain coping strategies on a daily basis

Pain Catastrophizing Scale (PCS)

- 13 item scale designed to measure the degree of distress the respondent experiences due to pain
- Designed to measure: (Sullivan, 1995)
  - rumination
  - magnification
  - helplessness

(Everhart, et al., 2020)

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Early Scores and Late Outcomes

-Arden, et al. (2013):

- Preoperative and 4 month post-operative scores found to be predictive of return to preinjury level at 1 year after surgery

-Podlong, et al, (2022):

- Athletes who returned at 12 months score significantly higher on the ACL-RSI at 6 and 12 months post-operatively

** Early interventions may be helpful for long term outcomes for these patients **

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Components of the Fear of Reinjury

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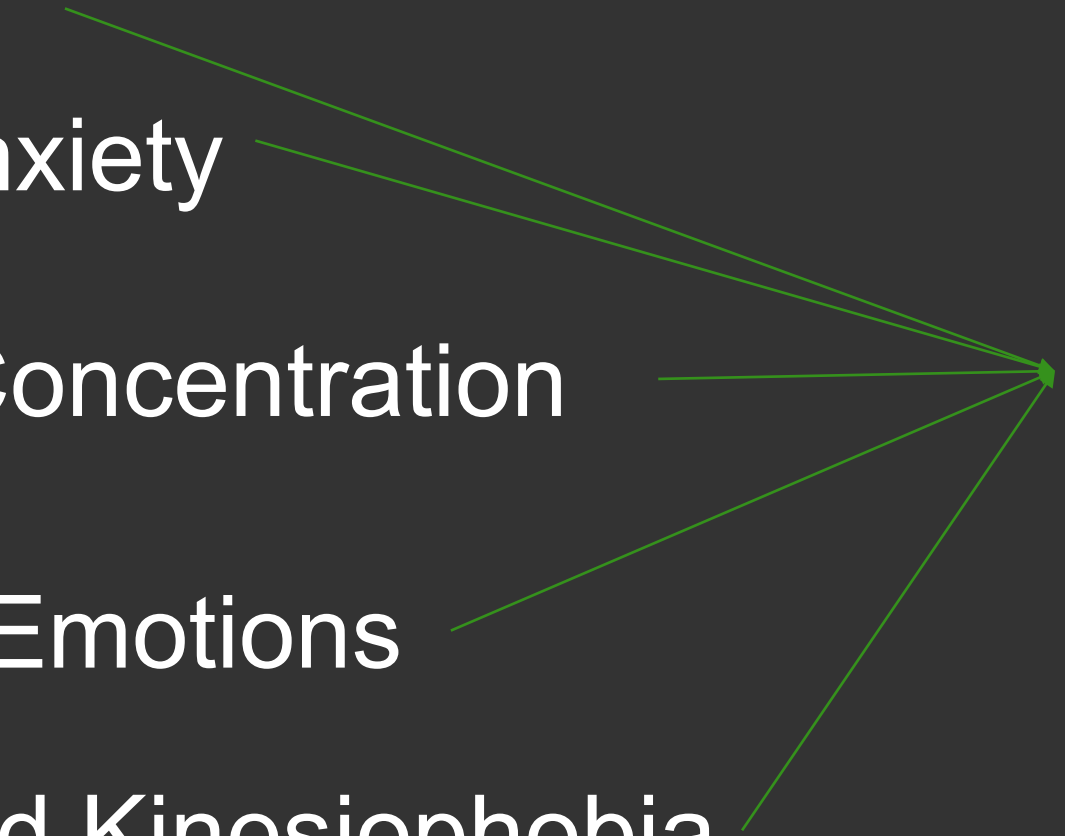
Fractured Confidence

Increased Anxiety

Decreased Concentration

Negative Emotions

Pain Related Kinesiophobia



Fear of Re-Injury

(Kvist, 2005; Mahood, 2020; Rodriguex, 2019; Lentz, 2014)

(Sheinbein, 2016)

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Psychological Interventions in the Rehabilitation Process

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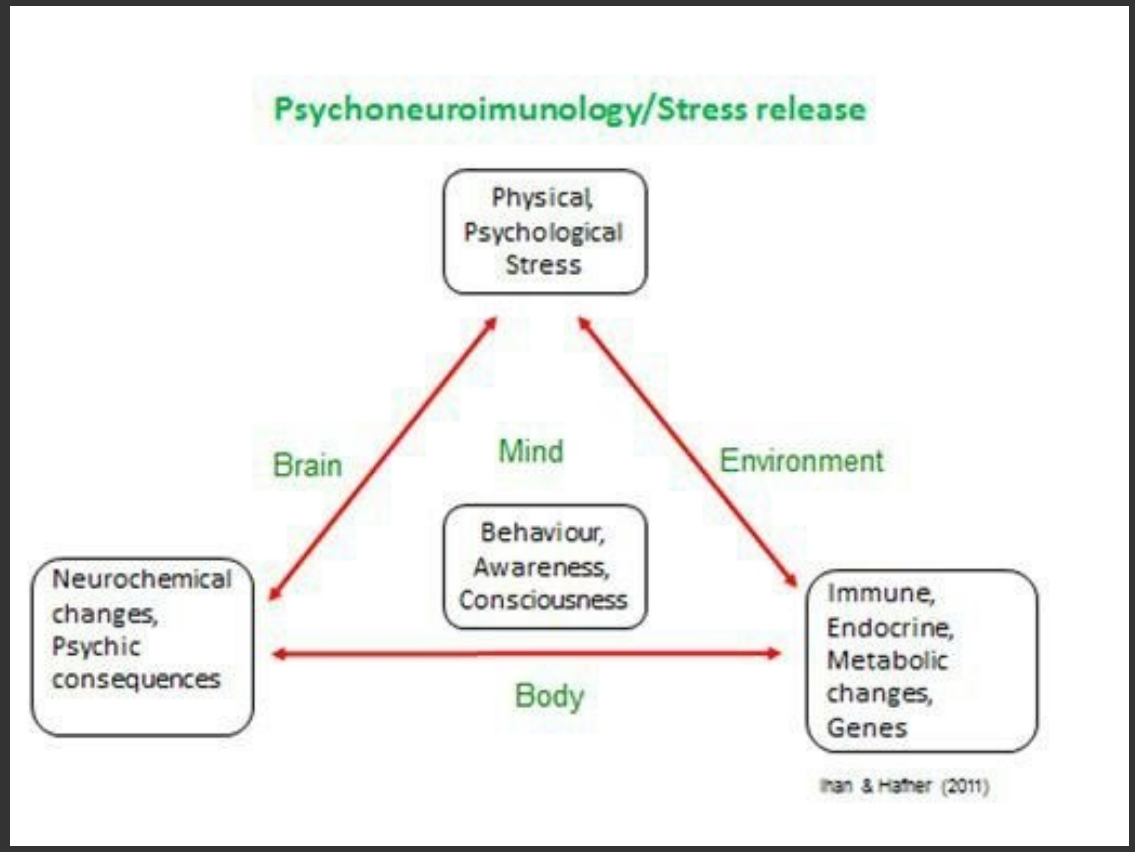
Connecting the Mind with the Body

Psychoneuroimmunological pathways

- Try to make this connection as early as possible with patients



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But why does stress matter?

- Stress → Muscular Tension → Increased fatigue → increased heart rate + increased muscle tension → lack of coordination/guarding (Wiese-Bjornstal, 2010; Sheinbein, 2016)

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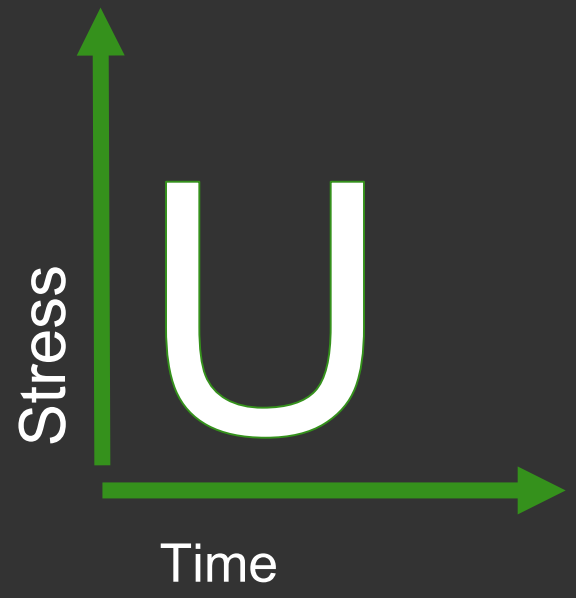
“U” Pattern of Recovery (Hsu, 2017)

- Psychological responses are generally greatest immediately after sports injury and then lessen during the rehab process
- but...these psychological responses rebound again as return to sport time nears



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What Can We Do?

- Educate, educate, educate
  (Francis 2000, O'Connor, 2005)
  - Early, often, consistent and complete
- Social Support (Rees, 2010, Hogan, 2002)
  - Trustworthy, open, positive
  - Encourage forging relationships outside of sport
- Communicate and **Listen**
  - Open, non-judgmental, thorough, constant

- Thought stoppage
  - Self-talk
- Enhance athlete beliefs
  - Shifting from "can't" to "can do"
- Short term goals that produce process goals (Hamson-Utley, 2008)

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Intervention Overview

Breathing/Relaxation Techniques (Johnson, 2000, Cupal, 2002)

Imagery (McKinney, 1997, Cupal, 2002, Maddison, 2012)

Goal setting (Hamson-Utley, 2008)

Productive vs unproductive self-talk (Podlog, 2011)

Graded Exposure (Woods, 2008)

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The Power of Breathing

Pain reduction - emphasis on deep, slow, rhythmic breathing **(Tekur, 2012)**

Emotion enhancement (Stromberg, et al., 2015)

Reduction in stress, anxiety and depression (Anju, et al., 2015)

Decreases blood pressure, increases heart rate variability and improves oxygenation in blood (Lehrer and Gevirtz, 2014)

Improves cardiorespiratory fitness and respiratory muscular strength (Shaw, et al., 2010)

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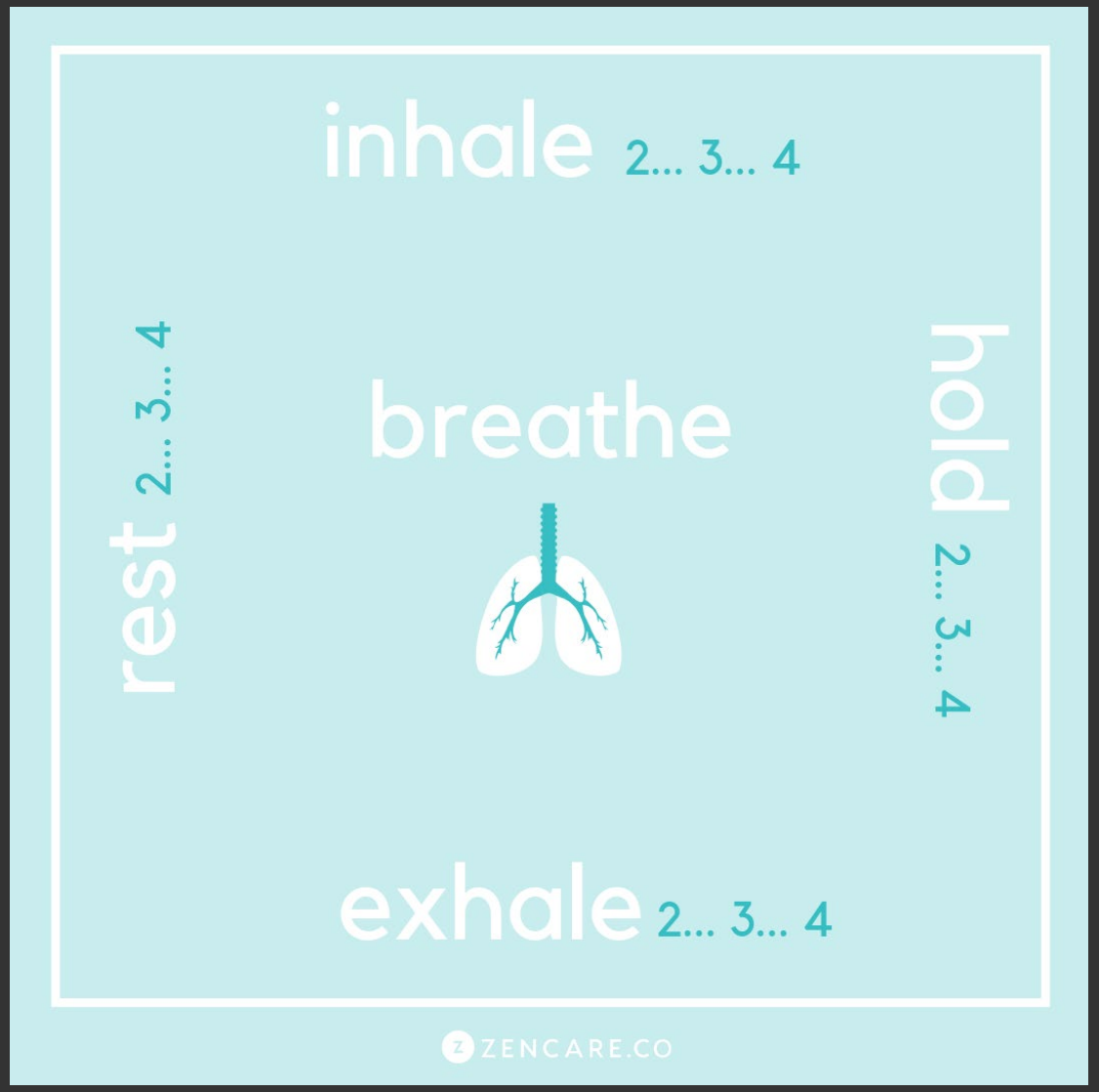
Box Breathing



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https://www.youtube.com/watch?v=2FriSddUY84

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Imagery in Rehab

- Reduced recovery time (Ievleva & Orlick, 1991)
- Increased strength, decreased re-injury anxiety, reduced pain (Cupal & Brewer, 2001)
- Increased self-efficacy (Milne, Hall & Forwell, 2005)
- Coping with pain (Wesch, 2012)
- Increased motivation, adherence and compliance
- Maintain sport specific skills
- Reduces neurobiological factors associated with anxiety and stress (noradrenaline and dopamine) (Rodriguez, 2019)
- Guided imagery leads to reduced anxiety of re-injury, lowered stress levels, increased muscle activation and decreased pain perception (Rodriguez, 2019)

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Healing Imagery Script (example)

“Turn your focus to your right knee. Look at the incision above your kneecap. See the skin healing and growing back together like a woven quilt. Notice the skin color near your incision returning to your natural tone. Feel the strength of this healing skin. See the graft site in your quadriceps tendon. Appreciate the blood flow moving into this healing site bringing all the nutrients your body needs to recover fully. The graft site is beginning to be flooded with new, nutrient rich blood and as your engage your quadriceps, you see this healing site translate up as your kneecap slides up. Squeeze your quad and release. “

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Principles of Imagery

- Key: vividness and controllability
- Use ALL senses
- Incorporate emotions
- Healing imagery
- Imagine in real time
- Use videos of prior performances

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Imagery Practice

Pick your favorite winter sport for this practice:

1. Set the environment (quiet room)
2. Write it down first (avoid letting your mind wander)
3. Take a few deep breaths to be relaxed
4. Play it out
5. Engage all of the senses

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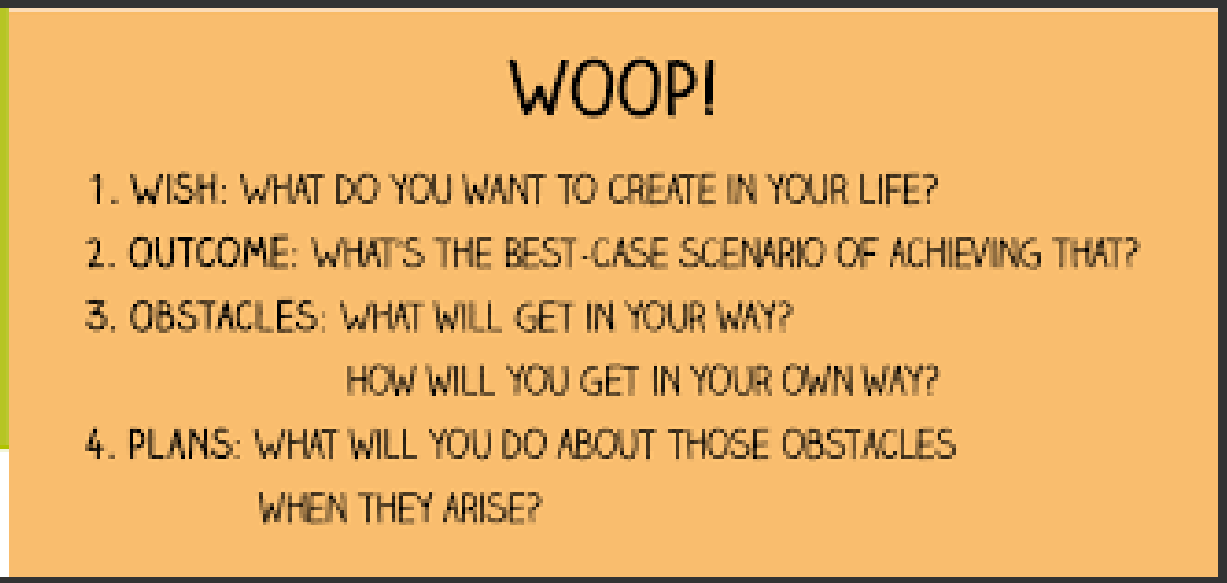
Goal Setting

- **SMART** (Doran)

- **WOOP Goals** (Oettingen)



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WOOP Goal

1. Wish	1. I want to run a sub 3 hour marathon
2. Outcome	2. Feeling accomplished when I cross the finish line with time above my head saying 2:58
3. Obstacle	3. I don't have time to train after work and I'm not motivated in the morning
4. Plan	4. If I get up in the morning, then I immediately put on my sneakers and go for a run even if I don't feel like it

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Benefits of Self Talk - Productive

- Reduced recovery time (Ievleva & Orlick, 1991)
- Positive emotions (Udry, 1997)
- Wellbeing, particular during setbacks (Rock & Jones, 2002)
- Joint restoration, muscular strengthening, rehearsing sport-related skills (Beneka, et.al., 2007)

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https://www.youtube.com/watch?v=_Gqwi7Y96sk

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Graded Exposure (Mahood, C., et al. 2020)

- ‘Desensitizing’ the awareness and focus on the fear
- Enables the athlete to focus on their performance and skills
- Progressing unpredictability offers the opportunity for ‘situational risk analysis

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I’ve done everything I can do for my athlete and I feel that they may benefit from additional resources…

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How and When to Refer

- Age of patient - In Colorado
  - <14 yrs - need to contact parent with the concerns that are present
  - >14 yrs - discuss communicating with the parent with the patient 1st
    - Try to empower the patient to ask for help themselves
- If patient is resistant...contact referring physician if they plan to return for follow-up
- If patient is willing, offer names of referral sources to patient

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Benefits of Referral

- Speeds healing and recovery time
- Normalize the link between injury, performance, and challenges faced
- Facilitate holistic health and well-being
- Important in a high level athlete's ongoing sport participation
- Returning to sport at optimal level
- Optimizing performance
- Genuine concern for the athlete/patient

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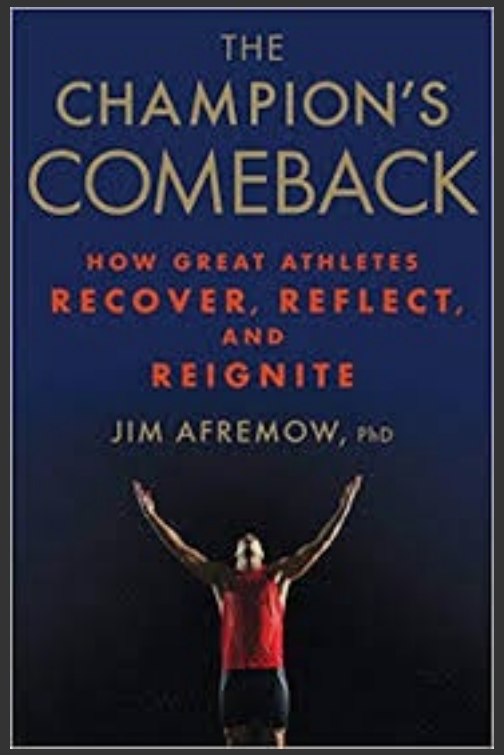
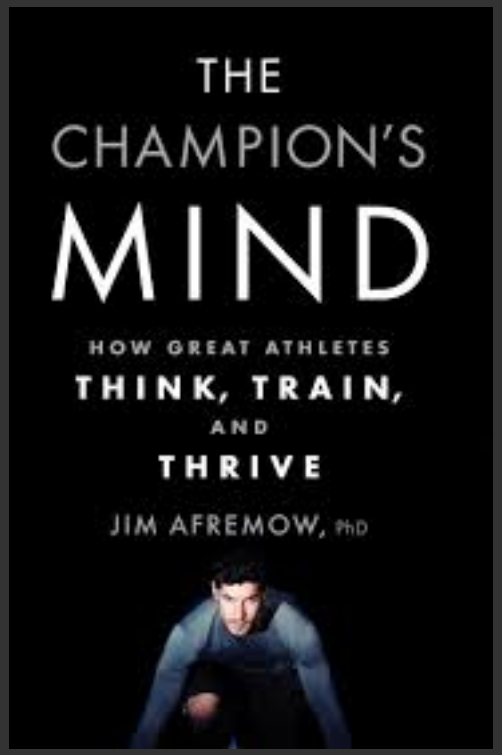
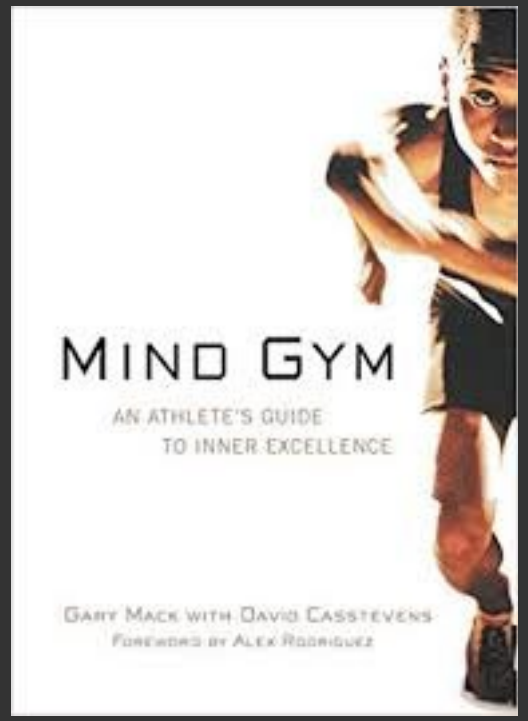
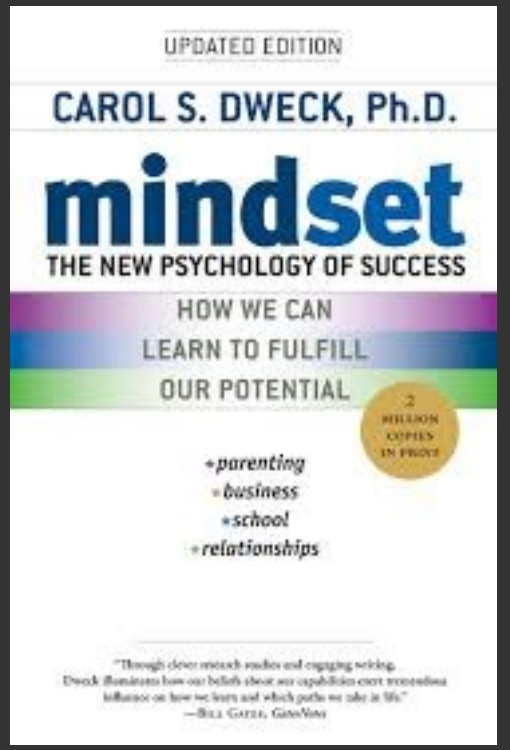
Resource Recommendations









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THANK YOU!!

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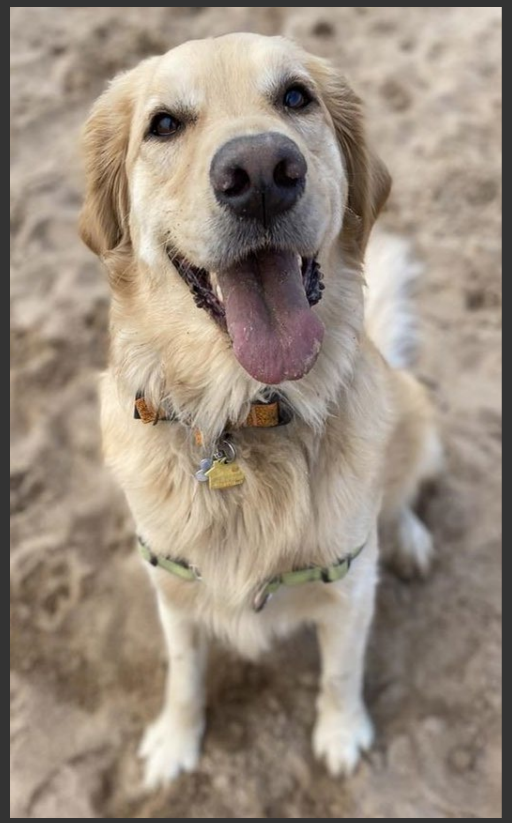

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References

Hoch JM, Houston MN, Baez SE, Hoch MC.Fear-Avoidance Beliefs and Health-Related Quality of Life in Post-ACL Reconstruction and Healthy Athletes: A Case-Control Study. J Sport Rehabil. 2019 Oct 18:1-5.

Clement D. Arvinen-Barrow M. Fetty T. Psychosocial Responses During Different Phases of Sport-Injury Rehabilitation: A Qualitative Study

Furman T. Silvers-Granelli. Return to Play After an Anterior Cruciate Ligament Injury: Prioritizing Neurological and Psychological Factors of the Decision-Making Algorithm. MDEdge. 17 Dec 2018.

Baez, S.E., Hoch, M.C. & Hoch, J.M. Knee Surg Sports Traumatol Arthrosc (2019).

Norte GE, Solaas H, Saliba SA, Goetschius J, Slater LV, Hart JM. The relationships between kinesiophobia and clinical outcomes after ACL reconstruction differ by self-reported physical activity engagement. Phys Ther Sport. 2019 Aug 8;40:1-9.

An YW, Lobacz AD., Baumeister J, Rose WC, Higginson JS5, Rosen J6, Swanik CB4.. Negative Emotion and Joint-Stiffness Regulation Strategies After Anterior Cruciate Ligament Injury.J Athl Train. 2019 Sep 25.

Paterno MV, Flynn K, Thomas S, Schmitt L. Self-Reported Fear Predicts Functional Performance and Second ACL Injury After ACL Reconstruction and Return to Sport: A Pilot Study. Sports Health. 2018 May/Jun;10(3):228-233.

Trigsted SM, Cook DB, Pickett KA, Cadmus-Bertram L, Dunn WR, Bell DR. Knee Surg Sports Traumatol Arthrosc. 2018 Dec;26(12):3682-3689.

Mahood, C., Perry M., et al. Chaos and confidence: managing fear of re-injury after anterior cruciate ligament reconstruction. *Phys Ther in Sport.* 2020 45:145-154.

Nwachukwa, et al. how much do psychological factors affect lack of return to play after anterior cruciate ligament reconstruction? A systematic review. *Ortho J Sports Med.* 2019; 7(5).

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References

Anju, D., Anita, C., Raka, J., Deepak, Y., and Vedamurthachar. (2015). Effectiveness of yogic breathing training on quality of life of opioid dependent users. *Int. J. Yoga* 8, 144–147. doi: 10.4103/0973-6131.154075

Lehrer, P. M., and Gevirtz, R. (2014). Heart rate variability biofeedback: how and why does it work? *Front. Psychol.* 5:756. doi: 10.3389/fpsyg.2014.00756

Rodriguez, R., et al. (2019). Reducing fear of reinjury and pain perception in athletes with first time anterior cruciate ligament reconstructions by implementing imagery training *J Sport Rehab*. 28:385-389.

Shaw, I., Shaw, B. S., and Brown, G. A. (2010). Role of diaphragmatic breathing and aerobic exercise in improving pulmonary function and maximal oxygen consumption in asthmatics. *Sci. Sports* 25, 139–145. doi: 10.1016/j.scispo.2009.10.003

Sheinbein, S. (2016). Psychological effect of injury on the athlete: a recommendation for psychological intervention. *AMAA*: 8-10.

Tekur, P., Nagarathna, R., Chametcha, S., Hankey, A., and Nagendra, H. R. (2012). A comprehensive yoga programs improves pain, anxiety and depression in chronic low back pain patients more than exercise: an RCT. *Complement. Ther. Med.* 20, 107–118. doi: 10.1016/j.ctim.2011.12.009

Truong, L., Mosewich, A., Holt, C., et al. (2020). Psychological, social and contextual factors across recovery stages following a sport-related knee injury;: a scoping review. *Br J Sports Med*; 0:1-11.

Wesch, N., et al. (2012). Self-efficacy, imagery use and adherence during injury rehabilitation. *Scan J Mef Sci*. 22:695-703.

Wiese-Bjornstal, D. (2010). Psychology and socioculture affect injury risk, response, and recovery in high intensity athletic sports (3M Athletic Trainers Statement). *Scandinavian Journal of Medicine and Science in Sports*. 20(2); 103-111.

SPORTS MEDICINE CENTER
Children's Hospital Colorado

References

Hsu, C, Melerbachtol, A, et al. (2017). Fear of reinjury in athletes: implications for rehabilitation. *Phys Ther*. 162-167.

Lentz, T., Zeppieri, G., et. al. (2014). Comparison of physical impairment, function, and psychological measures based on fear of reinury/lack of confidence, and return to sport status after ACL reconstruction. *AJSM*. 43:2; 345-353.

Kvist, J, Ek, A., et al. (2005). Fear of reinjury: a hindrance for returning to sports after anterior cruciate ligament reconstruction. *Knee Surg Sports Tramumatol Arthrosc*. 13: 393-397.

Arden, C., Taylor, N., Feller, J., & Webster, E. (2013). A systematic review of the psychological factors associated with returning to sport following injury. *British Journal of Sports Medicine*. 47; 1120-1126.

Sullivan MJL, Bishop SR, Pivik J. The Pain Catastrophizing Scale: Development and Validation. Psychol Assess, 1995; 7(4): 524-32

Chen, et al., (2022). Psychological factors associated with return to play after ulnar collateral ligament reconstruction. *Ortho Jof Sports Med*. 10(10); 1-6.

Wörner T, Thorborg K, Webster KE, Stålman A, Eek F. Psychological readiness is related to return to sport following hip arthroscopy and can be assessed by the Hip-Return to Sport after Injury scale (Hip-RSI). Knee Surg Sports Traumatol Arthrosc. 2021 May;29(5):1353-1361. doi: 10.1007/s00167-020-06157-4. Epub 2020 Jul 22. PMID: 32699920; PMCID: PMC8038984.

Gerometta A, Klouche S, Herman S, Lefevre N, Bohu Y. The Shoulder Instability-Return to Sport after Injury (SIRSI): a valid and reproducible scale to quantify psychological readiness to return to sport after traumatic shoulder instability. Knee Surg Sports Traumatol Arthrosc. 2018 Jan;26(1):232-240. doi: 10.1007/s00167-017-4645-0. Epub 2017 Jul 13. PMID: 28707114.

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References

Podlog, et al. Psychological readiness to return to sport following injury: a state of the art review. *Int Review of Sport Ex Psych*; 1-20.

Meierbachtol et al.**Psychological and Functional Readiness for Sport Following Advanced Group Training in Patients With Anterior Cruciate Ligament Reconstruction.** *J Orthop Sports Phys Ther 2018;48(11):864−872.*

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