Postoperative Compliance and Return to Work After Rotator Cuff Repair: Value of an Interactive Online Rehabilitation Program Among Patients Treated Under Workers' Compensation

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abstract

Outcomes after rotator cuff repair (RCR) typically are poorer for workers' compensation (WC) than for patients with private insurance. This study examined augmentation of the traditional rehabilitation protocol with an online exercise program. Between March 2016 and July 2018, 48 WC patients who underwent RCR were introduced to a digital rehabilitation program (application). Patients were divided into patients who used the application along with traditional physical therapy (PT) (group 1) and patients who underwent only traditional PT (group 2). Patient performance was assessed using standardized patient-reported outcome measures (PROMs), return-to-work (RTW) status, number of PT sessions, and complication/revision rate. Patients were monitored for a minimum of 1 year postoperatively. A significant improvement in RTW period was noted for group 1 patients, who resumed modified duty 10 weeks earlier than group 2 patients. A positive trend also was noted for return to full duty, with group 1 resuming full duty 7 weeks before group 2. There were no complications or reoperations in group 1 compared with 4 (16%) complications in group 2. The 2 groups underwent the same average number of PT sessions (27 sessions). Patient-reported outcome measures were captured only for group 1, which demonstrated average postoperative improvement of 3 points on a visual analog scale and 32.5 points in American Shoulder and Elbow Surgeons scores. Incorporating an online exercise program within the traditional rehabilitation protocol for WC patients undergoing RCR resulted in earlier return to work and was associated with better pain relief, greater return of function, and lower complication rate. [*Orthopedics*. 2021;44(2):e197-e202.]

Patients increasingly are interested in accessing their medical information online, communicating asynchronously with their health care providers, and engaging in programs designed to facilitate individualized treatment of their diseases. Many patients recovering from musculoskeletal injuries are unable to travel due to either immobilization of the affected extremity or lack of transportation, and most patients cannot afford the time lost from work or school. These factors delay or impede recovery and increase the cost of care. Augmenting rehabilitation of patients after musculoskeletal injury through online cloud-based software programs can improve ease of access while simultaneously reducing costs.

Injured patients treated under the workers' compensation (WC) system are known to have worse outcomes than patients with private insurance.[1-3] For patients who have undergone rotator cuff repair (RCR), these worse outcomes may manifest as persistent pain, longer time off from work, a greater proportion of patients unable to return to full-duty status, and increased complication and reoperation rates. Suggested inciting factors include secondary gain, job dissatisfaction,

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Table 1

Patient Characteristics by Group

Characteristic	No. Group 1 (N=23)	Group 2 (N=25)	*P*[a]
Sex			
Male	6 (26.1%)	14 (56.0%)	.045[b]
Female	17 (73.9%)	11 (44.0%)	
Type of work			
Sedentary	2 (8.7%)	1 (4.0%)	.715
Light	3 (13.0%)	2 (8.0%)	
Medium	15 (65.2%)	18 (72.0%)	
Heavy	1 (4.4%)	0 (0.0%)	
Very heavy	2 (8.7%)	4 (16.0%)	

[a]*Fisher exact test.*
[b]*Statistically significant (*P<*.05).*

poor motivation, lack of participation in rehabilitation, socioeconomic barriers to transportation, and adequate postoperative care.

An additional barrier is the insurance authorization process, which can interrupt rehabilitation with negative consequences.[4] After the initial set of authorized visits for physical therapy (PT) has been exhausted, the latter phase of rehabilitation often is characterized by lack of continuity. Generally, requests for additional therapy require recommendations from both the therapist and the physician, along with a utilization review, which may include peer-to-peer telephone conferences and third-party mediation. This can delay care and ultimately may impact patient recovery.

After considering concerns regarding suboptimal recovery outcomes in this population, the idea of incorporating a software-based solution to facilitate patient engagement and remote outpatient monitoring of the rehabilitation process was developed. The authors aimed to determine whether integrating a digital recovery program into the standard rehabilitation protocol resulted in better recovery outcomes, including an improved return-to-work (RTW) time frame and fewer reoperations.

Materials and Methods

In March 2016, all patients undergoing primary RCR under WC were introduced to an online, interactive PT software program to facilitate their recovery. Patients were invited to use the software, regardless of insurance, size or chronicity of the tear or repair, or their ability to pay for the program. Patients were divided into 2 groups: patients who chose to use the program along with PT (group 1) and patients who chose traditional PT only (group 2) (**Table 1**). Participation in 10 or more online sessions was an inclusion criterion for group 1 as the first 6 weeks consisted primarily of passive shoulder forward-flexion, wand external-rotation, pendulum, elbow, forearm, and hand exercises.

The interactive online rehabilitation and recovery application provided access to exercise programs using audio and high-definition videos, along with supporting written information. The application kept patients informed regarding their exercise routine. It was driven by an algorithm based on evidence-based rehabilitation protocols, specifically developed for each musculoskeletal diagnosis and surgical procedure. The software could record, score, and graphically display patient-reported outcome measures (PROMs) and feedback. The application also could track each participant's level of engagement and compliance with the program throughout the course of recovery. This allowed therapists and physicians to monitor and adjust the patient's progress online through an administrative portal/dashboard.

A fellowship-trained sports medicine orthopedic surgeon with more than 30 years of clinical experience performed all operations. Repairs were performed either arthroscopically or using a mini-open RCR procedure (for larger ligament tears), and all patients who underwent surgery were prescribed identical rehabilitation protocols. Peer-reviewed literature, protocols from national academic institutions (including the American Shoulder and Elbow Surgeons [ASES] consensus statement on rehabilitation following RCR), and expert clinical opinions were used to develop these protocols. Each protocol was divided into 5 phases to be completed during 26 weeks, which included the initial 6-week immobilization period. Isometric strengthening exercises were initiated between weeks 8 and 11, with patients progressing to isotonic exercises by weeks 10 to 12 (depending on the size of the tear).

Patients were counseled preoperatively regarding the goals of using an online application. Patients participated in a preoperative program prior to surgery and were transitioned into 1 of 2 rehabilitative programs on postoperative day 1, based on the surgical procedure (small-medium or large-massive repair) performed.

During the immediate 4-week postoperative period, engagement with the online program was the sole source of rehabilitation for patients in both groups. During postoperative visits, the surgeon would check each patient's progress and correlate it with the extent of engagement,

Table 2

Return-to-Work Time Intervals by Group

	Group 1 (N=23)			Group 2 (N=25)			
Variable	**No.**	**Mean±SD**	**Median (range)**	**No.**	**Mean±SD**	**Median (range)**	***P*[a]**
Physical therapy visits	23	27.9±5.1	26.0 (22.0-41.0)	25	27.6±11.2	25.0 (0.0-48.0)	.927
Return to modified duty, wk	23	17.0±7.6	15.7 (2.0-29.9)	25	26.7±17.6	21.4 (7.3-92.3)	.017[b]
Return to full duty, wk	22	28.1±9.0	27.3 (4.1-52.3)	25	35.2±18.0	30.1 (15.0-92.3)	.091

[a]*Calculated using Student* t *test.*
[b]*Statistically significant (*P*<.05).*

as per the application dashboard data. Formal PT was initiated at week 4.

Patients treated under WC had authorization for the initial 12 visits of PT. Additional sessions required written authorization, which was provided after a utilization review. This process frequently took 5 days to several weeks and was often delayed, causing gaps in implementation of the rehabilitation protocol.

Data including age, sex, dominant hand, size of the initial supraspinatus tear (<3 cm or >3 cm), RTW status, time frame required, complication rate, and number of PT sessions were collated for all patients. Additionally, the ASES Shoulder Assessment Form was used to evaluate group 1 patients preoperatively at baseline and at 1.5, 3, 6, 9, and 12 months postoperatively. Assessment using the visual analog scale (VAS) was performed at weekly intervals.[5,6] Institutional review board approval was received for chart-data review.

Statistical analysis was performed using SAS, version 9.4, software (SAS Institute Inc). Statistical analyses regarding categoric outcomes were assessed using Fisher exact test, and differences between the groups were analyzed using the *t* test. Significance was set at *P*=.05.

Results

Between March 2016 and July 2018, a total of 81 patients underwent primary RCR. Of these, 48 patients were covered under WC. Patients who accessed the online rehabilitation program more than 10 times (n=23) constituted group 1. Group 2 included the remaining patients who had been invited to use the program but did not use the program (n=25) and therefore served as controls.

More women in group 1 used the online program (73.9%) compared with women in group 2 (44%). Overall, women used the online program more frequently than men (*P*=.045). The majority of patients in both groups had occupations requiring medium-level work (65.2% in group 1 vs 72% in group 2).[7]

Group 1 patients completed an average of 64.5 (range, 15-261) online rehabilitation sessions. The mean time interval for returning to light/modified duty was 17.0±7.6 weeks for group 1 compared with 26.7±17.6 weeks for group 2; this difference was statistically significant (*P*=.017). Furthermore, patients who engaged with the application also returned to full duty sooner, with those from group 1 returning at 28.1±9.0 weeks vs 35.2±18.0 weeks for those in group 2 (*P*=.091). Notably, the authors were unable to confirm return to full-duty status for 1 patient in group 1. Both groups did not differ significantly regarding the number of in-clinic PT visits (27.9±5.1 for group 1 vs 27.6±11.2 for group 2) (**Table 2**).

Improvement in outcome as measured using ASES score was 34.5±15.5 at baseline (preoperatively) and 68.5±19.6 at the end of recovery for group 1. This was a mean improvement of 32.5±17.3, which was statistically significant (*P*<.001) as per paired *t* test. The minimal clinically important difference, a numerical indicator of successful recovery after RCR, consisting of 17 points as per ASES score, was identified in the literature.[8] The VAS score for group 1 was 5.7±2.6 at baseline and 2.7±2.1 at the end of recovery, which indicated a mean improvement of 3 points (*P*<.001); this difference was statistically significant (**Table 3**). The PROMs and VAS scores were calculated and reported automatically by the online program, and therefore these scores were unavailable for group 2 patients, who did not use the online application.

Complication and reoperation rates also were evaluated. None of the group 1 patients (0 of 23) required reoperation compare compared with 4 of 25 patients in group 2. Although 3 of 4 patients required reoperations to relieve stiffness and adhesions, 1 patient experienced failed RCR and required a secondary repair procedure (**Table 4**).

Discussion

The musculoskeletal software platform was incorporated in the authors' orthopedic sports medicine practice in March 2016 and was offered to every patient requiring postoperative rehabilitation, regardless of the procedure. The authors observed that many post-RCR patients who used the software did not struggle to regain range of motion or strength and experienced a better recovery.

The automated software uses a peer-reviewed evidence protocol with biologic

Table 3

Patient-Reported Outcome Measures[a]

Patient-reported outcome measure	No.	Mean±SD			95% CI
		Baseline	Final	Change	
ASES	20[b]	34.5±15.5	68.5±19.6	32.5±17.3	NA
VAS	23	5.7±2.6	2.7±2.1	-3.0±3.0	-4.3 to -1.7

Abbreviations: ASES, American Shoulder and Elbow Surgeons Shoulder Assessment Form; NA, not applicable; VAS, visual analog scale.
[a]Data points from group 1 only.
[b]Three patients did not complete the final ASES.

Table 4

Complication and Reoperation Rate

Variable	Group 1		Group 2[a]		*P*[b]
	No.	95% CI	No.	95% CI	
Reoperation rate	0 (0.0%)[c]	0.0% to 14.8%	4 (16.0%)[d]	4.5% to 36.1%	.111

[a]Three patients had frozen shoulder requiring capsular release and 1 had re-tear rotator cuff revision repair.
[b]Fisher exact test.
[c]Percentage of 23.
[d]Percentage of 25.

advancement governors (attachments for automatic control or limitation of speed) built into an algorithm and can develop itself, based on the patient's response to each type of exercise and the number of sessions performed.[9-11] The program can be paused, advanced, and customized for the patient. This technology has the advantage of providing corroborating evidence of a patient's compliance with home-based PT and can identify deficiencies or painful movements while patients perform exercises.

The nominal access fee for the entire 26-week rotator cuff program (<$100) compared favorably with the cost of 20 to 30 PT visits at approximately $150 per session ($3000 to $4500). The WC insurance carrier therefore was willing to cover the cost of the program to augment care. Ideally, patients would use the application for facilitating their home exercises and therefore use their time with the physical therapist more constructively to address individual, specific difficulties. The software reduced the cost of travel, parking, and lost work hours required to attend PT, thus incentivizing its use.

Significant differences were observed between the 2 groups in the RTW parameters. Group 1 patients returned to modified duty 10 weeks sooner (*P*=.017). Positive trends for return to regular duty also were noted for group 1 patients, who returned an average of 7 weeks sooner (*P*=.091) than group 2 patients. These findings challenge the stereotype of WC patients not being engaged in the rehabilitation process and being unmotivated to resume work. Given that costs associated with lost work are substantial, these findings demonstrate a larger impact of this program regarding cost cutting for both employers of injured workers and the WC system as a whole.

Although a cause-and-effect conclusion cannot be definitively drawn from this isolated study, the earlier RTW and decreased complication rate in group 1 are notable. None of the group 1 patients experienced frozen shoulder or re-tearing of the repaired rotator cuff. Group 1 patients, who attended the same number of clinical PT sessions as group 2 patients, also performed an average of 86.4 (range, 12-261) online sessions.

Aggressive PT can cause early disruption of RCR.[12] Conversely, a delay in PT can lead to development of shoulder stiffness.[13] The authors believe the standardized rehabilitation progression and consistent education provided to patients in group 1 through the application may have influenced the reduced number of complications compared with group 2. Nonengaged patients are at risk for joint stiffness, compromised outcomes, and reoperation. Although this study finding was not statistically significant, standardizing protocols for progressive exercises likely had a positive impact on the risk for complications, when considering that these variables have been supported in existing literature.[14,15] Longer and more comprehensive studies are indicated to definitively attribute causality of improved outcomes to the software.

Patients undergoing RCR under WC show worse functional outcomes and rates of RTW than patients undergoing RCR not under WC. Misamore et al[16] noted 54% vs 92% good-to-excellent results and significantly worse return to full activity in their WC vs non-WC patients (42% vs 94%), respectively. In a prospective study, Henn et al[2] noted significantly inferior outcomes in the WC group after correcting for multiple confounding variables. These studies

concluded WC status was an independent predictor of worse Disabilities of the Arm, Shoulder and Hand scores. Considering these findings, WC patients frequently are excluded from studies because their data skew that of non-WC patients. It has been demonstrated that nearly 20% of WC patients do not resume normal activity 6 months after surgery.[17]

Another barrier with WC is delay or interruptions in rehabilitation.[18] In California, bills SB 863 and SB 866, enacted in 2012, required all treatments to be preauthorized for patients covered under WC. Additionally, WC insurers have developed medical provider networks, requiring patients to obtain their treatment from specific providers or facilities for magnetic resonance imaging, physician services, and PT. Within the guidelines, there is a requirement for insurers to provide a determination of approval or denial in 5 to 14 days. In a meta-review, Gallagher et al[19] found early access to rehabilitation had positive impacts on range of motion recovery and functional outcomes within the first 3 to 6 months and promoted a positive trend toward lower complication rates. Incorporation of education and standardized care early in the rehabilitative process can positively influence outcomes of RCR.

Interest in technology and convenience were the primary motivating factors for group 1 patients, whereas patients in group 2 desired traditional and conservative care measures. Forty-eight percent of group 1 patients worked in health care compared with 28% of group 2 patients. Working in the health care industry may have contributed to a greater willingness to try innovative treatments due to a better understanding of health and wellness. Ninety-two percent of group 1 patients regularly used computers for data entry in their respective job roles compared with 56% of group 2 patients. This may indicate a greater comfort level with technology and may support willingness to consider incorporating a digital application into their rehabilitation regimen. More women in group 1 also may have contributed, as women tend to be the health care decision-makers in the majority (80%) of households.[20]

This cohort group compared favorably with published non-WC series and was significantly better than other WC series in the literature.[17,18,21] The authors believe the delivery of information at appropriate time intervals during the full course of recovery through the application influenced earlier RTW and decreased complication rates. The sentinel effect also may have played a role in improved adherence to treatment guidelines in group 1. Return to work is a significant, cost-driven consideration for employees undergoing RCR.

Although this study did not intentionally divide patients in the 2 groups by occupation, both groups were composed primarily of patients performing medium-level work. Patients with this occupational designation generally require longer rehabilitation to successfully return to regular work, considering their rigorous duties. This is in contrast to patients with less physically demanding (eg, white collar workers) occupations, who can resume work sooner with fewer restrictions.

This study had some limitations. The ASES and VAS scores of group 2 were not collected for comparison as these patients did not use the application, which automatically evaluated these scores and reported these data. Additionally, although the authors did not capture the full rationale behind the choice to engage with the application, studies examining the motivations of individuals who use digital recovery applications would be beneficial to help identify target demographics that would most benefit from this type of technology for postoperative rehabilitation.

Conclusion

Musculoskeletal rehabilitation software appears to support notable postoperative improvement in patients after RCR, even in a challenging WC-supported patient population. Augmenting standard PT with online rehabilitation software may significantly improve care after RCR in WC patients. Use of this technology increased patient engagement and supported earlier return to both light and regular duties. Application users also experienced fewer complications. Although functional outcomes were captured only for patients who used the rehabilitation software, the results compared favorably with those reported in the literature. This study did not focus on economic impact; however, use of this technology showed significant potential to reduce costs associated with continued postoperative care. Further studies are warranted to evaluate how application of technology for other musculoskeletal issues compares with established best practices.

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