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Prognostics of outcome of total knee replacement: on patient selection and intraoperative issues

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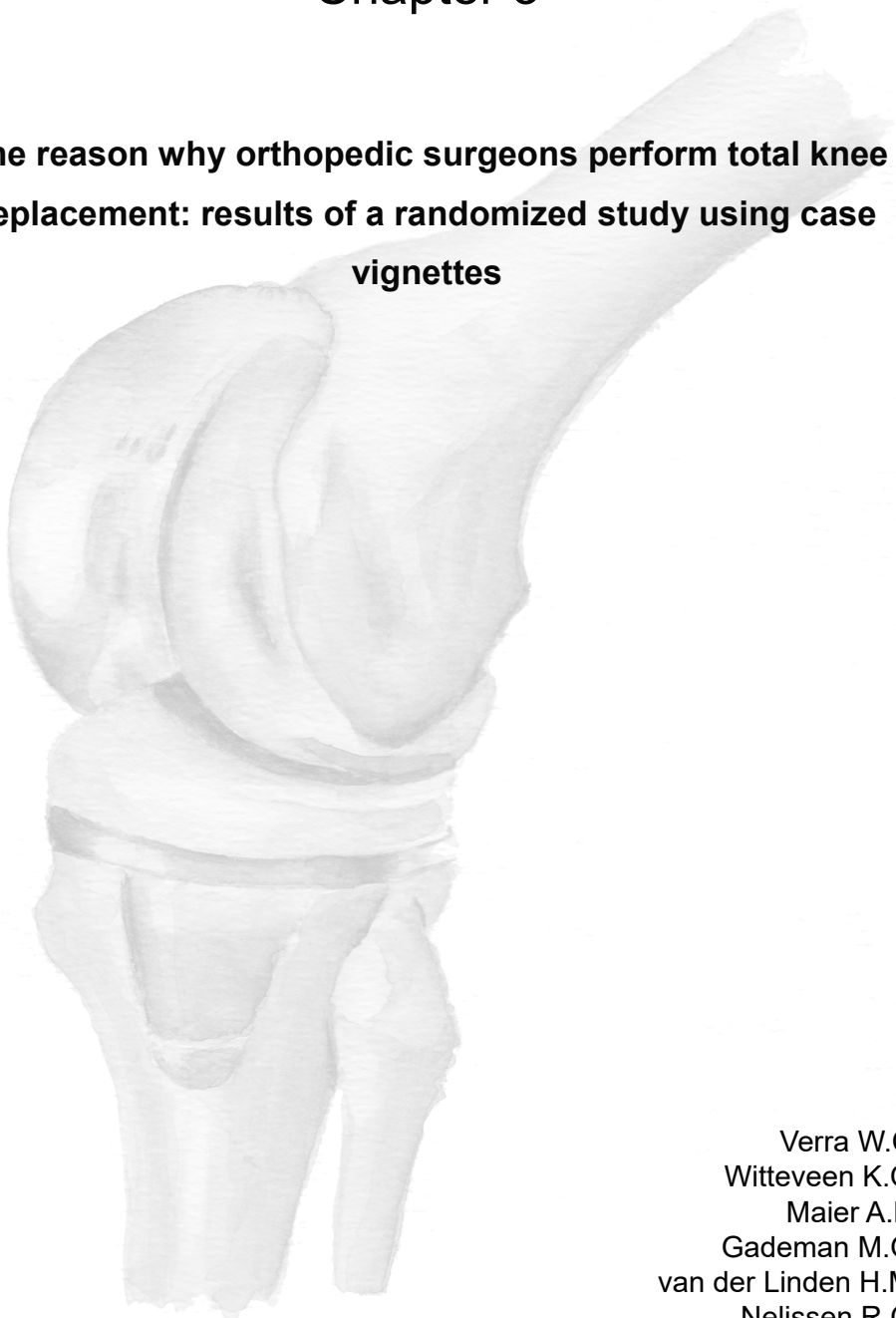
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Chapter 3

The reason why orthopedic surgeons perform total knee replacement: results of a randomized study using case vignettes



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Abstract

Introduction. End-stage knee osteoarthritis (OA) results in total knee replacement (TKR) surgery. The decision to perform TKR is not well defined resulting in variation of indications among orthopedic surgeons. Non-operative treatment measures are often not extensively used. Aim of this study is to investigate factors influencing the decision to perform TKR by Dutch orthopedic surgeons.

Methods. Three case vignettes, each case divided into two versions, being identical except for information on age (younger and older age), pain (mild and severe pain) or radiological OA (low and high grade) were developed. A questionnaire including these three case vignettes was sent to all 599 Dutch orthopedic surgeons, who were randomized to either one of the two versions. The orthopedic surgeons were asked if TKR would be the next step in treatment. Furthermore from a list of patient factors they were asked how strong these factors would influence the decision to perform TKR.

Results. 54% of the orthopedic surgeons completed the questionnaire (N=326). Orthopedic surgeons indicated to perform TKR significantly more often at higher age (73.3% vs. 45.5%, $p<0.001$). In presence of mild pain orthopedic surgeons were slightly more reluctant to perform a TKR compared to severe pain (57.0% vs. 64.0%, n.s.). Mild radiological OA made surgeons more reluctant to perform TKR compared to severe OA (9.7% vs. 96.9%, $p<0.001$).

Conclusions. Old age and severe radiological OA are variables which are considered to be important in the decision to perform a TKR. Pain symptoms of moderate or severe pain are unequivocal when considering a TKR.

Introduction

Knee osteoarthritis (OA) is a major cause of disability and functional limitations which affects millions of people in our aging population worldwide.^{1,2} A total knee replacement (TKR) is generally accepted to be an effective surgical treatment for end-stage knee OA.³⁻⁵ No succinct criteria on the decision making (i.e. patient selection) on TKR are available, other than “enough pain”.⁴ The latter not only results in variation among orthopedic surgeons in their decision to perform a TKR, but also in a potentially large percentage of patients not receiving adequate conservative (i.e. non-operative) treatment for knee OA.⁶⁻⁹ On the other hand, not all patients improve after TKR; a study from the Swedish arthroplasty register shows that 17-25% of the patients after primary TKR were not satisfied or were uncertain about the functionality of their TKR.¹⁰ Since patient expectations on their TKR surgery are not entirely met, well-timed surgery and preoperative counseling seem to be important variables to be addressed, even more considering the high prevalence of TKR surgery, with about 22.000 cases in 2012 in a small country such as the Netherlands and 719.000 cases in the United States in 2010.^{11,12} Pain and the degree of radiographic OA are considered important variables in the decision process to perform TKR surgery.^{4,7,13,14} Preoperative pain is a strong predictor of postoperative outcome; patients with severe preoperative pain complaints had worse postoperative outcomes compared to those with less severe pain complaints.^{15,16} On the contrary, patients with mild radiological OA showed little improvement of clinical symptoms compared to patients with severe radiological OA.¹⁷ Most orthopedic surgeons consider a TKR in case of moderate to severe radiological OA but there is a well-known weak association between pain symptoms/functional impairment and radiological OA.^{14,18} As for total hip replacement (THR), ranking determinants for their importance in the decision to perform surgery showed that radiological changes were of less importance than functional impairment, decreased range of motion and pain. Pain at rest, at night and/or pain during activities.¹⁹

This emphasizes the need to explore the variables being involved in the decision making process to perform TKR. The aim of this study was to evaluate how these factors influence the opinion of Dutch orthopedic surgeons in the decision to

recommend TKR surgery in a given patient. We have used case vignettes to mimic clinical practice; this has never been done before. We hypothesized that Dutch orthopedic surgeons would recommend TKR to patients with high grade radiological OA, high levels of pain and older age.

Materials and Methods

In April 2012 all 599 actively practicing orthopedic surgeons in the Netherlands who were member of the Dutch Orthopedic Association (NOV) were contacted by e-mail from the NOV to participate in the study. After two and four weeks a reminder was sent by e-mail to those who did not respond. All orthopedic surgeons were randomized into two groups, both groups filled out a different version of a case vignette (version A or B, see Appendix). Randomization lists were generated randomly by a computer.

Questionnaire

The web-based survey used in this study was partially based on questionnaires previously used in surveys among orthopedic surgeons studying different outcomes.^{14,19,20} In addition, one part of the questionnaire was adapted from a study on geriatric oncology patients.²¹ This study used case vignettes with different versions to explore the influence of older age on oncologists' cancer management.²¹ The TKR indication questionnaire was designed and critically appraised by two experienced knee specialists (RN and EL). Before the final versions were distributed to the Dutch orthopedic surgeons a pilot-test was performed among a test-panel of twelve orthopedic surgeons and residents for final feedback. The software used to distribute the questionnaire was NetQ (NetQuestionnaires BV, Amsterdam, the Netherlands).

The questionnaire was divided into three parts: part one consisted of general information of the respondent (gender, employment location (university medical center, general hospital (private group or fixed salary) or specialized private clinic), number of TKR performed each year (<50, 50-100 or >100) and years of experience).

Part two consisted of either version A or B of three case vignettes (Appendix A). The

case vignettes of the version A and B were entirely identical except for information on: 1. age (old versus young age), 2. severity of pain (mild versus severe) and 3. radiological OA (mild versus severe radiological destruction). Case 1 version A described a 54-year-old patient versus version B an 86-year-old patient.

Case 2 version A described a patient with mild pain symptoms and version B a patient with severe pain symptoms. Case 3 version A showed a radiograph with mild radiological OA and version B showed a radiograph with severe radiological OA. A radiograph of the knee was present in all three case vignettes (see Appendix). The diagnosis in all cases was primary OA with no other abnormalities in other joints of the lower extremities. Orthopedic surgeons were asked for each case: Is a TKR the next step in your treatment? “yes or no”. A short explanation in writing of the chosen answer was mandatory.

Part three of the questionnaire contained factors that might affect the decision to perform TKR surgery. These fourteen decision modifying factors were extracted from current orthopedic literature including; high co-morbidity, severe osteoporosis, obesity, dementia, low quality of life due to the knee problems, old age, young age, ineffective conservative treatment, limited walking distance, dependent on activities of daily living (ADL) due to knee problems, moderate motivation of the patient, severe pain, severe radiological OA and mild radiological changes.^{14,19} For this part of the questionnaire the respondents were instructed to select an answer on a five-point Likert-scale: strongly against surgery, against surgery, neutral, in favor of surgery and strongly in favor of surgery. The factors explored in the case vignettes of part two were also included in this part to evaluate their importance in relation to other modifying factors. It was not possible to return to the previous question.

Since no study patients were involved, official approval of an ethics board was not necessary.

Statistical analysis

For analysis of the case vignettes a Chi-squared test was used. The decision modifying factors of part three of the questionnaire were presented in a five-point Likert-scale. These factors were ranked in hierarchical order from most likely influencing the decision to perform TKR to most unlikely to perform TKR. ‘Strongly in

favor of surgery' and 'in favor of surgery together as well as 'strongly against surgery' and 'against surgery' were combined. We performed no sample size calculation since our sample size consisted of a fixed cohort (i.e. all actively practicing orthopedic surgeons member of the NOV). All analyses were performed using SPSS for Windows, version 20. Tests were two-tailed and p-values less than 0.05 were considered to be significant.

Results

Of the 599 questionnaires a total of 354 (59%) orthopedic surgeons responded after three mailings (Figure 3.1). Of the 354 responders 8 indicated not to participate in the questionnaire due to lack of experience in performing a TKR and 20 did not complete the whole questionnaire. Therefore 326 (54%) were included in the analysis. Group A (N=165) and B (N=161) had comparable general characteristics (Table 3.1).

Figure 3.1: Flow chart of participating orthopedic surgeons

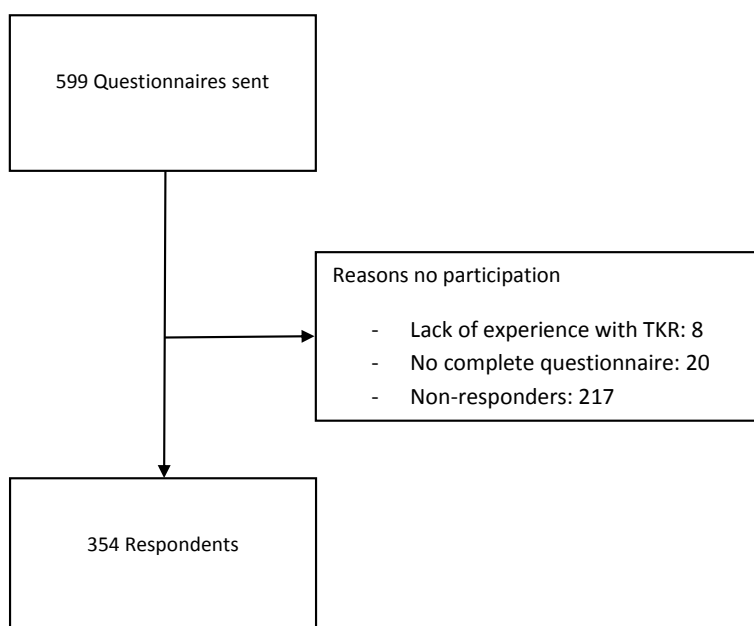


Table 3.1: General characteristics of the respondents, stratified by group (N=326)

Characteristics	Group		
	A	B	Total
	N=165	N=161	N=326
Gender			
Male N (%)	152 (92)	150 (93)	302 (93)
Working environment N (%)			
University medical center	17(10)	18 (11)	35 (11)
Private practice in general hospital	122 (74)	114 (71)	236 (72)
General hospital (fixed salary)	17 (10)	19 (12)	36 (11)
Specialized knee clinic	9 (6)	10 (6)	19 (6)
Number of knee replacements each year N (%)			
<50	50 (30)	59 (37)	109 (34)
50–100	91 (55)	86 (53)	177 (54)
>100	24 (15)	16 (10)	40 (12)
Years of experience median (IQR)	10 (5-19)	11 (4-20)	10 (5-10)

Values are displayed in frequency (N) and percentage (%) if not otherwise indicated.

IQR: interquartile range.

Case vignettes

Case 1, with difference in age, showed that orthopedic surgeons were willing to perform a TKR more often at higher chronological age (73% vs. 46%, $p < 0.0001$). Case 2, with difference in severity of pain symptoms, showed no difference on the decision to perform a TKR between the cases with mild and severe pain (57% vs. 64%, n.s.). Case 3, with difference in radiological knee OA, showed that orthopedic surgeons were less likely to perform surgery in a patient with mild compared to severe radiological OA (10% vs. 97%, $p < 0.0001$) (Table 3.2).

If a TKR was not recommended, valgus bracing of the knee, physiotherapy and unicompartmental knee prostheses were frequently proposed alternatives but heterogeneity between each of the three case vignettes and the two versions of the questionnaires was seen (Table 3.3-3.5).

Table 3.2: Differences in TKR recommendation, stratified by group based on case vignettes

Group		
A	B	
N=165	N=161	p-value
Case 'Age' 54-year-old patient (46%)	86-year-old patient (73%)	<0.0001
Case 'Pain' Mild pain symptoms (57%)	Severe pain symptoms (64%)	n.s.
Case 'ROA' Mild radiological OA (10%)	Severe radiological OA (97%)	<0.0001

The percentages of orthopedic surgeons who do recommend a TKR in the case vignette.

Case 1 described a patient a young patient (group A) and old patient (group B). Case 2 described a patient with mild pain symptoms (group A) and severe pain symptoms (group B). Case 3 described a patient with mild radiological OA (group A) and severe radiological OA (group B).

** ROA: Radiological Osteoarthritis. n.s.: not significant.*

Decision modifying factors

The fourteen patients' characteristics and modifying factors were ranked in hierarchical order from most likely influencing the decision to perform TKR to least likely (Figure 3.2). The factors activities of daily life (ADL) dependency, low quality of life, presence of severe pain, limited walking distance, ineffective conservative treatment and severe radiological OA were positively associated with the decision of orthopedic surgeons to perform a TKR. On the other hand mild radiological OA, moderate motivation of the patient, high co-morbidity, dementia and young age urged the orthopedic surgeons less likely to perform a TKR. Presence of obesity was negatively associated with the decision of the orthopedic surgeons to perform a TKR, although one third of the respondents had a neutral opinion about obese patients considering a TKR. Old age and severe osteoporosis were of no clear influence in the decision to perform a TKR.

Table 3.3: Explanation not recommending a TKR, case 'Age'

Case 1 'Age'	Group	
	A (young)	B (old)
	N = 90	N = 43
High tibial osteotomy	37	-
Unicompartmental knee prosthesis	29	4
Valgus bracing of the knee	17	13
Intra-articular injection	7	11
Expand conservative treatment	6	7
Knee arthroscopy	6	1
Radiographs (long leg)	6	-
MRI	6	-
Physiotherapy	6	5
Patient too young	5	-
Patient too old	-	3
Lateral heel lift	2	-
Lack of information	1	1
Optimize the level of painkillers	1	1

Notes are given in multiple responses (N)

Discussion

The most important finding of the present study was that 'older age' and 'moderate to severe radiological OA' were important variables in the decision making process for TKR by Dutch orthopedic surgeons, while the 'level of pain' was not strongly associated with the indication to perform a TKR. While latter is generally considered an important factor to perform TKR. Furthermore we found that the factors 'depending on ADL', 'low quality of life', 'severe pain', 'limited walking distance', 'ineffective conservative treatment' and 'severe radiological OA' were associated with the decision of orthopedic surgeons to perform a TKR.

Table 3.4: Explanation not recommending a TKR, case 'Pain'

Case 2 'Pain'	Group	
	A (mild)	B (severe)
	N = 71	N = 58
Unicompartmental knee prosthesis	19	22
Valgus bracing of the knee	15	13
Physiotherapy	14	6
Intra-articular injection	11	3
Knee arthroscopy	3	11
High tibial osteotomy	3	7
Lack of information	1	7
No indication for TKR surgery	7	1
Expand conservative treatment	4	1
Optimize the level of painkillers	2	3
Radiographs (stress view)	-	4
MRI	2	1
Watchful waiting	3	-
Lateral heel lift	1	1
Meniscectomy	1	-

Notes are given in multiple responses (N).

Age

Respondents did not consider old age as a contraindication to perform a TKR, but high co-morbidity negatively influenced the decision to perform TKR. Therefore, we assume that a relatively good health status is essential for the decision to perform a TKR in aged patients, which is line with the literature.²⁰ The majority of orthopedic surgeons delayed recommendation of a TKR in the younger age groups (<55 years), probably due to a higher revision rate within this group and the unpredictable outcome after revision TKR.^{22,23} Over 50% of the respondents recommended other

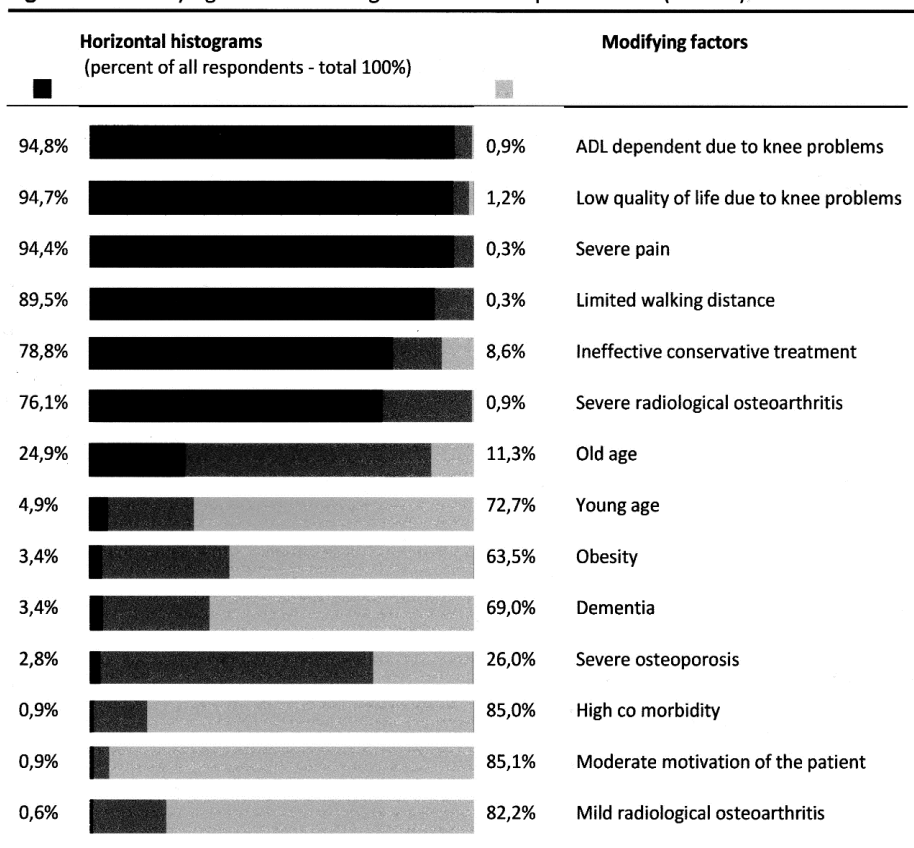
treatment options for this age group, like tibial osteotomy or unicompartmental knee prostheses.^{20,24-26}

Table 3.5: Explanation not recommending a TKR, case ‘Radiological OA’

Case 3 ‘Radiological OA’	Group	
	A (mild OA)	B (severe OA)
	N = 149	N = 5
Discrepancy: complaints vs ROA	47	<i>not applicable</i> *
Intra-articular injection	32	
MRI	24	
Knee arthroscopy	19	
Additional diagnostic testing	17	
Expand conservative treatment	17	
Physiotherapy	12	
Valgus bracing of the knee	7	
Bone scintigraphy	5	
Lack of information	5	
Radiographs (stress view)	4	
Optimize the level of painkillers	4	
X-ray (long leg)	3	
Unicompartmental knee prosthesis	2	
High tibial osteotomy	1	
Expectations too high	1	
Rheumatoid arthritis screening	1	
Weight loss	1	

*Notes are given in multiple responses (N). * Only 5 respondents who did not recommend a TKR (3.6 % of total).*

Figure 3.2: Modifying factors affecting the decision to perform TKR (N= 326).



In favor of surgery
 Neutral
 Against surgery

The black part of the bars represent the percentage of respondents who believed the modifying factor was a positive factor in the decision for surgery (in favor of surgery, strongly in favor of surgery). The dark gray part of the bars represents the percentage of surgeons who have a neutral opinion in considering a TKR related to this factor. The light gray part of the bars represent the percentage of surgeons who believe the factor was negatively affecting decision to perform TKR (against surgery, strongly against surgery).

Pain symptoms

Current literature highlights the importance of evaluating the pain level experienced by patients in the preoperative period since less severe pain experienced by patients (i.e. non-catastrophizing pain) predicts better postoperative outcome.^{13,15,16} Differences in pain symptoms (pain at rest, pain at night and pain at activity) did not

affect the decision to recommend a TKR in the case vignettes. Based on these results we can conclude that OA patients presenting with knee pain in the Netherlands seem to undergo similar treatment, independent of their pain characteristics. However, severe pain is identified by 95% of the orthopedic surgeons as a very important variable in the decision to perform a TKR (part three of the study). The OA Research Society International and Outcome Measures in Rheumatology (OARSI-OMERACT) working group has shown that pain and function are weakly predictive in the surgeon's recommendation for TKR, which underlines our results.⁷ Both results are conflicting with the importance of level of knee pain and function preoperatively which strongly affect the postoperative outcome of the patient (less severe knee OA obtain better outcome).^{13,15,16}

Radiological OA

Our study showed that the degree of radiological knee OA is an important variable which influences the orthopedic surgeons' decision to perform TKR, as was found by others as well.²⁰ Although clear evidence exists on the discrepancy between presence of radiological OA and clinical symptoms, most orthopedic surgeons consider TKR surgery in presence of moderate to severe radiological OA.^{5,14,27} The prevalence of knee OA is increasing, caused by both increasing life span, but also a growing group of people suffering from overweight and therewith negative metabolic changes on the cartilage as well as mechanical overuse of the knee joint.²⁸ This results in an increase of TKR surgery worldwide, with a predicted increase of over 700% until 2030 in the United States.²⁹ Not all patients with a TKR are satisfied. At one to five year follow-up about one fifth of patients with a TKR are not satisfied with their functional outcome.^{10,30} This stresses the importance of preoperative prediction models on which patients will benefit from a TKR, in order not only to increase quality of life of patients but also to reduce national health care costs. With the implementation of patient reported outcome measures (PROM's) in national registries and the presence of option grids for patients based on prediction models for outcome, the indication for surgery, and thus the variation among orthopedic surgeons to recommend TKR is likely to decrease. Strengths of this study are the relatively large number of respondents, which gives a good reflection of the opinion

of the Dutch orthopedic surgeon. Second, case vignettes with each case developed in two versions are never used before in orthopedic questionnaire research, and are an effective method to analyse the symptoms (age, pain symptoms and radiological OA) determining the decision of an orthopedic surgeon to perform TKR. With the use of case vignettes a clinical setting was mimicked but this virtual setting might still be different from what orthopedic surgeons actually do in their own clinical practice (i.e. still artificial). Case vignettes do not provide all clinical information, which could affect the decision-making process. For that matter, the influence of conjoined factors in the decision making process, like young age and severe radiological OA and severe pain combined could not be determined. Another limitation is that an inability in the questionnaire existed to select no-or less experience with TKR surgery, which allows orthopedic surgeons to finish the questionnaire without noticing they had no or less experiences in knee surgery. However, the latter might also be a strong feature if it was a barrier for some respondents to start or complete the questionnaire. Finally, our results are limited to a health care system comparable to the Dutch system where surgeons do not receive fee-for-surgery payments or bonus plans (i.e. as an addition to fixed salary employment). These latter factors could also be of important influence in the decision to perform TKR surgery and were not investigated within this study.

Further clinical research is required to clarify the indication criteria of an orthopedic surgeon for TKR surgery, prediction models of both the symptom state of patients in presence of a certain functional deficit and radiological osteoarthritis and the education level of the orthopedic surgeon will be important variables in such a model. International implementation of the case vignette questionnaire would make cross-cultural differences in indication for TKR among surgeons visible and might define option grids among the different patient groups even better.

Conclusion

Older age and severe radiological osteoarthritis are variables resulting in the decision by the Dutch orthopedic surgeon to perform a TKR. Symptoms of moderate or severe pain are unequivocal when considering a TKR.

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Appendix – Case Vignettes

Case 1

Medical history

A 54 years-old (*Other version: 86 years-old*) woman was referred to the outpatient clinic with complaints of progressive knee pain, especially on the left side. No trauma was reported. Start-up pain and morning stiffness are present. She mentioned a VAS pain score of 7. There were no complaints of a locking knee and she is unable to walk more than 30 minutes. She wants to do many activities with her two grandchildren, but she is hindered because of the knee problems.

Conservative treatment

- Painkillers: 3 months NSAID's with no effect.
- Walking aids: A stick for long distance walks.
- Intra-articular injection: Twice, with a short-term effect.

Physical examination

Minimal varus deformity of the left knee with effusion. Knee-flexion 100 degrees. 5 degree of fixed flexion deformity. Collateral- and cruciate ligaments are stable. Patella no abnormalities.



Standing radiograph knee

Is a Total Knee Replacement the next step in your treatment?

Case 2

Medical history

A 68 year old woman is referred to the outpatient clinic and is complaining about pain in both knees, more on the right side. Pain is presented during activities, almost every day. There is no pain at rest or at night while in bed. (*Other version: pain is constantly present including at rest and at night while in bed*) Start-up pain and morning stiffness are present. She is incapable of bicycling and has trouble with walking because of the knee problems. This causes great distress in her life.

Conservative treatment

- Painkillers: Minimal effect of NSAID's.
- Walking aids: Not applicable.
- Intra-articular injection: Few corticosteroid injections with short-term effect. She does not want the injections anymore.

Physical examination

Minimal varus deformity. Knee-flexion 110 degrees. 5 degree of fixed flexion deformity. Collateral- and cruciate ligaments are stable. Patella no abnormalities.



Standing radiograph knee

Is a Total Knee Replacement the next step in your treatment?

Case 3

Medical history

A 67 year old man with left sided knee pain is referred to the outpatient clinic. Pain at rest is present daily, and 2 or 3 times a week he has pain at night. Morning stiffness is present. Maximal walking distance is 1000 meters. It frustrates the patient that bicycling and working in the garden is no longer possible due to the knee problem.

Conservative treatment

- Painkillers: Paracetamol 4dd1 gram, if necessary diclofenac 50 mg.
- Walking aids: A stick when walking outdoors, for the last 3 months.
- Intra-articular injection: He is frightened of injections.

Physical examination

Minimal varus deformity and effusion. Knee-flexion 100 degrees. 10 degree of fixed flexion deformity. Collateral- and cruciate ligaments are stable. Patella-femoral crepitus.



Standing radiograph knee Case A

Is a Total Knee Replacement the next step in your treatment?

Radiograph of Case B:



3

