# Goal Attainment Scaling Rehabilitation Improves Satisfaction with Work Activities for Younger Working Patients After Knee Arthroplasty

## Results from the Randomized Controlled ACTION Trial

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**Background:** Knee arthroplasty (KA) is increasingly performed in relatively young, active patients. This heterogeneous patient population often has high expectations, including work resumption and performance of knee-demanding leisure-time activities. Goal attainment scaling (GAS) may personalize rehabilitation by using patient-specific, activity-oriented rehabilitation goals. Since unmet expectations are a leading cause of dissatisfaction after KA, personalized rehabilitation may improve patient satisfaction. We hypothesized that, compared with standard rehabilitation, GAS-based rehabilitation would result in younger, active patients having higher satisfaction regarding activities after KA.

**Methods:** We performed a single-center randomized controlled trial. Eligible patients were <65 years of age, working outside the home, and scheduled to undergo unicompartmental or total KA. The required sample size was 120 patients. Using GAS, patients developed personal activity goals with a physiotherapist preoperatively. These goals were used to monitor patients' goal attainment and provide goal-specific feedback during postoperative outpatient rehabilitation. Standard rehabilitation consisted of regular outpatient physiotherapy visits. The primary outcome measures were visual analogue scale (VAS) scores (scale of 0 to 100) for satisfaction regarding activities of daily living and work and leisure-time activities 1 year postoperatively, which were analyzed using generalized estimating equation models.

**Results:** Patient satisfaction with work activities was significantly higher in the GAS group (β = 10.7 points, 98% confidence interval [CI] = 2.0 to 19.4 points) than in the control group. Patient satisfaction with activities of daily living and leisure-time activities did not differ between groups. We found no differences in VAS satisfaction scores between unicompartmental KA and total KA.

**Conclusions:** Personalized, goal-specific rehabilitation using GAS resulted in higher patient satisfaction with work activities, compared with standard rehabilitation, 1 year after KA.

**Level of Evidence:** Therapeutic Level I. See Instructions for Authors for a complete description of levels of evidence.

The use of knee arthroplasty (KA) in patients <65 years of age is rapidly increasing[1,2]. These younger patients often have high expectations from their surgery, including a rapid return to work and the ability to perform knee-demanding leisure-time activities postoperatively[3,4]. Consequently, orthopaedic surgeons are facing a major challenge,

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A **data-sharing statement** is provided with the online version of the article (http://links.lww.com/JBJS/F936).

since we know that unmet expectations are the leading cause of dissatisfaction after KA[5,6]. Also, current data show that up to one-third of patients never return to work after KA[7]. Thus, relatively younger, active patients who undergo KA due to knee osteoarthritis are prone to dissatisfaction with the results.

The need for postoperative rehabilitation, including physical therapy, after KA is generally accepted, although there is much debate regarding the appropriate form[8-11]. Since younger patients have a wide variety of activity goals and expectations for KA[3,4], a "one-size-fits-all" rehabilitation approach likely does not suffice. Furthermore, the use of specific, difficult goals consistently leads to higher performance[12]. One possible instrument to tailor the rehabilitation to patients' personal goals is goal attainment scaling (GAS)[13,14]. Originally, GAS was developed as a method to score the extent to which patients' individual goals are attained during an intervention[14,15]. Theoretically, GAS could prove to be a more useful outcome measure compared with standard patient-reported outcome measures (PROMs), which have shown ceiling effects and a weak correlation with patient satisfaction in present-day heterogeneous KA populations[16]. In addition, GAS scores can be used as a direct feedback instrument for patients during rehabilitation, by objectively monitoring their progress. Involving patients in the formulation of their own rehabilitation goals increases the chances of actually attaining these goals[17-19]. Accordingly, this approach resulted in high patient satisfaction in several rehabilitation settings—for example, for children with motor delays and geriatric patients with multiple chronic conditions, including musculoskeletal diseases[15,20]. Despite these promising results, to our knowledge GAS has never been used to guide rehabilitation after KA.

Therefore, we investigated the effect of GAS-based rehabilitation following KA in relatively younger, active patients. We hypothesized that, compared with usual-care rehabilitation after KA, GAS-based, personalized, goal-directed rehabilitation leads to higher satisfaction scores for postoperative performance of activities.

## Materials and Methods

### *Study Design and Participants*

Study design and implementation followed the Consolidated Standards of Reporting Trials (CONSORT) statement guidelines for reporting randomized trials[21]. The study protocol for this single-center randomized controlled trial with 1:1 allocation was registered in the Dutch National Trial Register (NTR5251) and published[22]. The study was conducted in accordance with the principles of the Declaration of Helsinki. The local medical ethics review committee approved the study. All patients provided written informed consent. Eligible patients were younger than 65 years of age, had end-stage knee osteoarthritis, were awaiting KA, and worked (paid or voluntary) outside the home preoperatively. Exclusion criteria included cognitive impairments, insufficient understanding of the Dutch language, and comorbidities that prevented patients from performing regular rehabilitation activities or regular activities of daily living and work and leisure-time activities. The study was performed at a regional teaching hospital performing approximately 600 KAs annually.

### *Intervention*

We compared GAS-based rehabilitation with standard rehabilitation. Each of the patients in the intervention group was

| | | |
|---|---|---|
| **Setting** | A 59-year old female patient with left knee osteoarthritis. Patient works as a cleaner and she has to clean windows every day. She uses a step stool (± 40 centimeter) and has to step up and down the step stool to clean 20 – 30 consecutive windows daily. | |
| **Measurement** | The physiotherapist observes and counts the number of times that the patient can step up the step stool with her left leg and step down with her right leg. | |
| **Patient Instruction** | Step up the step stool with your left leg without support. Step down the step stool with your right leg. Repeat this as often as you can. | |
| **Goal Attainment Level** | | |
| **-3** | ***Decline*** | Patient can step up and down <4 times |
| **-2** | ***Baseline*** | Patient can step up and down 4 – 6 times |
| **-1** | ***Less than goal*** | Patient can step up and down 7 – 18 times |
| **0** | ***Goal*** | Patient can step up and down 19 – 30 times |
| **+1** | ***More than goal*** | Patient can step up and down 31 – 42 times |
| **+2** | ***Far more than goal*** | Patient can step up and down >42 times |

Fig. 1
Example of a GAS goal and GAS scale for a work activity.

referred to 1 of 23 GAS-trained physiotherapists prior to surgery[17,19]. Preoperatively, the patient and the physiotherapist discussed and formulated 3 postoperative activity goals (1 each for activities of daily living, work activity [Fig. 1], and leisure-time activity). Corrected metabolic equivalents of task values were calculated for each goal[4]. A multidisciplinary team consisting of 2 orthopaedic surgeons, a human movement scientist, an occupational medicine expert, a physiotherapist, and the primary investigator assessed the goals for applicability and feasibility. Based on these activity goals and the assessment, a postoperative rehabilitation scheme was designed by the physiotherapist. Our GAS-based rehabilitation is described in further detail in the published protocol[22] and in the Appendix. There were no additional costs for GAS because reimbursement for physical therapy after KA was standard. Postoperatively, patients visited physiotherapists at least once a week for at least 3 months. Standard rehabilitation consisted of usual-care outpatient physiotherapy, the content of which we described previously[23]. In short, patients were allowed immediate full weight-bearing and were advised to use crutches for 4 to 6 weeks. For postoperative weeks 1 through 4, primary goals were obtaining full extension as well as flexion up to 100° to 110° and starting low-resistance quadriceps training (for example, with a home trainer). From week 5 onward, more static and dynamic weight-bearing exercises, core stability training, and quadriceps and hamstrings exercises were added. A full range of motion was aimed for after 6 to 10 weeks.

### *Outcomes*

Data were collected with an electronic follow-up system (OnlinePROMs; Interactive Studios, the Netherlands). The primary outcome measures were 3 visual analogue scales (VASs), ranging from 0 to 100, for satisfaction regarding the performance of activities of daily living, work activities, and leisure-time activities

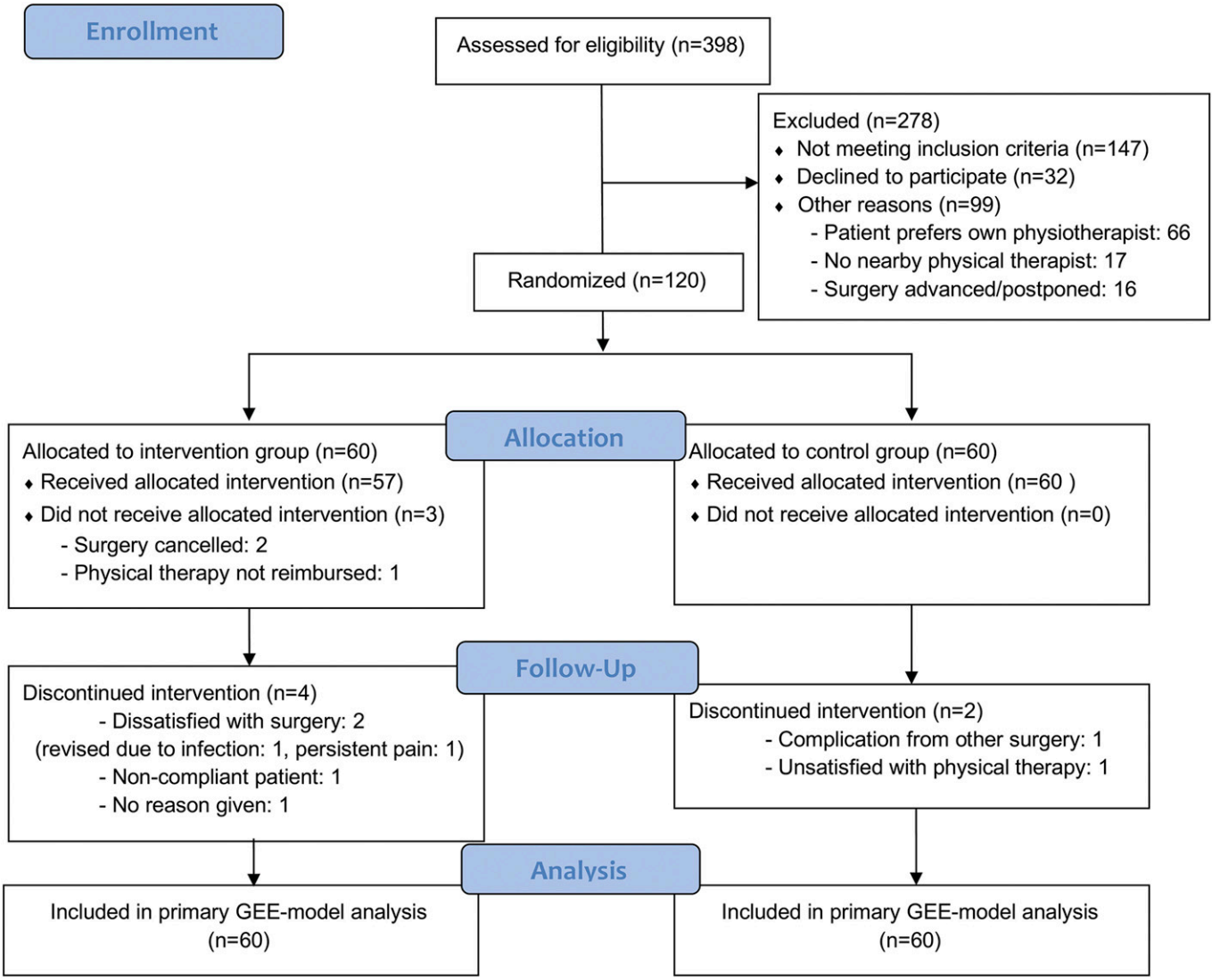


Fig. 2

CONSORT inclusion flowchart.

at 1 year postoperatively. Secondary outcome measures were the Knee injury and Osteoarthritis Outcome Score (KOOS)[24]; the Oxford Knee Score (OKS)[25]; the Work, Osteoarthritis or joint-Replacement Questionnaire (WORQ)[26]; the EuroQol-5 Dimensions (EQ-5D)[27]; and the Net Promoter Score (NPS)[28]. Physical activity was objectively measured preoperatively and 6 months postoperatively using a 3-dimensional (3D) accelerometer. The physical activity data were published previously[29].

### *Sample Size and Randomization*

We based our sample size calculation on a minimal clinically important difference of 10 points on a 100-point VAS[30] for patient satisfaction with postoperative performance of activities. The authors of a previous study reported work-related satisfaction of 62 points after KA[7]. Calculating with a power of 90%, 2-tailed testing with a p value of 0.05, and a standard deviation of 15 resulted in a minimum of 98 participants (nQuery Advisor, version 7.0; Statsols). To adjust for a 15% rate of dropouts, 120 participants (60 in each group) were deemed necessary[22]. Patients were randomized in a 1:1 ratio during an additional visit to the hospital. Block randomization, with separate blocks for total KA (TKA) and unicompartmental KA (UKA), was used. Sequentially numbered opaque envelopes that, prior to opening, were kept in a vault that was accessible only to the primary investigator were used. The primary investigator generated the random allocation sequence, enrolled participants, and assigned participants to interventions. By necessity, participants, researchers, and physiotherapists were unblinded to group allocation.

### *Statistical Analysis*

Descriptive statistics were used to report baseline characteristics. Primary outcome measures were analyzed according to the intention-to-treat principle. A generalized estimating equations (GEE) model was used to analyze differences in the change of the VAS satisfaction scores relative to the preoperative scores between the GAS and control groups and between TKA and UKA groups. The GEE model included time as the within-subject variable, GAS/No GAS (control) and TKA/UKA as factors, and the preoperative VAS satisfaction score as covariates, with an unstructured correlation matrix. Because we tested 3 primary outcome parameters, a Bonferroni correction was applied. Consequently, mean estimated VAS scores with the 98% confidence interval (CI) for the GAS and control groups were calculated. Secondary outcomes were analyzed according to the available-data principle. Independent samples t tests were performed to compare the change in scores from baseline to 3, 6, or 12 months postoperatively between the GAS and control groups. For the NPS, the percentage of detractors (scores of 1 to 6 out of 10) was subtracted from the percentage

**TABLE I Baseline Characteristics of the GAS and Control Groups***

| | GAS Rehabilitation (N = 60) | Standard Rehabilitation (N = 60) |
|---|---|---|
| Mean age (SD) *(yr)* | 58.3 (5.3) | 58.1 (4.6) |
| Female sex *(no. [%])* | 38 (63) | 34 (57) |
| Mean BMI (SD) *(kg/m²)* | 31.1 (5.6) | 31.9 (5.5) |
| ASA classification *(no. [%])* | | |
| I | 12 (20) | 10 (17) |
| II | 31 (52) | 35 (58) |
| III | 17 (28) | 15 (25) |
| Physical workload *(no. [%])* | | |
| Light | 26 (43) | 28 (47) |
| Intermediate | 18 (30) | 25 (42) |
| Heavy | 16 (27) | 7 (11) |
| Median corrected METs (IQR) | | |
| Activities of daily living goals | 5.3 (4.4-6.9) | — |
| Work goals | 5.1 (4.5-6.2) | — |
| Leisure-time goals | 8.0 (6.7-10.4) | — |
| KA type† *(no. [%])* | | |
| Total | 31 (52) | 31 (52) |
| Unicompartmental | 29 (48) | 29 (48) |

*ASA = American Society of Anesthesiologists, BMI = body mass index, IQR = interquartile range, MET = metabolic equivalent of task, and SD = standard deviation. †Surgery was canceled by 2 patients in the intervention group (both scheduled for unicompartmental KA).

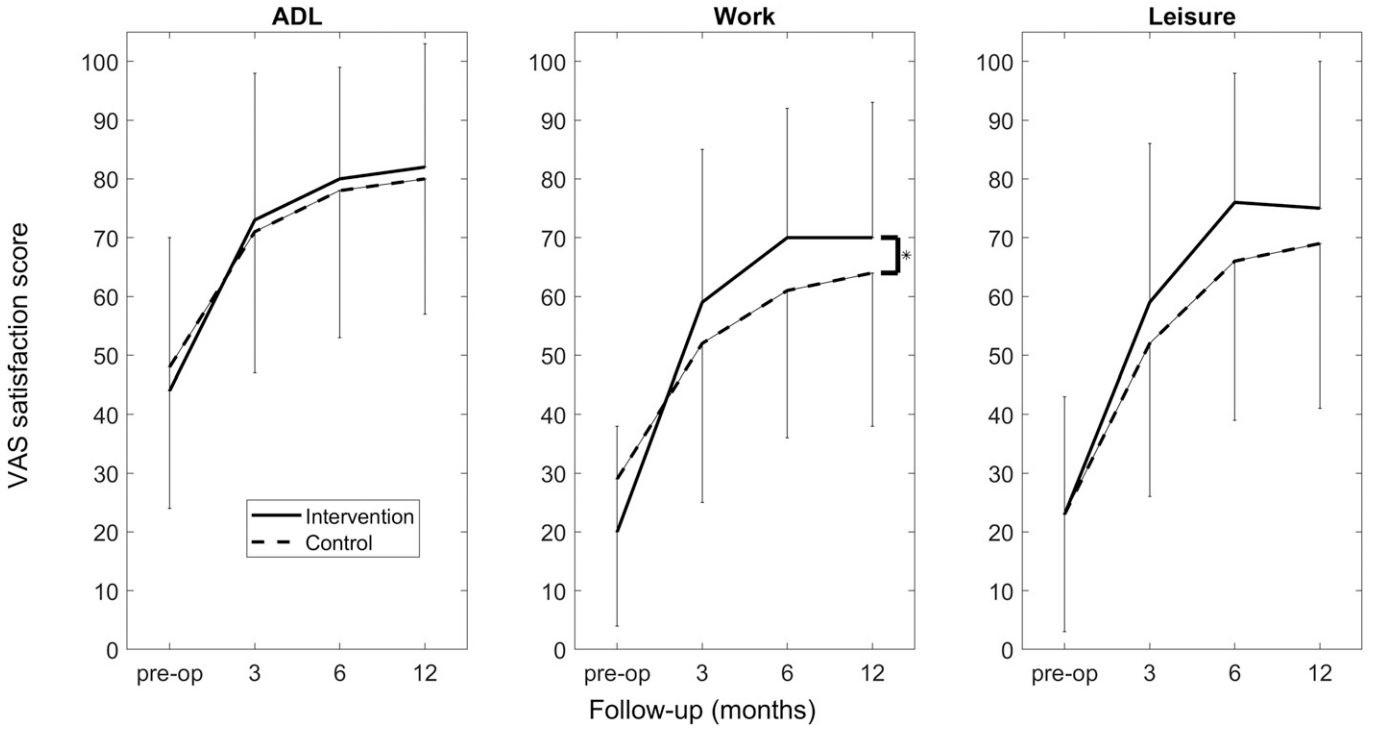


Fig. 3

Mean VAS satisfaction scores over time. Error bars represent 1 standard deviation, presented as positive error bars for the intervention (GAS) group and as negative error bars for the control group. *P < 0.01. ADL = activities of daily living.

of promoters (a score of 9 or 10 out of 10)[28], and the proportions of detractors and promotors were compared between groups using a chi-square test. We used SPSS software (version 24.0; IBM) for all statistical analyses.

## Results

### *Participants and Baseline Characteristics*

From October 2015 to November 2017, when the required number of patients was reached, 398 patients younger than 65 years of age were screened for eligibility; 147 of them did not meet the inclusion criteria, 99 declined to or could not participate for various reasons, and 32 declined to participate without any reason (Fig. 2). Thus, 120 patients were randomized to the GAS (n = 60) and control (n = 60) groups (Table I). Complete follow-up data were available for 53 patients in the GAS group and 58 in the control group (Fig. 2).

### *Primary Outcome Measures*

All patients indicated an increase in the mean VAS scores for satisfaction for all activities over time (Fig. 3). Based on the outcome of the GEE model, the difference in the work satisfaction score over time from preoperatively to 1 year postoperatively was 10.7 points (98% CI = 2.0 to 19.4 points) higher for the GAS group than the standard rehabilitation group (Fig. 3, Table II). We found no differences in the satisfaction scores for the performance of activities of daily living or leisure-time activities between the GAS-based rehabilitation and standard rehabilitation groups (Table II). In the same statistical model, no differences were found between the UKA and TKA groups for activities-of-daily-living or work or leisure-time activity satisfaction scores

### *Secondary Outcome Measures*

We found no significant differences between the GAS and standard rehabilitation groups for the improvements in KOOS scores from preoperatively to 3 or 12 months (Table III). Also, we found no differences between the 2 groups with respect to change scores at 3 and 12 months for the OKS, WORQ, EQ-5D, or NPS (Table IV).

**TABLE II GEE Model Analyzing the Effect of Therapy (GAS Versus No GAS) and Prosthesis Type (UKA Versus TKA) on VAS Satisfaction Scores Over Time**

| Type of Activity | Effect | Reference | β | 98% CI |
|---|---|---|---|---|
| Daily living | Therapy | No GAS | 2.1 | −5.6-9.8 |
| Daily living | Prosthesis type | TKA | 7.8 | 0.2-15.4 |
| Work | Therapy | No GAS | 10.7* | 2.0-19.4* |
| Work | Prosthesis type | TKA | 5.3 | −3.1-13.6 |
| Leisure | Therapy | No GAS | 7.3 | −2.1-16.7 |
| Leisure | Prosthesis type | TKA | 7.1 | −2.2-16.4 |

*A significant difference between the GAS and control groups.

**TABLE III Mean KOOS Scores and Change Scores at 3 and 12 Months**

| | GAS Rehabilitation* (N = 53) | | Standard Rehabilitation* (N = 58) | | |
|---|---|---|---|---|---|
| | Total Score | Δ | Total Score | Δ | P Value† |
| Pain | | | | | |
| Preoperatively | 41 (17) | — | 39 (18) | — | — |
| 3 months | 73 (16) | 32 (21) | 70 (19) | 31 (23) | 0.74 |
| 12 months | 87 (16) | 46 (22) | 80 (20) | 41 (26) | 0.27 |
| Symptoms | | | | | |
| Preoperatively | 49 (17) | — | 46 (19) | — | — |
| 3 months | 67 (16) | 18 (20) | 66 (16) | 20 (27) | 0.79 |
| 12 months | 78 (17) | 29 (21) | 78 (17) | 32 (26) | 0.57 |
| Activities of daily living | | | | | |
| Preoperatively | 49 (19) | — | 48 (18) | — | — |
| 3 months | 78 (15) | 29 (23) | 72 (18) | 24 (22) | 0.33 |
| 12 months | 85 (18) | 36 (24) | 81 (21) | 32 (26) | 0.50 |
| Sports/recreation | | | | | |
| Preoperatively | 15 (21) | — | 13 (18) | — | — |
| 3 months | 31 (26) | 16 (29) | 28 (27) | 16 (29) | 0.99 |
| 12 months | 46 (30) | 31 (27) | 46 (32) | 32 (28) | 0.85 |
| Quality of life | | | | | |
| Preoperatively | 23 (16) | — | 22 (14) | — | — |
| 3 months | 56 (20) | 32 (24) | 49 (22) | 26 (25) | 0.32 |
| 12 months | 67 (23) | 44 (28) | 64 (27) | 42 (29) | 0.57 |

*The values are given as the mean with the standard deviation in parentheses. Δ = change in score from preoperative to 3 months or from preoperative to 12 months. †Independent samples t test for the difference in the change score between the GAS and control groups at 3 or 12 months.

## Discussion

The hypothesis of this randomized controlled trial was that, compared with usual-care rehabilitation, goal attainment scaling (GAS)-based, personalized, goal-directed rehabilitation would lead to higher satisfaction with postoperative performance of activities after KA. We found that GAS-based rehabilitation resulted in significantly higher patient satisfaction with the performance of work activities but no difference in satisfaction regarding activities of daily living or leisure-time activities. We also found no differences between UKA and TKA in terms of satisfaction with activities of daily living or work or leisure-time activities.

Since fulfilment of preoperative expectations is crucial for patient satisfaction after KA[5,6,31], GAS's personalized approach theoretically leads to improved satisfaction. Toto et al. previously found that the use of GAS for geriatric patients with multiple chronic conditions facilitated patient-centered care and, more importantly, that the process of personalized goal-setting itself could facilitate goal attainment[20]. Although we found a patient-relevant and significant effect on work-related satisfaction, we did not observe this effect for satisfaction with activities of daily living or leisure-time activities. There may be several explanations for this discrepancy. First, our inclusion criteria focused specifically on patients who worked outside the home. It is possible that our patients were primarily focused on attaining their work-related goals since a return to work is both desirable and often a financial necessity[32]. Also, one could speculate that the activities-of-daily-living and leisure-time goals were not ambitious enough, given the previously reported low metabolic equivalent of task values in our cohort[4]. Finally, it is known that patients' perception that their knee symptoms are work-related is associated with worse results in terms of return to work after KA[33]. In our study, only in the intervention group, by formulating personal GAS goals, did patients specifically address their most important work-specific activity limitations caused by knee symptoms with their therapist. This consultation and the following focus on improving their most important work activity likely led to higher satisfaction with these work activities. An ongoing study is currently investigating whether GAS is also associated with faster and/or higher return-to-work rates in our cohort.

Given GAS's specific focus on goal attainment, and the known difficulties with capturing patient satisfaction using regular knee-related PROMs such as the KOOS[16,34], we did not expect significant differences between both groups with regard to the regular PROMs. Indeed, none of the change scores for

**TABLE IV Mean Scores and 3 and 12-Month Change Scores for the OKS, WORQ, EQ-5D, and NPS**

| | GAS Rehabilitation* (N = 53) | | Standard Rehabilitation* (N = 58) | | |
|---|---|---|---|---|---|
| | Total Score | Δ | Total Score | Δ | P Value† |
| OKS | | | | | |
| Preoperatively | 25 (7) | — | 23 (7) | — | — |
| 3 months | 36 (7) | 11 (10) | 35 (8) | 11 (10) | 0.87 |
| 12 months | 40 (7) | 16 (9) | 39 (9) | 16 (10) | 0.56 |
| WORQ | | | | | |
| Preoperatively | 44 (13) | — | 41 (16) | — | — |
| 3 months | 61 (18) | 17 (21) | 57 (19) | 16 (21) | 0.90 |
| 12 months | 73 (18) | 29 (18) | 69 (22) | 28 (21) | 0.88 |
| EQ-5D index | | | | | |
| Preoperatively | 0.60 (0.24) | — | 0.56 (0.25) | — | — |
| 3 months | 0.81 (0.19) | 0.21 (0.30) | 0.76 (0.22) | 0.21 (0.33) | 0.84 |
| 12 months | 0.85 (0.19) | 0.25 (0.24) | 0.86 (0.18) | 0.29 (0.27) | 0.76 |
| EQ-5D VAS | | | | | |
| Preoperatively | 64 (19) | — | 60 (19) | — | — |
| 3 months | 74 (16) | 10 (21) | 74 (11) | 14 (20) | 0.67 |
| 12 months | 77 (17) | 13 (16) | 75 (19) | 15 (21) | 0.60 |
| NPS | | | | | |
| 6 months | 38 | — | 36 | — | 0.27 |
| 12 months | 40 | — | 29 | — | 0.35 |

*The values are given as the mean with the standard deviation in parentheses. Δ = change in score from preoperative to 3 months or from preoperative to 12 months. †Independent samples t test for the difference in the change score (except for the NPS) between the GAS and control groups at 3 or 12 months.

the secondary outcomes differed between the 2 groups. In fact, we consider this a further endorsement for the use of GAS in KA rehabilitation for working patients since it is a PROM that can be individualized without ceiling effects. By allowing patients to set personalized goals, GAS may address constructs that are not captured by regular PROMs or quality-of-life measures.

Since this is the first study of which we are aware to focus on a post-KA rehabilitation that was personalized using GAS as an intervention, our ability to compare it with existing literature is limited. However, the effect of GAS-based rehabilitation has been recently studied in several other musculoskeletal conditions. We previously reported that, in a subgroup analysis, 91%, 93%, and 89% of patients who underwent GAS-based rehabilitation attained their desired goal for activities of daily living, work activities, and leisure-time activities, respectively, at 6 months of follow-up[4]. These rates were higher than the reported goal-attainment rates after GAS rehabilitation for patients with arthritis-related pain, with 13 of 17 of those patients attaining their desired goal after 4 months[35]. Encouragingly, 16 of those 17 patients were either satisfied or very satisfied with the success of their goal attainment[35]. In addition, GAS-based rehabilitation recently was shown to result in significant motor function improvements compared with standard rehabilitation in a randomized controlled trial of patients with Parkinson disease[36] as well as high patient satisfaction with treatment of chronic lower back pain[37]. Still, the most persuasive evidence until now comes from research in pediatric rehabilitation, in which GAS has been broadly used and could detect meaningful change, as experienced by patients and caregivers, in most studies[38].

A limitation of the present study was that the physiotherapists received only 1 training session. Ideally, a longer training program to introduce GAS into clinical practice should be used[17]. Our research team, including experienced GAS users, did monitor the GAS goals and rehabilitation schemes. However, we would advise future users to plan additional repeated face-to-face training sessions for new users[17]. Also, a large group of physiotherapists (n = 23) treated a relatively small group of patients (n = 60), which limited the additional benefit of increasing experience with GAS for physiotherapists. We believe that, by using GAS regularly, physiotherapists could improve their use of the tool. We also believe that the improvements in VAS satisfaction scores regarding activities might be further increased by optimizing the introduction of GAS into clinical practice. Lastly, the OKS Activity & Participation Questionnaire supplement[39], Patient Activation Measure[40], and Short QUestionnaire to ASsess Health-enhancing physical activity (SQUASH)[41] were described in the protocol but were not

included in the analysis because of erroneous data collection (wrong answering options were included in the online questionnaire). We believe that the lack of blinding did not influence our outcomes based on a recent meta-epidemiological study that showed that blinding of patients, health-care providers, or outcome assessors had no impact on effect estimates in randomized controlled trials[42].

The growing population of younger patients desiring KA highlights the need for a more patient-tailored approach to rehabilitation[43]. GAS's personalized, goal-oriented approach appears to be suitable for the increasingly heterogeneous KA population, as both an intervention in the rehabilitation and an outcome measure that can be individualized appropriately. Our studies showed that GAS-based rehabilitation is feasible for patients who have undergone KA and resulted in a high percentage of goal attainment[4]. These results may encourage future studies on the use of GAS in challenging orthopaedic patient populations, such as patients with jobs placing heavy demands on the knee. Tools to facilitate the use of GAS in daily rehabilitation practice are being developed, with the recent launch of an application (GOALed) encouraging self-care by allowing patients to monitor their own progress as the most recent promising example[44]. Our first results of using GAS as a tool for a more patient-tailored rehabilitation may encourage further research and implementation in order to improve patient-relevant outcomes after KA.

In conclusion, the satisfaction of working patients with the performance of work activities after KA was higher after rehabilitation based on GAS than after standard rehabilitation.

## Appendix

Supporting material provided by the authors is posted with the online version of this article as a data supplement at jbjs.org (http://links.lww.com/JBJS/F918). ■

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