



KU LEUVEN

GROEP BIOMEDISCHE WETENSCHAPPEN

FACULTEIT BEWEGINGS- EN REVALIDATIEWETENSCHAPPEN

Gait and balance recovery in patients with total and unicondylar knee arthroplasty

door Jonas VAN GUCHT
en Lore VERSCHEURE

masterproef aangeboden, tot het
behalen van de graad van Master of
Science in de
revalidatiewetenschappen en
kinesitherapie

o.l.v.
Prof. Dr. K. Claeys, promotor

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Woord vooraf

Wij hebben onze masterproef geschreven in het kader van het behalen van ons diploma van master in de revalidatiewetenschappen en de kinesitherapie aan de KU Leuven.

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Roeselare, 15 mei 2019

J.V.G.

L.V.

Situering

De vraag naar het verschil in revalidatie van gang en balans tussen patiënten met een totale knieprothese (TKP) en een unicondylaire knieprothese (UKP) is een onderwerp dat meer en meer belangstelling krijgt. Vanwege het weinige onderzoek op longitudinaal en cross-sectioneel niveau is deze masterproef een aanvulling binnen dit kader.

De plaatsing van een knieprothese is een frequent uitgevoerde operatie. De meest voorkomende oorzaak voor het plaatsen van een knieprothese is osteoartrose [1]. Tijdens 2015-2016 was de gemiddelde leeftijd van patiënten in België, waarbij een primaire knieprothese geplaatst werd, 67.5 jaar [1]. Tijdens deze periode werden er 45284 knieprothesen geplaatst [1]. Er bestaan verschillende types prothesen waarvan een TKP en een UKP twee soorten zijn. Bij een TKP wordt het volledige kniegewricht vervangen door een metalen prothese. Zowel de femur condylen, het tibia plateau en de patella worden vervangen. Tussen de metalen delen komt een polyethyleen stuk dat voor de schokdemping in het gewricht zorgt. Een UKP houdt in dat slechts de mediale of laterale femur condyl met respectievelijk het mediale of laterale deel van het tibia plateau vervangen wordt. In tegenstelling tot een TKP worden bij een UKP de kruisbanden behouden. In België kreeg 89.1% een TKP en slechts 7.5% een UKP gedurende 2015-2016 [1].

Optimale mobiliteit is een belangrijk aspect om gezond ouder te worden [2]. Gang en balans zijn hier een cruciaal deel van. Vooral tijdens de revalidatie van de onderste extremiteiten van een ouder wordende populatie zijn gang en balans van groot belang. Eén van de meest voorkomende oorzaken van een verhoogd valrisico bij ouderen is gang- en balansstoornissen [3]. Met toenemende leeftijd komt een abnormale gang frequenter voor [3]. Bijna een derde van de ouderen geeft op één jaar tijd een valincident aan [3]. Dit alles toont het belang aan van een optimale gang en balans bij oudere personen met een knieprothese.

Elementen als gang en balans kunnen getoetst worden met behulp van de Timed Up and Go test (TUG) en de Tinetti test [4-6]. Bij de TUG moeten patiënten rechtstaan uit een stoel, drie meter wandelen, draaien rond een kegel, terugkeren en gaan zitten [4]. Deze test evalueert functionele mobiliteit en dynamische balans [4,7,8]. De Tinetti test meet beperkingen in mobiliteit en het valrisico bij ouderen [5,6]. Deze test is op te delen in twee categorieën, balans (Tinetti-B test) en gang (Tinetti-G test).

In dit onderzoek vergelijken we patiënten met een TKP en een UKP op drie opeenvolgende testmomenten: twee of drie dagen, zes weken en zes maanden postoperatief. Patiënten

leggen telkens de twee functionele testen af en vullen vier gestandaardiseerde vragenlijsten in. Zo achterhalen we het verschil in revalidatie van gang en balans tussen beide type prothesen.

We zien een sterke verbetering in beide patiëntengroepen op vlak van gang en balans gedurende de eerste zes maanden van de revalidatie. De TUG geeft weer dat zowel TKP als UKP patiënten er sterk op vooruit gaan, zonder enig verschil tussen beide groepen. De Tinetti test toont een betere score aan voor patiënten met een UKP in vergelijking met een TKP op testmoment twee en drie ten opzichte van het eerste testmoment. We kunnen concluderen dat er weinig verschillen te vinden zijn tussen beide groepen. Minimale verschillen zijn meestal in het voordeel van UKP patiënten.

Referenties

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**Gait and balance recovery in patients with total
and unicondylar knee arthroplasty**

Abstract

Background: Gait and balance are two key factors into the rehabilitation of patients with knee arthroplasty (KA). The main aim of this study was to gain more insights into the recovery of gait and balance in patients with total knee arthroplasty (TKA) compared to patients with unicondylar knee arthroplasty (UKA).

Methods: Patients with TKA and UKA were recruited over a period of 12 months. At each test moment (two or three days, six weeks and six months postoperative), patients had to fill out four patient-reported outcome measures (PROMs) and had to perform two performance-based tests (PBTs).

Results: TKA and UKA patients scored both better for pain intensity, beliefs and functioning over time, only fear of movement did not reduce over time. Significant improvement of the Timed Up and Go test (TUG) was present in both groups. No significant differences were found between TKA and UKA patients during the follow-up. For the Tinetti test, patients with TKA and UKA had overall significantly better scores at test moment two and three in comparison to the first test.

Conclusion: TKA and UKA patients made significant progression in terms of gait and balance during the first six months. There were no significant nor relevant differences between patients with TKA and UKA. Minimal differences were found in favour of UKA patients.

Keywords: Total knee arthroplasty, Unicondylar knee arthroplasty, Gait, Balance

Introduction

Knee arthroplasty (KA) is a well-known, frequently performed surgical intervention in Belgium. During 2015-2016, a total of 45284 knee joint replacement procedures were executed of which 41774 were primary knee procedures [1]. The mean age of patients who received a primary KA is 67.5 years and the procedure is more frequently executed in women (63.0%) than in men (37.0%) [1]. Osteoarthritis is the most common indication for primary KA in both men and women, but avascular necrosis, fracture, inflammatory arthropathy, trauma and previous infections also ensure that patients need to undergo KA [1].

Different types of arthroplasty are available to orthopaedic surgeons. An important subclassification in KA is based on the parts of the joints that are replaced, namely a total knee arthroplasty (TKA) and an unicondylar knee arthroplasty (UKA). During 2015-2016, 89.1% of the patients in Belgium with a primary knee replacement received a TKA [1]. In this procedure, the femoral condyles, the total tibial plateau and the patella are replaced by metal prosthesis parts and a polyethylene disc. A posterior-stabilized TKA, where the cruciate ligaments are replaced with a tibial post and femoral cam mechanism [2], is the most common implant type of TKA [1]. Two other frequently used types are the posterior cruciate retaining and the bicruciate retaining implant types [1]. Posterior-stabilized knee arthroplasties are demonstrated to result in better improvement of range of motion compared to posterior cruciate retaining knee arthroplasties [2,3] and show better joint awareness compared to bicruciate retaining knees [4]. In UKA, the medial or lateral part of the tibial plateau and, respectively, the medial or lateral condyle of the femur are replaced. In Belgium, only 7.5% of the patients with a primary knee replacement received UKA during 2015-2016 [1]. The benefits of UKA compared to TKA may be the preservation of the cruciate ligaments, the less invasive intervention, the shorter hospital stay and the reduced readmission rate within 30-days postoperative [5]. Moreover, patients with UKA seem to rehabilitate easier and faster than patients with TKA, which is already demonstrated by screening the gait pattern [6,7]. UKA patients have a more physiological gait and a higher top walking speed compared to TKA patients [6]. Patients with UKA also have a more near normal gait one year postoperative compared to patients with TKA [7]. On the other hand, TKA patients have smaller magnitude moments around the knee joint compared to patients with UKA [8]. This may explain the lower revision rates for TKA patients [8,9].

Optimal mobility is an important aspect of healthy aging [10]. Gait and balance are a crucial part of mobility, especially during rehabilitation of lower limb injuries in an aging population. With increasing age, the occurrence of an abnormal gait becomes more frequent [11]. In

addition, gait and balance disorders are one of the most common causes of falls of the elderly, among other factors such as cognitive impairment, musculoskeletal conditions and pain [11]. In daily life, fall risk increases with age. Nearly one third of older adults report falling in a period of 12 months [11]. This demonstrates the importance of an optimal gait and balance at an older age. It is of primary interest to investigate the mobility in elderly, which is independently related to poor health outcomes, injuries and reduced social contact [10]. Therefore, it is of great importance to examine these two aspects in patients with KA.

The Timed Up and Go test (TUG) is a test where people are timed during rising from an armchair, walking three meters, turning around, walking back and sitting down [12]. The patients can use their own walking aid and/or orthosis to perform this test. The TUG evaluates functional mobility [12,13], dynamic balance [14] and it provides normative reference values that can be used to identify elderly with deficits in mobility and its underlying determinants (i.e. strength and balance) [15].

The Tinetti test or the Performance Oriented Mobility Assessment measures mobility dysfunctions and fall risk in the elderly [16,17]. The total scale of the Tinetti test includes two subscales: the balance subscale (Tinetti-B test) and the gait subscale (Tinetti-G test) [17,18]. The Tinetti-B test evaluates different positions and changes in position of patients and reflects stability ability related to daily activities [17]. The quality of the locomotion pattern of the patients is evaluated in the Tinetti-G test [17].

Research showed changes of gait in patients with KA. Gait analysis showed a reduction in gait velocity, cadence and stride length in TKA patients compared to a healthy group [7,19]. Impairment of the muscles of the lower extremity has also been established [20]. Up to 12 months after TKA surgery, patients exhibited residual deficits [19]. All these elements show that abnormal gait has been established after TKA surgery [20]. From the studies that investigated gait in UKA patients, it is concluded that patients with UKA had not been able to fully restore their gait pattern compared to healthy patients [21], because the landing position of the foot and the gait speed remained modified after surgery [22]. Opinions differ when comparing gait between TKA and UKA patients. On the one hand, studies showed that UKA patients had a more physiological, normal gait and a higher top walking speed compared to TKA patients [6,7]. On the other hand, one study showed that UKA patients were not superior to TKA patients with regard to three-dimensional gait characteristics eight weeks after the operation [23].

Both performance-based tests (PBTs), TUG and Tinetti test, contain the item gait. Sit-to-stand

is a specific movement that only occurs in the TUG. This biomechanical instrument helps to analyse the knee function of a TKA patient [12]. There was a significant difference between the maximal knee extension angle of TKA patients and their control group [12]. The group of elderly used more forward bending, had a higher extension velocity of the upper body and stood up more slowly during sit-to-stand compared to the younger group [24]. All of this became worse in TKA patients early postoperative [24].

The Tinetti test is the only test of the PBTs that specifically evaluates balance. No studies examined balance in patients with KA in general. However, research about balance in TKA patients has been done before. A number of studies concluded that patients with TKA showed an improvement in balance during rehabilitation, but they were not able to restore balance to a level compared to healthy controls [25-28]. Changes in the proprioceptive function of the knee joint and changes of joint motion and position sense could contribute to this [29]. Besides this, an increased velocity in medial-lateral sway of the knee challenged the postural control of patients [25]. Osteoarthritis and the procedure itself also damaged the proprioception of patients [26]. Hereby, TKA patients may have a higher incidence of fall risk compared to the general population [29,30]. Balance has not yet been examined in UKA patients. Studies that evaluate the difference in balance between the two arthroplasty groups are also not there yet.

It has been shown that the performance of the TUG is of longer duration in TKA patients compared to a control group, because patients need slightly more time if they experience more pain [12]. To our knowledge, research of TKA patients performing the Tinetti test and UKA patients performing the TUG or Tinetti test to evaluate gait and balance have not yet been conducted. Also, studies comparing patients with TKA and UKA in terms of gait and balance by making use of the TUG or Tinetti test has not yet been performed. In conclusion, little research has been done about the recovery of TKA and UKA patients and about the postoperative differences between the two arthroplasty groups in terms of gait and balance by making use of the TUG or Tinetti test.

The main aim of this study is to gain more insights into the recovery of gait and balance of patients with TKA compared to patients with UKA. The first specific aim is to assess the performance of TKA and UKA patients on the TUG and Tinetti test during a rehabilitation period of six months. The second specific aim is to investigate differences between the two groups concerning the performance on the TUG and Tinetti test. It's hypothesized that UKA patients may have a faster recovery compared to TKA patients, due to the less invasive intervention and the retention of the cruciate ligaments, which are considered to play an important role into knee joint stability and proprioceptive function.

Materials and methods

Characteristics of the patients

Patients were recruited at the orthopaedic department of the AZ Sint Lucas in Bruges by the orthopaedic surgeon. All patients with TKA received a posterior-stabilized knee prosthesis and all patients with UKA received a medial unicondylar knee prosthesis. The selected patients gave their written informed consent. Patients who were younger than 18 years old, who had a high comorbidity assessed by the surgeon, who have had a revision or who did not give their written informed consent were not included in the study. Test procedures were approved by the Medical Research Ethics Committee of KU Leuven with respect to the declaration of Helsinki. Appendix H provides more information about this. Table 1 gives an overview of the characteristics of the patients at intake.

Evaluation of the patients

All patients have been included over a period of 12 months. The recruited patients were evaluated three times over a period of six months after their surgery. The test moments were two or three days (just before discharge from the hospital), six weeks and six months postoperative. The first test was performed in the hospital and the two follow-up tests were performed in a lab. Figure 1 shows an overview of the patients participating in the study. Three patients were not present on the second test and two other patients on the third. Five patients did not complete some questionnaires and/or tests at test moment three. The reason for the patients who dropped-out were not knee related.

Table 1: characteristics of the patients at intake

Variable	TKA	UKA	Significance
	N = 17	N = 8	
Age (years)	Mean (SD) 67.18 (7.21)	Mean (SD) 62.38 (7.27)	0.14
Height (m)	1.71 (0.07)	1.71 (0.08)	0.84
Weight (kg)	80.06 (14.17)	84.63 (13.50)	0.45
BMI (kg/m ²)	27.19 (3.71)	29.24 (5.70)	0.29

TKA = total knee arthroplasty, UKA = unicondylar knee arthroplasty, N = number of patients, SD = standard deviation, m = meters, kg = kilogram, BMI = Body Mass Index

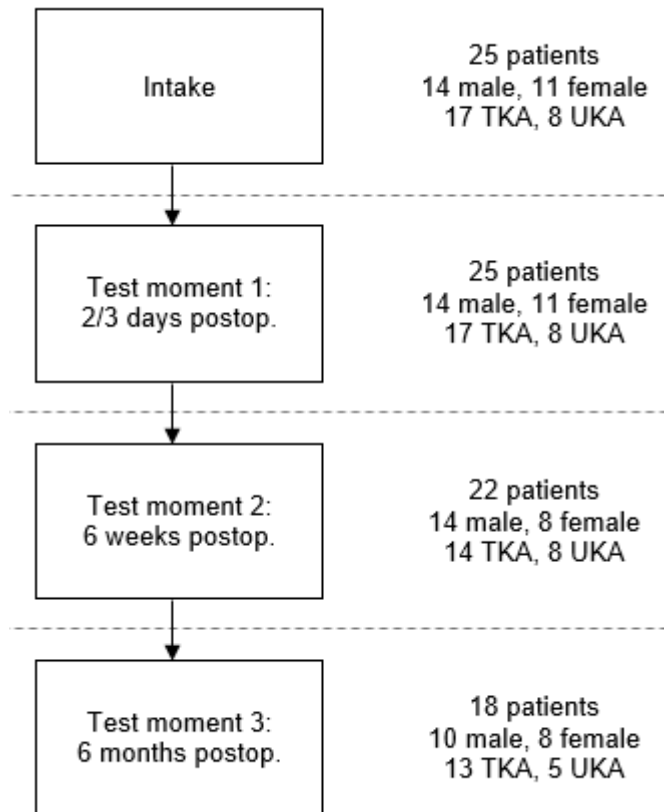


Figure 1: flowchart of the patients participating in the study

Patient-reported outcome measures (PROMs)

At each test moment, the patients had to fill out a Visual Analogue Scale (VAS) to assess the intensity of pain based on a straight line of which the ends represent the extreme limits of pain [31]. A score of seven and a half or more indicates severe pain [32]. The patients also had to fill out three questionnaires. Firstly, the Knee Osteoarthritis Outcome Score (KOOS) examines the beliefs of the patients about their knee and associated problems [33]. This questionnaire consists of five domains: pain, other specific symptoms, difficulties during activities of daily life (ADL), sport and recreational activities and knee-related quality of life (QoL) [33]. The score varies from zero to 100, with zero representing no knee problems at all and 100 the worst possible knee problems [34]. Secondly, the Oxford Knee Score (OKS) acquires information about knee pain and function by letting patients with knee prostheses reflect on their knee-related health status and benefits of treatment [33]. The minimum score zero corresponds with a maximum of limitation and the maximum score of 48 corresponds with a minimum of limitation [33]. Lastly, the Tampa Scale for Kinesiophobia (TSK) measures fear of movement and (re)injury of patients [35]. The minimum score is 17 and the maximum score 68. The higher the score, the higher the degree of kinesiophobia [35]. The score 37 is used as a cut-off score. Patients who score less than or equal to 37 belong to the low fear group and patients who

score more than 37 to the high fear group [35]. These validated questionnaires provide information about the impact of the intervention on the patient's physical and psychosocial level. Appendices A to D provide more information about the PROMs.

Performance-based tests (PBTs)

The patients had to perform the TUG and the Tinetti test (Tinetti-B and Tinetti-G test) at the three test moments to evaluate gait and balance. The TUG can be assessed quickly [9,13,36] and is easy to perform [12,36]. The TUG is a reliable and valid test for mobility and can be used in following clinical change over time [13]. A score over 14 on the TUG indicates an increased fall risk [37]. The Tinetti test is an easy test, only little experience is needed [17,38]. Additionally, the Tinetti test can be conducted in less than 15 minutes [17]. This test and its subscales have a good relative reliability, concurrent validity and discriminant validity [17]. The maximum score of the Tinetti test is 28 and the maximum scores on the Tinetti-B and the Tinetti-G test are respectively 16 and 12 [17]. A total score of 19 indicates a five-fold higher risk of falling [37,39]. Appendices E and F provide more information about the PBTs.

Statistical analysis

IBM, SPSS Statistics 25 (Chicago, IL) was used to perform all statistical tests [40]. The normality was evaluated by making use of a Shapiro-Wilk test. Analysis of variance (ANOVA), more specifically repeated measures of ANOVA, was used to compare test moment one with two, two with three and one with three within each group (TKA and UKA) and to evaluate the differences between the two groups at the three test moments for all variables under investigation. The level of significance was set at $p < 0.05$.

Results

Longitudinal follow-up of the characteristics, PROMs and PBTs

Patients with TKA had a significantly higher weight and Body Mass Index (BMI) at test moment three compared to test moment two. No significant differences for weight and BMI were found for patients with UKA. The characteristics (weight and BMI) of the patients are shown in Table 2 and 3 respectively for TKA and UKA patients.

Compared to the first test moment, there was a decrease of the VAS score in patients with TKA at test moment two and three. Over time, patients with TKA showed a lower KOOS. For KOOS-pain, TKA patients showed lower scores at the third test moment compared to the first and second. This was also found for KOOS-symptoms. Between test moment one and two and between test moment one and three, a lower KOOS-ADL and KOOS-QoL were found for TKA patients. A higher OKS was determined in patients with TKA at test moment two and three compared to test moment one. The significances of the PROMs for TKA patients are shown in Table 2.

Over time, a lower KOOS was demonstrated in UKA patients. For KOOS-pain in UKA patients, lower scores were found at test moment three compared to test moment one and two. The comparison of patients with UKA between all three test moments always showed a lower KOOS-symptoms. A lower KOOS-ADL was determined in patients with UKA at test moment two and three compared to test moment one. UKA patients showed a lower KOOS-QoL at test moment three compared to test moment one and two. The OKS in patients with UKA was higher at test moment three compared to test moment one. The significances of the PROMs for UKA patients are shown in Table 3.

Patients with TKA showed lower scores during the three test moments of the TUG. Patients with TKA had higher scores on the Tinetti test at test moment two and three compared to test moment one. The same conclusion can be drawn for the Tinetti-B test. Increasing scores were determined by comparing patients with TKA between all three test moments of the Tinetti-G test. The significances of the PBTs for TKA patients are shown in Table 2.

Over time, patients with UKA who have performed the TUG showed lower results. UKA patients had higher scores on the Tinetti test and its subscales at test moment two and three compared to test moment one. The significances of the PBTs for UKA patients are shown in Table 3.

Table 2: TKA longitudinal

	2/3 days	6 weeks	6 months	Significance
	postop.	postop.	postop.	
	Mean (SD)	Mean (SD)	Mean (SD)	
Weight (kg)	83.04 (14.84)	82.45 (12.53)	85.11 (13.29)	A: 1.000; B: 0.009 ; C: 0.158
BMI (kg/m ²)	27.82 (3.92)	27.69 (3.45)	28.57 (3.52)	A: 1.000; B: 0.005 ; C: 0.130
VAS	4.69 (1.93)	1.31 (0.95)	0.85 (0.80)	A: 0.000 ; B: 0.246; C: 0.000
KOOS (%)	43.94 (12.52)	24.30 (15.26)	14.45 (8.92)	A: 0.002 ; B: 0.033 ; C: 0.000
KOOS-p (%)	45.19 (17.70)	26.78 (23.38)	6.06 (6.19)	A: 0.141; B: 0.021 ; C: 0.000
KOOS-sy (%)	35.07 (13.44)	31.50 (10.33)	17.21 (9.15)	A: 1.000; B: 0.018 ; C: 0.002
KOOS-a (%)	39.84 (10.20)	14.18 (14.90)	8.43 (8.11)	A: 0.000 ; B: 0.318; C: 0.000
KOOS-sp (%)	70.00 (28.69)	47.10 (32.51)	45.85 (27.70)	A: 0.146; B: 1.000; C: 0.092
KOOS-q (%)	43.75 (17.88)	20.31 (15.11)	17.19 (14.13)	A: 0.016 ; B: 1.000; C: 0.002
OKS	28.46 (9.22)	40.00 (5.12)	42.92 (5.95)	A: 0.001 ; B: 0.167; C: 0.000
TSK	39.42 (6.90)	36.50 (7.05)	37.17 (7.94)	A: 0.737; B: 1.000; C: 1.000
TUG (s)	24.48 (10.07)	10.88 (3.07)	8.92 (1.84)	A: 0.000 ; B: 0.005 ; C: 0.000
Tinetti test	16.92 (3.84)	23.69 (3.20)	25.46 (2.37)	A: 0.000 ; B: 0.061; C: 0.000
Tinetti-B test	10.00 (2.52)	13.92 (2.33)	14.00 (2.20)	A: 0.003 ; B: 1.000; C: 0.001
Tinetti-G test	6.92 (2.60)	9.77 (2.09)	11.15 (1.62)	A: 0.008 ; B: 0.018 ; C: 0.000

Postop. = postoperative, SD = standard deviation, kg = kilogram, BMI = Body Mass Index, m = meters, VAS = Visual Analog Scale, KOOS = Knee injury and Osteoarthritis Outcome Score, p = pain, sy = symptoms, a = activities of daily life, sp = sports, q = quality of life, OKS = Oxford Knee Score, TSK = Tampa Scale for Kinesiophobia, TUG = Timed Up and Go test, s = seconds, Tinetti-B test = Tinetti balance test, Tinetti-G test = Tinetti gait test, A: 2/3 days postoperative vs. 6 weeks postoperative, B: 6 weeks postoperative vs. 6 months postoperative, C: 2/3 days postoperative vs. 6 months postoperative.

Bold values in the right column are the significance values.

Table 3: UKA longitudinal

	2/3 days	6 weeks	6 months	Significance
	postop.	postop.	postop.	
	Mean (SD)	Mean (SD)	Mean (SD)	
Weight (kg)	80.33 (9.35)	80.88 (5.94)	80.13 (7.80)	A: 1.000; B: 1.000; C: 1.000
BMI (kg/m ²)	26.48 (1.72)	27.37 (1.61)	27.20 (2.02)	A: 0.398; B: 1.000; C: 0.179
VAS	3.83 (1.72)	2.50 (1.87)	1.17 (1.33)	A: 0.785; B: 0.573; C: 0.187
KOOS (%)	45.32 (15.84)	32.06 (14.17)	16.58 (12.72)	A: 0.025 ; B: 0.002 ; C: 0.002
KOOS-p (%)	44.06 (20.75)	36.11 (28.87)	8.72 (10.69)	A: 1.000; B: 0.046 ; C: 0.001
KOOS-sy (%)	39.79 (13.11)	28.07 (8.85)	12.75 (7.68)	A: 0.023 ; B: 0.015 ; C: 0.004
KOOS-a (%)	37.60 (18.35)	21.43 (13.71)	14.07 (11.70)	A: 0.041 ; B: 0.101; C: 0.039
KOOS-sp (%)	73.55 (41.10)	63.55 (24.79)	40.70 (33.10)	A: 1.000; B: 0.278; C: 0.189
KOOS-q (%)	55.38 (15.06)	35.69 (18.65)	21.44 (16.67)	A: 0.057; B: 0.020 ; C: 0.002
OKS	30.86 (4.56)	33.14 (6.77)	43.00 (5.72)	A: 0.712; B: 0.059; C: 0.011
TSK	35.71 (4.89)	34.43 (7.44)	34.29 (6.73)	A: 1.000; B: 1.000; C: 1.000
TUG (s)	22.22 (9.51)	11.34 (2.40)	8.90 (1.84)	A: 0.046 ; B: 0.010 ; C: 0.022
Tinetti test	18.33 (3.33)	26.17 (2.04)	28.00 (0.00)	A: 0.008 ; B: 0.237; C: 0.003
Tinetti-B test	11.50 (1.38)	15.17 (1.60)	16.00 (0.00)	A: 0.027 ; B: 0.776; C: 0.001
Tinetti-G test	6.83 (2.04)	11.00 (1.67)	12.00 (0.00)	A: 0.032 ; B: 0.609; C: 0.005

Postop. = postoperative, SD = standard deviation, kg = kilogram, BMI = Body Mass Index, m = meters, VAS = Visual Analog Scale, KOOS = Knee injury and Osteoarthritis Outcome Score, p = pain, sy = symptoms, a = activities of daily life, sp = sports, q = quality of life, OKS = Oxford Knee Score, TSK = Tampa Scale for Kinesiophobia, TUG = Timed Up and Go test, s = seconds, Tinetti-B test = Tinetti balance test, Tinetti-G test = Tinetti gait test, A: 2/3 days postoperative vs. 6 weeks postoperative, B: 6 weeks postoperative vs. 6 months postoperative, C: 2/3 days postoperative vs. 6 months postoperative.

Bold values in the right column are the significance values.

Table 4: TKA versus UKA cross-sectional

	2/3 days postop.			6 weeks postop.			6 months postop.		
	TKA	UKA	Significance	TKA	UKA	Significance	TKA	UKA	Significance
	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Weight (kg)	83.04 (14.84)	80.33 (9.35)	0.306	82.45 (12.53)	80.88 (5.94)	0.345	85.11 (13.29)	80.13 (7.80)	0.703
BMI (kg/m ²)	27.82 (3.92)	26.48 (1.72)	0.290	27.69 (3.45)	27.37 (1.61)	0.199	28.57 (3.52)	27.20 (2.02)	0.630
VAS	4.69 (1.93)	3.83 (1.72)	0.664	1.31 (0.95)	2.50 (1.87)	0.068	0.85 (0.80)	1.17 (1.33)	0.679
KOOS (%)	43.94 (12.52)	45.32 (15.84)	0.877	24.30 (15.26)	32.06 (14.17)	0.367	14.45 (8.92)	16.58 (12.72)	0.506
KOOS-p (%)	45.19 (17.70)	44.06 (20.75)	0.773	26.78 (23.38)	36.11 (28.87)	0.390	6.06 (6.19)	8.72 (10.69)	0.473
KOOS-sy (%)	35.07 (13.44)	39.79 (13.11)	0.812	31.50 (10.33)	28.07 (8.85)	0.157	17.21 (9.15)	12.75 (7.68)	0.133
KOOS-a (%)	39.84 (10.20)	37.60 (18.35)	0.622	14.18 (14.90)	21.43 (13.71)	0.393	8.43 (8.11)	14.07 (11.70)	0.879
KOOS-sp (%)	70.00 (28.69)	73.55 (41.10)	0.937	47.10 (32.51)	63.55 (24.79)	0.254	45.85 (27.70)	40.70 (33.10)	0.363
KOOS-q (%)	43.75 (17.88)	55.38 (15.06)	0.323	20.31 (15.11)	35.69 (18.65)	0.255	17.19 (14.13)	21.44 (16.67)	0.857
OKS	28.46 (9.22)	30.86 (4.56)	0.727	40.00 (5.12)	33.14 (6.77)	0.012	42.92 (5.95)	43.00 (5.72)	0.555
TSK	39.42 (6.90)	35.71 (4.89)	0.805	36.50 (7.05)	34.43 (7.44)	0.594	37.17 (7.94)	34.29 (6.73)	0.251
TUG	24.48 (10.07)	22.22 (9.51)	0.558	10.88 (3.07)	11.34 (2.40)	0.867	8.92 (1.84)	8.90 (1.84)	0.868
Tinetti test	16.92 (3.84)	18.33 (3.33)	0.542	23.69 (3.20)	26.17 (2.04)	0.774	25.46 (2.37)	28.00 (0.00)	0.028
Tinetti-B test	10.00 (2.52)	11.50 (1.38)	0.166	13.92 (2.33)	15.17 (1.60)	0.987	14.00 (2.20)	16.00 (0.00)	0.051
Tinetti-G test	6.92 (2.60)	6.83 (2.04)	0.730	9.77 (2.09)	11.00 (1.67)	0.638	11.15 (1.62)	12.00 (0.00)	0.280

Postop. = postoperative, TKA = total knee arthroplasty, UKA = unicondylar knee arthroplasty, SD = standard deviation, kg = kilogram, BMI = Body Mass Index, m = meters, VAS = Visual Analog Scale, KOOS = Knee injury and Osteoarthritis Outcome Score, p = pain, sy = symptoms, a = activities of daily life, sp = sports, q = quality of life, OKS = Oxford Knee Score, TSK = Tampa Scale for Kinesiophobia, TUG = Timed Up and Go test, s = seconds, Tinetti-B test = Tinetti balance test, Tinetti-G test = Tinetti gait test.

Bold values are the significance values.

Cross-sectional follow-up of the characteristics, PROMs and PBTs

There were no significant differences between patients with TKA and UKA in terms of weight and BMI. The characteristics (weight and BMI) of TKA versus UKA patients are shown in Table 4.

At test moment two of the OKS, there was a significant difference in the comparison of TKA and UKA patients. Only one significant difference in the PBTs was found in the comparison of TKA and UKA patients. UKA patients had a higher score at the third test moment of the Tinetti test. The significances of the PROMs and PBTs for the comparison of TKA and UKA patients are shown in Table 4.

Discussion

The most crucial finding of current study is that patients with TKA and UKA showed an equal recovery process concerning gait and balance up to six months postoperative. This is in contrast with our hypothesis that patients with UKA should faster recover due to the less invasive surgical technique and the retention of the cruciates. However, UKA patients scored significantly better on the Tinetti test six months postoperative.

Over time, a significant improvement of the TUG is demonstrated in both arthroplasty groups. TKA and UKA patients needed significantly less time to complete the TUG through rehabilitation. Both arthroplasty groups exceeded the 14 seconds that indicate an increased risk of falling at the first test moment. At the second test moment, TKA and UKA patients belonged to the group that is independent for basis transfers. All patients were freely independent individuals at the last test moment. Factors as muscle strength and pain are dominant for these results as cited in some studies of TKA patients [12,41-43]. No significant differences were found when comparing the test moments of TKA and UKA patients. The averages of TKA patients were very close to the averages of UKA patients at every test moment.

For the Tinetti test, patients with TKA and UKA had overall significantly better scores at test moment two and three in comparison to test moment one. This was due to a quick progression during the first six weeks after the operation. There was no significant improvement from test moment two to three. TKA patients had a high fall risk at the first test moment, an increased fall risk at the second and a low fall risk at the third. UKA patients also had a high fall risk at the first test moment, but had already a low fall risk at the second and this was retained at the third test moment. Nevertheless, there was no significant difference between the two groups at the second test moment. A significantly better result of the Tinetti test was found for UKA patients compared to TKA patients at test moment three even though the two groups had a low risk of falling. In general, UKA patients had slightly higher scores compared to TKA patients. The preservation of the cruciate ligaments, that ensure motor control and the stability of the joint, and the less invasive procedure might have an influence on this difference between TKA and UKA patients.

Significant better scores at test moment two and three compared to test moment one were found in TKA patients when performing the Tinetti-B test. The same conclusion can be drawn for UKA patients. Previous research showed slower walking speed, smaller steps and reduced cadence in patients in the early postoperative phase of TKA as well as higher torques [22].

Deterioration of stability and balance were caused by the adaptations that patients had to make to their new conditions, the correction of the biomechanical axis of the legs and the influence of free moment in knee loads [22]. When comparing the test moments of patients with TKA and UKA, no significant differences were determined. Nevertheless, UKA patients scored slightly better on average at each test moment.

TKA patients performed significantly better at each test moment over time on the Tinetti-G test. Patients with UKA scored significantly better at the second and third test moment in comparison to test moment one. These results are confirmed by several studies [21,44,45]. Variables in gait influenced by the KA intervention were landing position of the foot, adaptation of the gait speed for comfortable walking and biomechanical axis correction [22]. The last aspect is only applied to TKA patients, but not to UKA patients. All patients with TKA receive a mechanical alignment and patients with UKA do not. In the beginning, patients wanted to compensate or were unable to adapt the speed. This was because of the higher free moments in the knee who were present in the early postoperative phase [22]. No significantly different scores were found for TKA and UKA patients at the three test moments.

TKA patients had a significantly lower pain intensity over time. The same applies for UKA patients, but the reduction between the test moments was not significant. TKA and UKA patients never reached the cut-off score, which indicates severe pain. There was a significant better KOOS for TKA and UKA patients over time. Even though there were no significant differences between the two groups, TKA patients always had less knee problems. TKA patients had already a satisfactory joint function at the second test moment, while UKA patients only had a score of mild to moderate knee arthritis. This demonstrates the significant difference between the two arthroplasty groups at the second test moment. The KOOS and the OKS showed that TKA patients achieve a slightly faster functional recovery. The small sample size and the faster recovery of pain in TKA patients can be the cause of these outcomes. During the entire testing period, no significant differences on movement related fear were found for both groups. TKA and UKA patients remained below the cut-off score of 37 with the exception of TKA patients at the first and third test moment. Because TKA patients exhibited more anxiety at these two test moments, this could have an influence on the execution of the PBTs. It can be concluded that attention for fear of movement is important during the rehabilitation of patients with KA. However, one study showed there was no correlation between kinesiophobia and the TUG in TKA patients [46]. The results of the TUG were similar between patients with low and high kinesiophobia [46]. Further investigation on this topic is recommended.

Different from the hypothesis, patients with UKA did not perform significantly better on the two PBTs in comparison to patients with TKA. This was just the case for the total Tinetti test at the

third test moment. It is striking that the significant cross-sectional difference of the Tinetti test at test moment three is not clinically relevant, because UKA and TKA patients reached both the stage of a low risk of falling. Previous studies showed the benefits of UKA regarding knee extensor strength, three-dimensional gait characteristics and physiological gait [5,6,23], while this study showed that there were no clinical relevant nor significant differences between TKA and UKA patients in terms of gait and balance. The results of this study are therefore less obvious compared to the previous ones. An interesting remark is that in previous research, patients were tested on specific aspects in rehabilitation, such as spatiotemporal parameters, postoperative complications, readmission rates and maximum speed [5,6,23]. None of these studies tested the patients with PBTs that provide a more general assessment and focus on ADL activities. It seems to be important to focus more on ADL activities and quality of life in the elderly. These patients are already a risk group on the aspect of falling. The PBTs contain the basics needed for an independent life. The sit-to-stand movement is used very often every day [47]. The ability to stand upright from a seated position is very important for the elderly [47]. The shift from kinematic tests to functional tests can be very important for improving quality of life, psychosocial factors and independence in the older population. It should be a main goal of rehabilitation to regain a normal life after knee surgery as soon as possible.

This study gives some nice clinical findings for patients recovering from KA. Shortly after the procedure, all patients had a very high risk of falling. After six weeks, UKA patients evolved into patients with a low fall risk. TKA patients, on the other hand, still had an increased risk of falling six weeks postoperatively. After six months, UKA patients had no fall risk at all while TKA patients still had a low fall risk. No significant differences were found in terms of age, height, weight and BMI at intake. The intervention itself is the logical explanation for the difference in fall risk between the two groups. Balance training, especially in TKA patients, is of the utmost importance to get patients rehabilitated as well and as quickly as possible. Patients must therefore be closely followed up in terms of gait and balance. This shows that PBTs are of large value during the rehabilitation of patients with KA. However, the TUG and Tinetti test are not used frequently in this setting. Further research into the usefulness of using the PBTs in a standardized test battery for people with KA is needed.

The total number of patients who participated in this study can be an indispensable limitation. Only 25 patients were recruited, 17 patients with TKA and 8 with UKA. The size of the groups were therefore not equal. Research with a larger population and an equal group size is recommended to reinforce the findings of this study. This study follows patients up to six months postoperatively. A longer follow-up period may provide additional information. The research, of which this study is a part, implements this. A comparison of TKA and UKA patients

with healthy subjects was not feasible, because no healthy control group was used. Due to this, it was not possible to make statements about achieving scores similar to healthy subjects. In this study two PBTs were used to assess daily skills. More challenging gait and balance tasks can be investigated to monitor differences between TKA and UKA patients.

Conclusions

Over time, TKA and UKA patients made significant progression on the PBTs. For the TUG and Tinetti test, there were no significant nor relevant different results in terms of gait and balance recovery between the two arthroplasty groups. Only small differences, mainly in favour of UKA patients, were established. This demonstrates the importance of monitoring the progress of gait and balance by making use of the PBTs. Research into the use of these tests with a larger population and a longer follow-up period still needs to be further investigated.

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Appendices

Appendix A

Test	Visual Analogue Scale (VAS)
Description	An instrument to measure a characteristic or attitude. It is often presented as a horizontal or vertical line (usually 10 centimeters). The ends of the line are the extremities of the measured parameter. The patient indicates on the line to what extent he or she experiences the requested parameter. Pain is often evaluated on the basis of this scale.
Purpose	Assessing the intensity of pain.
Scores	The score on the scale is the number of centimeters between the minimum score and the indication by the patient. - ≥ 7.5 centimeters: severe pain
References	Carlsson, A. M. (1983). Assessment of chronic pain. I. Aspects of the reliability and validity of the visual analogue scale. <i>Pain</i> , 16(1), 87-101. Wewers, M. E., & Lowe, N. K. (1990). A critical review of visual analogue scales in the measurement of clinical phenomena. <i>Research in nursing & health</i> , 13(4), 227-236. Freyd, M. (1923). The graphic rating scale. <i>Journal of educational psychology</i> , 14(2), 83.

No pain

Worst pain ever



Appendix B

Test	Knee Osteoarthritis Outcome Score (KOOS)
Description	A questionnaire to evaluate symptoms and limitations. It contains 42 items and consists of 5 different subscales: pain (9 items), symptoms (7 items), functioning during activities of daily life (17 items), functioning in sports and recreational activities (5 items) and knee-related quality of life (4 items). Each subscale has a 5 point Likert scale from 0 to 4.
Purpose	Examination of the opinion of the patient about the knee and associated problems.
Scores	The score on the scale varies from 0 to 100. <ul style="list-style-type: none"> - 0: no knee problems at all - 100: the worst possible knee problems
References	<p>Collins, N. J., Misra, D., Felson, D. T., Crossley, K. M., & Roos, E. M. (2011). Measures of knee function: International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Knee Injury and Osteoarthritis Outcome Score Physical Function Short Form (KOOS-PS), Knee Outcome Survey Activities of Daily Living Scale (KOS-ADL), Lysholm Knee Scoring Scale, Oxford Knee Score (OKS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Activity Rating Scale (ARS), and Tegner Activity Score (TAS). <i>Arthritis care & research</i>, 63(S11), S208-S228.</p> <p>Roos, E. M., & Lohmander, L. S. (2003). The Knee injury and Osteoarthritis Outcome Score (KOOS): from joint injury to osteoarthritis. <i>Health and quality of life outcomes</i>, 1(1), 64.</p> <p>Naili, J. E., Iversen, M. D., Esbjörnsson, A. C., Hedström, M., Schwartz, M. H., Häger, C. K., & Broström, E. W. (2017). Deficits in functional performance and gait one year after total knee arthroplasty despite improved self-reported function. <i>Knee Surgery, Sports Traumatology, Arthroscopy</i>, 25(11), 3378-3386.</p>

KOOS KNEE SURVEY

Today's date: ____/____/____ Date of birth: ____/____/____

Name: _____

INSTRUCTIONS: This survey asks for your view about your knee. This information will help us keep track of how you feel about your knee and how well you are able to perform your usual activities.

Answer every question by ticking the appropriate box, only one box for each question. If you are unsure about how to answer a question, please give the best answer you can.

Symptoms

These questions should be answered thinking of your knee symptoms during the **last week**.

S1. Do you have swelling in your knee?

Never Rarely Sometimes Often Always

S2. Do you feel grinding, hear clicking or any other type of noise when your knee moves?

Never Rarely Sometimes Often Always

S3. Does your knee catch or hang up when moving?

Never Rarely Sometimes Often Always

S4. Can you straighten your knee fully?

Always Often Sometimes Rarely Never

S5. Can you bend your knee fully?

Always Often Sometimes Rarely Never

Stiffness

The following questions concern the amount of joint stiffness you have experienced during the **last week** in your knee. Stiffness is a sensation of restriction or slowness in the ease with which you move your knee joint.

S6. How severe is your knee joint stiffness after first wakening in the morning?

None Mild Moderate Severe Extreme

S7. How severe is your knee stiffness after sitting, lying or resting **later in the day**?

None Mild Moderate Severe Extreme

Pain

P1. How often do you experience knee pain?

Never	Monthly	Weekly	Daily	Always
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

What amount of knee pain have you experienced the **last week** during the following activities?

P2. Twisting/pivoting on your knee

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

P3. Straightening knee fully

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

P4. Bending knee fully

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

P5. Walking on flat surface

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

P6. Going up or down stairs

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

P7. At night while in bed

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

P8. Sitting or lying

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

P9. Standing upright

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Function, daily living

The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A1. Descending stairs

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A2. Ascending stairs

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A16. Heavy domestic duties (moving heavy boxes, scrubbing floors, etc)

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A17. Light domestic duties (cooking, dusting, etc)

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Function, sports and recreational activities

The following questions concern your physical function when being active on a higher level. The questions should be answered thinking of what degree of difficulty you have experienced during the **last week** due to your knee.

SP1. Squatting

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SP2. Running

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SP3. Jumping

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SP4. Twisting/pivoting on your injured knee

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SP5. Kneeling

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Quality of Life

Q1. How often are you aware of your knee problem?

Never	Monthly	Weekly	Daily	Constantly
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q2. Have you modified your life style to avoid potentially damaging activities to your knee?

Not at all	Mildly	Moderately	Severely	Totally
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q3. How much are you troubled with lack of confidence in your knee?

Not at all	Mildly	Moderately	Severely	Extremely
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q4. In general, how much difficulty do you have with your knee?

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thank you very much for completing all the questions in this questionnaire.

Appendix C

Test	Oxford Knee Score (OKS)
Description	Patients must reflect on their knee-related health status and benefits of treatment. It consists of 12 questions concerning pain and functionality of the knee. Each question has a 5 point Likert scale from 0 to 4.
Purpose	The acquisition of knee pain and function.
Scores	The minimum score 0 corresponds with a maximum of limitation and the maximum score 48 corresponds with a minimum of limitation. <ul style="list-style-type: none"> - 0 and 19: severe knee arthritis - 20 and 29: moderate knee arthritis - 30 and 39: mild to moderate knee arthritis - 40 and 48: a satisfactory joint function
References	Collins, N. J., Misra, D., Felson, D. T., Crossley, K. M., & Roos, E. M. (2011). Measures of knee function: International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Knee Injury and Osteoarthritis Outcome Score Physical Function Short Form (KOOS-PS), Knee Outcome Survey Activities of Daily Living Scale (KOS-ADL), Lysholm Knee Scoring Scale, Oxford Knee Score (OKS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Activity Rating Scale (ARS), and Tegner Activity Score (TAS). <i>Arthritis care & research</i> , 63(S11), S208-S228. Dawson, J., Fitzpatrick, R., Murray, D., & Carr, A. (1998). Questionnaire on the perceptions of patients about total knee replacement. <i>The Journal of bone and joint surgery. British volume</i> , 80(1), 63-69.

PROBLEMS WITH YOUR KNEE

During the past 4 weeks..

✓ tick one box
for every question

1	<p><i>During the past 4 weeks.....</i></p> <p>How would you describe the pain you <u>usually</u> have from your knee?</p> <p style="text-align: center;"> None Very mild Mild Moderate Severe <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </p>
2	<p><i>During the past 4 weeks.....</i></p> <p>Have you had any trouble with washing and drying yourself (all over) <u>because of your knee?</u></p> <p style="text-align: center;"> No trouble at all Very little trouble Moderate trouble Extreme difficulty Impossible to do <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </p>
3	<p><i>During the past 4 weeks.....</i></p> <p>Have you had any trouble getting in and out of a car or using public transport <u>because of your knee?</u> (whichever you would tend to use)</p> <p style="text-align: center;"> No trouble at all Very little trouble Moderate trouble Extreme difficulty Impossible to do <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </p>
4	<p><i>During the past 4 weeks.....</i></p> <p>For how long have you been able to walk before <u>pain from your knee becomes severe?</u> (<i>with or without a stick</i>)</p> <p style="text-align: center;"> No pain/ More than 30 minutes 16 to 30 minutes 5 to 15 minutes Around the house <u>only</u> Not at all - pain severe when walking <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </p>
5	<p><i>During the past 4 weeks.....</i></p> <p>After a meal (sat at a table), how painful has it been for you to stand up from a chair <u>because of your knee?</u></p> <p style="text-align: center;"> Not at all painful Slightly painful Moderately painful Very painful Unbearable <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </p>
6	<p><i>During the past 4 weeks.....</i></p> <p>Have you been limping when walking, <u>because of your knee?</u></p> <p style="text-align: center;"> Rarely/ never Sometimes, or just at first Often, not just at first Most of the time All of the time <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </p>

During the past 4 weeks... ✓tick one box
for every question

7	<p><i>During the past 4 weeks.....</i></p> <p>Could you kneel down and get up again afterwards?</p> <table style="width: 100%; text-align: center;"> <tr> <td>Yes, Easily <input type="checkbox"/></td> <td>With little difficulty <input type="checkbox"/></td> <td>With moderate difficulty <input type="checkbox"/></td> <td>With extreme difficulty <input type="checkbox"/></td> <td>No, Impossible <input type="checkbox"/></td> </tr> </table>	Yes, Easily <input type="checkbox"/>	With little difficulty <input type="checkbox"/>	With moderate difficulty <input type="checkbox"/>	With extreme difficulty <input type="checkbox"/>	No, Impossible <input type="checkbox"/>
Yes, Easily <input type="checkbox"/>	With little difficulty <input type="checkbox"/>	With moderate difficulty <input type="checkbox"/>	With extreme difficulty <input type="checkbox"/>	No, Impossible <input type="checkbox"/>		
8	<p><i>During the past 4 weeks.....</i></p> <p>Have you been troubled by <u>pain from your knee</u> in bed at night?</p> <table style="width: 100%; text-align: center;"> <tr> <td>No nights <input type="checkbox"/></td> <td>Only 1 or 2 nights <input type="checkbox"/></td> <td>Some nights <input type="checkbox"/></td> <td>Most nights <input type="checkbox"/></td> <td>Every night <input type="checkbox"/></td> </tr> </table>	No nights <input type="checkbox"/>	Only 1 or 2 nights <input type="checkbox"/>	Some nights <input type="checkbox"/>	Most nights <input type="checkbox"/>	Every night <input type="checkbox"/>
No nights <input type="checkbox"/>	Only 1 or 2 nights <input type="checkbox"/>	Some nights <input type="checkbox"/>	Most nights <input type="checkbox"/>	Every night <input type="checkbox"/>		
9	<p><i>During the past 4 weeks.....</i></p> <p>How much has <u>pain from your knee</u> interfered with your usual work (including housework)?</p> <table style="width: 100%; text-align: center;"> <tr> <td>Not at all <input type="checkbox"/></td> <td>A little bit <input type="checkbox"/></td> <td>Moderately <input type="checkbox"/></td> <td>Greatly <input type="checkbox"/></td> <td>Totally <input type="checkbox"/></td> </tr> </table>	Not at all <input type="checkbox"/>	A little bit <input type="checkbox"/>	Moderately <input type="checkbox"/>	Greatly <input type="checkbox"/>	Totally <input type="checkbox"/>
Not at all <input type="checkbox"/>	A little bit <input type="checkbox"/>	Moderately <input type="checkbox"/>	Greatly <input type="checkbox"/>	Totally <input type="checkbox"/>		
10	<p><i>During the past 4 weeks.....</i></p> <p>Have you felt that your knee might suddenly 'give way' or let you down?</p> <table style="width: 100%; text-align: center;"> <tr> <td>Rarely/ never <input type="checkbox"/></td> <td>Sometimes, or just at first <input type="checkbox"/></td> <td>Often, not just at first <input type="checkbox"/></td> <td>Most of the time <input type="checkbox"/></td> <td>All of the time <input type="checkbox"/></td> </tr> </table>	Rarely/ never <input type="checkbox"/>	Sometimes, or just at first <input type="checkbox"/>	Often, not just at first <input type="checkbox"/>	Most of the time <input type="checkbox"/>	All of the time <input type="checkbox"/>
Rarely/ never <input type="checkbox"/>	Sometimes, or just at first <input type="checkbox"/>	Often, not just at first <input type="checkbox"/>	Most of the time <input type="checkbox"/>	All of the time <input type="checkbox"/>		
11	<p><i>During the past 4 weeks.....</i></p> <p>Could you do the household shopping <u>on your own</u>?</p> <table style="width: 100%; text-align: center;"> <tr> <td>Yes, Easily <input type="checkbox"/></td> <td>With little difficulty <input type="checkbox"/></td> <td>With moderate difficulty <input type="checkbox"/></td> <td>With extreme difficulty <input type="checkbox"/></td> <td>No, Impossible <input type="checkbox"/></td> </tr> </table>	Yes, Easily <input type="checkbox"/>	With little difficulty <input type="checkbox"/>	With moderate difficulty <input type="checkbox"/>	With extreme difficulty <input type="checkbox"/>	No, Impossible <input type="checkbox"/>
Yes, Easily <input type="checkbox"/>	With little difficulty <input type="checkbox"/>	With moderate difficulty <input type="checkbox"/>	With extreme difficulty <input type="checkbox"/>	No, Impossible <input type="checkbox"/>		
12	<p><i>During the past 4 weeks.....</i></p> <p>Could you walk down one flight of stairs?</p> <table style="width: 100%; text-align: center;"> <tr> <td>Yes, Easily <input type="checkbox"/></td> <td>With little difficulty <input type="checkbox"/></td> <td>With moderate difficulty <input type="checkbox"/></td> <td>With extreme difficulty <input type="checkbox"/></td> <td>No, Impossible <input type="checkbox"/></td> </tr> </table>	Yes, Easily <input type="checkbox"/>	With little difficulty <input type="checkbox"/>	With moderate difficulty <input type="checkbox"/>	With extreme difficulty <input type="checkbox"/>	No, Impossible <input type="checkbox"/>
Yes, Easily <input type="checkbox"/>	With little difficulty <input type="checkbox"/>	With moderate difficulty <input type="checkbox"/>	With extreme difficulty <input type="checkbox"/>	No, Impossible <input type="checkbox"/>		

Appendix D

Test	Tampa Scale for Kinesiophobia (TSK)
Description	A 17 item scale which measures the fear of movement related to pain. The level of activity of patients with fear of injury and avoidance behaviour as result can be concluded. The patient indicates in what extend he or she assumes the association between pain and movement. Each question has a 4 point Likert scale from 1 to 4 (items 4, 8, 12 and 16 are reversely scored).
Purpose	Measurement of fear of movement and (re)injury.
Scores	The minimum score is 17 and the maximum score 68. The higher the score, the higher the degree of kinesiophobia. The score 37 is used as a cut-off score. <ul style="list-style-type: none"> - ≤ 37: low fear - > 37: high fear
References	Vlaeyen, J. W., Kole-Snijders, A. M., Boeren, R. G., & Van Eek, H. (1995). Fear of movement/(re) injury in chronic low back pain and its relation to behavioral performance. <i>Pain</i> , 62(3), 363-372. Siqueira, F. B., Teixeira-Salmela, L. F., & Magalhães, L. D. C. (2007). Analysis of the psychometric properties of the Brazilian version the tampa scale for kinesiophobia. <i>Acta Ortopédica Brasileira</i> , 15(1), 19-24.

Tampa Scale for Kinesiophobia (Miller , Kori and Todd 1991)

- 1 = strongly disagree
 2 = disagree
 3 = agree
 4 = strongly agree

1. I'm afraid that I might injury myself if I exercise	1	2	3	4
2. If I were to try to overcome it, my pain would increase	1	2	3	4
3. My body is telling me I have something dangerously wrong	1	2	3	4
4. My pain would probably be relieved if I were to exercise	1	2	3	4
5. People aren't taking my medical condition seriously enough	1	2	3	4
6. My accident has put my body at risk for the rest of my life	1	2	3	4
7. Pain always means I have injured my body	1	2	3	4
8. Just because something aggravates my pain does not mean it is dangerous	1	2	3	4
9. I am afraid that I might injure myself accidentally	1	2	3	4
10. Simply being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my pain from worsening	1	2	3	4
11. I wouldn't have this much pain if there weren't something potentially dangerous going on in my body	1	2	3	4
12. Although my condition is painful, I would be better off if I were physically active	1	2	3	4
13. Pain lets me know when to stop exercising so that I don't injure myself	1	2	3	4
14. It's really not safe for a person with a condition like mine to be physically active	1	2	3	4
15. I can't do all the things normal people do because it's too easy for me to get injured	1	2	3	4
16. Even though something is causing me a lot of pain, I don't think it's actually dangerous	1	2	3	4
17. No one should have to exercise when he/she is in pain	1	2	3	4

Reprinted from:

Pain, Fear of movement/(re) injury in chronic low back pain and its relation to behavioral performance, 62, Vlaeyen, J., Kole-Snijders A., Boeren R., van Eek H., 371.
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Appendix E

Test	Timed Up and Go test (TUG)
Description	A test where people are timed during rising from an armchair, walking 3 meters, turning around, walking back and sitting down. The required time is measured with a stopwatch. The patient can use his or her own walking aid and/or orthosis.
Purpose	Measuring of functional mobility, dynamic balance and strength.
Scores	<ul style="list-style-type: none"> - < 10 seconds: freely independent individual - < 20 seconds: independent for basis transfers - 20 - 29 seconds: intermediate grey zone - ≥ 30 seconds: much more independent, need the assistance of others for many mobility tasks - > 14 seconds: increased overall fall risk
References	<p>Boonstra, M. C., Malefijt, M. D. W., & Verdonschot, N. (2008). How to quantify knee function after total knee arthroplasty?. <i>The Knee</i>, 15(5), 390-395.</p> <p>Podsiadlo, D., & Richardson, S. (1991). The timed "Up & Go": a test of basic functional mobility for frail elderly persons. <i>Journal of the American geriatrics Society</i>, 39(2), 142-148.</p> <p>Dunsky, A., Zeev, A., & Netz, Y. (2017). Balance performance is task specific in older adults. <i>BioMed research international</i>, 2017.</p> <p>Bohannon, R. W. (2006). Reference values for the timed Up and Go test: a descriptive meta-analysis. <i>Journal of geriatric physical therapy</i>, 29(2), 64-68.</p> <p>Zak, M., Krupnik, S., Puzio, G., Staszczak-Gawelda, I., & Czesak, J. (2015). Assessment of functional capability and on-going falls-risk in older institutionalized people after total hip arthroplasty for femoral neck fractures. <i>Archives of gerontology and geriatrics</i>, 61(1), 14-20.</p>

Appendix F

Test	Tinetti test or Performance Oriented Mobility Assessment (POMA)
Description	The total scale of the Tinetti test includes 2 subscales: the balance subscale (Tinetti-B test) and the gait subscale (Tinetti-G test). The Tinetti-B test evaluates different positions and changes in position of patients and reflects stability ability related to daily activities. The Tinetti-G test examines aspects of the locomotion pattern of patients.
Purpose	Measurement of mobility dysfunctions and fall risk in elderly.
Scores	<p>The maximum score of the Tinetti test is 28 and the maximum scores on the Tinetti-B and Tinetti-G test are respectively 16 and 12. The lower the score, the higher the problem.</p> <ul style="list-style-type: none"> - > 24: low fall risk - 19 - 24: increased fall risk - < 19: high fall risk - 19: 5-fold higher fall risk
References	<p>Zak, M., Krupnik, S., Puzio, G., Staszczak-Gawelda, I., & Czesak, J. (2015). Assessment of functional capability and on-going falls-risk in older institutionalized people after total hip arthroplasty for femoral neck fractures. <i>Archives of gerontology and geriatrics</i>, 61(1), 14-20.</p> <p>Köpke, S., & Meyer, G. (2006). The Tinetti test. <i>Zeitschrift für Gerontologie und Geriatrie</i>, 39(4), 288-291.</p> <p>Faber, M. J., Bosscher, R. J., & van Wieringen, P. C. (2006). Clinimetric properties of the performance-oriented mobility assessment. <i>Physical therapy</i>, 86(7), 944-954.</p> <p>Lin, M. R., Hwang, H. F., Hu, M. H., Wu, H. D. I., Wang, Y. W., & Huang, F. C. (2004). Psychometric comparisons of the timed up and go, one-leg stand, functional reach, and Tinetti balance measures in community-dwelling older people. <i>Journal of the American Geriatrics Society</i>, 52(8), 1343-1348.</p> <p>Tinetti, M. E. (1986). Performance-oriented assessment of mobility problems in elderly patients. <i>Journal of the American Geriatrics Society</i>, 34(2), 119-126.</p>

TINETTI BALANCE ASSESSMENT TOOL

Tinetti ME, Williams TF, Mayewski R, Fall Risk Index for elderly patients based on number of chronic disabilities. Am J Med 1986;80:429-434

PATIENTS NAME _____ D.o.b. _____ Ward _____

BALANCE SECTION

Patient is seated in hard, armless chair;

		Date	
Sitting Balance	Leans or slides in chair	= 0	
	Steady, safe	= 1	
Rises from chair	Unable to without help	= 0	
	Able, uses arms to help	= 1	
	Able without use of arms	= 2	
Attempts to rise	Unable to without help	= 0	
	Able, requires > 1 attempt	= 1	
	Able to rise, 1 attempt	= 2	
Immediate standing Balance (first 5 seconds)	Unsteady (staggers, moves feet, trunk sway)	= 0	
	Steady but uses walker or other support	= 1	
	Steady without walker or other support	= 2	
Standing balance	Unsteady	= 0	
	Steady but wide stance and uses support	= 1	
	Narrow stance without support	= 2	
Nudged	Begins to fall	= 0	
	Staggers, grabs, catches self	= 1	
	Steady	= 2	
Eyes closed	Unsteady	= 0	
	Steady	= 1	
Turning 360 degrees	Discontinuous steps	= 0	
	Continuous	= 1	
	Unsteady (grabs, staggers)	= 0	
	Steady	= 1	
Sitting down	Unsafe (misjudged distance, falls into chair)	= 0	
	Uses arms or not a smooth motion	= 1	
	Safe, smooth motion	= 2	
	Balance score		/16 /16

P.T.O.

TINETTI BALANCE ASSESSMENT TOOL

GAIT SECTION

Patient stands with therapist, walks across room (+/- aids), first at usual pace, then at rapid pace.

		Date	
Indication of gait (Immediately after told to 'go')	Any hesitancy or multiple attempts	= 0	
	No hesitancy	= 1	
Step length and height	Step to	= 0	
	Step through R	= 1	
	Step through L	= 1	
Foot clearance	Foot drop	= 0	
	L foot clears floor	= 1	
	R foot clears floor	= 1	
Step symmetry	Right and left step length not equal	= 0	
	Right and left step length appear equal	= 1	
Step continuity	Stopping or discontinuity between steps	= 0	
	Steps appear continuous	= 1	
Path	Marked deviation	= 0	
	Mild/moderate deviation or uses w. aid	= 1	
	Straight without w. aid	= 2	
Trunk	Marked sway or uses w. aid	= 0	
	No sway but flex. knees or back or uses arms for stability	= 1	
	No sway, flex., use of arms or w. aid	= 2	
Walking time	Heels apart	= 0	
	Heels almost touching while walking	= 1	
	Gait score		/12 /12
Balance score carried forward			/16 /16
Total Score = Balance + Gait score			/28 /28

Risk Indicators:

Tinetti Tool Score	Risk of Falls
≤18	High
19-23	Moderate
≥24	Low

Populaire samenvatting

Een gekende en veel uitgevoerde operatie in België is knie artroplastie (KA). De meest voorkomende indicatie om KA uit te voeren, is osteoartrose. Dit is een aandoening waarbij vooral het kraakbeen en de onderliggende botten van het gewricht aangetast worden. Er zijn verschillende types van KA, waaronder een totale knieprothese (TKP) en een unicondylaire knieprothese (UKP). Bij een TKP wordt de volledige knie vervangen door een kunstgewricht. Bij een UKP, of halve knieprothese, wordt slechts de binnenste of buitenste helft vervangen.

Het doel van deze studie was om meer inzicht te krijgen in het herstel van gang en balans bij patiënten met een TKP vergeleken met patiënten met een UKP. Om dit te verkrijgen, werd er een longitudinaal en cross-sectioneel onderzoek uitgevoerd. Dit hield in dat de revalidatie van alle patiënten op lange termijn werd bekeken en dat de twee groepen met elkaar vergeleken werden.

De patiënten werden gekozen op de orthopedische dienst van het AZ Sint Lucas te Brugge over een periode van één jaar. Ze werden op drie verschillende tijdstippen geëvalueerd: twee of drie dagen, zes weken en zes maanden na de operatie. Op elk testmoment vulden de patiënten vier vragenlijsten in en voerden ze twee testen uit. De eerste test, de Timed Up and Go test (TUG), is een test waarbij patiënten moeten rechtstaan uit een stoel, drie meter wandelen, draaien rond een kegel, terug wandelen en gaan zitten. De tweede test, de Tinetti test, is een test die bestaat uit twee subschalen, de Tinetti gang en de Tinetti balans. Deze twee testen evalueren de gang en balans alsook het valrisico van patiënten.

Patiënten met een TKP en een UKP scoorden doorheen de tijd beter op drie van de vier vragenlijsten. De scores op de laatste vragenlijst bleven tijdens de drie testmomenten gelijk. Gedurende de revalidatie maakten alle patiënten een betekenisvolle verbetering bij het uitvoeren van de twee testen. Er was geen beduidend en relevant verschil op te merken tussen patiënten met een TKP en een UKP bij het uitvoeren van de TUG. Bij de Tinetti test daarentegen hadden patiënten met een UKP een relevant beter resultaat op het tweede testmoment en een beduidend beter resultaat op het derde testmoment in vergelijking met patiënten met een TKP. De kleine gemeten verschillen waren dus ten voordele van patiënten met een UKP.

De beslissing vanwege de ethische commissie

20-11-2017 Goedkeuring: masterproef "longitudinaal onderzoek naar de... - Lore Verscheure

Goedkeuring: masterproef "longitudinaal onderzoek naar de uitvoering van de 'timed up and go' test bij patiënten na het plaatsen van een knieprothese" (MP002995)

SCONE <no-reply@gbiomed.kuleuven.be>
ma 13-11-2017 14:06
Aan:Lore Verscheure <lore.verscheure@student.kuleuven.be>;





Geachte professor,
Beste student,

De verstrekte informatie toont aan dat het onderzoek in het kader van de masterproef integraal deel uitmaakt van een studie die reeds werd goedgekeurd door een erkend ethisch comité.

U hoeft bijgevolg geen nieuw dossier in te dienen in het kader van uw masterproef. Wel dient u het UZ/KU Leuven toe te voegen als nieuw deelnemend centrum aan het huidige dossier indien dit nog niet het geval was. Gelieve u bij het betreffende comité te informeren en u te conformeren aan de daar geldende procedures en hun adviezen te volgen.

Onder voorbehoud van de volledigheid en correctheid van de door u verstrekte gegevens, krijgt u hierbij de goedkeuring om het onderzoek in het kader van de masterproef te starten.

Wij willen u erop attent maken dat u zelf verantwoordelijk blijft voor uw onderzoek. Bovendien doet elke wijziging aan de door u verstrekte gegevens omtrent de onderzoeksopzet elke eerdere goedkeuring vervallen. U dient in dat geval een amendement te maken aan uw huidig dossier bij het comité dat eerder uw dossier goedkeurde.

Veel succes!

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<https://owa.student.kuleuven.be/owa/#viewmodel=ReadMessageItem&ItemID=AAMkADM0NmYxYjg3LTImOTY1NGVlOS1lMGJlLWZhMDQ3NDIi...> 1/1

Appendix I

Richtlijnen voor auteurs voor publicaties van 'The Journal of Arthroplasty'

<https://www.elsevier.com/journals/journal-of-arthroplasty/0883-5403?generatepdf=true>