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# Patient Experiences of Recovery After Autologous Chondrocyte Implantation: A Qualitative Study

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**Context:** The recovery process after autologous chondrocyte implantation (ACI) can be challenging for patients and clinicians alike due to significant functional limitations and a lengthy healing time. Understanding patients' experiences during the recovery process may assist clinicians in providing more individualized care.

**Objective:** To explore and describe patients' experiences during the recovery process after ACI.

**Design:** Qualitative study.

**Setting:** Orthopaedic clinic.

**Patients or Other Participants:** Participants from a single orthopaedic practice who had undergone ACI within the previous 12 months were purposefully selected.

**Data Collection and Analysis:** Volunteers participated in 1-on-1 semistructured interviews to describe their recovery experiences after ACI. Data were analyzed using the process of horizontalization.

**Results:** Seven patients (2 men, 5 women; age = 40.7 ± 7.5 years, time from surgery = 8.7 ± 4.2 months) participated.

Four themes and 6 subthemes emerged from the data and suggested that the recovery process is a lengthy and emotional experience. Therapy provides optimism for the future but requires a collaborative effort among the patient, surgeon, rehabilitation provider, and patient's caregiver(s). Furthermore, patients expressed frustration that their expectations for recovery did not match the reality of the process, including greater dependence on caregivers than expected.

**Conclusions:** Patients' expectations should be elicited before surgery and managed throughout the recovery process. Providing preoperative patient and caregiver education and encouraging preoperative rehabilitation can assist in managing expectations. Establishing realistic goals and expectations may improve rehabilitation adherence, encourage optimism for recovery, and improve outcomes in the long term.

**Key Words:** cartilage, knee joint, rehabilitation, patient expectations, qualitative study

## Key Points

- In the recovery after autologous chondrocyte implantation, we identified 4 themes: the lengthy process, commitment to rehabilitation as an investment, team effort, and matching expectations to reality.
- Preoperative education can be helpful in assessing and managing patient expectations and in lessening feelings of hopelessness and frustration.

Articular cartilage injuries of the knee are common and, when left untreated, may cause significant deteriorations in function and quality of life and increase the potential for osteoarthritis to develop and progress. Because articular cartilage is avascular, injuries to this structure have a limited potential for healing,<sup>1</sup> and surgical intervention is often recommended. The type of surgical technique depends on a variety of factors, including patient age, lesion depth, concomitant injuries, and patient goals and expectations.<sup>1</sup> Autologous chondrocyte implantation (ACI) was introduced in the early 1980s by Brittberg et al<sup>2</sup> and has been recognized as a viable treatment option for full-thickness chondral injuries. The short-term clinical results of ACI are reported to be good or excellent in 71% to 90% of patients,<sup>3,4</sup> and rates of patient satisfaction with improved function and reduced pain levels

range from 72% to 100%.<sup>5,6</sup> The long-term durability of ACI was demonstrated by Peterson et al,<sup>4</sup> who reported good or excellent results in 84% of patients after an average follow-up of 11 years. However, despite improvements in self-reported symptoms, patients undergoing ACI continued to demonstrate functional deficits and weakness in the affected limb postoperatively.<sup>7-9</sup> These findings suggest the importance of postoperative rehabilitation after ACI.

Rehabilitation plays a vital role in clinical improvements after ACI and is necessary to ensure the repair is protected and to return patients to full function.<sup>10</sup> It has been suggested<sup>11</sup> that the 3 most important components of a rehabilitation program after ACI are progressive weight bearing, restoration of range of motion, and improvement of neuromuscular control and strength. Rehabilitation after ACI can be challenging due to the extended period of

**Table 1. Participant Characteristics**

Pseudonym	Age, y	Occupation	Time from Surgery to Interview, mo	Previous Surgeries, No.
Amy	46	Human resources director	12	1
Betty	38	Police officer, retired	4	1
Jim	46	Staff sergeant, US Army	12	2
Katie	25	Aquatics instructor	3	1
Linda	42	Teacher	12	2
Sara	44	X-ray technician	6	1
Terry	44	Financial advisor	12	3

weight-bearing restrictions and the lengthy recovery process: graft remodeling and maturation can take 3 years or more.<sup>12</sup> A recent study<sup>13</sup> investigated patients' expectations and knowledge regarding ACI. Patients were asked to address the relative importance of different factors in their clinical outcome: defect characteristics, personal risk factors, quality of the surgery, previous surgeries and treatment, and postoperative rehabilitation. Only 7.6% of patients considered postoperative rehabilitation an important factor influencing the clinical outcome, demonstrating that patients underestimated the value of rehabilitation.<sup>13</sup> At the current time, the evidence base for ACI rehabilitation is lacking.<sup>14-16</sup> In particular, the perspectives of patients regarding factors that contribute to successful outcomes after ACI have not been described. Therefore, it is necessary to identify factors during the rehabilitation process that may influence the outcome and quality of life from the patient's perspective.

Although patient-reported outcomes provide clinicians with useful information relative to technique effectiveness, patients' experiences, expectations, and attitudes offer a deeper understanding of factors that may contribute to successful recovery after ACI. Using qualitative methods to investigate patients' experiences in postoperative rehabilitation can benefit patients and clinicians alike by providing a more meaningful description of rehabilitation practices and their influence on patient success. Furthermore, understanding patients' experiences during the overall recovery process may lead to more effective care and improved outcomes. To date, we are not aware of any publications that have addressed patients' knowledge and experiences of the recovery process after ACI. Therefore, the aim of our study was to explore and describe patients' experiences during the recovery after ACI.

## METHODS

The qualitative method of phenomenology was selected because it offers a way to identify a phenomenon (ACI recovery) and how that phenomenon is perceived by participants. This method allows rich information to be gathered through inductive qualitative methods such as interviews and participant observation. *Phenomenology* is concerned with the perspective of the individual experiencing the phenomenon of interest and provides insight into the person's motivations and actions<sup>17</sup>; for our study, that included patients' perceptions of their recoveries, factors that affected their recovery, and what was important to both the patient and the caregiver. This information can be useful to surgeons, clinicians, and caregivers in improving patient care.<sup>18</sup>

## Participants

The study was approved by the University of Kentucky Institutional Review Board. We chose recruits strategically from an existing database of patients who had previously undergone ACI by the same surgeon. Eligible recruits were then approached during a follow-up visit with their surgeon to invite participation in the study. Purposeful sampling ensured that participants represented both sexes, varying ages, and urban and rural locations. Eligibility criteria were (1) having undergone the ACI procedure and postoperative rehabilitation within the previous 12 months (to minimize recall bias), (2) being between the ages of 16 and 65 years, and (3) being fluent in English and able to communicate during the interview process. Information was provided both orally and in writing, and participation was voluntary. Informed consent was obtained before the initial interview. Respondents were assured of confidentiality, and pseudonyms were used to protect anonymity. Participants were interviewed until data saturation occurred. Data saturation occurs when no new information is being provided during the interview process.<sup>19</sup>

A total of 7 patients agreed to participate in the study: 2 men and 5 women. Their age range was 25 to 46 years, with a mean of  $40.7 \pm 7.5$  years. The mean time from surgery to the interview session was  $8.7 \pm 4.2$  months. For more detailed information, see Table 1.

## Data Collection and Analysis

Data were collected through semistructured interviews conducted by the primary author (J.L.T.), an athletic trainer with 13 years of clinical experience in rehabilitation after knee surgery who was not involved in the participants' therapy. A guide was developed for use during the interviews. The open-ended interview guide was used to maintain consistency during the interview process among all participants. Each interview lasted between 25 and 50 minutes and took place in a quiet location chosen by the participant. Respondents were asked to describe their overall recovery experiences after ACI, including rehabilitation. All interviews were recorded and transcribed verbatim.

To understand the experiences of patients recovering from ACI, we used a data-analysis approach that encouraged reflection and interpretation. This analysis is a 6-step methodologic approach based on work by Colaizzi.<sup>20</sup> After the data were transcribed, we read the transcripts several times to gain an overall sense of the participants' perspectives. Next, significant statements that were related to the phenomenon of interest were extracted from the transcripts. Once significant statements were extracted,

**Table 2. Significant Statements of Patients' Rehabilitation Experiences and Corresponding Formulated Meanings**

Significant Statement	Formulated Meaning
"Getting back to having a life. I don't know if that is a part of rehabilitation. Yeah, that's been my biggest goal is getting back to normal."	Rehabilitation assists patients in achieving goals that allow them to return to normal daily activities.
"I mean, actually you're like an infant. I mean I couldn't do anything and me I'm the type of person where I need to get up and go but to just be like that there, I mean to be beat up, can't move."	Reliance on others and the inability to be independent during the recovery process is discouraging for patients undergoing cartilage repair.
"I've always wanted to go to therapy. I think there's only been like two days when I didn't care to go. I get excited to go to therapy because I know that I'm gonna make progress."	Rehabilitation after autologous chondrocyte implantation offers patients hope that improvements will occur.
"I go [to therapy] because I've gotta do it. I've gotta get better. So I have to push myself sometimes. I've gotta try to get back to work."	Therapy provides the motivation that patients need to improve and return to daily activity, including work.

duplicate statements were removed from the analysis. To organize the remaining significant statements, we performed *horizontalization*, a process in which all statements are treated as having equal value or significance.<sup>20</sup> Formulated meanings were then developed from the remaining significant statements and organized into clusters of themes, which provided a full description of the respondents' experiences. Finally, these themes were distributed to all participants for their feedback (member checks) as a means of validating the findings.

Several methods were used to establish scientific rigor. We conducted member checks during data analysis to ensure that we were providing an accurate description of the participants' experiences. All interviews were transcribed verbatim, and direct quotes from participants were used to enhance the credibility of the study.<sup>21</sup> An experienced qualitative researcher reviewed the interview protocol and was available to review and challenge the emerging interpretations of the data. This expert checking served to further minimize bias in the interpretation of the results. Finally, *epoché*, or phenomenologic bracketing, was used to validate findings. In *epoché*, the interviewer puts aside his or her own experience of the phenomenon and focuses on the views or experiences of the interviewee.

**RESULTS**

From 7 transcribed interviews, 150 significant statements were identified, 7 duplicate statements were removed from the analysis, and 18 formulated meanings were developed through horizontalization. Examples of significant statements and their corresponding formulated meanings are shown in Table 2. Four major themes and 6 subthemes emerged from patients' experiences with rehabilitation after ACI (Table 3). A description of each theme, including verbatim quotations from participants, follows.

**Theme 1: Recovery is an Ongoing, Emotional Process**

Many participants described the process from the initial injury to undergoing ACI as ongoing and marred by frustration and setbacks. Although recovery is often considered the process that occurs after surgery, for many participants, recovery encompassed several years, from injury to surgery and rehabilitation after surgery. Participants expressed initial feelings of frustration and hopelessness, but these emotions transitioned to feelings of optimism for their future.

**Feelings of Hopelessness That Nothing Will Fix the Pain.** This subtheme described respondents' emotional experiences from their initial injury to surgery. For many participants, previous surgeries were unsuccessful in reducing their symptoms and allowing them to return to work, sports, or daily activities. They described feelings of hopelessness that they would be forced to live with pain and functional limitations. Betty discussed her experience of injuring her knee on the job, undergoing an unsuccessful surgery and months of rehabilitation:

At one point in time, I didn't think anybody was going to be able to help me at all. Now I'm 38, and I'm just frustrated that I can barely move around, and I can't do the stuff I enjoy, like camping and hiking, and it's not going to get better. Ever. So I was very upset and very frustrated. All of it has hugely affected my life. I've gained a lot of weight 'cause I'm not doing the things I used to do, like my job, which was my passion for me. Like a lot of people hate their jobs, but my job was awesome. So I don't have that anymore. And that was very hard. I mean, I still have issues.

**Therapy Provides Optimism for the Future.** Participants' emotional states changed during the recovery process. In contrast to feelings of frustration and hopelessness, many respondents described a transition to feelings of optimism when they began therapy. Katie explained the feelings of optimism that came from attending therapy:

I was just tired and sore, and I guess I was also kind of glum because it seemed like recovery was never going to

**Table 3. Themes and Their Associated Subthemes**

Theme	Subtheme
Recovery is an ongoing, emotional process	Feelings of hopelessness that nothing will fix the pain
	Therapy provides optimism for the future
Therapy is an investment Recovery is a team effort	Therapy provides accountability
	Everyone involved in the recovery process must be on the same page
Expectations for recovery may not match reality	Dependence on others is a source of frustration
	There are other priorities besides recovery

happen at that point. But once I got to therapy, I was fine. I got over it. Like I've always wanted to go to therapy. I think there's only been two days when I didn't care to go. I get excited to go to therapy because I know that I'm gonna make progress.

Betty addressed her transition from feelings of hopelessness to feelings of optimism:

You know, the overall process of getting there was a nightmare, but now I'm finally getting there. I'm pretty happy. I feel like, if it keeps getting better from here, wow, you know. It's awesome. I'm just now feeling like I'm coming out of that and starting to feel better about the possibility of having a regular life.

Although recovery after chondral injury can be a lengthy and frustrating process, undergoing surgery and being involved in rehabilitation can help patients feel optimistic about the possibility of being able to return to normal everyday activities.

### **Theme 2: Therapy is an Investment**

For many participants, undergoing this surgical procedure was their last hope before undergoing total knee replacement. Due to their ages, many participants wanted to delay or avoid joint replacement. However, the recovery process after ACI is long, and respondents recognized that they would require 6 to 12 months of extensive rehabilitation to have the greatest chance for successful outcomes. By committing to rehabilitation, participants were investing in themselves and their futures. Terry realized the importance of this commitment:

I just think there's a lot of prep work upfront. Hey, you can be successful. It's just like anything else in life, you know, through discipline you're going to have success. You're investing in yourself. And you only get, you know, one pair of legs. You gotta commit to it and be able to have that.

Participants described the importance of attending therapy regularly and being committed to the process; therapy provided the accountability participants needed to stay focused on the goal of continued progress, yet several acknowledged that, once they were discharged from therapy, they found it difficult to allocate the time needed to maintain and improve on the progress they had made during therapy. Amy recognized this when she said, "Physical therapy was good because it made you do it. I mean, you were going in 2 or 3 times a week. So you were pretty much doing it." Terry also acknowledged the accountability that came with therapy:

Maybe you didn't need to go in because I could've been doing rehab at home that day. But I get that accountability. You have to have accountability. I think accountability is really important. If you can't do it yourself, you need to have that ability to go in and do it.

Because the recovery after ACI is lengthy, respondents recognized that they needed to be committed to the entire

process if they wanted to have the best possible outcomes. Therapy provided the accountability to remain committed to their overall recovery; however, once formalized therapy ended, participants struggled to find the motivation to continue with rehabilitation on their own.

### **Theme 3: Recovery is a Team Effort**

This theme described the importance that participants placed on having a support system during the recovery process, whether that support system came from friends and family or from the therapists. Katie highlighted her parents' support in helping her with therapy:

I've actually been staying with my parents, and they have been very supportive since surgery. They both brought me to therapy. They were very supportive. They helped me do my home therapy I couldn't do on my own.

Respondents were also comforted in the initial phases of therapy by having support from their therapists, particularly when they were fearful of injuring the knee. Linda described her first experience with removing her brace and walking without crutches:

You never have to do anything alone, which is very comforting, so that I guess in my mind, once they took me off of my crutches and out of my brace, I was worried that, what if I fall and I can't get up? And I didn't have to worry about that because they were there with me.

Although participants viewed recovery as a team effort, they also emphasized the value of being "on the same page" with the surgeon and therapist. Respondents acknowledged the significance of their therapist's communicating with and understanding the expectations of the surgeon. Betty depicted a negative experience with a previous surgeon:

And I kept telling the doctor I was having these problems, and I had gone to a lot of physical therapy. And he kept saying, "Welcome to my world," which was very frustrating for me because his world and my world were worlds apart.

After undergoing ACI, Betty recalled a time when she was progressing at a rate that was faster than she expected, based on what she had been told by the surgeon. She admitted that because the progress she was making in therapy did not match her expectations, she was concerned that she was not doing what she should be doing:

I mean my physical therapy went really—I was expecting it to be horrible. And it really wasn't. And my biggest thing was between what I thought he [the surgeon] said would be the steps or how quickly you can do things, and how quickly I was doing them in physical therapy didn't seem to mesh with me. And I was like very concerned at first that we weren't doing what we were supposed to be doing. It didn't make me doubt my therapist. It made me wonder if she knew what everyone

else was saying. So like I'd ask her questions, and luckily she was like not one of those people that gets angry when you ask them questions. She didn't do that. I mean, a couple of times, she was like, "I swear I know what I'm doing."

Patients do not go through recovery alone, and our participants acknowledged that having adequate support throughout the recovery process was essential to a positive experience. All members of the team must be on the same page so that expectations can be managed and support provided.

#### **Theme 4: Expectations for Recovery May Not Match Reality**

Respondents spoke at length about their expectations for recovery. For many, the process was much longer and more difficult than they had anticipated. Even after a patient is discharged from therapy, ACI recovery continues for months and even years. Participants acknowledged that most of their expectations regarding the recovery process came from talking with their surgeons. They recognized that the recovery process would be long, especially in the initial 6 to 8 weeks after surgery, when their weight bearing was restricted. Jim's expectations for this initial recovery period did not coincide with the reality: "I think I was told I was gonna be laid up some. But I didn't know it was going to be to that extent." Terry was prepared for a lengthy recovery; however, he acknowledged that he did not fully appreciate the amount of time it would take to return to certain activities. Although his expectations for recovery at 12 months did not match the reality of his situation, he realized that more time was necessary for full recovery:

Even though I was prepared for longer, I don't know if I fully understood that. I have to remind myself every once in a while, hey, we're only so many months out. But I don't know yet 'cause I'm still, you know, I was thinking I'd be further than I am now. But I guess realistically I'm looking at 18 months to 20 months to say, all right, this is 95% where it's going to be.

**Dependence on Others is a Source of Frustration.** When considering expectations for recovery, many participants described their lack of independence during the initial recovery period as unexpected. Jim was frustrated:

I mean, actually you're like an infant. I mean, I couldn't do anything, and me, I'm the type of person where I need to get up and go but to just be like that there. I mean, to be beat up, can't move, it's just I hate being lame. I hate being where I can't do nothing for myself. I can't get up and go. And I was wanting to rush it.

Sara pushed herself early in therapy to become independent again: "My main thing was motion and strength so I could get up and walk and be able to not be completely dependent on people."

**There are Other Priorities in Life Besides Recovery.** This second subtheme emerged as respondents described the recovery process, which at times became secondary to other priorities in life, such as family and work. Due to the

length of the recovery process, participants acknowledged that, over time, they were unable to maintain recovery as a priority in their lives. Terry described the effect of his recovery on his children:

When I've had to say, no, Daddy can't do that, or I didn't carry my girls around for 12 weeks, which they were used to for the 6 weeks before. That was more the tough part, not for me, but for the kids.

As time passed, participants found less time to commit to their recovery because they needed to devote more time to work and family. Linda, a schoolteacher, admitted that she returned to work too soon after surgery and found it difficult to commit to therapy:

I went back to school way too early. I mean, because the start of the school year, you don't want to miss, so that was barely 3 weeks postop. I should have stayed home at least 3 or 4 more weeks. But sometimes you do what you have to do. It's difficult making the time to do it [therapy] when your life is crazy, working all day, and then going to therapy and then getting home after 6.

Respondents expressed frustration that their expectations for recovery did not match the reality of the situation. Recovery was longer and more challenging than anticipated, and over time, participants were not able to prioritize their recovery because of other commitments in their lives.

## **DISCUSSION**

Recovery after ACI is a lengthy process, one for which many participants were unprepared. They described a feeling of hopelessness before surgery; however, these feelings were replaced by optimism for the future throughout rehabilitation. Overall, respondents were committed to the recovery process and understood that rehabilitation was an investment in their future. Having an appropriate support system in place reassured participants that they were not going through recovery alone. Finally, they expressed concern that their expectations for recovery did not match the reality of the recovery process. The length of the recovery process, coupled with the lack of independence during the early phases, was described as a surprise and a frustration by many respondents.

The feelings of hopelessness that many participants described leading up to surgery were an unexpected finding. All but 1 reported that they had originally undergone unsuccessful treatment by a different surgeon and sought another opinion. For several respondents, a previous failed procedure to address the cartilage injury contributed to this feeling of hopelessness. Autologous chondrocyte implantation is often indicated as a secondary treatment option in patients who do not improve after 1 or more articular cartilage procedures.<sup>11</sup> Patients with an articular cartilage lesion commonly report symptoms such as pain, swelling, giving way, locking, and a subsequent decrease in function.<sup>22</sup> Given the chronicity of the injury, combined with previous failed treatments, it is not surprising that many participants expressed a feeling of hopelessness and a decrease in their overall quality of life. Several respondents wondered if "normal" would once again be possible. This

finding may have significant implications for an individual's quality of life, which needs to be addressed before and during the recovery process, as it may affect recovery and subsequent outcomes. Evaluating these emotional responses using patient-reported–outcome measures can provide clinicians valuable information regarding an individual's mental state. For example, the Short Form 36 is a global measure of health-related quality of life that evaluates the effect of injury on an individual's mental health.<sup>23</sup> By using outcome measures such as the Short Form 36 to assess and track an individual's emotional response to injury, surgeons and rehabilitation providers can tailor the plan of care to address and manage these concerns.

Previous authors have noted similar feelings of hopelessness in patients scheduled to undergo knee surgery. In a qualitative study of patients' experiences with total knee arthroplasty, participants described a sense of enduring osteoarthritis and their emotional struggles as they tried to pursue a normal life while waiting for surgery.<sup>24</sup> Our findings demonstrate that despite participants' feelings of hopelessness, rehabilitation contributed to feelings of optimism about the future. During ACI recovery, it is common for patients to see noticeable improvements in pain and function in 3 to 6 months.<sup>25</sup> For patients who have struggled with pain and a decreased quality of life for several years or longer, it is not surprising that this progression leads to feelings of optimism. Patients who are optimistic about their recovery during rehabilitation are less likely to experience feelings of hopelessness and depression, which can be detrimental to the overall recovery process.<sup>26</sup> For those with chronic disabilities, optimism may promote persistence in and adherence to rehabilitation, which is crucial after ACI, especially given the lengthy recovery process. Encouraging patients to attend rehabilitation preoperatively may help to alleviate any fears regarding the recovery process. The purposes of preoperative rehabilitation are to introduce the patient to the therapist, establish realistic goals for recovery, provide additional education regarding expectations for recovery, and prepare the patient both physically and mentally for surgery.

Although participants in our study were hopeful that the surgical procedure would alleviate their symptoms, they also recognized that rehabilitation was an important part of the recovery process. Respondents acknowledged that, by adhering to the rehabilitation program, they were investing in themselves. Postoperative rehabilitation has been emphasized as a contributing factor in patients achieving positive outcomes after ACI.<sup>2,11,27</sup> Adherence to therapy offers several advantages: accountability, improved optimism, and the ability to see functional improvement. These advantages are particularly important to reemphasize at 6 weeks after surgery, when weight-bearing restrictions are removed but the patient still has significant activity limitations. It is easy for patients to become discouraged during this time as they want to increase their activity but are unable to do so based on the healing constraints of the tissue.

Patient adherence to rehabilitation after ACI can be challenging, especially considering the lengthy recovery process. Full maturation of the repair tissue can take up to 2 years; however, formalized rehabilitation does not often extend past 3 months due to insurance restrictions.

Therefore, it is frequently the responsibility of patients to continue the recovery process on their own. Some rehabilitation clinics offer a wellness program for patients who have been discharged from therapy. This wellness program allows the patient to continue using the clinic facilities at a reduced cost. This option can be beneficial to patients as it provides a level of accountability and availability of the clinician for questions or concerns. If a wellness plan is not available, communication between the patient and rehabilitation provider must continue. This communication is important for the patient's safe progression through the exercises and activities and to help maintain a level of self-motivation throughout the entire recovery process. Previous researchers have demonstrated that self-motivation<sup>28–30</sup> and the value of rehabilitation to the patient<sup>31</sup> can positively influence adherence to rehabilitation. Therefore, participants who view their commitment to recovery as an investment in themselves are more likely to comply with their postoperative recommendations.

Respondents also described the importance of a collaborative environment for their treatment. They expressed the significance of their therapist and surgeon being “on the same page.” Although most of their experiences were positive, several participants described scenarios in which their therapist was unfamiliar with the procedure and subsequent rehabilitation and therefore took an overly cautious therapeutic approach. Furthermore, participants described the desire to progress faster than the surgeon or therapist recommended. Given the fact that ACI is a relatively new and unknown procedure and that rehabilitation must be individualized, a collaborative environment among the patient, surgeon, and therapist is fundamental to the recovery process.<sup>11,32</sup> Patient education regarding the recovery process, including avoidance of activities that may harm the repaired tissue, and the importance of adherence to the rehabilitation program are essential during the early phases of recovery. Furthermore, communication between the therapist and surgeon is necessary for appropriate progression, which is based on lesion size, location, and any other concomitant injury.<sup>32</sup>

A fundamental finding of this study was the inconsistency between what participants expected regarding the length of the recovery process and what actually occurred. To date, only 1 group<sup>13</sup> has investigated patients' expectations and knowledge regarding ACI. According to Niemeyer et al,<sup>13</sup> patients undergoing ACI estimated the time from implantation of chondrocytes to full maturation of the repaired tissue to be 13.3 months.<sup>13</sup> However, full maturation of the repaired tissue after ACI takes up to 24 months.<sup>11,33</sup> These results suggest that patients undergoing ACI may be unprepared for the lengthy recovery process. Previous qualitative investigators have also shown incongruence between patients' expectations and reality. In a study<sup>34</sup> of patients recovering from total joint arthroplasty, participants were frustrated that they did not know what to expect after surgery and that their expectations were not consistent with the reality of their recovery. This finding has also been confirmed in a study<sup>35</sup> of patients recovering from anterior cruciate ligament reconstruction, who acknowledged unrealistic expectations regarding the content of their rehabil-

**Table 4. Clinical Recommendations Based on Themes****Theme 1: Recovery is an ongoing, emotional process**

- Monitor patient's emotional response to recovery with the use of health-related quality-of-life outcome measures, such as the Short Form-36.
- Assist patient in identifying a rehabilitation provider preoperatively and encourage a prehabilitation meeting between patient and rehabilitation provider to establish goals and manage patient expectations.

**Theme 2: Therapy is an investment**

- Understand insurance requirements and restrictions preoperatively. This allows the patient to plan visits in advance.
- Recommend that the patient clarify with family and friends preoperatively what assistance will be needed postoperatively.
  - Showering
  - Mobility: getting in and out of bed
  - Driving: getting to and from therapy
- Consider steps to plan for recovery. Patients may need to modify their home to provide an optimal healing environment.
  - Patients may require use of a shower seat while weight-bearing restrictions are in place (6-8 wk).
  - Patients who cannot climb stairs while under weight-bearing restrictions may need to consider whether their houses will accommodate recovery occurring on 1 floor.
- Commitment to and adherence with a long-term maintenance program are necessary to optimal long-term outcomes.
  - Advise patients that motivation in recovery may decrease around 3 months postoperatively, as it is common to plateau at this time point.
  - Regular communication between patient and rehabilitation provider after discharge is important: the patient should be proactive in requesting this aspect of care.
  - Detailed home exercise program that can be implemented in any setting is needed.

**Theme 3: Recovery is a team effort**

- Encourage rehabilitation provider to obtain operative notes so that the rehabilitation plan can be individualized based on the exact size and location of lesion.
- Consistent communication (every 2 wk) between rehabilitation provider and surgeon is necessary to document patient progress and any setbacks.

**Theme 4: Expectations for recovery may not match reality**

- Preoperative education program
  - Overview of surgical procedure
  - Education should include all caregivers responsible for assisting patient during recovery.
  - Timeline of recovery
    - Weight-bearing restrictions
      - No weight bearing for 2 wk
      - Limited or partial weight bearing for 4–6 wk
    - Driving restrictions
      - In place as long as weight-bearing restrictions exist
      - To begin driving without limitations, 90° knee flexion without a brace is necessary
    - Return to work and daily activities
      - 6-8 wk: full weight bearing
      - Squatting (gardening, cleaning): 3 mo
      - Most patients are back to all activities of daily living by 12 mo
    - Return to athletics
      - Running: approximately 12 mo
      - Restricted until 18–24 months

of immobility that occurs after surgery. Depending on the location of the lesion, most patients undergoing ACI have significant restrictions in weight bearing for 6 to 8 weeks.<sup>14,32</sup> This lengthy period of immobility as well as the overall recovery time may have been described to the patient before surgery; however, our participants still reported incongruence between their expectations for recovery and reality. Therefore, it is critical that patient expectations be managed throughout the recovery process, including before surgery and consistently throughout rehabilitation. Both the surgeon and rehabilitation provider play critical roles in managing patient expectations. Education regarding the procedure and the rehabilitation process is a critical component that should be addressed during the patient's preoperative education. Table 4 provides clinical recommendations based on the major findings of this study.

Preoperative education is a common practice for many orthopaedic surgical procedures, including total joint arthroplasty. The goal of preoperative education is to prepare patients and caregiver(s) for surgery, make them aware of what to expect during rehabilitation, and discuss expectations relative to surgery and the overall recovery process. These educational programs are often multidisciplinary and involve surgeons, physical and occupational therapists, athletic trainers, nurses, and care coordinators. Patients who are more educated regarding the recovery process are more satisfied with their treatment and more likely to actively participate in their care.<sup>36</sup> A meta-analysis<sup>37</sup> indicated that preoperative education had a positive effect on postoperative outcomes in patients undergoing a variety of surgical procedures. Furthermore, the author observed that 67% of patients receiving preoperative education had more favorable outcomes and that their outcomes were 20% better than those of patients not receiving any form of preoperative education.

Formalized patient education, in the form of classes or videos, is not the current standard of care for patients undergoing ACI. We recommend that formalized preoperative education, including preoperative rehabilitation, be offered to all patients and their families considering ACI. Preoperative education for patients undergoing ACI might include the following: information on the surgical procedure itself; importance of weight-bearing restrictions and driving limitations; exercises commonly performed during rehabilitation to improve strength and mobility; expectations of pain, functional limitations, and improvements during the various phases of recovery; importance of adherence to postoperative guidelines; and estimated time to return to high-level functional activity. In the current study, patients described their frustrations with the postoperative restrictions, such as weight bearing, driving, return to work, and return to physical activity. A clear and concise healing timeline, individualized to each patient, that details the return to full weight-bearing, independent driving, work, and physical activity may help to manage patient expectations and alleviate frustrations that commonly occur during the recovery process.

Participants in our study also expressed frustration that they had to depend on others during the early phase of recovery after surgery. Although it is routine to rely on others for assistance postoperatively, the lack of

itation and frustration that the recovery period lasted longer than they expected.

Given these findings and ours, it is important that clinicians understand and manage the expectations of patients undergoing ACI. Autologous chondrocyte implantation is a unique procedure because of the extended period



independence after ACI can be surprising and discouraging for patients and caregivers alike: it may take a minimum of 6 weeks before the weight-bearing restrictions are eased and the patient is able to be independent. Formalized preoperative education should include the patient's primary caregiver(s) and should provide adequate information so that the patient and caregiver(s) can plan for recovery. This includes understanding what caregiver assistance, including showering, getting in and out of bed, and traveling to and from rehabilitation sessions, will be necessary postoperatively. Furthermore, modifying the home environment can help to facilitate a successful recovery. Suggestions include the use of a shower seat and minimal use of stairs until full weight bearing is permitted.

Our findings contribute to the understanding of the recovery process after ACI, but it is difficult to generalize the experiences of these participants to others who have gone through the recovery process. We purposefully selected both male and female patients of various ages who resided in rural and urban settings to represent the heterogeneity of patients from 1 orthopaedic practice. Although the findings may not be generalizable to patients in all settings, this study does provide information on factors that are important to consider during the recovery process after ACI.

## CONCLUSIONS

We aimed to explore and describe the recovery of patients undergoing ACI. We identified 4 major themes during the recovery process: emphasizing the lengthy and ongoing recovery process, the commitment to rehabilitation as an investment in the future, the role of the team during recovery, and inconsistencies between patient expectations for recovery and the reality of the process. Given these findings, health care providers must manage patient expectations throughout the recovery process. Preoperative education is 1 way in which patient expectations can be assessed and managed to better inform patients undergoing ACI and ensure realistic expectations. Educating patients and managing unrealistic expectations can help to alleviate feelings of hopelessness and frustration that are likely to occur during the lengthy recovery process.

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