FIGURE 1. Oblique radiograph taken less than 1 hour following evaluation, demonstrating an avulsion fracture at the base of the fifth metatarsal (arrow).

FIGURE 2. Lateral radiograph demonstrating an avulsion fracture at the base of the fifth metatarsal (arrow).

Fifth Metatarsal Avulsion Fracture in an Adolescent Tennis Player

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A 17-year-old male tennis player presented to physical therapy via direct access with complaints of intermittent left lateral foot pain that had been present for 1 week following a lateral cutting maneuver during a match. The day before evaluation, he reported increased pain during a tennis match that remained constant following the match. He reported pain-free daily function at home and school. Past medical history was noncontributory.

Upon observation, no effusion or ecchymosis was present. The patient had no significant deviations or pain with ambulation. Lateral foot pain increased with jogging and single-limb hopping. Ankle and foot range of motion was full and pain free; however, pain increased with resisted eversion in plantar flexion, but not when tested in a dorsiflexed position. Fracture-quality pain was produced with palpation to the base of the fifth metatarsal. Axial loading of the fifth metatarsal reproduced symptoms.

Due to positive fracture testing and application of the Ottawa foot/ankle rules,[2] an orthopaedist was consulted and radiographic imaging was performed. Radiographs revealed a nondisplaced avulsion fracture of the fifth metatarsal (**FIGURES 1** and **2**). The patient was placed in a walking boot for 10 days at full–weight-bearing status. During this time, aerobic exercise, core and lower-quarter strengthening, and proprioceptive training were performed. An orthotist created an orthosis with a lateral rearfoot wedge for his tennis shoe to reduce stress at the fifth metatarsal during sport.[3]

This case highlights the correct application of the Ottawa foot/ankle rules, which allow for full weight bearing if the other factors of trauma and pain with palpation are present, as in this case. Interdisciplinary management and pain-free sport-specific tasks allowed the young athlete to return to sport in time for the state tournament 3 weeks post evaluation.[1] *J Orthop Sports Phys Ther 2019;49(8):620. doi:10.2519/jospt.2019.8534*

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On-field Rehabilitation Part 2: A 5-Stage Program for the Soccer Player Focused on Linear Movements, Multidirectional Movements, Soccer-Specific Skills, Soccer-Specific Movements, and Modified Practice

In part 1,[6] we described 4 pillars underpinning high-quality on-field rehabilitation: (1) restoring movement quality, (2) physical conditioning, (3) restoring sport-specific skills, and (4) progressively developing chronic training load. In part 2, we describe how these pillars contribute to a 5-stage on-field rehabilitation program to help injured players transition to team practice and match play. We explain this program using an example case of a soccer player with ambitions to return to sport (RTS) after anterior cruciate ligament (ACL) reconstruction.

How Does On-field Rehabilitation Fit With RTS?

When planning high-quality on-field rehabilitation, it is necessary to understand (1) where on-field rehabilitation fits within the overall recovery process, and (2) whether the player has sufficient fitness to RTS practice. A prospective study found that 4% of elite-level soccer players with ACL reconstruction sustain a graft rupture prior to their first match,[16] highlighting the need for caution during the transition back to sport.

On-field rehabilitation represents the period when the player is transitioning from gym-based rehabilitation to the competitive team environment.[6,7,9] Overall, the transition process can be considered a continuum (**FIGURE 1**) of on-field rehabilitation, safe resumption of full-team training, and gradual reintroduction to full competitive match play.[7] Players on European Champions League teams returned to practice at 202 days after ACL reconstruction, on average. Players returned to competitive match play at 225 days,[16] leaving only 23 days between finishing rehabilitation and playing a match to prepare for high-level competition. Twenty-three days is unlikely to be long enough to adequately prepare a player physically, technically, tactically, and psychologically for competitive match play after 202 days away from the soccer pitch. This might be one of the reasons why 4% of players suffer ACL graft rupture before the first match, and 3% soon after the return-to-play period (less than 3 months).[16]

SYNOPSIS: This paper is part 2 of a 2-part series aimed at discussing the key elements of on-field rehabilitation training. In part 1, we described 4 pillars underpinning high-quality on-field rehabilitation: (1) restoring movement quality, (2) physical conditioning, (3) restoring sport-specific skills, and (4) progressively developing chronic training load. In part 2, we describe how the pillars contribute to a 5-stage on-field rehabilitation program to help injured players transition to team practice and match play. We use the example of a soccer player with ambitions to return to sport after anterior cruciate ligament reconstruction. The program moves through 5 field-based training stages: (1) linear movement, (2) multidirectional movement, (3) soccer-specific technical skills, (4) soccer-specific movement, and (5) practice simulation. The staged program is research based and facilitates communication, planning, control, and safety in return to sport following long-term injury.
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KEY WORDS: *criterion-based rehabilitation, on-field rehabilitation, performance rehabilitation, reconditioning, return to sport*

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An extended period of RTS preparation might help injured players safely return to play after ACL reconstruction. We propose 5 stages of on-field rehabilitation,[6] followed by a progressive return to team practice and gradual return to competitive match play. The player can focus on regaining soccer-specific movement, with physical, technical, and tactical performance and psychological readiness to perform.

Given the high-intensity physical demands of on-field rehabilitation, the player requires sufficient lower-limb strength (quadriceps, hamstrings, gluteals), movement control in foundation tasks and running, and adequate aerobic and anaerobic fitness.[14]

We suggest the player meet the following criteria prior to commencing on-field rehabilitation following ACL reconstruction: (1) no knee pain or swelling,[9] (2) no subjective knee instability,[9] (3) negative knee laxity tests,[3,9] (4) a minimum of 80% limb symmetry during isokinetic assessment of knee flexor and extensor strength (100% limb symmetry before discharge from on-field rehabilitation),[9] (5) good movement quality (ideally, assessed qualitatively with video analysis) in basic foundation movement exercises,[3] and (6) ability to run aerobically (ie, without blood lactate accumulation) for greater than 10 minutes at 8 km/h with sufficiently normalized running mechanics (ideally, assessed qualitatively with video analysis).[9]

Progression should be based on the criteria described in **TABLE 1**. On-field rehabilitation should be completed alongside additional gym-based strength and conditioning and movement retraining.

5 Stages of High-Quality On-field Rehabilitation

Effective on-field rehabilitation is characterized by a structured approach to planning and managing variation in training load. A consistent increase in training load underpins an increase in the body's capacity to do work.[5] Training load can be progressed by changing volume (the quantity of activity performed), intensity (the qualitative component of the exercise), and frequency (the number of sessions in a period of time) of training,[5] based on the player's capacities and needs.

We recommend the rehabilitation clinician use a global positioning system (GPS), which can provide a valid measure of external workload,[8] to quantify on-field rehabilitation training load. For soccer players, we monitor 7 metrics, which provide a relatively simple but complete and reliable picture of the workload demands of soccer (**TABLE 2**): total distance walked/run in a session, peak running speed, high-speed running distance (at speeds greater than 19.8 km/h), sprint distance (at speeds greater than 25 km/h), total acceleration distance, total deceleration distance (with acceleration/deceleration greater than ±3 m/s^2), and time in the aerobic and anaerobic heart-rate zones. We calculate heart-rate zones as either (1) heart rate at lactate thresholds, measured during an incremental running test, with thresholds of 2 mmol/L and 4 mmol/L for aerobic and anaerobic zones, respectively[11]; or (2) arbitrary heart-rate zones (ie, aerobic zone at 70% to 85% of maximal heart rate and anaerobic zone at greater than 85% of maximal heart rate).[1] We use the GPS and heart-rate metrics to objectively support transitions through on-field rehabilitation, which fits between gym-based rehabilitation and return to training with the team (**FIGURE 2**).

Stage 1: Linear Movement The aim of stage 1 is to transition to the field, to prepare physically and mentally for increasing sport-specific demands.

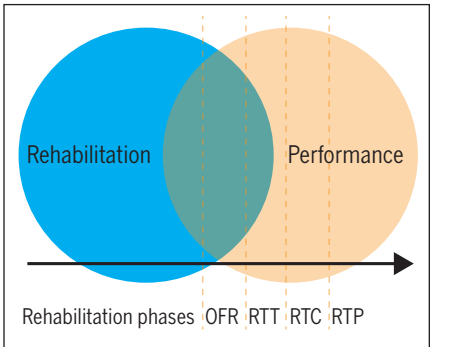

FIGURE 1. A RTS process involving a gradual transition from rehabilitation to performance training and a continuum of OFR, RTT, RTC, and RTP. Abbreviations: OFR, on-field rehabilitation; RTC, return to competitive match play; RTP, return to performance; RTS, return to sport; RTT, return to training. Modified with permission from Buckthorpe et al.[7]

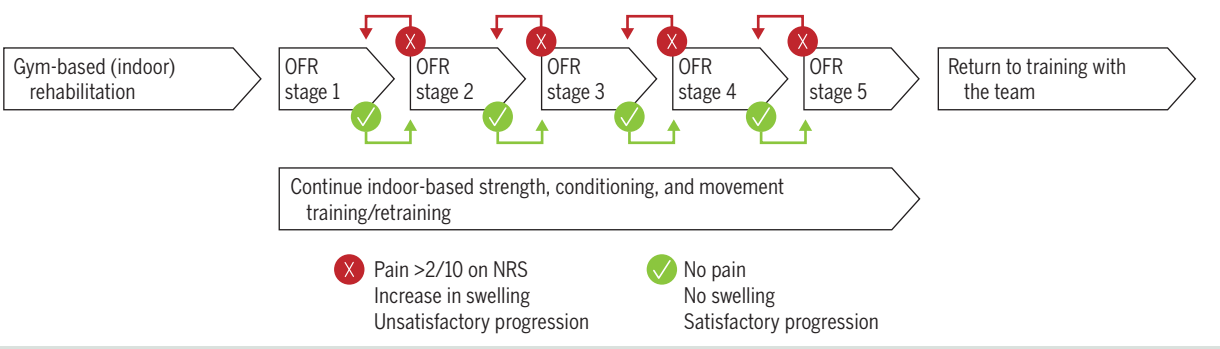

FIGURE 2. Timeline following anterior cruciate ligament reconstruction. On-field rehabilitation fits between indoor rehabilitation and return to training with the team and is subdivided into 5 stages. During OFR, indoor training can continue. Pain greater than 2/10 on an NRS, an increase in swelling, and/or unsatisfactory progression should trigger regression to the previous stage. Abbreviations: NRS, numeric rating scale; OFR, on-field rehabilitation.

TABLE 1 Five Stages of On-field Rehabilitation, With the Overall Focus for Each Stage, the Type of Activity, and Specific Examples of Content

	On-field Rehabilitation Program				
	Stage 1	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**
Specific entry criteria	• No pain or swelling • No subjective instability • No positive laxity tests[3,9] • Symmetrical ROM • Knee flexor and extensor LSI >80%[9] • Ability to run at 8 km/h for 10 min with sufficiently normalized running mechanics[9] • Sufficient movement quality during foundation movements	• No pain or swelling • Satisfactory progression through stage 1 on-field activity	• No pain or swelling • Knee flexor and extensor LSI >90% • Optimal movement quality during preplanned sport-type tasks • Satisfactory progression through stage 2 on-field activity	• No pain or swelling • Satisfactory progression through stage 3 on-field activity	• No pain or swelling • Satisfactory progression through stage 4 on-field activity
Goal of stage	• Linear movement coaching	• Multidirectional movement coaching	• Soccer technical and reactive movement training	• Soccer-specific movement and skill restoration	• Training simulation/reconditioning
On-field activity					
Movement	• Linear running (forward and lateral) • Foundation movement tasks (eg, squatting, lunging, athletic walks) • Deceleration tasks in preplanned situations of differing velocities • Mobility drills	• Increased speeds of movements from stage 1 • Multidirectional preplanned coordination drills (eg, cutting drills at increasing angles, curved running drills, figure-of-eight drills, accelerations, decelerations)	• Maximum-speed preplanned linear and multidirectional movement drills (change-of-direction drills, peak running speed exposure, ladder drills) • Reactive movement retraining: high-speed multidirectional preplanned speed, acceleration, and deceleration training (closed tasks) and movement practice under external focus with technical-based drills	• Continued preplanned and reactive movement training: high-speed multidirectional preplanned and reactive movements, movement in soccer-specific situations, closed soccer-specific fitness drills (eg, stage 3 soccer movement drills for conditioning), repeated sprint running • Reactive movement training with perturbations (eg, ropes; Swiss ball; agility circuit with ropes, Swiss balls, player contact) • Technical drills with pressure, contact to force the player off balance	• Soccer-specific movement training: soccer-specific plus speed and agility training in preplanned and reactive tasks, with and without fatigue

Table continues on page 573.

We start with simple movement drills involving discrete linear tasks.[3,9] Multidirectional movements and higher movement speeds place greater load on the knee, so it is important to gradually increase movement speeds[15] and complexity.[2,17] Keeping the sessions short and focusing on restoring movement quality (pillar 1 of on-field rehabilitation) are the starting points of stage 1.[6] We minimize soccer-specific activity (with the soccer ball) to reduce movement variability and possible exposure to "high-risk" scenarios (eg, reacting by reaching for an unexpected bad pass). However, players are allowed and should be encouraged to have very "controlled" activity with the soccer ball (eg, "keep-ups," touches between the inside of the feet, and standing/predictable volleys or passes).

There is an increase in training load once a player commences on-field rehabilitation. Therefore, we prioritize load for high-quality movement retraining. In the gym, it is possible to use additional non–weight-bearing cardiovascular training (eg, interval-based training on the bike or cross-trainer) to develop cardiovascular fitness while limiting knee load. Key movement tasks must include unidirectional forward and lateral running drills at self-selected speeds and controlled accelerations and decelerations during these movements (**TABLE 1**, **ONLINE VIDEO 1**).

Stage 2: Multidirectional Movement The aim of stage 2 is to execute preplanned multidirectional movements at or near full speed and without poor biomechan-

TABLE 1 Five Stages of On-field Rehabilitation, With the Overall Focus for Each Stage, the Type of Activity, and Specific Examples of Content (continued)

	On-field Rehabilitation Program				
	Stage 1	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**
Physical	• Aerobic conditioning achieved during running	• Aerobic conditioning using interval-based running (10-20 min) • High-speed running exposure	• Linear continuous or interval-based running for aerobic and anaerobic (12 min above AT); peak linear running speed exposure	• Aerobic and anaerobic conditioning (>15 min above AT) during agility and soccer-specific situations	• Aerobic and anaerobic (15-20 min above AT) during soccer-specific activity (eg, possession drills, soccer circuits)
Technical/tactical	• Simple technical drills such as "keep-ups," touches between the inside of the feet, and standing/predictable volleys/passes	• Easy soccer technical drills with knee control in standing position: standing volleys, simple passes, maintaining balance, and optimal limb control	• Soccer technical program: technical drills (preplanned closed tasks) of increasing difficulty (passing: short to long, touch work, crossing, and shooting)	• Soccer skills program: activities from stage 3, with pressure and/or at higher speeds and with greater number of decisions; introduction to 1-versus-1 and 2-versus-1 drills in increasingly varied games (with no contact/light tackling)	• Soccer-specific training: soccer simulation training in realistic drills and situations, contact introduction at the necessary intensity
Loading (see **TABLE 2**)	• Introduction to outfield activity: exposure to running volume (3-4 km)	• Develop total running distances • Exposure to high-speed linear accelerations, decelerations, and running speeds	• Exposure to sprint running thresholds • Develop volume in all areas	• Approach training intensity	• Mimic the physical loading demands of team training • Develop chronic loading

Abbreviations: AT, anaerobic threshold; LSI, limb symmetry index; ROM, range of motion.

ics or hesitation. Once the player can do this, he or she can commence soccer-specific practice, with focus on movement coaching/coordination training, and progress to preplanned multidirectional movements of increasing speed and complexity.[2,15,17]

Movements practiced in stage 1 can be performed at higher speeds (eg, high-speed linear running, accelerations, and decelerations). Then, the player can progress through increasingly more complex change-of-direction drills, gradually reducing task constraints and progressively increasing the intensity of accelerations and decelerations (eg, progress from 2 m/s^2 to 3.5 m/s^2). The GPS can confirm when the player is able to complete the metrics of these tasks at the desired movement intensity (eg, achieve near peak decelerations and the planned volume of accelerations and decelerations in excess of ±2 m/s^2). Linear running speed can increase (eg, greater than 25 km/h); cardiovascular conditioning (linear running only), using effective work-to-rest ratios to specifically target energy system development, is also appropriate. Simple soccer drills can be practiced during controlled tasks (eg, straight-line dribbling, controlled volleying, simple passing drills). Linear movement drills can be performed with a task goal (eg, forward and backward running with a controlled volley/pass exercise) (**TABLE 1**, **ONLINE VIDEO 2**).

Transition to stage 3 is criterion based (**TABLE 2**) to ensure the player is well-prepared for soccer-specific training (eg, technical training, soccer-specific movement drills).

Stage 3: Soccer-Specific Technical Skills The aim of stage 3 is to complete the technical soccer program and train "agility" (movement with reactive decision making).[13]

The player commences more intense soccer-specific practice. In stage 3, the focus is on progression through a soccer-specific technical program and training "reactive movements." Technical training involves practice of preplanned soccer-specific drills (eg, control the ball and pass to the player on your right), with no pressure from other players. Technical elements can be progressively added to linear and multidirectional movement tasks practiced in stage 2 to add specificity (eg, external focus of attention with greater neurocognitive demands). Reactive-movement training involves performing movements such as cutting while reacting to an external stimulus (eg, running forward and changing direction at the cone, either right or left, depending on how the player reacts to the cue presented immediately before the required task).

Reactive movements can challenge biomechanics and increase knee loads more than planned movements.[2] Thus, delaying reactive movement training until the player has achieved safe biomechanics in preplanned tasks and restoring and confirming safe biomechanics

TABLE 2 An Example of Progressive Loading and Management During the 5 Stages of On-field Rehabilitation for an Elite Soccer Player Prior to RTS After ACL Reconstruction*

	Stage				
	1	2	3	4	5
Sessions, n	3-5	3-5	3-5	4-6	4-6
Peak speed, km/h	17-21	22-25	28+	30+	30+
Total distance, m	3000-4500	4000-5000	4000+	4500+	4500+
HSR distance, , m†	0-100	100+	200-400	500	400-800
Sprint distance, m‡	0	50	100	150+	100-300
Combined acceleration and deceleration distance, m§	0-55	80+	100-200	>250	>300
HR at 70% to 85% of maximum, min	0-10	10-20	30	20-30	20-30
HR at >85% of maximum, min	0	0-5	15	15-20	20+

Abbreviations: ACL, anterior cruciate ligament; HR, heart rate; HSR, high-speed running; RTS, return to sport.
**Seven key metrics are adopted, with progression through stages based on achieving the desired intensity and quality of work, alongside other rehabilitation criteria (eg, movement quality, psychological readiness, strength and power, no pain or swelling).*
†Defined as 20 to 25 km/h.
‡Defined as greater than 25 km/h.
§Defined as greater than ±3 m/s².

in reactive movements prior to RTS are crucial aspects of this stage of the on-field rehabilitation process.

Physical therapists should train technical drills and reactive movements separately, prior to progressing to skills training. Skills training involves performing soccer-specific drills, either under pressure from an opponent or during open tasks (involving greater choices and environmental stimuli), and typically requires reactive movements, quick decision making, and less control.

In stage 3, physical therapists should progressively increase training load and cardiovascular conditioning of the athlete on the field to develop the player's physical fitness, limit/avoid fatigue during complex movement tasks, and improve performance and avoid poor biomechanics.[4,6,10] Movements trained in stage 2 may now be performed at maximal speed to develop anaerobic performances (eg, speed training) (**TABLE 1**, **ONLINE VIDEO 3**).

Stage 4: Soccer-Specific Movements The aim of stage 4 is to progress toward team practice intensity (eg, 85%-90%), including 1-versus-1 drills under match-type scenarios (eg, a goal) and controlled contact practice (eg, light contact for confidence, perturbation training in 1-versus-1 situations).

Training neuromuscular control in soccer-specific movements and during skill-based training sessions helps the player prepare for safe participation in soccer. To do this, a program of progressive sport-specific movements must be created to support the transfer of movement patterns into sport-specific scenarios. This includes a gradual progression to more challenging tasks at higher speeds and with more challenging visuomotor requirements (eg, a greater number of choices),[15] so the player must progressively become able to safely execute high-speed multidirectional movement drills while fatigued.

Physical therapists should use soccer-specific fitness drills to train technique development, with simultaneous cardiovascular conditioning. Soccer fitness training also provides a cognitive stimulus, challenging the technical aspects under fatigue as preparation for return to unrestricted team practice. Physical therapists should monitor workload during these tasks, assessing the GPS metrics in detail to ensure that the desired speeds during running and acceleration and deceleration thresholds and the desired cardiovascular stress (eg, average heart rate and minutes at an intensity of greater than 85% of maximum) are achieved (**TABLE 1**, **ONLINE VIDEO 4**).

Stage 5: Practice Simulation The aim of stage 5 is to prepare for return to unrestricted practice with the team by creating a practice environment that mimics the physical, technical, and psychological loading demands of the sport.

Stage 5 aims to bridge the gap between on-field rehabilitation and unrestricted team practice. During this stage, the player can participate in modified team practice (eg, join in the warm-up and technical skills sessions), where uninjured players are enlisted to replicate the soccer practice environment (eg, have an uninjured goalkeeper help with shooting practice; 1 or 2 players for possession or drill activities, such as crossing and/or finishing). Emphasize group-based technical and tactical drills, including possession drills in 1-versus-1 and 2-versus-2 situations.

Monitor load progression (intensity and volume) using a GPS (or other load-monitoring system) to ensure the correct stimulus for adaptation and development of chronic training load (**TABLE 2**).[12] The player's key load metrics must be achieved during soccer-specific activity (eg, soccer fitness drills, possession scenarios, skills practice) and not during supplementary activity (eg, end-of-session runs). The exception may be high-intensity/sprint running, which may be difficult to achieve in some types of soccer practice (eg, small-sided games) and may require additional high-intensity/sprint sessions. The player must perform at a minimum of 90% of the required practice intensity and complete at least

90% of the preinjury training volume (or relative to a normative value where preinjury data are unavailable). In addition, the soccer player should have reached at least 70% of the preinjury chronic training load (or relative to normative values) in all relevant physical workload metrics (**TABLES 1** and **2**).

Criteria for return to unrestricted team practice[7] include clinical (pain, swelling, stability/laxity, range of motion), functional (strength, endurance, body composition), biomechanical (movement analysis testing), psychological (fear of reinjury, confidence), and sport-specific (ability to support volumes and work intensities in training, sport-specific physiological screening) factors.

Summary

We focus on 4 pillars of high-quality on-field rehabilitation when helping players transition back to sport after long-term injury: restoring movement quality, physical conditioning, restoring sport-specific skills, and progressively developing chronic training load.[6] A 5-stage program, focused first on coaching linear movements and subsequently on multidirectional movements, then on restoring soccer-specific technical skills and movements and reaching practice simulation before return to usual team activities, may help rehabilitation clinicians and players communicate, plan, and execute a safe RTS. ◉

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Patient and Parent Perceptions of Rehabilitation Factors That Influence Outcomes After Anterior Cruciate Ligament Reconstruction and Clearance to Return to Sport in Adolescents and Young Adults

BACKGROUND: Wide variation in outcomes after anterior cruciate ligament reconstruction (ACLR) exists among adolescents and young adults. However, little evidence is available regarding key rehabilitation factors that may be driving these differences.

OBJECTIVE: To explore patient and parent perceptions of key rehabilitation drivers related to outcomes after ACLR.

METHODS: In this qualitative study, which used an interpretive phenomenological methodology, semi-structured interviews were conducted with patients who had returned to sport after ACLR and with their parents. The interviews asked about respondents' experience with physical therapy and how it related to their outcomes after ACLR. The interviews were recorded, transcribed, and coded. Themes were then identified using open and axial coding processes.

RESULTS: There were 3 primary themes that patients and parents perceived as key factors influencing their rehabilitation outcomes after ACLR: (1) patient attributes (ie, motivation, confidence, accountability, access to resources, and social support), (2) physical therapist-patient relationship qualities (physical therapist as guide, motivator, booster of confidence, fosterer of perseverance, and coordinator of care), and (3) elements of the system (ie, availability and utilization of therapy visits, clinic environment, and coordination among care providers).

CONCLUSION: Patient and parent perspectives of key drivers that influence ACLR rehabilitation outcomes include patient, therapist, and system factors. Developing specific strategies to target these factors may enhance patient and parent perceptions of the experience. The awareness gained from these results provides a foundation for future studies examining how these factors affect outcomes and how to improve rehabilitation after ACLR.

LEVEL OF EVIDENCE: Therapy, level 3. *J Orthop Sports Phys Ther 2019;49(8):576-583. Epub 13 Feb 2019. doi:10.2519/jospt.2019.8608*

KEY WORDS: *anterior cruciate ligament reconstruction, outcome, patient/family experience, qualitative*

Approximately 50% of patients do not return to the same competitive level of activity after anterior cruciate ligament reconstruction (ACLR),[1,2] and as many as one third of young, active patients with ACLR sustain a second anterior cruciate ligament (ACL) injury within 2 years of returning to activity.[17,26] These data suggest that our current management of patients with ACLR is failing.

Research on ACLR rehabilitation outcomes has often focused on identifying high-risk movement patterns, demographic variables,[13,18,19] and psychosocial risk factors associated with poorer outcomes,[6,9,24] with social interaction and system considerations receiving much less attention. Postoperative ACLR management typically involves months to more than a year of rehabilitation focused on

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addressing impairments, overcoming psychological barriers, and navigating a complex health care environment.[5] Increased awareness and understanding of patient and parent experiences with the rehabilitation process may offer new insights and opportunities to improve long-term ACLR outcomes and enhance clinicians' ability to provide patient-centered care.

The purpose of this study was to identify rehabilitation factors adolescent and young adult patients and their parents perceive as having strongly impacted their outcomes after ACLR. Adolescents and young adults were selected as the target population, because the highest incidence of ACL injury occurs around this age[22] and lifestyle and activity goals often differ between younger and older individuals. The results are intended to help identify areas to improve and optimize ACLR rehabilitation processes, both now and in future studies.

METHODS

Theoretical and Methodological Approach

This qualitative study used an interpretivist/constructivist orientation and a social phenomenological lens for the analysis.[3,15,21,23] Qualitative methods support a discovery-oriented design and allow for a systematic, but flexible, means to enhance understanding of how people think about, reflect on, and interpret their experiences.[11,15] The interpretivist/constructivist orientation guides data-collection and data-analysis approaches that could adequately capture participants' lived experiences. The social phenomenological lens emphasizes exploring how participants' reflections on their social interactions with medical and rehabilitation staff, the health system, and the rehabilitation environment may have shaped their perceptions of the rehabilitation process and outcomes. The Standards for Reporting Qualitative Research and the COnsolidated criteria for REporting Qualitative research were used to guide reporting of study results and methods.[16,25]

Study Design, Participants, and Setting

Approval by the Cincinnati Children's Hospital Medical Center Institutional Review Board was obtained prior to the start of the study. An active ACLR research participant registry database was used to identify potential participants between the ages of 10 and 25 years with a presurgery goal to return to pivoting and cutting sports (eg, soccer, basketball). Patients were consecutively contacted to determine their interest. Fourteen potential participants were contacted. Ten parents and 10 patients agreed to participate. Interviews occurred over a 6-month period. Participants represented a spectrum of those who successfully completed rehabilitation and returned to the preinjury level of activity and those who never completed the rehabilitation process or returned to sport. Informed consent was received from all parents and adult patients, and assent was received from each participant under the age of 18 years.

Data Collection

Data collection entailed audio-recorded joint interviews with patients and their parents, or separate interviews when scheduling a joint interview was not possible. Interviews were conducted using a semi-structured question guide developed with input from the study team, clinicians, patients, and parents (**APPENDIX A**, available at www.jospt.org). The primary investigator (M.P.), a physical therapist and experienced clinical researcher, conducted all the interviews independently. All interviews were either conducted in person at a physical therapy clinic or by phone and were transcribed verbatim. Data collection and analysis were treated as reciprocal processes, whereby data collection and theme generation began with the initial interview and continued until the research team agreed that theoretical saturation had been reached (ie, the final few interviews were not uncovering any new themes).[4,15]

Data Analysis

A variety of strategies were used to ensure the rigor and trustworthiness of the analysis, with an emphasis on triangulation of information from multiple sources and levels of expertise. The authorship team was assembled strategically to provide a diverse array of stakeholder perspectives to support the interpretivist/constructivist orientation and social phenomenological analysis lens.

The analysis began with independent open coding by 3 trained members of the research team: (1) an experienced physical therapist/ACLR clinical researcher (M.P.), (2) an experienced physical therapist/clinical researcher with expertise in qualitative methods and a personal history of ACLR (C.Q.Y.), and (3) an undergraduate student with no history of ACLR or prior research experience (N.D.). Each coder performed a line-by-line review of the transcripts and generated initial codes related to how they each interpreted the participants' comments. The 3 coders met repeatedly to identify higher-order themes and nested subthemes. Discussions emphasized a consideration of the social phenomenological elements within the participants' descriptions of their experiences, particularly as they related to their social interactions with others during their ACLR recovery process and the rehabilitation environment. The coders also reflected on and discussed individual biases and experiences that might have influenced their coding (researcher reflexivity) to guard against the bias of any single coder.

Once the coding scheme was stabilized, case-by-case analysis of each transcript was performed for each theme, yielding frequency counts for each theme. The intent of the frequency count was not to provide the relative weight of each theme, but rather to provide insight into the consistency of the themes across participants and identify conflicting cases. Study team members (S.T., L.S., and R.R.) independently reviewed the coding scheme and provided feedback, based on their own experiences and perspectives as a patient with a history of 2 ACLRs, an experienced clinical (physical therapist) researcher, and the mother of

3 daughters who underwent ACLR with varying outcomes, respectively.

RESULTS

Ten patients (6 male, 4 female; mean ± SD age, 16.9 ± 2.2 years) and 10 parents participated in the study. A total of 11 interviews were conducted (9 parent-patient dyads, 1 parent of an ACLR patient only, and 1 ACLR patient without a parent). Interviews lasted between 23 and 32 minutes (median, 26 minutes). **TABLE 1** provides participants' background information.

Three higher-order themes were identified as key factors that influenced patients' rehabilitation outcomes after ACLR: (1) patient attributes, (2) physical therapist-patient relationship qualities, and (3) elements of the system. Several subthemes associated with each of the broader themes were also identified. The study team developed a visual framework depicting how these factors come together to potentially influence rehabilitation outcomes throughout the rehabilitation process, starting with the onset of the ACLR recovery process and continuing through long-term outcomes (**FIGURE**). **TABLE 2** provides the frequency count of each theme relative to each participant. **APPENDICES B** through **D** (available at www.jospt.org) provide additional representative quotes and context descriptions for each theme.

Perceptions of Patient-Related Factors

Patients and parents alike acknowledged that some key factors they felt contributed to rehabilitation outcomes were related to personal attributes of the patient. Common examples included (1) motivation, confidence, and accountability; (2) access to resources such as a school-based athletic trainer, home equipment, or local gyms; and (3) social support from others (**APPENDIX B**); however, the data suggested that these factors could be equalized or compensated for by other factors or interventions.

Motivation, Confidence, and Accountability Participants' descriptions of motivation, confidence, and accountability often intermixed these constructs, which ultimately led the coders to group them as a single theme. For example, motivation was often described as being regulated by confidence and accountability, as well regulating confidence and accountability. At times, these attributes were described as a relatively stable aspect of the patient's personality, and at other points they were conveyed as ebbing and flowing over the course of the rehabilitation process. As one participant described, "I've always been a confident person as far as my skill on the field, but tearing it [ACL] definitely humbled me as far as knowing that I'm not invincible the way I thought I was" (patient 10).

Access to Resources Several of the patients noted that access to specific resources, such as school-based athletic trainers, availability of special equipment at home, and the ability to use school or membership-based gyms, had a positive impact on their outcomes. Three patients noted that although they had access to athletic trainers, they preferred to not work with them because they did not feel like they had a great connection with the athletic trainer (patients 3 and 7) and they "didn't really want any help" (patient 4). Another patient said he would have liked to work with his athletic trainer more, and the athletic trainer would have liked to work with him more, but there were system limitations (patient 8). Transportation issues, a lack of motivation, and lower comfort levels working with resources outside of the physical therapy clinic were all described as barriers limiting utilization.

TABLE 1 Demographic Information for All Participants

Participant	Current Age of Patient, y	Age of Patient at Time of ACL Injury, y	Time From Injury to RTS, mo	Sex of Patient	Parent	Second ACL Tear	Sport(s) Played
Patient 1, parent 1	16.11	14.10	7.9	Female	Mother	Yes*	Basketball
Patient 2, parent 2	18.40	17.04	6.1	Male	Mother	No	Track and football
Patient 3, parent 3	15.42	14.04	Did not RTS	Female	Mother	No	Soccer
Patient 4, parent 4	17.54	16.04	7.0	Male	Mother	Yes*	Soccer
Patient 5, parent 5	16.55	15.64	7.1	Male	Mother	Yes†	Basketball
Patient 6, parent 6	12.51	11.63	10.2	Male	Father	No	Basketball, soccer, and baseball
Patient 7, parent 7	17.09	16.13	Did not RTS	Female	Mother	No	Soccer and discus
Patient 8, parent 8	17.43	16.59	7.1	Male	Mother	No	Basketball
Patient 9, parent 9	16.40	15.12	13.4	Female	Mother	No	Volleyball
Patient 10	21.68	19.85	Never cleared	Male	NA	Yes†	Semi-professional football
Parent 10	NA	15.76	Did not RTS	Female	Mother	No	Gymnastics

Abbreviations: ACL, anterior cruciate ligament; NA, not applicable; RTS, return to sport.
**Ipsilateral side.*
†Contralateral side.

Social Support Both patients and parents acknowledged the significant role that family and friends, and even strangers, played in bolstering motivation and supporting rehabilitation processes. One of the patients was particularly young when he injured his ACL, and his father noted how his young age necessitated heavy involvement of his parents, as he had limited access to resources such as athletic trainers (parent 6). One mother said that perhaps there would be a benefit to facilitating a social group to enable patients to "talk to other kids who've already been through rehab and they're back playing their sports, or some kind of peer support . . . for the mental and emotional part of it" (parent 3).

Perceptions of Core Physical Therapist-Patient Relationship Qualities

A second higher-order theme identified was the critical role that patients' relationships with their physical therapist played in the rehabilitation process (**APPENDIX C**). This theme was supported in terms of the volume of patients and parents who articulated this as a prominent factor and the importance each participant placed on this factor. Four subthemes emerged relative to this theme, including the physical therapist as (1) guide, (2) motivator, (3) booster of confidence, and (4) coordinator of care.

The Physical Therapist as Guide Many participants expressed sentiments about their lack of experience and understanding of what the postoperative and rehabilitation processes would entail. Physical therapists were often described as a resource that filled knowledge gaps and helped guide them through the recovery process on both the medical and rehabilitative sides. As one parent described it, her son's physical therapist "was really instrumental in helping him understand his injury," because, prior to working with his physical therapist, "he was really, really confused" (parent 4).

Although some participants noted that the guidance was often supplemented with other information sources (ie, school athletic trainer or coach), most participants expressed the consistent need to receive guidance from a physical therapist throughout the rehabilitation process. A patient who had undergone 2 ACLRs specifically compared her 2 primary therapists in terms of their guidance. She noted that her therapist after her first ACLR "gave me a lot of guidance," whereas her therapist after her second ACLR was not "giving me enough guidance." The patient went on to describe how she ultimately switched to another physical therapist after her second ACLR in order to get the guidance she felt she needed (patient 1).

Multiple patients and parents noted that in addition to the guidance their physical therapist provided, they believed they would have benefited from a more explicit way of knowing how they were faring in terms of rehabilitation milestones. As one patient described, "I wish I would have a chart of where I should be . . . so I could know what I'm shooting for . . ." (patient 4). Likewise, one parent noted how a milestone chart may have helped keep progress in perspective and fostered perseverance, so that his child could say, "Okay, I've got that. Now I've got to get to this point" (parent 6).

The Physical Therapist as Motivator Many patients and parents noted the challenge of staying motivated to continue rehabilitation over so many months, and their physical therapist served as a valuable source of motivation, almost like a coach. This was true on a day-to-day level

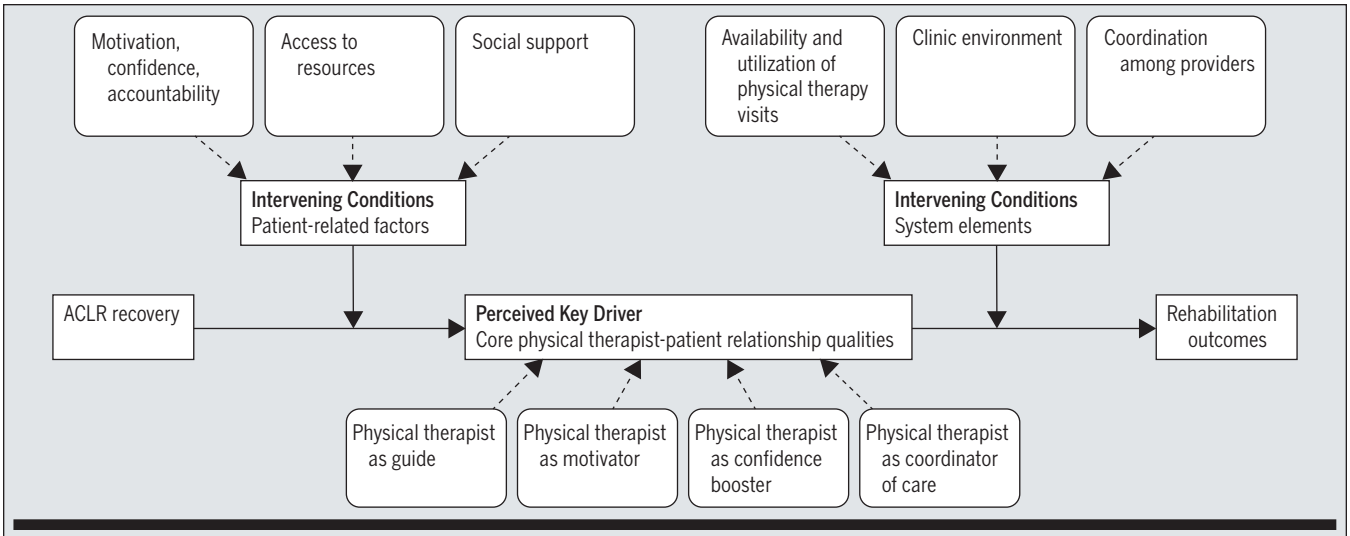

FIGURE. This drawing represents a proposed thematic model that is inclusive of the factors identified in the patient/parent interview process that influence a patient's experience with the rehabilitation process, categorized into patient attributes, core physical therapist-patient relationship factors, and system elements. As patients progressed from anterior cruciate ligament surgery through the ACLR recovery process, their outcomes were most frequently influenced by the strongest/most often mentioned key driver—the physical therapist-patient relationship. Secondarily, other intervening conditions, such as patient attributes and system elements, were described as having great potential to influence the rehabilitation process. Abbreviation: ACLR, anterior cruciate ligament reconstruction.

and for the overall experience of ebbs and flows in motivation. As one patient said, "I have had a lot of bad days, a lot of good days. Probably, without my therapist, I wouldn't have made it the whole way through" (patient 2).

Many patients and parents commented on how the physical therapist was a key resource that helped them persevere through the low points and stay on track to complete rehabilitation. Several patients described how, early after surgery, the rehabilitation was physically challenging, which made it a struggle for them mentally and emotionally. One patient noted that the physical challenge of performing his therapy exercises was a struggle at first because, as she explained, "I'm kind of in pain right now. I don't think I want to . . ." (patient 7). The middle period of the rehabilitation was commonly reported as a period of mental and emotional struggle as well, but for slightly different reasons. Broadly, this phase of rehabilitation was described as a period of frustration and depression that was driven by feeling functional yet still unable to fully return to activities.

Participants' perceptions of the physical therapist as a motivator were often influenced by the style and personality of the physical therapist. As one participant expressed, his physical therapist "was always the person that kept me motivated. . . . He was the person I loved to talk to no matter what. We talked about music, sports . . . we just have a good old time" (patient 8). Another patient said, "It was harder mentally than it was physically. . . . I really like having a fun and encouraging therapist . . . that helps me a lot" (patient 3).

In contrast, a few participants described feeling that their physical therapist was not serving as an effective guide to the rehabilitation process, which negatively affected their motivation to work hard. One patient noted, "I feel like some of the things I did at home were just too easy—like I should have been doing another thing" (patient 4). A second patient reported, "Sometimes, I thought my therapist was giving me really weird stuff to do . . . giving me exercises with my ankles, and I did not understand what the relationship of that [was] with my knee" (patient 9). Her mother added that her physical therapist "tried to explain it, but it felt like he was neglecting her injury and kind of nitpicking" (parent 9).

The Physical Therapist as Booster of Confidence Fear and a lack of confidence were common among many of the participants and their parents. The role of the physical therapist as a booster of confidence appeared to be prominent throughout the phases of rehabilitation, but particularly in the final phase. Patients and parents described the final phase as being the most challenging in terms of coping with the fear of returning to high-level activities, both about reinjury and whether they would be able to return to their preinjury level of competitiveness. As described by one patient, "Going back . . . was like, 'How do I minimize my chance of that happening again?' . . . I think there was more of me freaking myself" (patient 2). In response to a query about how confident she felt in her rehabilitation process, another participant said, "I feel a little bit more confident because my [physical therapist] told me I would be able to get back to my sport. So, knowing without a doubt I would be able to go back made it all better" (patient 7).

The Physical Therapist as Coordinator of Care A final role that patients and parents reported as critical was the physical therapist's ability to aid in the coordina-

TABLE 2 Frequency Counts for Each Theme by Participant

	Patient Attributes*			Physical Therapist Engagement†				System Elements‡		
	1	2	3	1	2	3	4	1	2	3
Patient 1	✓	✓	✓	✓	✓	✓		✓		✓
Patient 2	✓	✓	✓	✓	✓	✓	✓			✓
Patient 3	✓		✓	✓	✓	✓				
Patient 4	✓	✓	✓	✓	✓					✓
Patient 5	✓		✓			✓		✓		✓
Patient 6		✓								
Patient 7	✓	✓			✓	✓			✓	
Patient 8		✓	✓	✓	✓	✓	✓		✓	✓
Patient 9	✓	✓	✓	✓	✓		✓	✓	✓	
Patient 10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Parent 1	✓	✓		✓	✓		✓	✓		✓
Parent 2	✓	✓	✓	✓	✓		✓		✓	✓
Parent 3	✓	✓	✓	✓		✓	✓	✓	✓	
Parent 4		✓		✓	✓	✓				
Parent 5	✓			✓			✓	✓		✓
Parent 6	✓	✓	✓	✓	✓			✓		
Parent 7							✓	✓		
Parent 8		✓		✓			✓			✓
Parent 9	✓			✓	✓		✓			✓
Parent 10	✓	✓		✓	✓		✓			✓
Total	15	15	11	16	14	9	12	9	6	12

**Subtheme 1, motivation, confidence, and accountability; subtheme 2, access to resources; subtheme 3, social support.*
†Subtheme 1, physical therapist as guide; subtheme 2, physical therapist as motivator; subtheme 3, physical therapist as booster of confidence; subtheme 4, physical therapist as coordinator of care.
‡Subtheme 1, availability and utilization of physical therapy visits; subtheme 2, physical therapy clinic environment; subtheme 3, coordination among providers.

tion of care. As one mother emphasized, "I think that a [physical therapist] has to have a very important voice in the decision of the care of the patients" (parent 10). Many patients and parents described different pathways and stakeholders in their care, with the physical therapist serving as a primary broker in the communication and coordination of those efforts. For example, one patient had access to an excellent athletic trainer and relied on his physical therapist to communicate his needs and progression plans to the trainer. Parents also commonly reflected on how the physical therapist often served as a key coordinator in their child's care by helping to make a plan about clinic visits relative to insurance coverage limitations.

Perceptions of System Elements

Patients and parents mentioned several elements of the global and local systems that they perceived as influencing the rehabilitation process and outcomes (see **APPENDIX D**). The most common system elements highlighted included (1) the availability and utilization of physical therapy visits, (2) the clinic environment, and (3) coordination among care providers.

Availability and Utilization of Physical Therapy Visits Many patients said they had insurance limitations on the number of therapy visits, which led to a need to continuously strategize about how best to utilize the available visits. At times, this worked out well, particularly when the patients had other resources such as athletic trainers and access to equipment outside of the clinic. However, several patients and parents noted that they thought their rehabilitation experiences and outcomes fell shy of their needs due to insurance limitations, especially in the final rehabilitation phase.

Several patients and parents noted that additional physical therapy visits for a few months after the return to sport, or intermittently for the first year after return to sport, would have been helpful to address new concerns or issues that arose. One of the patients said, "I wish that I would have somebody that would keep tabs on me after I'm done to make sure that I'm going in the right direction . . . Even though I'm clear to play, I want to make sure that I'm not going backwards or headed in the wrong direction" (patient 10). Another constraint insurance limitations placed on the rehabilitation process involved the ability to use presurgical visits to help prepare patients and their parents, physically and mentally, for the rehabilitation process ahead. With a limited number of visits, a choice often had to be made: using visits sooner to better facilitate the early rehabilitation process came with the risk of not having them available later, as the patient was trying to return to higher-level activities.

Clinic Environment Several patients noted that the physical therapy clinic environment had a large impact on their perceptions of their rehabilitation experience. As one patient said, "I could walk in and someone will [say], 'Hey, [name redacted]' . . . I'm like, I actually know who that is, and I can connect with them . . . They're always so kind and so nice and they would always interact with you" (patient 8). Others noted that the equipment and space at the physical therapy clinic were potential influencers of outcomes.

Coordination Among Providers Patients with ACLR and their parents often meet many care providers over the course of their diagnosis, surgical, and rehabilitation processes. Several patients and parents noted how the coordination among providers either enhanced or hindered their perceptions of the rehabilitation experience and, ultimately, their outcomes. Many gave examples about how coordination among providers comforted them and felt seamless, allowing for good communication and no doubts about progress. One parent noted, "I think that's completely critical . . . making sure that the team, that there is a team and the team isn't just, you know, a separate doctor and a separate [physical therapist] but a real team, including the sports medicine doctor, because we're talking about an athlete" (parent 10). Others noted that if there was a communication gap or disconnect between providers, it led to problems later. In one case, this was manifested as a rehabilitation complication that delayed identification and treatment.

DISCUSSION

The aim of the current study was to identify and describe rehabilitation factors young patients and their parents perceive to impact ACLR outcomes. The study team identified 3 overarching themes as key factors that young patients and their parents perceive to affect rehabilitation outcomes considerably. The specific examples and contexts provided by the qualitative interviews relative to each of these themes provide insights and potential strategies clinicians can draw on to adopt a more patient-centered model of care.

Patient Attributes

The theme of patient attributes raised some interesting areas for clinicians to expand the questions and considerations they might incorporate into coproducing an ACLR plan of care with young patients and their families. It may be helpful for clinicians to discuss personality traits, access to resources, and social support at the onset of rehabilitation and to revisit them throughout the process. The theme of patient attributes also resonates with patients' sense of self-management and may yield important information about how to predict and plan for the extent to which a patient may need to rely on others and external resources to achieve optimal rehabilitation outcomes. Additionally, it aligns well with a subset of the literature that has explored psychosocial factors associated with post–ACLR rehabilitation outcomes, including findings that suggest that locus of control, self-efficacy, and fear of reinjury can influence perceived ACLR outcomes.[5,6,12,24]

The current study distinctly highlights how patients and their parents are often

aware of their own motivation, confidence, and accountability strengths and weaknesses. It also highlights opportunities for clinicians to personalize their care of patients by identifying access to other resources and social support, and then leveraging these in accordance with patients' needs and preferences. Additional research into how patients' personal attributes affect rehabilitation outcomes may yield valuable and constructive approaches for improving clinicians' ability to incorporate and leverage these resources advantageously.

Core Physical Therapist-Patient Relationship Qualities

The 4 subthemes relative to the physical therapist-patient relationship provide an interesting perspective on how patients and parents view the role of the physical therapist in the rehabilitation process, beyond that of provider of therapeutic exercises. A number of patients said that the physical therapist played a critical role in their rehabilitation, but their perceptions of their physical therapist's ability to fulfill their needs and preferences depended heavily on the effectiveness of the communication style and the ability to make physical therapy sessions comfortable and fun. These subthemes provide a robust set of new research questions to drive future investigations. To highlight a few potential areas for prospective studies: (1) what behaviors should physical therapists engage in to serve as successful guides, motivators, boosters of confidence, and care coordinators for ACLR rehabilitation? (2) How do these roles independently and jointly contribute to rehabilitation outcomes? (3) Do certain subgroups of patients necessitate unique strategies or tactics relative to these roles (eg, age of patient at time of injury, access to resources, and social support)? As emphasized by the results of 1 systematic review on the psychosocial factors influencing recovery after ACLR, there is great opportunity for therapists to help shape realistic expectations and use counseling strategies to reduce anxiety and frustration and even improve adherence to rehabilitation recommendations.[24] More research is necessary to help develop and provide effective training and resources to support interventions of this nature.

System Elements

The system-elements theme also uncovered some potential new and important areas for future research. Of particular need for further investigation is the impact of insurance limitations. In some cases, worries about and frustration with visit limitations could sometimes be offset by strategizing with the physical therapist about how to best use visits and maximize access to other resources. However, many patients and parents expressed how valuable they felt presurgical physical therapy and post–return-to-sport visits were (when they had them) or could have been (when they did not have them). Likewise, a common sentiment was a desire for an option for "booster" check-ups or rounds of therapy 1 to 2 years later, to help identify remaining or new limitations and reduce their risk for reinjury. The value of presurgical physical therapy with ACLR[7] and "booster" check-ups with total knee arthroplasty[8] has previously been described in the literature and warrants further investigation in the ACLR population.

Limitations

There are several limitations of the current study. First, the intent of the study was to explore and identify perceived key drivers rather than to confirm patient and parent perceptions in a large sample. These results should be confirmed in a larger cohort of patients after ACLR. Second, the identified factors are only representative of patient and parent perceptions of factors that influenced outcomes, and, therefore, do not represent how these factors directly impact actual patient outcomes.

Third, the target sample for the current study was young patients with a goal of returning to sport and their parents. Older adults and their families and patients who do not desire to return to sport and their families may have different perceptions of the factors that influence outcomes. Finally, in most cases, the interviews took place with the patient and parent both present. Though it would be interesting to analyze and explore how perceptions may vary between parents and their children, the discussion often involved dynamic interactions between the parent and his or her child. Thus, it was not appropriate to draw any conclusions in this regard for the purposes of this study. Future research could provide specific insight into how parents and their children may perceive the rehabilitation experience.

CONCLUSION

The current wide variation in outcomes after ACLR may, in part, be influenced by the patient's experience of physical therapy. This study identifies factors perceived by patients and parents as key drivers of ACLR rehabilitation outcomes. These factors, including patient-specific attributes, physical therapist-patient relationship qualities, and system-specific elements, were consistently identified by this cohort as significantly affecting the patient experience of rehabilitation and, ultimately, outcomes after ACLR. Future work must confirm these factors and design innovative rehabilitation paths of care to address these patient- and family-specific needs to improve the ability of a rehabilitation intervention to personalize and optimize outcomes after ACLR. ◉

KEY POINTS

FINDINGS: Adolescent and young adult patients after anterior cruciate ligament reconstruction (ACLR) and their families value patient-specific factors, their relationships with their physical therapists, and system-level factors as key influencers of success in rehabilitation.

IMPLICATIONS: Patient preferences for rehabilitation can inform future studies investigating how to better meet patient needs and improve outcomes of rehabilitation after ACLR.

CAUTION: These findings are based on a relatively small sample of young patients. This sample limits the generalizability of these findings to other populations and requires further investigation into both the younger population (to validate the findings) and older population (to assess generalizability).

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APPENDIX A

INTERVIEW SCRIPT

Redefining Rehabilitation After ACL Reconstruction: Parent/Patient Interview Script

Introductory Question

Say your name (first name only) and state your primary goal for having an ACL reconstruction (ie, why did you decide to have ACL reconstruction?)

Opening Question: Be Brief (5 Minutes)

1. Tell me about your rehabilitation experience after your ACL reconstruction.
   a. Prompt: How long (ie, how many months) were you in physical therapy/rehabilitation after your ACL reconstruction surgery?
   b. Prompt: What parts of your physical therapy/rehabilitation were difficult?
   c. Prompt: Did anything make it less difficult?
   d. Prompt: What limited your ability to fully participate in your recommended rehabilitation and/or the recommendation made by your therapist? Did the amount of time it took to complete rehabilitation seem longer or shorter than what you expected?

Transition Question (5 Minutes)

2. How were you injured?

Key Questions (20 Minutes)

3. Before surgery, what goals/expectations did you have about returning to activity?
   a. Prompt: Were you hoping to return to your preinjury level of activity?
   b. Prompt: Were you able to achieve your goals? If not, what got in the way of you achieving your goals?

4. Thinking back to when you first injured your knee, tell us a little bit about how your injury affected your desire to return to the activity in which you were injured.
   a. Prompt: Were you ever afraid to participate in an activity for fear of getting hurt again?
   b. Prompt: After your rehabilitation, were you confident that you could participate in activities that you did before your injury?
   c. Prompt: Did rehabilitation help reduce your fears of and/or improve your confidence in participating in activities after your surgery?

5. Tell me about the exercises/activities you were asked to complete at home as part of your home exercise program.
   a. Prompt: Were you able to complete them as recommended?
   b. Prompt: What made it difficult to complete your home exercises?
   c. Prompt: What type of assistance did you have at home/at your school/in your community to help complete your home exercises?

6. Let's talk about your clinical physical therapy appointments. Was there anything that limited your ability to attend the recommended physical therapy clinic visits?
   a. Prompt: Did you attend less therapy because your insurance company limited the number of therapy visits?
   b. Prompt: Did you have any transportation issues?
   c. Prompt: Were there any scheduling issues (ie, therapist availability or clinic availability)?

7. What were the biggest challenges for you during your rehabilitation?
   a. Prompt: Were there physical limitations (ie, difficulty doing exercises or getting stronger?)
   b. Prompt: Did you have any difficulty getting motivated to complete exercise throughout the rehabilitation process?
   c. Prompt: Was it ever hard to find time to complete the rehabilitation?
   d. Prompt: Was it ever hard to find time to attend your rehabilitation appointments?

8. What other assistance or resources would have been helpful to you during your rehabilitation after ACL reconstruction?
   a. Prompt: Tell me about how your clinic visits guided you through your rehabilitation path.
   b. In your opinion, was there enough guidance provided for you through your time in rehabilitation? If not, what would have helped?
   c. Prompt: When you were given home exercises, were they provided in a way that you were able to do the same things at home? If not, what could we have done to make them easier to complete at home?

APPENDIX A

9. I am sure many people helped you with your care after your injury, including doctors, nurses, physical therapists, athletic trainers, and maybe others. Tell me about the communication among all of these people.
   a. Prompt: Was everyone in agreement with your plan of care?
   b. Prompt: Tell me about the coordination of your care by all these providers.
   c. Prompt: If there were communication issues among providers, how did this affect your rehabilitation?

10. Were there any additional barriers that limited your ability to fully participate in your recommended rehabilitation course?

Ending and Final Questions: Summary

At this time, we would like to get any additional information that might help us to develop better rehabilitation programs for patients after ACL reconstruction.

11. If you were in charge of developing a rehabilitation program after ACL reconstruction, what would it include?

12. Can you think of anything we should have talked about but didn't?

Abbreviation: ACL, anterior cruciate ligament.

APPENDIX B

REPRESENTATIVE QUOTES AND DESCRIPTIONS OF PERCEIVED PATIENT ATTRIBUTES THAT AFFECTED OUTCOMES

Subthemes	Representative Quotes and Descriptions (Participant ID)
Motivation, confidence, and accountability	"It is something that I want to do, so I do it anyway, but I have a fear every day that this could be the wrong step or every step will be the wrong step" (patient 10) One participant lamented that she felt her own "laziness" was a limiting factor, stating: "My laziness . . . I don't think it was, like, really motivation. Maybe I think it was just, like, time, like putting in time to do it" (patient 1) ". . . motivation, you know. The laziness, time, schedules. Although we went (to the local gym), we didn't go as regularly as we had hoped to go" (patient 1)
Access to resources	
Access to supplemental expertise	"There were times where our trainer would help . . . probably 70/30 with the trainer [versus by myself]" (patient 2) Two participants noted they had access to and interacted with their athletic trainer but relied more heavily on their physical therapist to guide the rehabilitation process (patients 3 and 7) "We had, like, 30 visits a year. So, it worked out . . . the therapist would work directly with the trainers at [school]" (parent 5) "I would just make sure they would have other resources other than just the doctors or the nurses or the therapists, they would have somebody else that they would work with at their school" (patient 5)
Access to equipment	"We did go and get a gym membership in order to be able to, you know, perform those particular activities" (patient 1) "I worked out every Tuesday and Thursday after school at my high school gym. Just lifting . . ." (patient 4) "I had a gym that's right around my house that I could just go through with their machine" (patient 9) "It was lucky that we had additional equipment at home . . . [the therapist] had recommended anything like that" (parent 3) "We got some exercises from the therapist to be able to do as far as on the different wave machines and things, so we were doing some of that. Outside of just the home exercises, but some additional things and riding the bike at the gym" (parent 6)
Social support	"Random people would come up to me and they're like, 'So, you did therapy?' Or like, we're having a connection like a community that is, like, I'll have that same thing you're going through. It's kind of nice" (patient 9) ". . . the day of his injury, I mean, [the doctor] saw us immediately. We immediately went to MRI. Then [another doctor] got us right in to [the surgeon]. So, I mean, it's all in who you know as well" (parent 2) One patient noted how his father would motivate him by saying, "Your leg is never going to get straight unless you do it. Your leg is never going to get stronger if you don't do it" (patient 8) Likewise, another patient described how his mother would call him and "be like, 'Did you do your stretches this morning?'" and that his girlfriend "kept regular tabs" on him, too, by calling to check up on him and making sure he was doing all of his exercises (patient 10)

Abbreviation: MRI, magnetic resonance imaging.

APPENDIX C

REPRESENTATIVE QUOTES AND DESCRIPTIONS OF PERCEIVED PHYSICAL THERAPIST-PATIENT RELATIONSHIP QUALITIES THAT AFFECTED OUTCOMES

Subthemes	Representative Quotes and Descriptions (Participant ID)
Physical therapist as guide	
Guidance for things to anticipate	"She [his child's physical therapist] was very good about telling me explicitly what I need to look for and things, and once I knew that, it was more comfortable for me" (parent 6) "You hear so much stuff, you know, the day of surgery . . . Do this . . . remove that . . . watch the pain . . . if I hadn't heard that earlier, I would have forgotten that. He [her son's physical therapist] was good about before the surgery, talking about those sort[s] of things, so that really helped me remember a lot" (parent 5)
Guidance for progression	"He [her son] just preferred to be with somebody who does have expertise because he doesn't want to injure himself" (parent 2) "She [his physical therapist] kept it, in a sense, real with me about things . . . don't overdo yourself and don't rush back while, as opposed to people on my team [who were] like, 'Hurry up and get back.' . . . She was the most, I believe, most honest with me as far as my trainers and everybody . . . she was the most active as far as getting everything back together as far as my rehab; she's who I trusted. She wouldn't lie to me . . . so that's why I trusted her as opposed to everybody else" (patient 10)
Physical therapist as motivator	"He [the physical therapist] would encourage me . . . if we started off running and stuff, he will just say, like, 'Faster, faster,' and it reminded me of, like, having a basketball coach . . . It kind of made me feel like I'm back in the sport" (patient 1) In response to what was most helpful for him, one patient articulated, "a therapist that cares, definitely—definitely someone who is patient and wants to see the success that you want to see" (patient 2) "She actually likes her physical therapist because he had high expectations of her, and she liked to be challenged . . . so that was good" (parent 10) "[My therapist] is pretty funny, so he relates it to the activity that I'm doing. . . . So, I feel like I tell myself, 'This is how it helps. You need to do this'" (patient 1) "If they know you didn't do all 8 sets or whatever . . . they make sure you did it even if you want to give up because it hurts so much . . . because, like, even when it hurt, she's like, 'Keep going,' which in the end benefited me because then I was able to get my knee stronger" (patient 7) "I'm in the medical field . . . but I don't have the expertise . . . that and motivating, you know, the kids or what have you, and [the physical therapist] being alongside of them helps them get better quicker" (parent 2)
Early rehabilitation	One patient conveyed that early in rehabilitation, he was constantly asking himself, "'Should I do this? Should I do that? Should I actually go do that?' . . . Just being with [my therapist] and everyone is, I mean, they just motivate me" (patient 8) "I think, in the beginning, it was kind of hard . . . for him to figure out exactly, I guess, being comfortable doing it, and for me, a nerve-racking experience because I had the fear that every time he did something that wasn't exactly correct, that he was going to tear his knee again . . . I think in the beginning it was just kind of an emotional kind of a depressing feeling . . . and once we got over that, it was a lot easier to cope with after that" (parent 6)
Mid-to-late rehabilitation	"I was just, like, really discouraged. It felt like it was taking forever to heal" (patient 3) "He went through a small period of time where it was harder to do, I think, from an emotional standpoint, that it was harder to get himself going and motivated to—to do it at home because it's—it's hard—it's hard when you're [an] adult, but it's harder when you're 11 or 12 years old" (parent 6) "He was just contained in the therapy . . . so some psychological stuff that was going on . . . just kind of feeling depressed and down in the dumps. . . . He just didn't know how to deal with that kind of frustration. At home, he was really angry . . . at one time, you know, even he broke down and started crying" (parent 4)
Physical therapist as booster of confidence	"I guess the fear of getting hurt again . . . basketball kind of, like, turned off for me. I just wanted to get back to volleyball. . . . Basketball . . . with cutting [there is a] danger of bumping into somebody, whereas in volleyball I'm more, like, secluded on my side of the court" (patient 9) "She hasn't had physical therapy in a while . . . when I see her play now, she is very hesitant sometimes . . . obviously, she's not back 100% . . . maybe she's scared . . . [it's] scary for her to push herself because she's afraid to get reinjured. You know, she's playing on the same field that she got hurt [on]. So, I can see, well, that could be scary" (parent 7) "We all have a high degree of confidence in her therapist, and I think it was that trust that went both ways, that we weren't going to push too hard and she [the therapist] wasn't going to say, 'Okay, go!' until she knew it was really safe to do so" (parent 3)
Physical therapist as coordinator of care	"I think it was very easy, so easy for us just because [her son's physical therapist] took charge of that with the athletic trainers. And it made it simple that when [her son] went to the athletic trainers, they knew what he was supposed to be doing . . . and he knew what he was doing. . . . He started driving, and the therapy was really close to our house to begin with, so it was rare that my husband or I had to go in and talk to [his therapist] . . . not that we didn't want to, but that we didn't have to because we knew everything was being communicated and it was all coordinated together" (parent 5) "I think it was doable, and I think working with the physical therapist, like, she said, 'Well, this is how many [physical therapy visits] we have, this is how we're going to maximize what we have.' So, it was good to have her expertise as well on that" (parent 7)

APPENDIX D

REPRESENTATIVE QUOTES AND DESCRIPTIONS OF PERCEIVED SYSTEM ELEMENTS THAT AFFECTED OUTCOMES

Subthemes	Representative Quotes and Descriptions (Participant ID)
Availability and utilization of physical therapy visits	"We had to go to self-pay. And at that point, we started spreading the visits out a little more . . . I think he probably would have done better, and I guess return[ed] sooner, maybe, if we had been able to do the visits the way we needed to and we were able to . . ." (parent 6) "She was released to play and . . . so she played and then she was kind of, like, hesitating and she . . . has the scary point. So, maybe just kind of regrouping and say[ing], 'Okay, this is where I'm still feeling a little uneasy; can we do more physical therapy or more strengthening here or there?' . . . The difference between kicking a ball in physical therapy and going after a ball in physical games is a little bit different" (parent 7)
Clinic environment	"Maybe a lot of people say this, but I think my environment was probably one of the more perfect settings" (patient 2) "I thought it was the best experience I've had. I've done therapy before and it was okay, but it wasn't as fun as it was here because, like, all the physical therapy people, like, help you out, it just wasn't that one person, and they make you laugh and just joke around with you while you were doing your exercises" (patient 7) "I did observe that the equipment at one facility was different than the equipment at the other facility." She noted, "Knowing there was a discrepancy, it kind of made me wonder, 'What's the trade-off? Is it worth driving a little further to have access to the same equipment?'" (patient 3)
Coordination among providers	"You know, down from the doctor, all the way down to the therapist and school trainer and everything was in place" (parent 8) "I don't think it was as seamless as it needed to be. I also don't think the doctor was utilizing the physical therapist's information as much as they should have been. And the reason I say that is because there were at least 1 appointment that I can remember, and I'm pretty sure there were 2 appointments, where the physician hadn't looked at the notes, until I brought it up, from the physical therapist. And then, there was an instance where the physical therapist was supposed to put some notes into the system, but I don't know if he did, and it didn't get there fast enough" (parent 10)

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"Sit Up Straight": Time to Re-evaluate

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Posture is a frequent topic of discussion for patients, clinicians, the media, and society. A common belief is that spinal pain is caused by sitting, standing, or bending "incorrectly." Despite the absence of strong evidence to support these common beliefs, a large posture industry has flourished, with many interventions and products claiming to "correct" posture and prevent pain. Unfortunately, many health care professionals provide advice in line with this non–evidence-based perspective. In this Viewpoint, we reflect on common beliefs regarding posture and spinal health and why they are so widely held, and consider how clinicians can positively influence these beliefs.

Beliefs About Posture

Health care professionals and the community typically agree that avoiding spinal flexion is the safest way to sit[5,9] and bend.[8] Patients and pain-free members of the community are commonly advised to sit upright and undertake bending and lifting tasks in a "natural" lordotic posture. Manual handling guidelines in the United States and the United Kingdom advocate a straight back or a slight bend of the back during lifting tasks. A slightly lordotic posture is also commonly identified as the ideal standing position.[5] The assumption is that maintaining these postures might protect spinal structures, and posture beliefs likely reflect the fact that sitting, standing, and bending are often provocative for complaints such as low back pain. Awkward postures and heavy lifting may precipitate episodes of acute low back pain, and some links between lifting and injury have been reported. Despite widespread beliefs about correct posture, there is no strong evidence that avoiding incorrect posture prevents low back pain, or that any single spinal curvature is strongly associated with pain.[6]

Protecting the spine is also advocated by the fitness industry. Common advice is that the "core" muscles of the trunk must be consciously activated to maintain a "correct" posture and protect the spine. Advice about "perfect form" given in relation to weight-training is often applied away from the lifting platform. While there is additional muscular effort required for correct posture when sitting and lifting, there is no evidence to suggest that correct posture prevents or reduces pain and disability. People with low back pain bend their spine less and show more trunk muscle activity when forward bending and lifting. The notion that people with low back pain must be careful and "protect" their spine is further challenged by the association of higher levels of fear and lower self-efficacy with a guarded way of moving.[2]

The non–evidence-based perspective that pain can be prevented by avoiding incorrect posture, such as slouching, is reinforced by fear-inducing messages in the mainstream media. People might become concerned about their spinal health when they are exposed to articles about potentially damaging postures and advertisements for posture-correction aids. Unhelpful posture ideals are also reinforced by long-standing stereotypes that suggest posture reflects a person's sex, dignity, respectability, attractiveness, and morality.[3]

Assessing the Posture of People With Pain

Observing the posture of a person presenting with musculoskeletal pain has a role. It may help patients to feel they are being taken seriously and allow the clinician to identify rare cases of clinically

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relevant deformity such as a significant, deteriorating scoliosis. Importantly, the clinician may observe overly protective postures, levels of muscle tension, apprehension, vigilance, distress, mood, and body image that can provide insights into behavioral responses and how people make sense of their pain experience. We strongly encourage building a relationship with patients to explore why they adopt certain postures. Although there is evidence that people with low back pain may find certain postures provocative,[1] it cannot be concluded that the postures are the cause of pain.

Assessing the Posture of People Without Pain

There is no evidence to support posture or movement screening for primary prevention of pain in the workplace. People come in different shapes and sizes, with natural variation in spinal curvatures. Preferential lifting style and posture adaptability are influenced by spinal curvatures.[11] The mandatory manual handling training and ergonomic assessments in offices that pain-free people are often subjected to may perpetuate a misconception that common daily tasks and working environments are dangerous.

"Mind Your Back": Mind Your Language!

The iatrogenic nature of low back pain is a reminder of the clinician's responsibility to be mindful of the language we use. Advice given by clinicians can lead to fear and encourage hypervigilance. Here are some examples.

"Sit Up Straight" In the absence of any good evidence that one posture exists to prevent pain, asking patients to work hard to achieve correct posture may set them up for a sense of failure and create more anxiety when their pain persists.

"Sitting Is Bad for You" Encouraging people to move and change position can be helpful. Sedentary lifestyles are a risk factor for low back pain, among many other health conditions. Nevertheless, it is important for clinicians not to perpetuate worry that sitting down for more than 30 minutes in one position is dangerous or should always be avoided.

"It's Caused by Your Swayback Posture" There is some resistance within health care to shift away from the biomedical model of pain. Consequently, pain is often ascribed to relatively "normal" variations and asymmetries, despite the lack of strong evidence. We urge clinicians to be cautious in their explanations to avoid further worry about posture "flaws."

Clinical Recommendations: Help People to Sit, Stand, and Move More Easily

Helping people to adopt more relaxed postures, while reassuring them that these postures are safe, can provide symptom relief.[4,7,10,12] Comfortable postures vary between individuals, so it is useful to explore different postures. The clinician might consider how to expose people to postures and ways of moving that they have avoided, and how to encourage change in habits that may be provocative. Alterations in posture or movements that feel good in the acute stage may not be needed long term.

Some people who find upright postures provocative may be required to adopt such a posture for their sport/role (eg, ballet dancers, military personnel). It is possible for people to be upright and be more relaxed. If clinicians help people to experience an upright, relaxed posture, it may be beneficial—even symptom modifying! Although the posture may be required for the sport/role, it may not be required for spinal health and, as such,

1. **There is no single "correct" posture.** Despite common posture beliefs, there is no strong evidence that one optimal posture exists or that avoiding "incorrect" postures will prevent back pain.
2. **Differences in postures are a fact of life.** There are natural variations in spinal curvatures, and there is no single spinal curvature strongly associated with pain. Pain should not be attributed to relatively "normal" variations.
3. **Posture reflects beliefs and mood.** Posture can offer insights into a person's emotions, thoughts, and body image. Some postures are adopted as a protective strategy and may reflect concerns regarding body vulnerability. Understanding reasons behind preferred postures can be useful.
4. **It is safe to adopt more comfortable postures.** Comfortable postures vary between individuals. Exploring different postures, including those frequently avoided, and changing habitual postures may provide symptom relief.
5. **The spine is robust and can be trusted.** The spine is a robust, adaptable structure capable of safely moving and loading in a variety of postures. Common warnings to protect the spine are not necessary and can lead to fear.
6. **Sitting is not dangerous.** Sitting down for more than 30 minutes in one position is not dangerous, nor should it always be avoided. However, moving and changing position can be helpful, and being physically active is important for your health.
7. **One size does not fit all.** Postural and movement screening does not prevent pain in the workplace. Preferred lifting styles are influenced by the naturally varying spinal curvatures, and advice to adopt a specific posture or to brace the core is not evidence based.

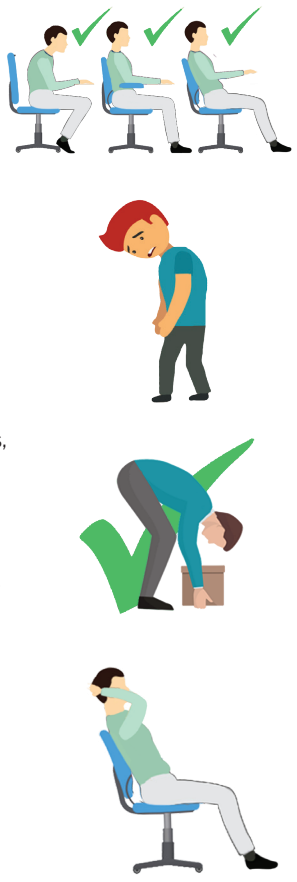

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FIGURE. Key points to change the posture narrative.

may not need to be transferred to other aspects of life.

Recommendations for Beyond the Clinic

There are challenges in reframing the idea of "correct" posture. Science does not support the common posture and "core" beliefs often held by clinicians, manual handling trainers, and society. Forty years ago, it was common practice to recommend bed rest for people with low back pain. Persistent evidence-based education means bed rest is no longer an appropriate recommendation.

Let us work together to change the "posture narrative." The spine is a robust, adaptable structure to be trusted. The **FIGURE** highlights this and other key points from evidence related to spinal posture. Discussions about spinal health and pain with colleagues, patients and pain-free members of the community should also include other evidence-based factors such as physical activity, stress, and sleep. An educational campaign to change the posture narrative may encounter resistance in certain areas of the physical therapy and ergonomic professions, whose business models may not align with what we now understand to be best practice for managing low back pain. ◉

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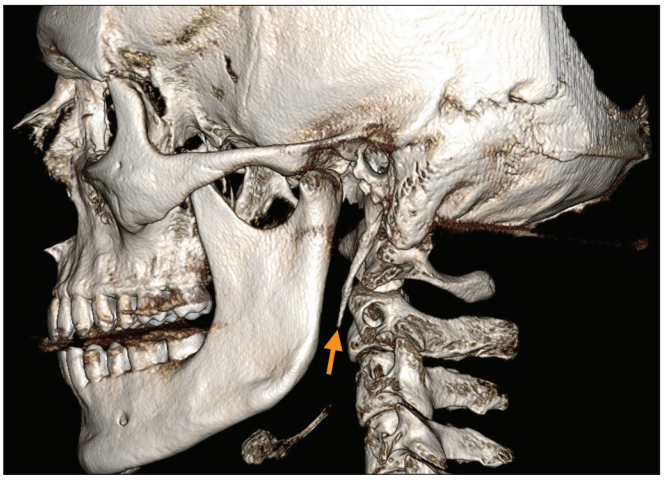

FIGURE 1. An oblique view of a 3-D reconstruction from cone-beam computed tomography showing the left cervical/cranial region with an elongated styloid process (arrow), diagnosed as "Eagle syndrome" or "stylohyoid syndrome" and sometimes referred to as "styalgia" when painful.

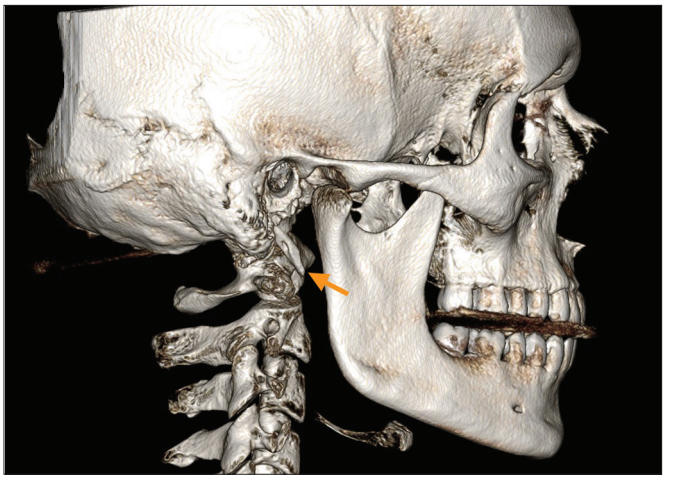

FIGURE 2. An oblique view of a 3-D reconstruction from cone-beam computed tomography showing the right cervical/cranial region with an average-length styloid process (arrow).

Stylohyoid Syndrome

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A 26-year-old male dental student presented with an ache deep to the angle of the left mandible and moderate, constant pain with swallowing. His symptoms began 3 years earlier. He was initially diagnosed with tonsilloliths and underwent tonsillectomy. Symptoms were not relieved and continued to worsen. While in radiography training, he volunteered for oral cavity imaging. An elongated left styloid was noted. He sought additional medical examination and was diagnosed with Eagle syndrome, characterized by cervical/oropharynx pain due to an elongated styloid process (**FIGURES 1** and **2**).

The patient consulted a physical therapist. Evaluation findings included a Neck Disability Index score of 11/50, a global pain rating of 4/10, a mild forward head posture, mild limitations in cervical active range of motion with right rotation and right sidebending, and concurrent muscular tension symptoms on the left. The patient demonstrated limitations in hyoid passive right lateral glide and mild discomfort with left retromandibular space palpation. Active craniocervical flexion and left sidebending reproduced his symptoms.

Based on imaging and examination findings, the patient was instructed on a home exercise program of cervical stretching while swallowing to increase tissue mobility, and a manual right glide of the hyoid to improve stylohyoid ligament mobility. Six weeks later, the patient reported that he was able to swallow with only minimal, intermittent discomfort. His Neck Disability Index score improved to 4/50, and he rated his pain at 2/10.

This rare syndrome has been reported in children and adults.[2] Limited evidence involving physical therapy is available, and caution is indicated when considering the use of cervical spine manipulation.[1,3] The interventions and resultant positive outcomes in this case provide additional information for physical therapists who encounter patients with this unusual diagnosis. ◉ *J Orthop Sports Phys Ther 2019;49(8):621. doi:10.2519/jospt.2019.8759*

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Nonoperative Management Prior to Hip Arthroscopy for Femoroacetabular Impingement Syndrome: An Investigation Into the Utilization and Content of Physical Therapy

BACKGROUND: There has been a significant increase in surgeries for femoroacetabular impingement syndrome in recent years, but little is known about the use of physical therapy prior to surgery.

OBJECTIVES: To investigate the use of physical therapy prior to hip arthroscopy for femoroacetabular impingement syndrome, by assessing the number of visits and use of exercise. A secondary objective was to evaluate whether comorbidities prior to surgery were associated with the use of physical therapy.

METHODS: In this retrospective observational cohort study, eligible participants between the ages of 18 and 50 years undergoing hip arthroscopy between 2004 and 2013 in the Military Health System were included. Patients were categorized based on whether they saw a physical therapist for their hip in the year prior to surgery. For physical therapy patients, dosing variables were identified, including total number of visits and visits that included an exercise therapy procedure code.

RESULTS: Of 1870 participants, 1106 (59.1%) did not see a physical therapist for their hip prior to surgery. For those who did, the median number of visits was 2. Only 220 (11.8%) had 6 or more unique visits with an exercise therapy procedure code. Exercise was coded in 43.4% to 63.0% of the total visits in each individual course of care (mean, 52.3%). There was an association between substance abuse and exercise utilization. No other comorbidities were associated with physical therapy or exercise therapy utilization.

CONCLUSION: Physical therapy was not commonly used before undergoing arthroscopic hip surgery by patients seeking care in the Military Health System. Further research is needed to understand the reasons for poor utilization and better define failed nonoperative management.

LEVEL OF EVIDENCE: Therapy, level 2b.
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KEY WORDS: *arthroscopic surgery, conservative treatment, exercise, femoroacetabular impingement, rehabilitation*

Surgery rates for various musculoskeletal conditions have increased in recent years, despite significant costs, potential risks, and no guarantee of satisfactory outcomes.[5,25,30,39,45] A condition for which elective surgical management has increased is femoroacetabular impingement (FAI) syndrome. The frequency of surgery for FAI syndrome has increased significantly in recent years from 365% to 400%, reportedly due to advances in tools used during hip arthroscopy, improved ability to diagnose symptomatic intra-articular pathology, and an increasing number of new fellowship-trained surgeons.[10,14,28,31]

Due to their invasive nature, many elective orthopaedic surgeries are considered appropriate only after a course of nonoperative management.[2] For FAI syndrome, as with other musculoskeletal conditions, the definition of "adequate nonoperative management" is poorly described in the literature and lacks a consensus on optimal prescription and dosage parameters.[18,34] The lack of a general standard of "adequate nonoperative treatment" has likely led many to the unfortunate conclusion that nonoperative treatment has failed. A recent scoping review found that only 44% of studies (n = 47) identified failed nonoperative management as a requirement for hip arthroscopy, with 1 study reporting that only 30% of individuals underwent a regimen of physical therapy prior to surgery.[34] This highlights the need to explore and define what is currently being considered "adequate physical therapy intervention."

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Stepped care models emphasize less invasive, lower-risk treatment options as initial care strategies, moving on to more intensive and higher-risk interventions for those who do not respond to the "first-step" interventions. However, without a clear definition of "adequate nonoperative management," it is difficult to differentiate individuals who have received appropriate initial stepped care from those who have not. The stepped care model is advocated in many areas of medicine,[11,46] specifically for chronic musculoskeletal pain conditions,[3] such as FAI syndrome, and in Military Health System (MHS) settings.[26] These stepped care models can help to prevent unnecessary procedures and undue harm. These courses of "nonoperative care," however poorly defined, often guide decisions for progressing to the next level of care—in this case, surgery. The current study is the first step in understanding physical therapy intervention, which is to investigate current practice for patients with FAI syndrome.

Understanding how comorbidities influence the utilization of physical therapy may assist in determining which individuals are more or less likely to participate in physical therapy. Patients with certain comorbidities may be more likely to receive physical therapy.[17] In other cases, managing health care providers may not consider referring a patient to physical therapy if he or she has comorbid conditions, believing it may be inappropriate or unsafe. At this time, the impact comorbidities may have on the utilization of physical therapy, including exercise, in patients with FAI syndrome is unclear.

The purpose of this study was to investigate the utilization of physical therapy in the year prior to undergoing hip arthroscopy. Utilization of physical therapy included physical therapy evaluations, the number of total rehabilitation visits, and how often exercise therapy was incorporated in the overall visits. We also aimed to identify differences in the presence of select comorbidities between those who saw a physical therapist and received exercise therapy and those who did not.

METHODS

Study Design

This was a retrospective observational cohort study of patients undergoing hip arthroscopy for FAI syndrome in the MHS from June 30, 2004 through July 1, 2013, with presurgical health care utilization extracted for each individual out to 12 months before surgery.

Data Source

Data were extracted from the MHS Data Repository, a centralized data repository that captures, validates, integrates, distributes, and archives US Defense Health Agency corporate health care data worldwide. It receives data from the US Department of Defense's worldwide network of more than 260 health care facilities and from non–Department of Defense data sources. These data include person-level data for all outpatient and inpatient medical visits, both in military and civilian hospitals. They also include information about medical procedures and drug prescriptions. Data were provided to the investigators in raw form, meaning one line for each unique medical visit, and an aggregated file at the person level was created. This aggregated file provided a total sum of each care variable for each individual. One investigator validated the aggregated data against the raw data.

Participants

Patients seen in the MHS for arthroscopic hip surgery associated with FAI syndrome occurring between June 30, 2004 and July 1, 2013 were included in the cohort. We identified surgical procedural codes most used for FAI syndrome because there is no dedicated International Classification of Diseases-Ninth Revision (ICD-9) code for FAI syndrome (Current Procedural Terminology [CPT] codes 29862, 29914, 29915, 29916). Conditions other than FAI syndrome that also could have received these same surgical procedures were excluded (hip osteoarthritis; osteomyelitis of the hip; malignant neoplasms of the pelvis, hip, or lower extremity; avascular necrosis of the hip; or any other arthritic condition of the hip) if present in the 12 months prior to surgery. We also excluded all arthroscopy codes labeled as diagnostic procedures or for the purpose of loose-body removal if they were present without one of the codes above.

Because FAI syndrome is common in younger adults (mean age range, 24-37 years),[9,16] we excluded anyone under 18 or over 50 years of age. This accurately represented the active-duty service member demographic, and any cases over this age who still met the other criteria would have been very minor.[36] Finally, anyone who was not an eligible beneficiary for the entire surveillance period of 36 months (12 months before and 24 months after the surgery) was also excluded. Although postsurgical health care utilization was identified for the entire cohort, only presurgical data were evaluated for this study. Details of the data extraction have been published elsewhere.[35]

Study Variables

Descriptive Variables Demographic variables, including age, sex, beneficiary category, military service branch (ie, Army, Air Force, Marine Corps, Navy, Coast Guard), location of surgery (either military or civilian hospital), and prescription opioid use, were presented according to utilization of physical therapy prior to surgery and fewer than 6 or 6 or more exercise therapy visits.

Independent Variables The primary variables of interest were the use of physical therapy prior to surgery, including a dichotomous measure for seeing a physical therapist, the number of individual rehabilitation visits, and the number of exercise therapy visits (**TABLE 1**). To satisfy the physical therapy utilization criteria, patients needed to have at least 1 physical therapy evaluation specifically for a hip diagnosis 31

days or more before surgery (CPT code 97001). We chose this as a very conservative threshold because a new evaluation with a physical therapist within 30 days of surgery was unlikely to have been for the purpose of satisfying the "nonoperative care" criterion, as surgeries are often scheduled several months out in this setting (mean, 4.3 months).[27] Instead, these few occurrences were likely to have included immediate presurgical care or gait training to prepare the patient for changes in ambulation following surgery. We also identified all visits with physical rehabilitation procedure codes (CPT codes ranging from 97010 to 97799), including those specifically coded for exercise (CPT code 97110).

Patients were divided into groups based on the number of visits, and then based on whether exercise was utilized during these visits. Exercise was isolated as an intervention because it has been advocated in clinical practice guidelines for FAI syndrome[13] and is a safe and effective intervention for a variety of musculoskeletal disorders.[33,42] Utilization of exercise was further classified into utilization ratios and amount of exercise utilization (**TABLE 1**). We chose fewer than 6 or 6 or more exercise therapy visits to dichotomize exercise users into a low group and high group, respectively, as 6 visits represent a typical course of care of physical therapy in the MHS, even though other guidelines have advocated longer treatment.[13]

Comorbidities Because comorbidities can influence overall health care utilization and potentially influence rehabilitation, we identified comorbidities using corresponding ICD-9 codes in medical visits. We were unsure whether patients with certain comorbidities would be more or less likely to present to physical therapy or influence referral to physical therapy. The comorbidities identified included cardiometabolic syndrome, mental health disorders, insomnia, chronic pain, systemic arthropathy, and substance abuse. Discussion on the extraction of these variables and the relevance of comorbidities to overall prognosis in patients with musculoskeletal disorders has been published elsewhere.[35] We then looked to see whether there was a difference in the presence of comorbidities between utilizers versus nonutilizers of physical therapy and between low and high utilizers of exercise.

Data Analysis

Descriptive characteristics, including means, standard deviations, and frequencies, were calculated for patients based on the utilization of physical therapy, including exercise, prior to surgery. Descriptive data included person-level demographic information. Baseline analyses for comparison included chi-square or Fisher's exact tests for categorical variables and independent *t* tests for continuous variables. A *P* value of less than .05 was selected for significance. All analyses were performed using SPSS Statistics Version 21.0 (IBM Corporation, Armonk, NY).

TABLE 1 Description of Commonly Used Variables

Variable	Description
Physical therapy utilization	At least 1 evaluation by a physical therapist 31 days or more before surgery, identified by CPT code 97001
Rehabilitation visit	A visit with the use of a rehabilitation code (CPT codes 97010-97799)
Exercise therapy visit	A rehabilitation visit specifically with the use of exercise (CPT code 97110)
Exercise utilization ratio	The proportion of all rehabilitation visits that included exercise therapy visits (total exercise therapy visits/total rehabilitation visits × 100%)
Exercise utilizers	
Low utilizers	5 or fewer exercise therapy visits
High utilizers	6 or more exercise therapy visits

Abbreviation: CPT, Current Procedural Terminology.

RESULTS

Of 1870 eligible participants who underwent hip arthroscopy, 1106 (59.1%) did not receive physical therapy prior to surgery, and in those who did, only 220 (11.8% of the total cohort, 28.8% of those who saw a physical therapist) received 6 or more exercise therapy visits. Demographics for the cohort are described in **TABLE 2**. The patients differed statistically in age, sex, and branch of service. Physical therapy utilizers were more likely to serve in the Army (48.0%) than in other military branches. High exercise utilizers were more likely to be female and younger (55% female; mean age, 29.9 years).

Of the 764 (40.9% of the total cohort) individuals who initiated physical therapy, 79 (10.3% of all who saw a physical therapist) received no additional care beyond the initial evaluation. The median number of visits for those who did receive physical therapy was 2. Two hundred seventeen (28.4% of all who saw a physical therapist) received only 1 to 2 follow-up visits, while 315 (41.2% of all who saw a physical therapist) received 6 or more visits (**FIGURE 1**).

The exercise utilization ratio, on average, was 52.3%, meaning that roughly half of all total visits in each individual course of care included an exercise component. The percentages ranged from 43.4% to 63.0%. There were 220 patients (11.8% of the total cohort, 28.8% of those who saw a physical therapist) who had 6 or more physical therapy visits that also included exercise therapy (**TABLE 2**). **FIGURE 2** outlines the mean exercise utilization ratios for the various groups.

Patients were analyzed for the presence of comorbidities, as this may provide some insight into physical therapy or exercise participation (**TABLE 3**). There was a statistically significant difference between low and high exercise utiliza-

tion in those diagnosed with substance abuse (P = .03). No other comorbidities were significantly associated with physical therapy or exercise therapy utilization.

DISCUSSION

Although there is evidence supporting the use of physical therapy in the management of patients with FAI syndrome,[13] most individuals in this cohort did not see a physical therapist, and when they did, it was usually only for a small number of visits. Exercise therapy was also not used for most individuals in this cohort, even though guidelines recommend its use.[18] The presence of comorbidities was similar, regardless of utilization of physical therapy or exercise therapy, with the exception of substance abuse, which did impact exercise use. It is not known why the majority of this cohort did not undergo a trial of physical therapy, including exercise, prior to progressing to surgery.

Individuals in this cohort received far fewer physical therapy visits than the number of visits recommended in the best current guidelines. Although the definitive value of exercise in the nonsurgical management of FAI syndrome is still not fully determined, the premise for its use is sound. Exercise emphasizing strengthening of core and hip musculature and improving neuromuscular control has been shown to be an effective treatment option for FAI syndrome,[7,18,27,48] as well as other musculoskeletal disorders.[20,37,40,41] In this study, exercise was not utilized as often as expected prior to surgery. Only 315 (16.8% of the total cohort) patients had 6 or more visits as part of their nonoperative care, and only 220 (11.8% of the total cohort) patients had at least 6 visits that each specifically included exercise.

There are many intervention options for use in physical therapy, but the strongest evidence is for exercise, so it is unclear why the individuals in this study did not receive more exercise therapy. In patients with knee osteoarthritis, 24 sessions of exercise and supervised exercise 3 times per week have large effect sizes when compared to smaller doses.[24,49] Hence, there is some precedent for specific dosing variables impacting outcomes in musculoskeletal conditions. This raises the question of whether the frequency and dosage that patients in this study

TABLE 2 Descriptive Statistics for Different Comparison Groups*

	Physical Therapy Utilization Prior to Surgery (n = 1870)			Physical Therapy Utilization With at Least 1 Exercise Visit (n = 559)		
Variable	No (n = 1106)	Yes (n = 764)	*P* Value	Low† Exercise Utilizers (n = 339)	High† Exercise Utilizers (n = 220)	*P* Value
Mean ± SD age, y	32.9 ± 8.3	31.3 ± 7.7	<.001	31.5 ± 7.7	29.9 ± 7.5	.02
Sex (female)	470 (42.5)	363 (47.5)	.03	155 (45.7)	122 (55.5)	.02
Beneficiary category			.47			.76
Active duty	739 (66.8)	524 (68.6)		242 (71.4)	149 (67.7)	
Dependent	249 (22.5)	171 (22.4)		68 (20.1)	48 (21.8)	
Guard/reserve	5 (0.5)	1 (0.1)		1 (0.3)	0 (0.0)	
Retired military	16 (1.5)	6 (0.8)		3 (0.9)	2 (0.9)	
Other/unknown	97 (8.8)	62 (8.1)		25 (7.4)	21 (9.5)	
Branch of service			.003			.05
Army	466 (42.1)	367 (48.0)		171 (50.4)	88 (40.0)	
Coast Guard	20 (1.8)	10 (1.3)		6 (1.8)	2 (0.9)	
Air Force	263 (23.8)	204 (26.7)		91 (26.8)	72 (32.7)	
Marine Corps	144 (13.0)	81 (10.6)		38 (11.2)	24 (10.9)	
Navy	207 (18.7)	98 (12.8)		31 (9.1)	34 (15.5)	
Other/unknown	6 (0.5)	4 (0.5)		2 (0.6)	0 (0.0)	
Surgery location (military hospital)‡	571 (51.6)	396 (51.8)	.93	176 (51.9)	115 (52.3)	.94
Prescription opioid use						
Unique individuals with opioid prescriptions	540 (48.8)	395 (51.7)	.22	163 (48.1)	121 (55.0)	.11
Mean ± SD unique prescriptions	2.7 ± 4.0	2.8 ± 3.1	.31	2.8 ± 2.9	2.9 ± 2.8	.64
Mean ± SD days' supply	15.0 ± 45.0	16.0 ± 43.9	.65	13.4 ± 29.3	15.1 ± 32.7	.53

**Values are n (percent) of patients unless otherwise indicated.*
†Low exercise utilizers had fewer than 6 exercise therapy visits. High exercise utilizers had at least 6 exercise therapy visits.
‡Versus civilian hospital.

received constitute adequate conservative management. Some patients may have received only a home exercise program to satisfy the "nonoperative treatment" criterion; however, the efficacy of a home exercise program has not been studied and, therefore, is unknown in this population. In addition, compliance with home exercise programs is difficult to assess, whereas supervised exercise allows for immediate feedback and modifications, if necessary.[21,44]

Current indications for surgery are inconsistently described[4] and lack consensus.[43] It is possible that the lowest-level evidence for the use of nonoperative management, including that which falls under the umbrella of "physical therapy," may drive decisions to progress to surgical interventions, with little concern for specificity of interventions or appropriate dosing. On the other hand, some patients may not be amenable to completing a full course of physical therapy. In one survey, 21% of patients were not willing to participate in a trial of nonoperative management lasting 6 months.[38] This may be especially true if patients believe surgery is a more definitive solution and do not understand how exercise could help. Fifty percent of individuals with back pain reported that they would be willing to undergo spine surgery based solely on abnormalities detected on magnetic resonance imaging, regardless of whether they had any symptoms.[15] This is where surgeon input could be of great value, as 71% of patients in a recent survey stated that physician recommendation was the primary influence on decisions about treatment choice.[6]

It is unknown whether the plan of care for those receiving physical therapy in this study was limited to 1 or 2 visits or initially included a full course of 6 or more visits but was impacted by early patient self-discharge. Individuals treated by physical therapists in the MHS are at minimal risk for adverse events,[32] so it appears that the benefit of physical therapy outweighs the risk. Hence, the utilization of physical therapy should be the prudent clinical pathway implemented prior to progressing to an invasive surgical procedure, where health risks are possible.[22,23] Further prospective trials are required to understand the criteria health care providers are using to define failed nonoperative management before progressing their patients to surgery, as well as patient barriers to engaging in physical therapy.

Comorbidities were similar based on utilization of physical therapy or exercise therapy, except for substance abuse disorders. There were a significantly larger number of patients with substance abuse disorders in the low exercise group (**TABLE 3**). Physical activity and exercise are widely recommended by health care professionals for those with substance abuse disorders.[8,12,29] However, details related to specific exercise parameters used in this study are not available to better understand exactly why individuals with substance abuse disorders received differing amounts of physical therapy or exercise.

These data do not provide us with information on why individuals may or may not have received physical therapy and exercise. Although there is evidence suggesting that exercise is beneficial for those with substance abuse disorders, individuals often exhibit a lack of motivation, which leads to low adherence to an

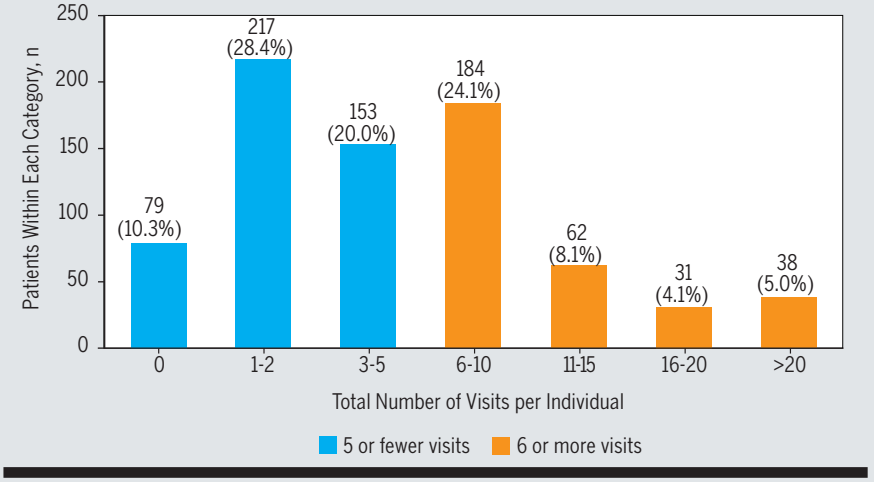

FIGURE 1. Total visits for individuals who were seen by a physical therapist (n = 764, 40.9% of cohort).

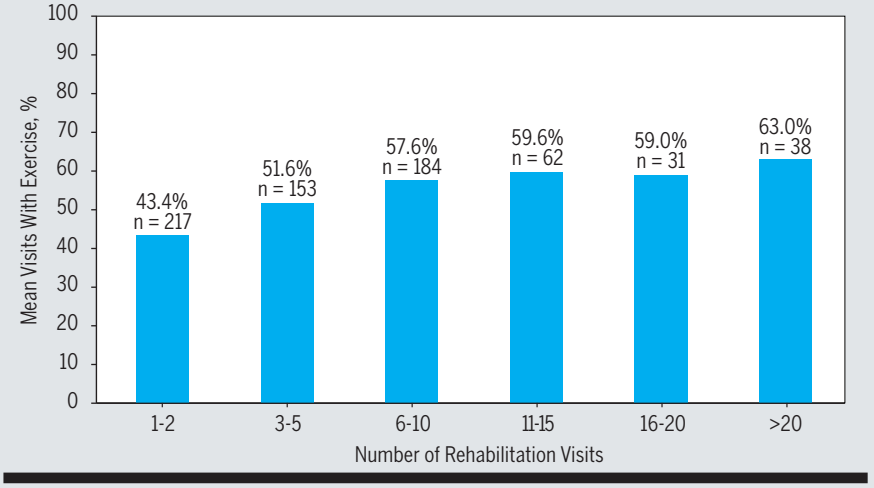

FIGURE 2. Mean exercise utilization ratio (n = 685, 36.6% of cohort), determined by dividing the number of exercise visits (numerator) by the total number of rehabilitation visits (denominator).

exercise program.[1,47] It is possible that patients in this cohort were not motivated to exercise, which led to low utilization. However, the reasons for this finding in our study are unknown and should be investigated in the future, especially because the probability of having physical therapy or high or low exercise usage did not differ with other comorbidities. It is also unknown whether comorbidities developed before or after the visit to a physical therapist.

The findings in this cohort provide no information to better assess the value of physical therapy before surgery, primarily due to the lack of a nonsurgical comparison group. It is unclear how many individuals received physical therapy intervention and did not go on to have surgery, and how the dosing and utilization of exercise in their care compared to this presurgical cohort. Therefore, we are unable to delineate the differences that physical therapy would have on downstream health care utilization after surgery. However, if the definition of nonoperative management includes physical therapy with exercise, then this study highlights that physical therapy and exercise therapy are underutilized and likely underdosed in this population.

There are some limitations to this study. In a retrospective cohort study that includes a large sample of claims data, the integrity of the data is limited to the accuracy of the coding. Physical therapy and/or rehabilitation procedures might have been coded incorrectly or not coded at all. In other words, physical therapy could have addressed the hip, but the only code entered for the visit was for back pain. However, even when looking at exercise therapy visits linked to any diagnosis in the entire body, the overall number in this cohort that would have had 6 or more exercise therapy visits would have risen by only approximately 5%. The MHS is a closed, single-payer system, and, therefore, results may be different in other settings. However, as insurance and cost are not a consideration, it would be expected that utilization rates would be higher than in traditional third-party-payer systems in settings where copayments are common.

We only included patients who underwent surgery, and utilization of physical therapy and exercise could have been higher in patients with FAI syndrome who did not undergo surgery. We also only included patients with at least 2 years of eligibility for military medical benefits after surgery, so those who left service prior to 2 years after surgery would not have been included in this analysis. Patients who had a more complete course of physical therapy more than a year prior to surgery would not have been captured in this study. Finally, the management of FAI syndrome continues to improve and evolve, and it is possible that utilization patterns would be different from 2013 to the present.

CONCLUSION

Physical therapy and exercise therapy are infrequently utilized in the MHS for patients with FAI syndrome before undergoing hip arthroscopy. In those who did have physical therapy, the majority had very few visits, which did not reach a threshold considered adequate by current clinical practice guidelines. There was a significantly greater number of patients with substance abuse disorders who were low exercise utilizers. However, no other comorbidities were associated with physical therapy or exercise therapy utilization. Future research is required to better understand how failed nonoperative management prior to progression to surgery is defined. ◉

KEY POINTS

FINDINGS: Physical therapy was not commonly used by patients with femoroacetabular impingement (FAI) syndrome before undergoing hip arthroscopy in the Military Health System; 59.1% did not receive any hip-related physical therapy. Only 16.8% of all patients had 6 or more visits, and exercise was utilized

TABLE 3 Presence of Comorbidities in Different Physical Therapy Utilization Groups*

	Physical Therapy Utilization Prior to Surgery (n = 1870)			Physical Therapy Utilization With at Least 1 Exercise Visit (n = 559)		
Comorbidities Present Before Surgery	No (n = 1106)	Yes (n = 764)	*P* Value	Low† Exercise Utilizers (n = 339)	High† Exercise Utilizers (n = 220)	*P* Value
Cardiometabolic syndrome	53 (4.8)	31 (4.1)	.49	19 (5.6)	8 (3.6)	.24
Mental health disorder	212 (19.2)	160 (20.9)	.35	84 (24.8)	40 (18.2)	.07
Insomnia	86 (7.8)	79 (10.3)	.06	36 (10.6)	21 (9.5)	.68
Chronic pain	102 (9.2)	72 (9.4)	.88	36 (10.6)	18 (8.2)	.34
Systemic arthropathy	25 (2.3)	9 (1.2)	.09	4 (1.2)	3 (1.4)	.85
Substance abuse	160 (14.5)	128 (16.8)	.18	69 (20.4)	29 (13.2)	.03

**Values are n (percent) of patients unless otherwise indicated.*
†Low exercise utilizers had fewer than 6 exercise therapy visits. High exercise utilizers had at least 6 exercise therapy visits.

only half of the time. Substance abuse disorders influenced the utilization of exercise.

IMPLICATIONS: Most patients who underwent hip arthroscopy for FAI syndrome did not have a course of physical therapy in the year prior to surgery. When patients received physical therapy, they often had few visits and fewer that involved exercise therapy. With its potential benefits and lower risk and cost, physical therapy could be afforded greater consideration as a treatment option for patients with FAI syndrome before surgery.

CAUTION: We did not compare to a non-surgically treated cohort, so the value of physical therapy is unknown. We only included individuals who were receiving care in the Military Health System, which may limit generalizability.

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