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Chapter 7

The provision of preoperative and postoperative physiotherapy in elderly people with hip and knee osteoarthritis undergoing primary joint replacement surgery

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Abstract

Background and Purpose: The numbers of persons receiving total hip or knee arthroplasty (THA or TKA) are increasing worldwide. Although physiotherapy (PT) is considered to be a cornerstone in the rehabilitation, little is known of actual extent of delivery and its contents before and after surgery. The aim of the study was to describe the usage and characteristics of preoperative and postoperative PT among persons undergoing THA or TKA in the Netherlands as well as their determinants.

Methods: A survey was sent to 1005 persons who underwent THA or TKA in 4 hospitals in the previous year. It comprised questions regarding referral, setting, duration and content of preoperative and/or postoperative PT as well as participants' characteristics including sociodemographic characteristics, comorbidity, physical functioning and quality of life. The analysis consisted of descriptive statistics, a comparison of characteristics of participants who did and did not receive PT (Analysis of Variance, Mann-Whitney U or Chi-Square tests) and examination of the impact of age, sex, hospital, and time since surgery on features of PT (multivariate logistic regression analyses).

Results: The response rate was 52% (282 THA, 240 TKA), with 337 (65%) women, mean age 70.0 years (SD 9.3). Of the participants, 210 (40%) reported receiving preoperative PT and 514 (98%) postoperative PT, with similar proportions in THA and TKA. Female sex was the only participants characteristic related to the use of preoperative PT. Referrals were made by the orthopedic surgeon in 31% and 77% of participants receiving preoperative interventions were aerobic exercises and walking stairs and the most common postoperative interventions included aerobic, muscle strengthening and range of motion exercises, walking stairs, and gait training. Older age was related to fewer referrals by the orthopedic surgeon and a shorter duration of postoperative PT, whereas female sex was associated with a longer duration of postoperative PT. Moreover, the hospital and time since surgery were related to some features of preoperative and/or postoperative PT.

Discussion: In participants who underwent THA or TKA 40% reported the use of preoperative PT and almost all the participants used postoperative PT. There was considerable variation regarding the provided interventions, in particular before surgery. The results of this study suggests the presence of practice variation, in line with the sparse literature. Conclusions must be interpreted with caution since this study concerned a self-generated survey and was retrospectively carried out in a limited number of hospitals in one country. **Conclusions:** Larger, prospective studies including multiple hospitals and countries are needed to determine the extent of practice variation regarding the delivery of preoperative and postoperative PT. Their results, combined with cost-effectiveness studies on clearly defined PT interventions, may contribute to the optimization of care for persons undergoing THA or TKA.

Introduction

Hip and knee osteoarthritis (OA) are among the most prevalent chronic joint diseases, with total joint replacement being a very effective treatment option in the end stages.^{1,2} A considerable number of persons undergo total hip arthroplasty (THA) or total knee arthroplasty (TKA): respectively 1.6 and 1.2 per 1000 people per year in 2009 in Western countries.³ Due to the aging of society, the number of THAs and of TKAs are expected to increase in the coming years.³

Rehabilitation is integral to the care of individuals undergoing THA and TKA, with physiotherapy (PT) playing an important role in achieving functional independence and returning to work and recreational activities.⁴⁻⁵ The current evidence underpinning the effectiveness of PT in THA or TKA mainly regards postoperative PT. Both a systematic review and two subsequent randomized controlled trials (RCTs) substantiate the effectiveness of postoperative PT regarding function, range of motion, and quality of life.⁶⁻⁹ The literature is, however, less conclusive with respect to the effect of preoperative PT on functioning after THA and TKA.^{10,11}

The most frequently reported PT interventions in joint replacement surgery are aerobic, muscle strengthening, and functional exercises.⁶⁻¹¹ Although not explicitly reported in the abovementioned literature, patient education is usually integrated into preoperative and postoperative PT.^{12,13}

The precise content, frequency, duration, and timing of the PT program varies widely in total joint arthroplasty clinical trials.⁶⁻¹¹ A study of hospital PT departments in the United Kingdom concluded that PT was more common following TKA than THA, with group therapy including strengthening and stretching exercises most often being reported.¹⁴ An Australian survey of hospital PT departments demonstrated the consistent provision of PT after TKA, but considerable practice variation with respect to the modes of rehabilitation and criteria for discharge from rehabilitation.¹⁵ Overall, the perspective of persons undergoing joint replacement surgery on PT is rarely considered. In one patient survey, respondents reported that recovery after TKA would require more PT compared with THA.¹⁶ In addition, a focus group study showed that, compared with health professionals, those undergoing THA or TKA had different, but overlapping views regarding rehabilitation practices and outcome.¹⁷

Practice variation and the disparity between the views of patients and health professionals could reflect knowledge gaps regarding the most effective timing, duration, dosage, and contents, as well as insufficient implementation, of evidence-based practices. There are, however, few studies available, so there is a need for more insight into the actual provision of PT in THA and TKA in daily practice. Moreover, to our knowledge no information from the patient perspective is available. Therefore, the purpose of this study was to describe the patient perspective of the usage and characteristics of preoperative and postoperative PT when undergoing THA or TKA. In addition, factors potentially related to its usage and features were examined. The outcomes could guide both the research agenda with respect to perioperative PT as well as priorities for the improvement of the quality of care in THA and TKA.

Methods

Study design

This multicenter study had a retrospective design. It comprised a survey among persons who underwent THA or TKA in 2011 in one of four hospitals in the Netherlands: Leiden University Medical Center in Leiden (Hospital 1), Rijnland Hospital in Leiderdorp (Hospital 2), Groene Hart Hospital in Gouda (Hospital 3), and Reinier de Graaf Hospital in Delft (Hospital 4). Hospital 1 is an academic center, Hospitals 2 and 3 are general hospitals, and Hospital 4 is a large teaching hospital. Hospital 3 offered a group educational and exercise program to persons taking part in a fast-track THA or TKA program. This program provided a preoperative education session, functional exercises during hospital stay, and four sessions of exercises after discharge to groups of four persons undergoing the same procedure. The PT treatment in the other three hospitals was individualized.

Ethics

The study was carried out from July to October 2012, thus a potential minimum of 5 months and a maximum of 22 months after surgery. As this study concerned a survey filled in only once, it was judged to fall outside the remit of the Dutch law (Medical Research Involving Human Subjects Act; MO), and thus an exemption of medical ethical review was given by the Medical Ethical Committee of the Leiden University Medical Center. The study was conducted in accordance with the Handbook for Good Clinical Research Practice of the World Health Organization, and the Declaration of Helsinki principles [http://www.wma.net/en/30publications/10policies/b3/].

Recruitment of participants

Persons were eligible for the study if they underwent primary THA or TKA because of OA between January 1st and December 31st, 2011. Exclusion criteria were revision surgery and diagnoses other than OA (such as rheumatoid arthritis). In earlier surveys among outpatients with chronic musculoskeletal conditions performed by our group, response rates of about 60% were obtained.^{18,19} We anticipated a somewhat lower response rate of about 40% in the group of persons undergoing THA and TKA, as they are not routinely monitored over the longer term. Taking this into account, and aiming to attain a total number of 400 completed questionnaires (200 THA and 200 TKA), we planned to invite 1000 persons. For that purpose, all persons with a diagnosis of primary THA or TKA in

the four hospital registries between January 1st and December 31st, 2011 were first identified. Subsequently, all persons with a diagnosis of hip or knee OA were selected.

In Hospitals 1 and 2, all eligible persons were invited. In Hospitals 3 and 4, selected eligible persons were invited, because the total number of persons undergoing THA or TKA was much larger than in the other two hospitals in the study period. Inviting all eligible persons in these hospitals would lead to a very uneven distribution of the sample sizes in the four hospitals. To ensure an equal distribution over the year in Hospitals 3 and 4, the past year was divided in four guarters. In each guarter an evenly amount of first consecutive persons who underwent surgery was selected.

In all hospitals, the treating orthopedic surgeon sent an invitation letter to all eligible persons, together with an information leaflet. The mailing also contained an informed consent form; the survey; and a pre-stamped, pre-addressed return envelope. Non-participants were asked if they were willing to provide the main reasons. No reminders were sent and we did not gather information on the non-responders.

Survey on PT provision

The survey comprised a set of questions regarding preoperative and postoperative PT (Appendix). The questions on postoperative PT were similar to those on preoperative PT, with separate questions for the post-acute phase directly after discharge from hospital. and for the chronic phase thereafter. The survey was pilot-tested on two persons who underwent THA and TKA, and the only changes were corrections to typographical errors.

Participants' characteristics and comorbidity

Participants' characteristics included:

- length (cm) and weight (kg) to calculate the Body Mass Index (BMI),
- time since surgery,
- hospital where surgery took place.

To assess the presence of comorbidity, a questionnaire from the Dutch Central Bureau of Statistics (CBS) on 19 different comorbidities was used²⁰, as well as the Charnley Classification^{21,22} (Class A: single joint arthroplasty and no significant medical comorbidity; Class B: one other joint in need of an arthroplasty, or an unsuccessful or failing arthroplasty in another joint; Class C: multiple joints in need of arthroplasty, multiple failing arthoplasties and/or significant medical or psychological impairment).

Physical functioning, quality of life, and satisfaction

Measures on current postoperative physical functioning included the Hip disability Osteoarthritis Outcome Score (HOOS) and the Knee injury Osteoarthritis Outcome Score (KOOS).^{23,24} These are self-reported questionnaires comprising the following subscales:

• age (years), • sex,

• 4 memory problems response: 522 (52%) 2 received no physiotherapy 1 reading problems total hip: 282 total knee: 240 preoperative physiotherapy postoperative physiotherapy ves N=210 no N=312 yes N=514 no N=8 hip N=118 knee N=02 hip N=276 knee N=238 Reinier Rijnland Leiden Rijnland Groene Leiden Groene Reinier University Hospital Hart de Graaf University Hospital Hart de Graaf Medical Hospital Hospital Medical Hospital Hospital Center Center N = бо N = 58 N= 33 N = 145 N = 16 N = 76 N= 165 N = 171 hip: 10 hip: 38 hip: 40 hip: 30 hip: 21 hip: 97 hip: 89 hip: 69 knee: 28 knee: 68 knee: 82 knee: 76

knee: 12

total hips and knees in all

4 hospitals N=1518

total surveys sent: 1005

total knee: 701

total knee: 466

total hip: 817

total hip: 539

8 persons filled in the questionnaire but

non responders of total survey (N=475):

6 participating in other research project

give no informed consent

• 304 unknown

• 8 high age

43 not interested

• 7 burdensome

 5 multi comorbidities 5 too many questions

Figure Flowchart of participants and responses

knee: 22

knee: 36

knee: 6

symptoms; stiffness; pain; function, daily living; function, sports and recreational activities; and quality of life. For this survey, the subscale "function, daily living" was used to assess physical functioning: it consists of 17 items in both the HOOS and KOOS.^{23,24} Quality of life was measured with the Short Form (SF) 36 questionnaire.²⁵ The SF36 contains 8 subscales, which can be transformed into a physical and mental component summary scale (PCS and MCS) by means of a norm-based scoring method.²⁵ The score of these summary scales ranges from 0-100, with a higher score indicating better quality of life.

Statistical Analysis

Descriptive statistics were used for the characteristics of the participants and the provided PT. Analysis of Variance (with Post-Hoc Bonferroni tests, if appropriate), the Mann-Whitney U test, or Chi Square test, where appropriate, were used to compare response rates, characteristics of participants, and features of PT; among the four hospitals, participants undergoing THA versus TKA, and participants either receiving or not receiving preoperative or postoperative PT. In addition, we analyzed the impact of four factors, divided into participants characteristics (age and sex), provider characteristics (hospital), and study design (time since surgery) on the provision of PT. Thus, independent variables included age (< 70 versus \geq 70), sex, hospital (1, 2, 3, or 4), and time since surgery (< 15 weeks versus \geq 15 weeks), whereas the dependent features of preoperative PT were mode of referral (orthopedic surgeon versus other), frequency (once versus twice weekly or more), duration (less or more than 12 weeks), and the provision of each of the following four interventions: active exercises (yes/no), passive exercises (yes/no), physical modalities (yes/no), and patient education (yes/no) by means of multivariate logistic regression analyses (method enter).

All data were analyzed using the SPSS statistical package (version 20.0, SPSS, Chicago, Illinois). The level of statistical significance was set at .05 for all analyses.

Results

Response

The flow of participants in this study is presented in the Figure. Fifteen hundred and eighteen persons received THA or TKA for OA in the four participating hospitals. According to the inclusion criteria, 1005 persons were selected, of whom 539 (53.6%) underwent THA and 466 (46.4%) TKA. Of the 1005 persons, 530 (52.7%) returned the survey. Eight persons completed the survey but did not provide informed consent, resulting in 522 (51.9%) persons being included: 282/539 (52.3%) THA and 240/466 (51.5%) TKA. The response proportions in Hospitals 1, 2, 3, and 4 were 64.8%, 61.6%, 52.1%, and 42.3% respectively. Of the 475 non-responders, 81 (17.1%) returned the survey stating the reasons why they did not want to participate: not interested (n = 43, 53.1%), too old (n = 8, 9.9%), finding participation too burdensome (n = 7, 8.6%), or miscellaneous reasons (n = 23, 28.4%).

Participant characteristics

Table 1 shows the characteristics of the 522 participants. The only significant differences between the THA and TKA group were a significantly higher average BMI, a lower proportion of participants in Charnley Class A, a higher proportion of participants in Charnley Class C, and a lower mean physical functioning score in the TKA group compared with the THA group. The only differences in baseline characteristics of the participants in the four hospitals were a significantly lower mean SF36 PCS score in Hospital 2(M = 38.6, SD = 6.3) compared with Hospitals 3(M = 47.9, SD = 8.1) and 4(M = 47.0, SD = 8.0), p < .005, different proportions of male TKA participants (66.7%, 29.3%, 41.6%, and 22.7% in Hospitals 1, 2, 3, and 4 respectively), p = .006, and different proportions of participants who underwent THA and were classified as Charnley C (81.8%, 50.0%, 50.7%, and 40.6% in Hospitals 1, 2, 3, and 4 respectively), p = .007.

In total, 210 participants (40.2%) received preoperative PT and 514 participants (98.5%) postoperative PT, with the proportions being similar in THA and TKA and in all four hospitals. In the acute phase after surgery, 78 (47.6%) of the 172 participants from Hospital 3 reported participation in the fast-track program: 42 (46.7%) participants with THA and 36 (43.9%) participants with TKA. The 210 participants who received preoperative PT did not differ from the participants who did not receive preoperative PT, on any of the sociodemographic and health characteristics, except for sex (proportions female 70.5% and 60.1% respectively: p = .02).

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	All patients	Total Hip	Total Knee	
Variabele	(N=522)	(N=282)	(N=240)	P-value
Sex, female	337 (64.6%)	179 (63.4%)	158 (65.8%)	0.55
Age, years, mean (SD)	70.0 (9.3)	69.9 (9.5)	70.2 (9.0)	0.92
Body Mass Index, mean (SD)	27.8 (4.7)	26.7 (4.1)	29.2 (5.1)	<0.001*
Time since surgery, months (SD)	15.0 (3.5)	14.9 (3.5)	15.2 (3.5)	0.36
Hospital				
1. Leiden University Medical Center	35 (7.0%)	22 (7.8%)	13 (5.4%)	0.28
2. Rijnland hospital	172 (33.0%)	90 (31.9%)	82 (34.2%)	0.59
3. Groene Hart hospital	148 (28.4%)	71 (25.2%)	77 (32.1%)	0.08
4. Reinier de Graaf hospital	167 (32.0%)	99 (35.1%)	68 (28.3%)	0.10
$HOOS^{\dagger}$ or $KOOS^{\dagger}$ physical functioning; mean (SD)	78.9 (20.8)	81.4 (18.8)	76.1 (22.7)	0.01*
SF36 mental component summary scale; mean (SD)	47.7 (7.7)	48.0 (7.6)	47.5 (7.8)	0.61
SF36 physical component summary scale; mean (SD)	45.4 (8.6)	45.6 (8.9)	45.2 (8.2)	0.54
Charnley Classification (N=505)				
Class A	125 (24.7%)	81(29.9%)	44 (18.6%)	0.004*
Class B	102 (20.2%)	56 (20.7%)	46 (19.7%)	0.78
Class C	278 (55.0%)	134 (49.4%)	144 (б1.5%)	о.ооб*
Coexisting disorders (N=521)				
None	29 (5.6%)	20 (7.1%)	9 (3.8%)	0.10
One coexisting disorder	136 (26.1%)	78 (27.8%)	58 (24.2%)	0.35
Two or more coexisting disorders	356 (68.3%)	183 (65.1%)	173 (72.1%)	0.09
Preoperative physiotherapy	210 (40.2%)	118 (41.8%)	92 (38.3%)	0.42
Postoperative physiotherapy	514 (98.5%)	277 (98.2%)	237 (99.8%)	0.63

 Table 1 Characteristics# of 522 participants with hip and knee osteoarthritis undergoing joint replacement surgery in 2011

All variables expressed as numbers (%), unless stated otherwise

 \star Statistically significant difference (P < 0.05; Chi-square test or an Mann-Whitney U test, where appropriate)

 $^{\rm t}{\rm Hip}$ disability / Knee injury Osteoarthritis Outcome Score (HOOS/KOOS)

Table 2. Self-reported characteristics of preoperative physiotherapy in 210 participants with hip and knee osteoarthritis undergoing joint replacement surgery: referral, setting, duration and mode of delivery

Variable % (95% Confidence Interval)	Hip (N=118)	Knee (N=92)	p-value
Referral			
Orthopedic surgeon	23.7% (16.6-32.6)	40.2% (30.3-51.0)	0.006*
General practitioner	36.4% (27.9-45.9)	25.0% (16.8-35.3)	0.10
Direct access to physiotherapy without referral	26.3% (18.8-35.3)	22.8% (15.0-33.0)	0.65
Setting			
Primary care only	89.8% (82.6-94.4)	90.2% (81.8-95.2)	0.93
Primary and secondary care	10.2% (5.б-17.4)	9.8% (4.9-18.2)	o.86
Average frequency			
Once per week	65.5% (55.0-72.9)	57.6% (46.9-67.7)	0.24
Twice per week	32.7% (24.1-41.5)	41.3% (31.3-52.1)	0.20
3 times per week or more	1.7% (0.0-6.6)	1.1% (0.1-6.8)	0.70
Duration			
2-4 weeks	14.4% (8.2-21.4)	17.2% (9.7-25.8)	0.59
5-8 weeks	20.7% (13.0-28.0)	21.8% (13.2-30.6)	0.85
9-12 weeks	19.8% (12.3-27.1)	17.2% (9.7-25.8)	0.64
More than 12 weeks	45.0% (33.4-51.8)	43.7% (31.3-52.1)	0.85
Time between last physiotherapy session and surgery			
less than one week	23.0% (15.1-30.8)	36.4% (25.4-44.9)	0.04*
1-2 weeks	34.5% (24.8-42.4)	28.4% (18.7-37.6)	0.36
3-5 weeks	14.2% (8.2-21.4)	13.6% (7.2-22.1)	0.92
6 weeks or more	28.3% (19.5-36.2)	21.6% (13.2-30.6)	0.28
Mode of delivery			
Individual	77.1% (68.3-84.1)	81.5% (71.8-88.6)	0.44
Group therapy	16.1% (10.2-24.3)	15.2% (8.9-24.6)	0.76
Aquatic therapy	1.7% (0.3-6.6)	4.3% (1.4-11.4)	0.24

* Differences between persons undergoing Total Hip Arthroplasty and Total Knee Arthroplasty were calculated by means of a Mann-Whitney U test or Chi-square test where appropriate. The alpha level of statistical significance was set at 0.05

Table 3. Content of self-reported preoperative physiotherapy in 210 participants with hip and knee osteoarthritis undergoing joint	
replacement surgery	

Variable % (95% Confidence Interval)	Hip (N=118)	Knee (N=92)	P-value
Exercises (more than one possible answer)			
Any form of active exercises	86.4% (78.6-91.8)	97.8% (91.6-99.6)	0.003*
Muscle strengthening exercises	32.2% (24.1-41.5)	55.4% (44.7-65.7)	0.001*
Active Range of Motion exercises	39.0% (30.3-48.4)	32.6% (23.4-43.3)	0.34
Aerobic exercises (including cycling indoors on a home trainer)	61.0% (51.6-69.7)	70.7% (бо.1-79.5)	0.15
Gait training (including instructions how to use walking aids)	46.6% (36.6-55.2)	53.3% (42.6-63.6)	0.28
Balance exercises	15.3% (9.5-23.3)	15.2% (8.9-24.6)	0.99
Any form of functional exercises	80.5% (72.0-87.0)	80.4% (70.6-87.7)	0.99
Walking stairs	б2.7% (53.3-71.3)	б4.1% (53.4-73.7)	0.83
Rising and sitting down	53.4% (44.0-62.6)	57.6% (46.9-67.7)	0.54
Walking exercises	37.3% (28.7-46.7)	40.2% (30.3-51.0)	0.67
Cycling outside	13.6% (8.2-21.4)	17.4% (10.6-27.0)	0.44
Other individualized physical activities	20.3% (13.7-29.0)	9.8% (4.9-18.2)	0.04*
Passive Range of Motion (by manual exercises or machines)	36.4% (27.9-45.9)	51.1% (40.5-61.6)	0.03*
Physical modalities			
Any form of physical modalities	29.7% (21.8-38.9)	30.4% (21.5-41.0)	0.9
Massage	25.4% (18.1-34.4)	19.6% (12.3-29.4)	0.32
Heat therapy	3.4% (1.1-9.0)	9.8% (4.9-18.2)	0.06
Ice packs	0	9.8% (4.9-18.2)	0.001*
Other physical modalities	3.4% (1.1-9.0)	4.3% (1.4-11.4)	0.72
Patient education related to surgery and rehabilitation			
(more than one possible answer)			
Any form of patient education	77.1% (68.3-84.1)	84.8% (75.4-91.1)	0.16
Joint replacement surgical procedure	39.8% (31.1-49.3)	53.3% (42.6-63.6)	0.05
Exercises after surgery	49.2% (39.9-58.5)	56.3% (45.8-66.7)	0.29
Allowed daily activities after surgery	48.3% (39.1-57.7)	52.2% (41.6-62.6)	0.58
Loading restriction after surgery	49.2% (39.9-58.5)	52.2% (41.6-62.6)	0.66
Possible necessary adaptations to be prepared at home(after surgery)	44.9% (35.8-54.3)	29.3% (20.6-39.9)	0.02*
Possible necessary personal or domestic help (after surgery)	27.1% (19.5-36.2)	31.5% (22.5-42.2)	0.49
Possible necessary walking aids (after surgery)	57.6% (48.2-66.6)	59.8% (49.0-69.7)	0.75

* Differences between participants undergoing Total Hip Arthroplasty and Total Knee Arthroplasty were calculated by means of a Mann-Whitney U test or Chi-square test where appropriate. The alpha level of statistical significance was set at 0.05.

 Table 4. Self-reported characteristics of postoperative physiotherapy in 487 participants# with hip and knee osteoarthritis undergoing joint replacement surgery: referral, setting, duration and mode of delivery

Variable (%; 95% Confidence Interval)	Нір (N=2бо)	Knee (N=227)	p-value
Referral	(N=249)	(N=222)	
Orthopedic surgeon	74.3% (68.3-79.5)	83.0% (77.6-87.9)	0.007*
General practitioner	6.0% (3.5-9.9)	1.8% (0.6-4.9)	0.02
Direct access to physiotherapy without referral	19.7% (15.0-25.3)	14.8% (10.6-20.4)	0.20
Setting			
Primary care only	92.7% (88.6-95.4)	96.9% (93.5-98.6)	0.04*
Primary and secondary care	7.3% (4.6-11.4)	3.1% (1.4-6.5)	0.07
Average frequency	(N=254)	(N=225)	
Once per week	40.6%; 34.5-46.9)	25.3% (19.9-31.6)	<0.001*
Twice per week	58.3% (51.9-64.4)	68.0% (61.4-74.0)	0.03*
3 times per week or more	1.2% (0.3-3.7)	б.7% (3.9-11.0)	0.002*
Duration	(N=249)	(N=214)	
2-4 weeks	10.4% (7.1-15.1)	7.5% (4.5-12.1)	0.27
5-8 weeks	22.9% (17.9-28.7)	21.5% (16.3-27.7)	0.72
9-12 weeks	23.3% (18.3-29.1)	20.6% (15.5-26.7)	0.48
More than 12 weeks	43.4% (37.2-49.8)	50.5% (43.6-57.3)	0.13
Mode of delivery	(N=231)	(N=217)	
Individual	89.2% (84.3-92.7)	83.9% (78.1-88.4)	0.80
Group therapy	10.4% (б.9-15.2)	14.3% (10.1-19.8)	0.12
Aquatic therapy	0.4% (0.0-2.8)	1.8% (0.6-5.0)	0.13

Excluding 27 participants

(17 THA and 10 TKA) who used postoperative PT in secondary care (hospital, rehabilitation center or nursing home)
* Differences between participants undergoing THA and TKA were calculated by means of a Mann-Whitney U test or Chi-square test where appropriate. The alpha level of statistical significance was set at 0.05.

 Table 5. Content of self-reported postoperative physiotherapy in 487 participants# with hip and knee osteoarthritis undergoing joint

 replacement surgery

Variable % (95% Confidence Interval)	Hip (N=260)	Knee (N=227)	P-value
Exercises (more than one possible answer)			
Any form of active exercises	95.0% (91.4-97.2)	93.8% (89.7-96.5)	0.57
Muscle strengthening exercises	57.3% (51.0-63.4)	65.2% (58.6-71.3)	0.08
Active Range of Motion exercises	70.7% (63.6-75.1)	70.2% (б3.1-75.4)	0.99
Aerobic exercises (included cycling indoors on a home trainer)	73.1% (67.2-78.3)	75.8% (69.6-81.1)	0.16
Gait training (including instructions how to use walking aids)	82.3% (77.0-86.6)	78.4% (72.4-83.5)	0.28
Balance exercises	54.2% (48.0-бо.4)	53.7% (47.0-60.3)	0.91
Any form of functional exercises	89.2% (84.7-92.6)	84.1% (78.6-88.5)	0.59
Walking stairs	62.3% (56.1-68.2)	62.1% (55.4-68.4)	0.97
Rising and sitting down	61.9% (55.7-67.8)	57.3% (50.6-63.7)	0.30
Walking exercises	56.5% (50.3-62.6)	50.2% (53.6-56.9)	0.16
Cycling outside	16.9% (12.7-22.2)	18.1% (13.4-23.8)	0.74
Other individualized physical activities	17.7% (13.4-23.0)	15.9% (11.5-21.4)	0.26
Passive Range of Motion (by manual exercises and machines)	36.9% (31.1-43.1)	59.9% (53.2-66.3)	<0.001*
Physical modalities			
Any form of physical modalities	31.5% (26.0-37.6)	42.3% (35.8-49.0)	0.014*
Massage	28.1% (22.8-34.0)	34.4% (28.3-41.0)	0.18
Heat therapy	0.8% (0.1-3.1)	1.8% (0.6-4.8)	0.32
Ice packs	0	б.7% (3.9-10.9)	<0.001*
Other physical modalities	5.8% (3.4-9.5)	9.3% (б.о-14.0)	0.14
Patient education related to surgery and rehabilitation			
(more than one possible answer)			
Any form of patient education	81.2% (75.8-85.6)	77.1% (71.0-82.3)	0.40
Allowed daily activities after surgery	63.8% (57.7-69.6)	51.1% (44.4-57.8)	0.004*
Loading restriction after surgery	66.9% (60.8-72.5)	65.6% (59.0-71.7)	0.77
Possible necessary adaptations to be prepared at home	17.3% (12.7-22.2)	14.5% (10.4-20.0)	0.47
Possible necessary personal or domestic help	15.0% (11.0-20.1)	11.9% (8.1-17.0)	0.32
Possible necessary walking aids	36.9% (31.1-43.1)	35.2% (29.1-41.9)	0.70

Excluding 27 participants

(17 THA and 10 TKA) who used postoperative PT in secondary care (hospital, rehabilitation center or nursing home)

* Differences between participants undergoing THA and TKA were calculated by means of a Mann-Whitney U test or Chi-square test where appropriate. The alpha level of statistical significance was set at 0.05.

Preoperative PT

Characteristics of preoperative PT: referral, setting, frequency, duration, and mode of delivery

Table 2 shows the characteristics of provided PT as reported by 210 participants. A significantly larger proportion of participants was referred by the orthopedic surgeon in the TKA group compared with the THA group. Overall, about a quarter of the referrals were self-referrals in both the THA and TKA groups. Preoperative PT was provided in primary care and on an individual basis in the large majority of participants, with two thirds of the participants reporting an average frequency of once per week, and slightly more than half of them registering a duration of less than 12 weeks in both the THA and the TKA groups. In more than half of the participants, preoperative PT was continued until surgery (significantly higher proportion in TKA than in THA) or until two weeks before surgery.

Content of preoperative PT

Table 3 shows the reported content of preoperative PT. The large majority of participants received some form of active exercise. The proportion of participants who reported receiving active exercises was, however, significantly higher in the TKA (97.8%) than in the THA group (86.4%) (p = .003).

With respect to the type of exercise, aerobic exercises and walking stairs were each reported by the largest proportions of participants (> 60%), whereas gait training and rising and sitting down were reported by 49% or more of the participants in the THA and the TKA groups. All other exercises were each reported by 42% or less of the participants. There were no significant differences in the rates of provision of the different active treatment forms between the THA and the TKA groups, except for a significantly higher proportion of participants who reported muscle strengthening exercises in the TKA (55.4%) than in the THA group (32.2%). Passive Range of Motion (ROM) exercises (42.9%) and massage (22.9%) were the most frequently employed passive interventions, with passive ROM exercises being significantly more often reported by participants undergoing TKA (51.1%) than undergoing THA (36.4%).

With respect to the provision of education on topics related to the planned surgery, the possible need for walking aids after surgery was the most frequently addressed topic (58.6%). In addition, post-surgical exercises, allowed daily activities, and loading restrictions were reported by about half of the participants. Significantly more participants in the THA group (44.9%) than in the TKA group (29.3%) reported the receipt of information on the possible need for home adaptations after surgery. Otherwise there were no other differences between THA and TKA groups.

Characteristics of participants and hospitals related to features of preoperative PT In the multivariate analyses there were only two factors associated with any of the features of preoperative PT: the hospital was related to the proportion of referrals made by the orthopedic surgeon (proportion of participants referred to Hospital 1: 60.0%, Hospital 2: 31.0%, Hospital 3: 34.7%, and Hospital 4: 22.2%, with p=0.05), and to longer time between surgery and the provision of physical modalities (7-14 months: 50.5%, 15-22 months 35.6%, with p=0.03).

Postoperative PT

$Characteristics \ of \ postoperative \ PT: \ referral, \ setting, \ frequency, \ duration, \ and \ mode \ of \ delivery$

Table 4 shows the characteristics of postoperative PT, which was used by 514 of 522 (98.5%) participants. In the post-acute phase, 265 of these 514 participants used PT only in a primary care private practice or at home (51.6%), whereas 249 participants (48.4%) first (n = 222) or only (n = 27) had postoperative PT in a secondary care setting (i.e. hospital, rehabilitation center, home for the elderly, nursing home, or care hotel). Thus, in total, 487 (94.7%) used postoperative PT in a primary care practice and/or at home.

The 249 participants who used postoperative PT in secondary care in the post-acute phase, with or without primary care PT thereafter, were significantly older: 71.3 years, SD 9.0 versus 68.7, SD 9.3, p = .01, and had a lower HOOS / KOOS physical functioning mean score: 76.4, SD 22.4 versus 81.2, SD 19.0, p = .02 than the participants only using PT in primary care in the post-acute phase.

Referrals to postoperative PT were made by the orthopedic surgeon in three quarters of the participants (significantly more often in TKA than in THA). The duration was more than 12 weeks in about half of the participants, with most participants reporting an average frequency of twice per week. The proportions of participants reporting an average frequency of twice per week or three times per week or more were significantly higher in the TKA group (74.7%) than in the THA group (59.5%).

Content of postoperative PT

Table 5 shows that postoperative PT was mainly provided on an individual basis. Muscle strengthening, aerobic, balance control, and active ROM exercises; gait training; walking stairs; rising and sitting down; and walking were reported by 50% or more of the participants in both the THA and TKA groups. Passive ROM exercises were reported by about half of the participants, yet significantly more frequently in the TKA (59.9%) than in the THA group (36.9%). Massage was the most frequently reported physical modality (31.0%). Regarding the provision of education, the surgery-related topics that were most frequently reported included allowed daily activities (57.9%), which had a significantly higher proportion in THA (63.8%) than in TKA (51.1%), and information on loading restrictions (66.3%). Regarding the characteristics of primary care postoperative PT, the only significant difference between the group of participants who had PT in primary care only (n = 265) and those who had also used PT in secondary care in the post-acute phase as well (n = 222) was that the latter group showed relatively more participants who reported an average frequency of once per week (38.1%) and a duration of less than 9 weeks (37.5%) compared with treatment in primary care alone: 29.5%, p = .05 and 26.2%, p = .008 respectively (results not shown).

Characteristics of participants and hospital related to features of postoperative PT In the multivariate analyses, older participants were found to be less frequently referred (73.1%) than younger participants (81.9%) to postoperative PT by orthopedic surgeons, (p=0.02), and older participants less often (41.6%), and women more often (51.0%), received treatment for more than 12 weeks, compared with younger participants (51.5%) and men (39.5%), (p= 0.03 and p=0.02, respectively). The hospital was related to the duration (more than 12 weeks); Hospital 1: 76.7%, Hospital 2: 52.3%, Hospital 3: 41.6%, and Hospital 4: 39.2%, with p=0.001, frequency of treatment(twice per week); Hospital 1: 71.9%, Hospital 2: 57.5%, Hospital 3: 71.9%, and Hospital 4: 56.0%, with p=0.01, and the provision of passive exercise; Hospital 1: 62.5%, Hospital 2: 52.3%, Hospital 3: 61.3%, and Hospital 4: 52.3%, with p=0.02. Time since surgery was not related to any features of postoperative PT.

Discussion

A survey among 1005 persons undergoing THA and TKA showed that respectively 41.8% and 38.3% received preoperative PT and 98.2% and 99.8% postoperative PT. Regarding the proportions of participants who had preoperative PT, we have no other studies for comparison, as all previous research on PT usage in THA and TKA concerned postoperative PT. Although the evidence for the effectiveness of preoperative PT in THA and TKA is scant.¹⁰ it is conceivable that it is, nevertheless, used in daily practice. This could be based on the observation that in conditions other than OA, a faster recover after surgery was achieved in high risk persons with PT .²⁶ However, in our study the participants who received preoperative PT did not appear to be a selection of high-risk persons. Their characteristics did not, apart from sex, differ from those who did not receive preoperative PT. The considerable rate of usage of preoperative PT should, however, be interpreted with some caution. Its duration was more than 12 weeks in over 44% of the participants who used it, self-referrals or referrals by the General Practitioner (GP) were more common than referrals by the orthopedic surgeon, and the waiting list for THA and TKA in the Netherlands was relatively short (4 to 6 weeks) at the time the study was conducted. Therefore it is possible that, in some participants, preoperative PT was rather a continuation of the non-surgical management of hip or knee OA than a specific program aimed at improving postoperative outcomes. Regarding the characteristics of preoperative PT, our data can only be compared with the characteristics of preoperative PT programs as described in clinical trials, such as those included in the systematic review by Hoogeboom et al.¹⁰ In that review, the number of sessions ranged between 2.5 and 3 times a week, with a duration of 4 to 8 weeks, while the results of our study suggest a lower frequency (once a week in 66% (THA) and 58% (TKA)) and longer duration (more than 9 weeks in 65% (THA) and 61% (TKA)) in many participants in daily practice. The programs in the RCTs included in that review contained resistance, aerobic, and functional exercises,¹⁰ similar to the reported contents of PT in our study. However, in our study, an active ROM and balance exercises, gait training, and various types of functional exercises were also reported by many participants.

In line with the literature, postoperative PT was reported by almost all participants, suggesting that physician referrals and self-referrals in the post-acute phase are consistently and routinely done. In our study, almost all participants received postoperative PT on an individual basis in primary care, while previous studies only reported on PT in the hospital setting.^{14,15} Artz et al¹⁴ found that 11 of 23 orthopedic centers in the UK referred persons to an exercise group. In the Netherlands, postoperative group exercise programs are not commonly available primary care and secondary care. The mean frequency of postoperative PT reported by Naylor et al¹⁵ was twice a week, whereas, in our study, 63% received PT twice a week, but the other participants had a lower frequency of postoperative PT. The duration of treatment cannot be directly compared between the studies.

Concerning the types of interventions, our findings are largely in line with those of previous studies, concluding that strengthening, stretching, gait training, and task oriented exercises were those most often provided after THA and TKA¹⁴ and that the rates of provision of active and functional exercises after TKA were 83% and 57% respectively.¹⁵ The rates cannot be directly compared, however, as the previous studies were based on physical therapists' estimations, whereas we used the reports of individual participants.

Taking into account the reported features of PT, overall the variation in exercises appeared to be larger with preoperative than with postoperative PT. This is based on the observation that there were fewer exercise modalities that were reported by 60% or more of the participants with preoperative PT than with postoperative PT. The larger practice variation could be related to the absence of evidence on its effectiveness. The variation could also be related to the fact that preoperative PT was for some patients probably not based on a specific program to prepare for the operation. Moreover, the relatively high reported proportions (> 40%) of passive ROM exercises and massage (> 22%) before and after surgery in our study are noteworthy. Although the passive

treatment modalities were combined with active exercises in all participants, the provision of these interventions seems in contrast to the literature, where an active approach is often recommended.⁶⁻⁹ Finally, in our study, patient education on one or more topics related to surgery was provided as part of PT to about 80% of participants both before and after surgery. This is partly comparable to reported preoperative education rates in a review by Wallis et al¹³, but difficult to compare with the provision of postoperative education rates reported by Westby et al,¹⁷ since detailed information is missing.

We examined the provision of PT for THA and TKA separately. This led to a number of interesting observations, such as differences in the individuals' characteristics as well as the features of their treatment, despite overall similar usage rates. The observation that in TKA the duration of postoperative PT was longer than in THA is in line with the results of De Beer et al ¹⁶. suggesting that rehabilitation after TKA is different from THA.

Age, sex, hospital, and time since surgery were significantly related to some of the reported features of preoperative and postoperative PT. Older age seemed to be related to fewer referrals by the orthopedic surgeon and a shorter duration of postoperative PT. whereas female sex was associated with a longer duration of postoperative PT. Moreover, the hospital had an impact on some features of preoperative or postoperative PT. The observation that the time since surgery, a consequence of the retrospective study design, was also related to some outcomes, underpins the need for a prospective study.

A strength of our study is that, in contrast to the approach used in previous research, we used the patient perspective. By only using data from health care providers, in particular orthopedic departments, information on persons who refer themselves to PT or are referred by GPs is lost. We demonstrated in our study that the numbers of selfreferrals and referrals made by GPs are considerable. Moreover, this approach was helpful to gather information on variation in actually provided treatment modalities as part of PT among individual persons, which was indeed considerable.

This study has a number of limitations. First, it concerned a self-generated survey, which was not validated by reviewing individual medical records or data from health care insurers. Therefore, the provision of socially desired answers, incorrect interpretation of the questions, and recall bias cannot be totally ruled out. Indeed, time since surgery was found to have an impact on the reporting of the use of some features of PT. Another limitation of the study is that it was done in only four hospitals in one country and that the response rate was 52%, so that the results may not be generalizable to all patients undergoing THA or TKA. Nevertheless, the sociodemographic and clinical characteristics of the participants were quite similar to those of persons who underwent THA or TKA in other observational studies,¹⁴⁻¹⁶ so selection bias may be limited. Finally, the retrospective nature of the study as well as the lack of detail regarding the actual dosage of PT interventions do not allow an adequate analysis of the impact of the use of preoperative and postoperative PT, as well as its features, on the outcomes of THA or TKA. All these limitations underline the need to conduct studies with a prospective design, including multiple hospitals in, preferably, multiple countries. Studies should include subjects as long before the operation as possible and register the preoperative health status, as well as describe preoperative and postoperative PT usage and other health care usage. The use of more objective sources of information, such as medical records on health care usage is strongly advocated. However, it should be noted that physicians may not routinely record referrals to PT, and persons can also refer themselves. Moreover, for PTs, the standardized registration of a fixed set of features of individual treatments is still uncommon.

Conclusions

In this retrospective study of older persons who underwent THA or TKA, almost all persons received postoperative PT and 40% received preoperative PT. Preoperatively, there was considerable variation in PT treatment interventions. The reported features of PT were associated with age, sex, the hospital, and time since surgery. The results should be interpreted cautiously due to the limited response, the retrospective nature of the study, and the fact that it was carried out in a specific area in one country. Despite these limitations, the observed practice variation observed in this relatively small study warrants future, prospective research. In addition to cost-effectiveness studies on clearly defined PT interventions, such research may contribute to the optimization of care for persons undergoing THA or TKA.

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Appendix.

Survey on preoperative and postoperative physiotherapy in persons with osteoarthritis undergoing total hip and total knee surgery Characteristics of preoperative and postoperative physiotherapy

 Before surgery: Did you receive physiotherapy in the three months before surgery?

 Yes
 No

 After surgery: Did you receive physiotherapy after surgery?

2. If so, who referred you?:

🗆 Yes 🛛 No

- □ orthopedic surgeon,
- general practitioner
- direct access

3. Where did the PT took place?:

- primary care, i.e. private practice or at your home
 hospital
 rehabilitation center
 home for the elderly
 nursing home
- □ care hotel

4. What was the average frequency of physiotherapy?

- once a week
- \Box twice a week
- \Box three times per week or more

5. What was the duration of physiotherapy?

- 🗆 2-4 weeks
- 🗆 5-8 weeks
- 🗆 9-12 weeks
- more than 12 weeks

6. What was the time between the last physiotherapy session

and surgery?

- \Box less than one week
- □ 1-2 weeks
- □ 3-5 weeks
- \square more than 6 weeks

- 1 2 3 4 5 6 7 8 9
- 8. Which of the following physiotherapy modalities were provided (more than one possible answer)?
 Muscle strengthening exercises
 Active exercises to move the joints
 Aerobic exercises (including cycling indoors on a home trainer)

7. What was the delivery mode of physiotherapy?

□ Gait training

□ individual

 \Box aquatic therapy

□ group

- (quality of walking and instructions how to use walking aids)
- exercises
- Walking stairs
- $\hfill\square$ Rising and sitting down
- □ Walking exercises (speed, distance)
- □ Cycling outside
- \Box Other individualized physical activities
- □ Moving of the leg by the physiotherapist
- 🗆 Massage
- Heat therapy
- Ice packs
- □ Other physical modalities
- Which of the following aspects of patient education related to surgery and rehabilitation were provided
- (more than one possible answer)?
- Joint replacement surgical procedure
 (only asked before surgery)
- □ Exercises after surgery (only asked before surgery)
- □ Allowed daily activities after surgery
- □ Loading restriction after surgery
- □ Possible necessary adaptations to be prepared at home
- Possible necessary personal or domestic help
- \Box Possible necessary walking aids