

[Orthopaedic Surgery]

Activity Profile of Members of an Online Health Community After Articular Cartilage Repair of the Knee

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Background: Articular cartilage repair (ACR) procedures aim to alleviate pain and restore function for individuals with chondral defects. Rehabilitation is lengthy, and there are limited data on return to sports and exercise activities after ACR in non-elite-athlete populations. The Internet is a growing source of health-related information for patients, and it has resulted in the emergence of online health communities.

Purpose: To establish a postoperative activity profile of users of an online health community who have undergone ACR of the knee and to compare this profile with those from the same community who have undergone initial anterior cruciate ligament reconstruction (ACLR).

Study Design: Cross-sectional.

Methods: Tegner Activity Scale ratings were collected via a self-reported online questionnaire from 201 participants of an online health community who had undergone tibiofemoral and/or patellofemoral ACR (n = 75) or ACLR (n = 126).

Results: A higher Tegner activity level was significantly correlated to time from surgery for ACR ($P < 0.005$) and ACLR ($P < 0.01$). At a minimum of 24 months' follow-up, the ACR group had a median postoperative Tegner score of 3, compared with 6 for the ACLR group. Tegner score was significantly negatively correlated with age at time of surgery for ACLR ($P < 0.05$) but not for ACR. Men demonstrated significantly higher Tegner activity levels than did women for both ACLR and ACR ($P < 0.05$).

Conclusions: Activity levels after ACR in this population increased with postoperative time but remained lower than expected when compared with current published clinical and normative data.

Clinical Relevance: Engagement with an online health community may influence expectations regarding return to sports and exercise activities. Reporting of activity-level data within clinical studies should be differentiated on the basis of sex. Further research is needed to elucidate factors that determine return to sports and exercise activities after ACR.

Keywords: articular cartilage repair; knee; Tegner Activity Scale; outcome measures; sport

Articular cartilage repair (ACR) procedures aim to alleviate pain and restore function for people with chondral defects. Activity-level assessment after tibiofemoral and patellofemoral ACR is important, given that rehabilitation is lengthy²⁷ and clinicians are being increasingly confronted with patients who have the desire to continue with sports activity after knee surgery.^{49,60,71} Even though returning to sport and exercise activities is one of the main reasons people elect to undergo ACR,²⁵ there are limited data on return to sports and exercise activities in non-elite-athlete populations.^{25,27,57}

Activity-level scales provide a measure of "what patients are doing." Because of the measurement of different constructs, knee population studies should use a validated patient-reported outcome measure, a general health questionnaire, and a validated activity scale for knee pain and mobility impairments.^{10,46,63} The Tegner Activity Scale (TAS) was published in 1985⁸⁰ and is cited as the most widely used activity scoring system for patients with knee disorders.^{10,23} The first systematic review of TAS usage for ACR of the knee was published in 2010.²⁶

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Although the medical profession remains the most trusted source of health information for orthopaedic patients,¹⁴ the Internet is a growing source of supplemental information on health-related issues.^{13,22,37,66,72} People are often keen on being in contact with others with similar health conditions,³⁸ and this has played an important role in the development of online health communities (OHCs).^{2,15,19} Return to sport is one of the most frequent question themes posted on Internet message boards relating to knee problems⁹ and is a common topic of discussion on knee OHCs.^{9,25} The upsurge of OHCs provides opportunities for online health consumers to influence their own and their peers' health care decisions, expectations, perspectives, and, ultimately, outcomes. However, the limited research in orthopaedic and musculoskeletal fields has focused on how online consumers search for health information on the Internet rather than how participation in an OHC may affect expectations and outcomes.^{22,64,72,74}

The aim of this study was to establish a postoperative activity profile of users of an OHC who had undergone ACR of the knee and to compare this profile with users from the same OHC who had undergone initial anterior cruciate ligament reconstruction (ACLR).

METHODS

Setting and Participants

The focus of this study was on participants from the KNEEGuru OHC (<http://www.kneeguru.co.uk>). The KNEEGuru website is a resource for people with knee problems, with more than 22 000 registered members at the time of this study, principally from the United Kingdom and the United States. A published analysis of patient information about knee arthroscopy on the web identified KNEEGuru as 1 of only 16 sites that provide patient information of sufficient quality such that it can be recommended to patients.⁷⁰ The KNEEGuru OHC is based on a dynamic bulletin board to which participants older than 18 years must register to interact. The bulletin board is an active community, and for the duration of the survey, there was an average of 407 new topics and 7125 new posts per month. Research has indicated that function in sports and return to sports activity are viewed as issues of high importance by participants on this OHC who have undergone either ACR or initial ACLR of the knee.^{28,29}

An online questionnaire was developed through Moodle 1.5.3 (<http://moodle.org>) using the questionnaire activity module (version 2005062701). Responses were stored anonymously with numeric reference identification numbers and exported as comma-separated value files for analysis. The demographic data used to describe the study cohort were self-reported date of birth and sex. Surgical data comprised self-reported responses for type, location, month, and year of knee surgery (Table 1). The ACR group included participants who had undergone either marrow stimulation, osteochondral grafting, or cell-based ACR procedures (Table 1). The ACLR group included those who had undergone initial ACLR; those who had undergone either revision ACLR procedures or

Table 1. Self-reported surgical characteristics of articular cartilage repair group.

Articular Cartilage Repair	Patients, n (%)
Type	
Plugs ^a	14 (19)
Cell based ^b	22 (29)
Microfracture	35 (47)
Other	4 (5)
Location	
Medial femoral condyle	26 (35)
Lateral femoral condyle	9 (12)
Patella	16 (21)
Trochlea	3 (4)
Tibia	1 (1)
Multiple	17 (23)
Don't know	3 (4)

^aOsteochondral autograft transfer, mosaicplasty; OsteoBiologics, Inc.

^bAutologous chondrocyte implantation; autologous chondrocyte transplantation; matrix-induced autologous chondrocyte implantation.

multiple-ligament repairs were excluded. The recruited sample captured the course/spectrum of postoperative experience of each procedure. Information and support needs change over time.^{5,69} Therefore, no specific inclusion requirements were set that related to time elapsed since surgery. Potential OHC users were invited to participate in the study via postings in relevant topic areas on the KNEEGuru online bulletin board.

The purpose and aims of the study and the role of the participants and their rights were included in the invitation to participate, per established guidelines for online research.^{7,18} Institutional ethical approval was obtained as part of a larger study. Self-registration to the study and self-submission of the questionnaire were taken as further consent to participate.⁷⁵ Data collection took place between July 2007 and December 2008. Participants who were younger than 18 years at the time of their surgery were excluded. Data were saved to a secure server only if participants chose to submit the questionnaire. Stored data for each submitted questionnaire were linked to a unique response identification number.

Outcome Measure

The TAS was used as the self-report measure of physical activity level.^{79,80} A gold standard self-report physical activity scale has not yet been identified for use with ACR populations. The TAS was selected because it is one of the most widely used activity scoring systems for patients with knee disorders,^{10,23} because there are published TAS normative data,¹² and because it is frequently used as a patient-reported

Table 2. Demographic characteristics by surgery group and sex subgroups.

	Articular Cartilage Repair		Anterior Cruciate Ligament Reconstruction	
Participants, n	75		126	
Age at time of surgery				
Mean years (range)	34.8 (20-52)		32.6 (14-59)	
Standard deviation	8.1		9.7	
Average time from surgery				
Months (range)	15.6 (0-51)**		11.0 (0-114)**	
Standard deviation	13.8		14.5	
Tegner Activity Scale				
Mean \pm standard deviation	2.9 \pm 1.9**		4.2 \pm 2.7**	
Median (range)	3 (0-10)		4 (0-10)	
	Men	Women	Men	Women
Participants, n	32	43	61	65
Age at time of surgery				
Mean years (range)	34.5 (20-47)	35.1 (22-52)	31.6 (16-59)	33.5 (14-53)
Standard deviation	7.9	8.5	8.8	10.5
Average time from surgery				
Months (range)	13.9 (1-50)	16.8 (0-51)	12.2 (0-114)	9.8 (0-48)
Standard deviation	12.6	14.7	17.9	10.4
Tegner Activity Scale				
Mean \pm standard deviation	3.5 \pm 1.9*	2.2 \pm 1.4*	4.8 \pm 2.7*	3.7 \pm 2.7*
Median (range)	3.5 (0-10)	2.0 (0-6)	5.0 (0-10)	4.0 (0-9)

* $P < 0.05$ (between men and women).

** $P < 0.001$ (between articular cartilage repair and anterior cruciate ligament reconstruction groups).

activity scale in ACR and ACLR clinical studies.²⁶ The TAS scores a person's activity level between 0 and 10, where 0 is *on sick leave/disability* and 10 is *participation in competitive sports such as soccer at a national or international elite level*. In this study, respondents were instructed to indicate the highest level of activity in which they were able to participate at the time of completing the survey, by clicking on 1 of 11 available options.

Data Analysis

Statistical analysis was performed with SPSS 15.0, and data were summarized with descriptive statistics. Medians and ranges were calculated for ordinal data,⁷⁶ but means and standard deviations were also calculated to make comparisons with previous research, per published recommendation.⁴⁰ Nonparametric analysis was performed with the Mann-Whitney U test for comparison of data among participant subgroups. Spearman ρ was used for assessing associations between variables.

Participants were grouped on the basis of time from surgery at survey completion: 0-3 months, 4-6 months, 7-12 months, 13-24 months, and 25 months and longer. Participants were also subgrouped on the basis of sex and age at time of surgery. Prior studies on ACLR have selected a cutoff point of 40 years of age to delineate between young and middle age, and on this basis, 2 groups were established for this study comprising those participants younger than 40 years and those 40 years or older at the time of surgery.^{3,8,52} Reported P values are 2-tailed with an α level of 0.05 indicating significance.

RESULTS

The online survey was completed by a total of 201 participants (75 ACR and 126 ACLR). Data collection was complete, aside from 12 participants who failed to enter a valid date of birth. (Table 2).

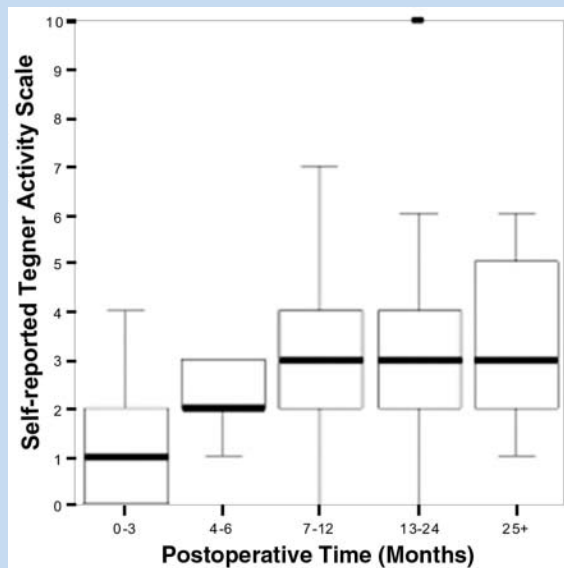


Figure 1. Box plot of self-reported Tegner Activity Scale for articular cartilage repair at different postoperative times. The bold line represents the median value; the box area represents 25th and 75th quartiles; and the whiskers represent the 10th and 90th percentiles. Outliers are shown.

The ACLR group tended to be slightly older at time of surgery, with an average age of 34.8 years, compared with 32.6 years for the ACR group, but this difference was not significant ($P = 0.124$). However, there was a significant difference in average time from surgery between the ACR group (mean, 15.6 months) and ACLR group (mean, 11.0) (Mann-Whitney $U = 3329.0$, $P = 0.001$) and in TAS between the ACR group (median, 3.0) and ACLR group (median, 4.0) (Mann-Whitney $U = 3243.0$, $P < 0.000$).

TAS was negatively correlated with age at time of surgery for ACLR ($\rho = -0.213$, $P < 0.05$); for ACR, there was no significant correlation. TAS was positively correlated to time from surgery for ACLR ($\rho = 0.713$, $P < 0.01$) and for ACR ($\rho = 0.322$, $P < 0.005$) (Figures 1 and 2).

There were no significant differences in age at time of surgery or average time from surgery between men and women for each surgical procedure (Table 2). There was, however, a significant difference in TAS between men and women for both the ACR group ($P = 0.005$) and the ACLR group ($P = 0.037$), with men exhibiting a significantly higher TAS than women. There was no significant difference in TAS between participants who were 40 years and older at the time of surgery and those who were younger for either the ACR group ($P = 0.294$) or the ACLR group ($P = 0.214$).

Eleven percent of participants from the ACR group reported a TAS of 0, with a mean postoperative time of 6.38 ± 6.16 months and a maximum reported postoperative time of 17 months. Nine percent of participants from the ACLR group

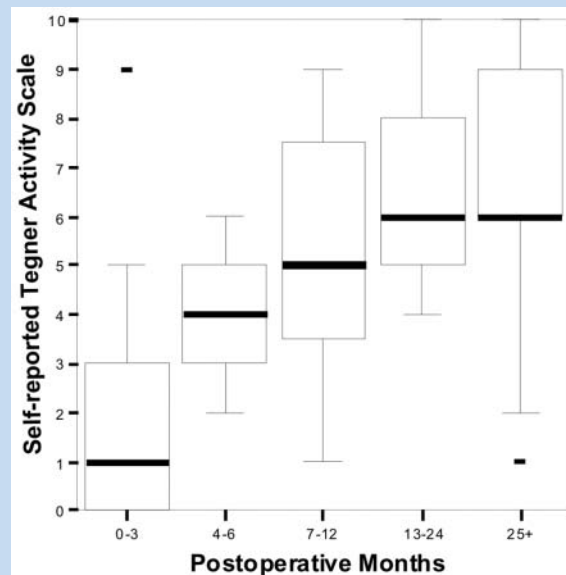


Figure 2. Box plot of self-reported Tegner Activity Scale for anterior cruciate ligament reconstruction at different postoperative times. The bold line represents the median value; the box area represents 25th and 75th quartiles; and the whiskers represent the 10th and 90th percentiles. Outliers are shown.

reported a TAS of 0, with a mean postoperative time of 0.82 ± 0.75 months and a maximum postoperative time of 2 months.

DISCUSSION

The most important finding of the study was that activity levels after ACR in this OHC population increased with postoperative time but remained lower than expected when compared with clinical^{34,35,51,56,57,62} and normative data.¹² Current published literature indicates that a postoperative TAS score of 6 is a common outcome after both ACR^{34,35,51,56,57,62} and ACLR.* This compares well with a reported average activity level of 5.7 for a population with normal knee function.¹² On this basis, someone undergoing either of these knee surgeries can expect to return to an activity level close to that of a person of similar age and sex with normal knee function. This is at a level that includes participation in a recreational sport such as tennis or jogging at least 5 times a week (TAS, 6).

The activity levels of participants from the 2 groups were significantly correlated with time from surgery; so, in overall terms, people who undergo these interventions can expect their activity levels to improve with postoperative time (Figures 1 and 2). TAS scores for the ACR group were expected to be lower than the ACLR group for the first 18 postoperative months because of differences in rehabilitation

*References 1, 21, 36, 39, 41, 42, 57, 73, 77, 78, 85.

and return-to-sport guidance.^{27,31,55,65,82} However, despite initial improvements after surgery, the ACR group reached a maximum median TAS level of only 3 (Figure 1), an unexpected result based on current published literature.^{26,57} Importantly, at no postoperative time point did the 75th quartile reach a TAS level of 6 for this group. These results are intriguing, especially given the reason participants from this OHC frequently give for undergoing ACR—namely, to take part in sports and exercise.^{24,28} In contrast, the ACLR group demonstrated a median TAS score of 6 from 13 months postoperatively onward (Figure 2), which compares well with the expected TAS score based on clinical studies[†] and with a noninjured population.¹²

The majority of participants who had undergone ACR returned to basic activities of daily living, including walking, light work, and low-impact exercise; however, few went on to return to participation in sports activities. Physical inactivity has been cited as the biggest public health problem of the 21st century,⁴ and the promotion of physical activity is now a major worldwide public health initiative.^{16,30} The relatively low median postoperative activity level found in this ACR group may have wider long-term health implications, especially for those who are younger at the time of ACR surgery. The reporting of a TAS level does not distinguish between a restriction in participation due to an impairment in body function and structure (eg, reduced knee range of movement) or one due to the influence of environmental or personal contextual factors (eg, OHC culture, fear of future impairments, expectations, empowerment, self-efficacy).⁸¹

Another pertinent finding from this study was the difference in profile between the ACLR and ACR groups for those who were on sick leave or disability pension because of knee problems (TAS, 0). Patients undergoing ACR are expected to take longer to return to work than those undergoing ACLR based on the longer rehabilitation timescales for ACR procedures.²⁷ However, the mean time that individuals were on sick leave or disability pension was 6.4 months for ACR, compared to only 0.8 months for ACLR. This tends to indicate that the ACR group was experiencing higher levels of limitation of activity and/or restriction of participation than that expected based on published outcomes.²⁶

Significant differences have been reported in TAS ratings for men and women in a noninjured population.¹² Although sex has been implicated as a potential factor in TAS reporting,²⁰ this is the first study to have analyzed TAS scores by sex following ACR.²⁶ Although the results showed a good range of TAS for men (0-10) for ACR and ACLR, the range for women was slightly lower for ACLR (0-9) and considerably lower for ACR (0-6). Overall TAS scores for women were found to be significantly lower than for men for both ACLR and ACR groups (Table 2), which is in accordance with normative data for ACLR¹¹ and which was expected per the established research on women's participation in sport.⁴⁷

[†]References 1, 21, 39, 41, 42, 73, 77, 78, 85.

The sport exercise life course is one where participation in sport and exercise decreases with age.⁴⁷ This trend has been established in TAS profiles in a normal knee population.¹² A decrease in TAS score over time was therefore expected as a reflection of the normal adaptation to older age and changed phases of life.^{36,77} In this study, the TAS score was significantly negatively correlated to age at time of surgery for ACLR but not for ACR. This may indicate that other factors have a greater influence on return to sports activity than does age at time of surgery in an ACR population.

Any explanation for the difference in activity levels between ACR and ACLR groups will likely be multifactorial. There are 3 areas that are worthy of further consideration. First, ACLR surgical techniques are more established and have a higher prevalence than do ACR techniques. At the current time, the evidence base for ACLR is larger and more complete than that of ACR, especially in the area of postoperative return to physical activity. Where techniques are novel or literature is sparse, clinicians are likely to adopt a more cautious and conservative approach to advice for their patients regarding such aspects as returning to sport and exercise participation. Second, ACR requires a significantly longer rehabilitation process than that of ACLR, which has a psychological⁸⁴ and social support impact. This may result in differences in coping styles and drives between the 2 groups that are subject to change with postoperative time.⁵ It may also result in differences in perception of each condition that are exhibited in subsequent differences in illness behavior. Third, the ACR group in this study is not representative of the general ACR population. The use of a nonprobability-based sampling technique may have resulted in selection bias. The evaluation of selection bias poses a particular problem for web-based surveys, given that it is difficult to determine nonresponse rates and that selective participation may result in responders' having stronger views (positive or negative) than nonresponders.^{6,44} The higher-than-expected TAS level of 0 (sick leave or disability pension because of knee problems) is potentially explained by selection bias because those people with more time may be more likely to respond than those who have returned to work.

The absolute activity levels reported in this study for the ACR group were significantly lower than expected, which raises the issue of representativeness of the general ACR population. Lee and Hawkins⁴³ proposed that the higher an unmet need for information or support, the more likely a person is to spend time in social support groups such as OHCs.⁴³ Therefore, those who are using the KNEEGuru OHC following their surgery may arguably have unmet needs for information or support. Conversely, when these needs are met, a person is less likely to spend time on an OHC. Anecdotal evidence from OHC participants supports this view in relation to returning to physical activity: "If they healed fine and returned to sport, they are not generally hanging out on this board" and "I don't know if this is the best place to look for positive encouragement in general about returning to sports following

a surgery.” This potentially explains why the ACR group’s TAS levels were lower than expected, but if this is the case, then why did a large proportion of the ACLR group members not only return to sport activities but remain on the OHC once they had returned?

Research has indicated that participation in OHCs empowers patients, especially in the areas of “being better informed” and “enhanced social well-being.”⁸³ However, clinicians need to be cognizant of the potential negative influences that an OHC can have on functioning and disability. The Internet provides an opportunity for nonrepresentative groups to exert a potentially more rapid and larger effect than that of individuals on their own, according to social capital theory.^{59,66} Strong subgroups within an OHC influence a community and its membership.^{48,86} There is rationale for proposing that a lack of successful former patients on an OHC, who have returned to higher levels of activity, may contribute to more negative expectations of the group overall, by virtue of their absence. The rise of OHCs has many positive benefits; however, the presence of nonrepresentative subgroups increases the potential for dissemination of false, inaccurate, or misleading information to patients.⁴⁵

A counterargument is that the ACR group may actually represent the general ACR population and that it is the results of published studies that are not representative. A recent review of the quality of ACR studies concluded that “caution is required when interpreting results after surgical cartilage repair.”³² Publication bias is a widely accepted phenomenon in clinical literature that affects patient care.^{33,61} It is generally accepted that specialist centers are more likely to publish, that some studies introduce participant bias by using inclusion criteria that select only those patients who have the best chances to do well, and that clinicians often expect and/or rate function and activity levels higher than do patients.^{50,58,67,68} A recently published study from a major European cartilage center found that if all the published randomized controlled trial inclusion criteria were utilized, 95.6% of their patients with symptomatic focal cartilage defects in the knee would be ineligible for participation.¹⁷ This study concluded that results from published randomized controlled trials might not be representative of the gross cartilage population. The issue of representativeness requires further research, given the considerable implications for the generation of expectations from clinician and patient perspectives and the subsequent management of these expectations.

Several limitations to this study focused on the outcome measure used and the study design implemented. The clinical utility of the TAS has contributed to its widespread use in orthopaedics and sports medicine, but it has received criticism. The TAS is based on specific sports deemed arbitrarily categorized⁵³ and not necessarily representative of sports across all cultures. If an individual does return to his or her original sport, it may be with limitations in level, frequency, and/or duration of training and competition. This is not something that the TAS picks up.⁵⁴ Therefore, it may be preferable to

measure components of sports function rather than specific sports.⁵³ This approach has not been widely adopted in ACR studies to date, possibly because of the lack of a suitable outcome measure.

In terms of study design, the study had 4 limitations. First, the participants were self-registered, and they self-reported their activity levels, surgical procedure, and location of lesion. Second, details were not known, including duration of symptoms, alignment, number of lesions, lesion size, and rehabilitation programs. Third, although more than 200 participants responded, the subgroups were often of fairly small sample sizes. Fourth, the study was a cross-sectional design and looked at postoperative TAS scores only.

CONCLUSIONS

Overall, both groups demonstrated postoperative trends in activity levels related to time, age, and sex that were consistent with the literature, but the activity levels of the ACR group were much lower than expected from the current evidence base. The results highlight the potential impact that engagement with an OHC can have on expectations regarding return to sports and exercise activities. Reporting of activity-level data within clinical studies should be differentiated on the basis of sex.

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