The Group Experience: Remodelling Outpatient Physiotherapy after Knee Replacement Surgery

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ABSTRACT

Purpose: To estimate responses to short-duration (4–6 weeks) group-based physiotherapy after knee replacement in terms of pain, function, and satisfaction. **Method:** The study used a prospective, observational design. A total of 169 participants (111 women, 58 men) were consecutively recruited to attend a twice-weekly post-operative knee replacement class focused on mobility, strength, balance, and functional retraining. Changes in pain, function, and satisfaction were measured using the P4 pain intensity measure, the Lower Extremity Functional Scale (LEFS), a timed stair test (TST), knee range of motion (ROM), the Patient Specific Functional Scale (PSFS), and the Client Satisfaction Questionnaire (CSQ-8). Using Stata version 12.1, the data were summarized descriptively, and change scores were calculated with 95% CIs. **Results:** On average, participants were discharged within 11 classes, having achieved their treatment goals. More than 77% exceeded the minimal detectable change at the 90% confidence level (MDC₉₀) on the LEFS, TST, PSFS, and ROM assessments. The mean CSQ-8 score at discharge was 31.8 (SD 1.46); 66.7% recorded a perfect score of 32. **Conclusions:** Patients attending a short group-based outpatient knee replacement class demonstrated significant improvements in pain and lower extremity function and were highly satisfied with their physiotherapy treatment.

Key Words: arthroplasty, knee; exercise therapy; outcome measures; outpatients; rehabilitation.

RÉSUMÉ

Objectif : Estimer la réaction des patients à un traitement de physiothérapie en groupe de courte durée (de 4 à 6 semaines) à la suite d'une arthroplastie du genou en ce qui concerne la douleur, la fonction et la satisfaction. **Méthode :** L'étude a utilisé un concept prospectif d'observation. Au total, 169 patients (111 femmes) ayant subi une arthroplastie du genou ont été recrutés de façon consécutive pour assister deux fois par semaine à un cours axé sur la mobilité, la force, l'équilibre et le recyclage fonctionnel. Les changements relatifs à la douleur, à la fonction et à la satisfaction ont été mesurés à l'aide du questionnaire sur l'intensité de la douleur (P4), de l'échelle fonctionnelle des membres inférieurs (EFMI), d'un test de l'escalier chronométré (TEC), d'une mesure de l'amplitude des mouvements (ADM) du genou, de l'échelle fonctionnelle spécifique au client (EFSC) et du questionnaire de satisfaction de la clientèle (CSQ-8). À l'aide de STATA 12.1, les données ont été résumées de façon descriptive et les valeurs numériques des changements ont été calculées avec des intervalles de confiance de 95%. **Résultats :** En moyenne, les patients ont obtenu leur congé en 11 séances ou moins, leurs objectifs de traitement ayant été atteints. Plus de 77% des participants ont dépassé le seuil de changement détectable à un niveau de confiance de 90% (CDM₉₀) pour les évaluations de l'EFMI, du TEC, de l'EFSC et de l'ADM. La note moyenne au CSQ-8 à l'obtention du congé était de 31,8 (ET 1,46); une note parfaite de 32 a été obtenue dans 66,7% des cas. **Conclusions :** Les patients ayant participé à un cours de courte durée en service externe après une arthroplastie du genou ont affiché une nette amélioration en ce qui concerne la douleur et la fonction des extrémités inférieures et se sont montrés très satisfaits de leur traitement de physiothérapie.

Total knee replacement (TKR) is an effective procedure that can provide significant improvements in pain, function, and health-related quality of life for patients with end-stage knee arthritis.^{1,2} As the demand for TKR

continues to rise,³ increasing surgical volumes, in combination with reduced health care budgets and other system pressures, have been the impetus for national partnering to address the needs of this population.⁴ In

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2004, hip and knee replacement was one of the key areas in Ontario's Wait Time Strategy,⁵ leading to the introduction of additional resources to address significant capacity issues in the province. Although access to TKR improved, patients' access to rehabilitation services was reduced with the delisting of publicly funded physiotherapy services in 2005.⁶ In a qualitative study exploring the patient's perspective, reductions in length of stay and limited access to physiotherapy services had a detrimental effect on care.⁷ In 2010, the Excellent Care for All Act laid the foundation for improving the quality of care with a greater focus on evidence to guide funding decisions.⁸ Taken together, these changes present health care professionals with the challenge of delivering high-quality care in a fiscally restrained environment.

These factors led the Sunnybrook Holland Orthopaedic & Arthritic Centre (Holland Centre) in Toronto to evaluate and redesign processes of care after TKR. In 2007, to maximize limited human resources while still providing quality care, the outpatient physiotherapy team shifted away from the traditional model of individual treatment sessions and introduced a new post-operative knee replacement class (PKRC). When the class began, evidence supporting group-based physiotherapy treatment was limited; however, several studies supporting this treatment model have been published more recently.^{9–11}

Before developing our class, we established core guiding principles: goal-based individualized treatment plans, progressive functional and strengthening exercises, decisions based on standardized outcome measures, variable treatment duration based on patient progress, and streamlined documentation through the introduction of a standardized care pathway.

As this approach represented a significant change in practice, the team was concerned about the impact on patient outcomes and acceptability. We therefore planned a study to evaluate the typical outcomes achieved; any gender differences, because prior research has shown that functional status levels differ by gender both before and after surgery;^{12–15} and patient satisfaction with the class. Our primary goals were (1) to describe the change in pain and function of patients attending the PKRC; (2) to explore whether outcomes differed between men and women; and (3) to evaluate patient satisfaction with the PKRC.

METHODS

Using a prospective, observational design, we recruited consecutive patients (from December 2009 to September 2011) who had undergone unilateral knee replacement surgery at the Holland Centre and were eligible for treatment in a group class. As part of routine care, all patients are initially assessed by one of the outpatient physiotherapists to determine the need for ongoing individual or group-based therapy. When possible, the patient is

treated in a class run by that same physiotherapist, unless the patient requires a different schedule. Although most patients are deemed eligible for a class, those who need close monitoring for surgical concerns (e.g., non-routine physiotherapy orders) or medical concerns (e.g., a cardiac event after surgery) would be treated individually. Potential participants were excluded from the study if they had insufficient English language skills to complete the study questionnaires, had additional surgical procedures at the time of their joint replacement, or had an infectious disease that would prevent their participation in a group class.

Ethics approval for the study was obtained from the Sunnybrook Research Ethics Board, and all participants provided written informed consent.

Holland Centre's Post-Operative Knee Replacement Class

At the Holland Centre, patients undergoing TKR generally stay in hospital 3–4 days, with a goal of home discharge; the post-discharge plan usually includes referral to an outpatient physiotherapy facility (see Figure 1). The Holland Centre PKRC is run by a physiotherapist, a physiotherapy assistant, and a volunteer; on average, there are 10 to 12 participants. Each class lasts approximately 90 minutes and includes modalities to address pain and swelling (e.g., heat before treatment and ice after treatment); range of motion (ROM) exercises with joint mobilizations by the therapists (provided for most patients); progressive strengthening exercises (e.g., unilateral leg press, hip abductor training, quarter squat, hamstring strengthening); functional training (e.g., stair climbing, chair rise, stationary bicycle, gait training); and balance training (e.g., single-leg stance, forward or lateral stepping on different surfaces; see Appendix 1 online). Although exercise prescription includes a core set of exercises (see Appendix 2 online), the number of exercises, number of repetitions, and resistance prescribed are tailored to each patient's needs and abilities. The number of sessions varies, but on average patients attend the PKRC for 4–6 weeks, generally twice a week for a total of 8–12 sessions.

To facilitate efficient and focused charting, and in view of the class sizes, we developed a care pathway with standardized intake and discharge assessment forms, a daily activity record (which includes prescribed exercises, repetitions, and a record of measured ROM for the session), and charting progress forms for the PKRC (see Appendix 1). Standardized outcome measures and routine physiotherapy assessment components are administered at intake and discharge.

Outcome measures

We use the following measures, all of which have been previously studied in the joint replacement population: the Lower Extremity Functional Scale (LEFS),^{16,17} the P4 pain intensity measure (P4),^{18–20} the Patient Specific Functional Scale (PSFS),^{21–23} a timed stair test (TST),²⁴

Figure 1 Sunnybrook Holland Centre Knee Replacement Model of Care.

and active ROM (AROM).^{25,26} To measure quadriceps strength, we use a unilateral leg press to determine the one-repetition maximum (1RM) of the operative and non-operative legs, expressed as a ratio. We used the Client Satisfaction Questionnaire (CSQ-8) as a measure of general satisfaction.^{27,28}

Lower Extremity Functional Scale

Conceived by Binkley and colleagues,¹⁶ the LEFS is a 20-item self-report measure of lower extremity functional status. Items assessing the disablement concepts of functional limitation (activity limitation) and disability (participation restriction)¹⁶ are scored on a 5-point scale (ranging from 0 to 4), for a total LEFS score ranging from 0 to 80; higher scores are associated with higher levels of function. Research evidence has supported the reliability and validity of the LEFS, including its ability to detect change in people with knee osteoarthritis (OA) progressing to TKR.^{17,29,30} The minimal detectable change at the 90% confidence interval (MDC₉₀) for the LEFS is 9 points.¹⁶

P4 pain intensity measure

The P4 is a four-item measure of pain intensity that asks about pain in the morning, in the afternoon, in the evening, and with activity.^{18,19} Each item is scored on an 11-point numeric pain scale (0 = no pain; 10 = pain as bad as it can be), for a total score ranging from 0 to 40; higher scores represent higher pain levels. Support for the use of the P4 in people with knee OA has been published previously.²⁰ The MDC₉₀ for the P4 is 9 points.¹⁸

Patient Specific Functional Scale

The PSFS asks respondents to identify three to five important activities that they are unable to do or are having difficulty with as a result of their injury or prob-

lem. The respondent then scores each activity on an 11-point scale (0 = unable to do the activity; 10 = able to perform the activity at the same level as before the injury or problem). The PSFS allows clinicians and patients to focus on activities that the patient is having difficulty accomplishing.²¹ Validation studies have supported the interpretation of PSFS scores at the level of both individual items and total score.^{22,31} MDC₉₀ is 2 points for the total score and 3 points for individual items.²²

Timed stair test

The TST requires patients to ascend and descend nine stairs (step height = 20 cm) in their usual manner, at a safe and comfortable pace. Patients are instructed to use their cane, the railing, or both, as required. Time is measured to the nearest tenth of a second using a stopwatch. The reliability and validity of the TST in the population with TKR has been reported previously,²⁴ and the MDC₉₀ has been established as 5.49 seconds for both hip and knee replacement populations.²⁴

Knee active range of motion

We assessed knee AROM using a universal goniometer, aligning the axis of the goniometer with the lateral epicondyle of the femur, the proximal arm with the greater trochanter, and the distal arm with the lateral malleolus. Flexion was documented in degrees of flexion; extension beyond zero was expressed as hyperextension, and extension values for patients who were unable to achieve 0° were recorded as degrees of flexion. To measure active knee flexion, the patient sat with legs bent over the edge of the therapy bed and was instructed to bend the operated knee as far as possible. To assess extension, the patient was in long sitting with a roll placed under the operative knee and was instructed to lift the

Table 1 Descriptive Statistics of Patient Sample

Descriptive statistics	Median (1st quartile, 3rd quartile)*		
	Total (n = 169)	Men (n = 58)	Women (n = 111)
Age, mean (SD) y	68.0 (8.7)	69.4 (7.8)	67.3 (9.1)
Time since surgery, d			
Initial visit	15 (11, 20)	14 (11, 17)	15 (11, 21)
Discharge visit	52 (47, 63)	51 (46, 63)	52 (47, 65)
Classes attended, no.	11 (10, 11)	11 (10, 12)	11 (10, 11)

*Unless otherwise indicated.

heel off the bed to maximally extend the knee. Previous research has estimated MDC₉₀ to be 6.3° for extension and 9.6° for flexion.²⁶

Extensor ratio

To measure quadriceps strength, we used a unilateral 1RM leg press of the operative and non-operative legs to create an extensor ratio. We divided the operative 1RM by the non-operative 1RM, using the non-operative leg as the benchmark, irrespective of any existing knee pathology such as OA. The test was administered using a universal leg press machine, requiring patients to go from 90° flexion (or maximal knee bend, if less) to their maximum extension. Because patients were still in the acute postoperative phase, and in view of the likelihood of fatigue, we tried to minimize the trials done with the operative leg. The 1RM of the non-operative leg was used to guide the starting weight for the operative leg, using 40% of 1RM as an estimate and progressing the weight accordingly.

Client Satisfaction Questionnaire

The CSQ-8 is an eight-item generic measure of satisfaction originally designed for mental health and general care settings.³² It has high internal consistency (coefficient $\alpha = 0.93$) and has undergone construct validation in several studies.²⁷ Response options differ from item to item, but all are based on a 4-point scale; the eight items are summed to produce an overall score ranging from 8 to 32, with higher scores indicating greater satisfaction.

Statistical analysis

All data analyses used Stata version 12.1 (StataCorp LP, College Station, TX). We calculated descriptive statistics (including means, standard deviations, and percentages, as appropriate to the data) as well as change scores, calculated as the difference between initial and discharge scores for each of the standardized outcome measures (LEFS, P4, PSFS, TST), AROM measures, and strength measures. Although several methods exist for estimating a change threshold value, we used MDC₉₀ values because they were available for most of our study

Table 2 Summary of Outcome Measure Results

Outcome measure	Mean (SD)		
	Total (n = 169)	Men (n = 58)	Women (n = 111)
Active flexion, degrees			
Initial	94.2 (16.8)	92.1 (16.9)	95.4 (16.7)
Discharge	129.5 (8.0)	130.2 (6.8)	127.5 (8.5)
Active extension, degrees*			
Initial	13.8 (6.9)	15.0 (7.1)	13.3 (6.7)
Discharge	0.5 (1.3)	0.6 (1.3)	0.5 (1.4)
LEFS			
Initial	24.3 (9.9)	26.3 (9.1)	23.3 (10.2)
Discharge	45.9 (9.6)	49.0 (9.3)	44.3 (9.5)
P4			
Initial	20.2 (7.8)	17.7 (9.0)	21.5 (7.5)
Discharge	11.9 (7.4)	10.3 (7.3)	12.7 (7.4)
PSFS			
Initial	0.8 (1.1)	1.1 (1.3)	0.7 (0.9)
Discharge	8.5 (1.5)	8.9 (1.1)	8.3 (1.6)
TST, s			
Initial	50.9 (24.9)	45.0 (20.9)	54.0 (26.4)
Discharge	17.7 (10.5)	14.0 (4.0)	19.7 (12.2)
Extensor ratio			
Initial	0.57 (0.15)	0.56 (0.17)	0.58 (0.14)
Discharge	0.84 (0.14)	0.84 (0.16)	0.84 (0.13)

*Measured in degrees of flexion.

P4 = four-item pain intensity scale; LEFS = Lower Extremity Functional Scale; PSFS = Patient Specific Functional Scale; TST = timed stair test.

measures. Applying these literature-based estimates, we determined frequency counts and calculated the percentage of patients who exceeded the MDC₉₀ for each measure. We then performed *t*-tests for independent sample means to examine potential gender differences in change scores. Our null hypothesis was that there would be no difference in change scores for men and women for any of the assessed outcomes. Finally, in addition to calculating the mean CSQ-8 score, we calculated the percentage of patients who recorded a perfect score of 32.

RESULTS

As Table 1 shows, 169 patients (111 women, 58 men) with a mean age of 68.0 (SD 8.7) years were recruited. Participants attended an average of 11 classes; the median time to begin attending the class was 15 days after surgery. Table 2 summarizes the mean admission and discharge scores for each outcome measure by gender. Table 3 summarizes the change scores and the proportion of patients who exceeded the MDC₉₀ for each outcome measure: More than 77% exceeded MDC₉₀ on the LEFS, PSFS, TST, and AROM measurements. Table 4 reports change scores by gender; with the exception of knee flexion, we did not find any significant differences between men and women in terms of the amount of change recorded over the reassessment

Table 3 Outcome Measure Change Scores

Outcome measure	Change, mean (SD); 95% CI	Participants > MDC ₉₀ , no. (%)
Active flexion, degrees	34.2 (14.5); 32.0–36.5	168 (99.4)
Active extension, degrees*	–13.3 (6.5); –14.3 to –12.3	144 (85.2)
LEFS† (<i>n</i> = 167)	21.5 (10.4); 19.9–23.1	151 (90.4)
P4‡	8.3 (8.3); 7.0–9.5	77 (46.1)
PSFS§	7.6 (1.8); 7.4–7.9	131 (77.5)
TST, s¶	33.2 (19.7); 30.2–36.2	164 (99.4)
Extensor ratio** (<i>n</i> = 153)	0.27 (0.14); 0.24–0.29	N/A

Note: *n* = 169, unless otherwise indicated.

*Measured in degrees of flexion.

† Out of 80; higher = better function.

‡ Out of 40; lower = less pain.

§ Out of 10; higher = better function.

¶ Fewer seconds = better function.

**A small percentage of patients were not tested due to lumbar pathology or hip replacement.

MDC₉₀ = minimal detectable change at the 90% confidence level; LEFS = Lower Extremity Functional Scale; P4 = four-item pain intensity scale; PSFS = Patient Specific Functional Scale; TST = timed stair test; N/A = not available.

Table 4 Change in Outcome by Gender (Men's Value Minus Women's Value)

Outcome measure	Mean (SD) change		Mean difference (95% CI)	<i>p</i> -value
	Men	Women		
Active flexion, degrees	38.2 (14.5)	32.2 (14.2)	6.0 (1.4–10.9)	0.010
Active extension, degrees*	14.4 (6.7)	12.8 (6.3)	–1.6 (–3.7 to 0.4)	0.11
LEFS (<i>n</i> = 167)	22.6 (10.0)	20.8 (10.7)	1.8 (–1.5 to 5.2)	0.29
P4	7.4 (8.0)	8.8 (8.5)	–1.4 (–4.0 to 1.3)	0.30
PSFS	7.8 (1.8)	7.6 (1.7)	0.2 (–0.3 to 0.8)	0.42
TST, s	31.0 (19.9)	34.3 (19.5)	–3.3 (–9.6 to 3.0)	0.30
Extensor ratio† (<i>n</i> = 153)	0.28 (0.17)	0.26 (0.12)	0.02 (–0.02 to 0.07)	0.33

Note: *n* = 169 unless otherwise indicated.

*Measured in degrees of flexion.

† A small percentage of patients were not tested due to lumbar pathology or hip replacement.

LEFS = Lower Extremity Functional Scale; P4 = four-item pain intensity scale; PSFS = Patient Specific Functional Scale; TST = timed stair test.

interval. The mean CSQ-8 score at discharge from the class was 31.28 (SD 1.46); 66.7% of the sample recorded a perfect score.

DISCUSSION

Participants in our study were highly satisfied with a short-duration (4–6 weeks) group-based physiotherapy programme after their knee replacement surgery and demonstrated statistically and clinically relevant changes in knee AROM, lower extremity strength, and lower extremity function. Reductions in pain levels were statistically significant, although the mean change score fell just below the MDC₉₀ threshold; this finding was not unexpected, because a recent systematic review found that between 10% and 34% of patients reported painful joints 3–60 months after TKR.³³ In support of our hypothesis, we found that gender did not predict the amount of change in functional outcomes recorded after participation in the PKRC. As Table 2 shows, women in our sample started with lower functional status scores;

similarly, previous research found that although women started with lower functional status scores, their rate of change was similar to men in the first 4 months after surgery.¹⁴ Although our findings appear to show a significant gender difference in knee flexion (see Table 2), note that we performed seven tests, which inflates the probability of a Type 1 error. To correct for this potential error, we adjusted the critical *p*-value from 0.05 to 0.007, indicating a non-significant difference for each of the tests. This adjustment concurs with prior research modelling ROM recovery after knee replacement, in which gender was not a predictor.²⁶

We did not specifically measure exercise intensity. The group classes were originally developed on the basis of evidence for the importance of early intervention after TKR with progressive strengthening and functional re-training,^{34,35} but recent research has highlighted a need for higher intensity exercise after knee replacement to address physical impairments and functional limitations.^{36–38}

Our centre's group-based treatment model is consistent with the findings of a telephone survey of 24 National Health Service orthopaedic centres in England and Wales, in which group exercises were the preferred format in high-volume centres.⁹ Evidence is mounting that group-based therapy is an efficient and effective method of physiotherapy treatment after TKR. Ko and colleagues¹¹ found that one-to-one therapy did not produce superior outcomes to group- or home-based therapy, and Coulter and colleagues¹⁰ found that patients attending a group physiotherapy programme after hip or knee replacement achieved statistically and clinically important improvements in function. In their cohort study, they observed no clinical or statistical differences in outcomes between supervised home physiotherapy and hospital group rehabilitation.¹⁰ Although we did not evaluate the cost efficiency of the group class in our study, Coulter and colleagues¹⁰ found the group format more cost efficient than a home physiotherapy programme, even though patients attended the group class eight times and the home physiotherapy group received only four home visits. Both of these studies also measured patient satisfaction and found that patients in the group-based physiotherapy programmes reported a high level of satisfaction with their treatment.^{10,11}

Given the current changing health care landscape, it was encouraging to find that although the programme was relatively brief and offered in a group format, patients achieved clinically relevant improvements and were highly satisfied with the PKRC.

LIMITATIONS

Although the results of our study are encouraging, they must be considered in the context of the observational study design. We did not collect data on patients receiving individual therapy before the introduction of the class to allow a comparison with patient outcomes from group-based therapy. In addition, some of the improvements noted may have been due to the natural course of healing after surgery.

CONCLUSION

Patients attending a 4- to 6-week group-based outpatient knee replacement physiotherapy class demonstrated significant changes in pain and lower extremity function. Gender was not a significant predictor of change for the standardized functional outcome measures, with the exception of active knee flexion. Overall, patients were highly satisfied with the group-based intervention.

KEY MESSAGES

What is already known on this topic

As the evidence for physiotherapy interventions after knee replacement continues to grow, evidence is emerging that group therapy is an effective delivery method.

What this study adds

This study adds further evidence in support of using outpatient group therapy after knee replacement surgery. Patients achieved significant functional gains and were highly satisfied with a 4- to 6-week group-based class. The standardized care pathway (see Appendix 1) will provide a template for sites choosing to implement a similar programme.

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