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Pain, quality of life, proprioception and physical function in patient with knee osteoarthritis: Comparison of different grades

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Abstract

This study aimed to determine the differences in pain, quality of life and functional status of individuals with Knee Osteoarthritis (KOA) between grades. The study included 90 patients with different grades (Grades 1, 2, and 3) of KOA. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Lower Extremity Functional Scale (LEFS), Berg Balance Scale (BBS), Knee Injury and Osteoarthritis Outcome Score-Physical Function Shortform (KOOS-PS), Short Form Health (SF-12), Oxford Knee Score (OKS) and Visual Analogue Scale (VAS) scales were applied. Timed Up and Go test (TUG), Five Times Sit to Stand Test (5STS), Stair Climb Test (SCT), 6-minute Walking Test (6MWT) and proprioception measurements were performed for functional assessments. Foot Posture Index (FPI-6), Navicular Drop Test (NDT) and Foot Function Index (FFI) tests were used for foot posture evaluations. In the functional tests performed in the study, a significant decrease in test performance was observed in the 6MWT and SCT tests as the grade level increased ($P<0.05$). In TUG and 5STS tests, a significant decrease in performance was detected only in Grade 3 compared to other grades ($P<0.05$). Similarly, there were significant differences between the grades in all scales applied ($P<0.05$). In proprioception evaluations, similar medians were found between sides ($P>0.05$). In FFI averages, significant differences were found especially in pain ($P=0.036$) and insufficiency ($P=0.008$) parameters compared to grade 3. This study revealed noticeable differences in knee scores, pain, quality of life scales and functional tests at different stages of KOA. These differences were generally negative as grade levels increased. However, consistent with previous research, conflicting results were identified, emphasizing the need for a nuanced understanding of KOA.

Keywords: Osteoarthritis, knee score, physical functions, life quality, kellgren lawrence classification

Introduction

Knee Osteoarthritis (KOA) is a disease that starts with cartilage degeneration and involves degeneration of surrounding tissues, causing chronic inflammation with bone remodeling [1]. KOA increases with age and is highly prevalent in individuals aged 40 years and older [2]. In people over 65 years of age, it is recognized as the leading cause of disability [3]. KOA is characterized by progressive loss of articular cartilage leading to joint pain, stiffness, limited range of motion, functional impairment, disability and reduced quality of life [4]. Pain, being the most fundamental symptom of the disease, is directly correlated with radiographic alterations as well as other symptoms and signs and it serves as a dependable indicator for predicting future disability [2].

The Kellgren-Lawrence (K/L) scale based on radiography is used to monitor the progression of KOA and evaluate the

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outcome [5]. The K/L is categorized into 1-4 groups according to the degree of severity with radiographic findings, and when KOA reaches advanced grades, conservative treatment generally does not work to reduce pain, leading to functional loss, pain, and decreased quality of life, with the combination of all these factors, the clinical condition of the patients worsens and functional total knee arthroplasty (TKA) becomes the last option for the patient [1,6]. In addition, cartilage lesions, bone marrow edema pattern, meniscal and ligamentous lesions are frequently observed on magnetic resonance imaging (MRI) images in patients with osteoarthritis, especially in advanced grades, which may lead to functional loss and pain in patients in addition to KOA [7].

In people with KOA, activities such as climbing stairs, walking, climbing become difficult over time with poor balance, restriction in range of motion, deformities, damage to joint mechanoreceptors and increased pain [8]. Since proprioception originates from proprioceptors in skeletal muscles, tendons, ligaments and joint capsule, a decrease in proprioceptive sensation can be seen with the progression of KOA, and a decrease in proprioception may be a cause of increased knee pain or activity limitation [9–12]. There are studies showing significantly higher pain scores, lower quality of life scores, and decreased knee proprioception in KOA compared to healthy individuals [13,14]. However, when clinical symptoms such as pain and function are evaluated in individuals with KOA, especially according to radiologic grades, no clear conclusion can be reached.

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) pain and physical function and Visual Analogue Scale (VAS) scores have also been reported to be highly significant [2,15].

In the literature, there are many studies evaluating pain, physical activity and functional status in individuals with KOA, but the studies were mostly compared with healthy controls. In the systematic reviews, it is stated that comparisons should also be made according to radiologic severity [16,17]. In addition, although there are studies examining pain, quality of life and functional status in KOA, no study has been found to examine all these parameters together between radiologic grades. It is thought that by using K/L staging with the significance that may be found between staging and these parameters, it is possible to comment on the patient's pain and functional status and to provide more practical advice and treatment. When evaluated with all this information, the aim of our study was to compare knee scores, pain and knee function in patients diagnosed with KOA at 3 different grades. The study hypothesized that negative outcomes in knee scores, pain and physical function would increase with increasing grade according to the KOA classification.

Material and Methods

Participants

In this study, 18 male and 72 female patients, aged between 23 and 73 years, with a mean age of 53 years, who were admitted to the Orthopedics and Traumatology Outpatient Clinic of Samsun Training and Research Hospital between January 2022 and April 2023, with a diagnosis of KOA, were evaluated. GPower 3.1 program and a-priori test were used to determine the number of participants. As a result of the power analysis sampling study, it was calculated that the study could be completed with 24 patients for each group (effect size: 0.86; actual power: 0.90). The subject group consisted of a total of 90 patients diagnosed with grade 1, grade 2 and grade 3 KOA, 30 patients each according to K/L classification. The inclusion criteria were patients with grade 1, 2 or 3 knee KOA according to the K/L classification, patients who had been followed up for at least 6 months with their diagnosis, patients between the ages of 20-75 years, patients without any deformity or arthrosis findings in the lower extremity other than KOA diagnosis, and patients without any rheumatologic diagnosis. Exclusion criteria were those who had undergone TKA, had any cardiorespiratory disease, and had a history of previous lower extremity surgery.

Experimental Design

The study was designed according to a cross-sectional multiple group experimental design. In this design, patients diagnosed with KOA at 3 different grades (Grade 1, 2 and 3) were compared. The patients visited the clinic three times in total including the familirization session for the tests to be applied. In the first visit, age, height, weight, body mass index (BMI) and other anthropometric measurements of the subjects were made, information about the tests to be performed was given and they were subjected to trial tests. In 2 visits, the subjects were given practice cards (1- The Oxford Knee Score (OKS), Visual Analogue Scale (VAS), Knee Joint Proprioceptive Sensory Measurements, Five Times Sit to Stand Test (5STS), Stair Climb Test (SCT) and Berg Balance Scale (BBS). 2- Knee Injury and Osteoarthritis Outcome Score-Physical Function Shortform (KOOS-PS), The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Short Form Healty Survey (SF-12), Lower Extremity Functional Scale (LEFS), Timed Up and Go test (TUG) and 6-Minute Walking Test (6MWT)) were randomized according to the type of test they took. All measurements were performed at the same time of the day (14:00-16:00). The study protocol was approved by the Ethical Committee of the Gümüşhane University (protocol code: E-95674917-108.99-222916).

Procedures

Radiological Grade Assessment

Bilateral standing, fixed flexion knee radiographs were taken. The radiographs were evaluated by a specialist. In our study, radiographic severity was evaluated using the K/L classification system [18]. Participants were divided into 3 groups according to severity according to radiographic findings: grade (K/L grade: 0 or 1), initial grade (K/L grade: 2), and intermediate grade (K/L grade: 3) (Figure 1).

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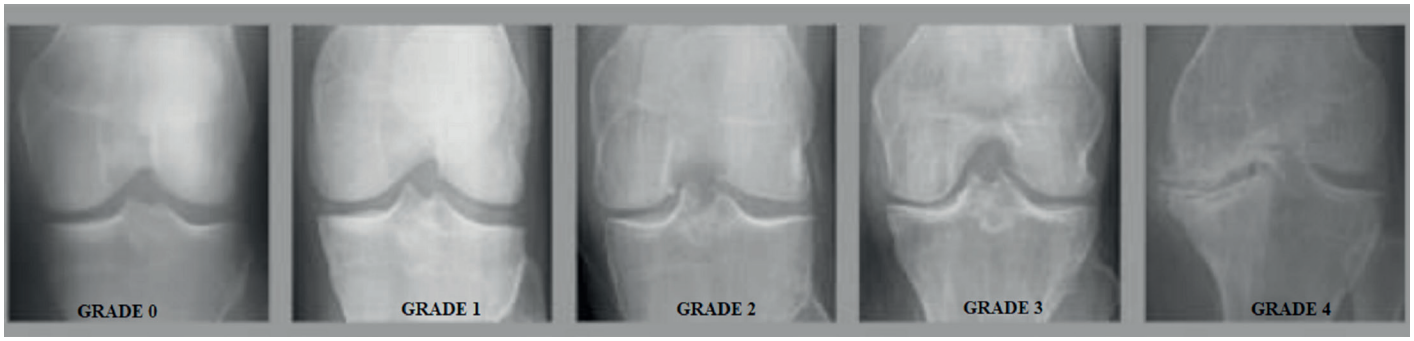

Figure 1. The Kellgren-Lawrence classification of KOA

Assessment of Physical Performance

Timed Up and Go Test (TUG): The TUG was created as a means to evaluate functional mobility. Participants were instructed to rise from a chair equipped with armrests, walk a distance of 3 meters, turn around, walk back to the chair, and sit down. A stopwatch was used to record the time taken to complete the test in seconds [20].

Five Times Sit to Stand Test (5STS): During the 5STS assessment, all participants were seated in an identical chair (measuring 44 cm) within the same clinical assessment room. They were instructed to cross their arms over their chest and lean against the chair's backrest. Subsequently, they were prompted to stand up and sit down five times as quickly as possible. The duration of the test was measured in seconds using a stopwatch [21].

Stair Climb Test (SCT): During the SCT, participants navigated a 5-step staircase, with each step measuring 17.5 cm in height, at their preferred speed. Patients were positioned in front of the initial step and instructed to ascend the stairs, return to the top step, and then descend back to the starting position. They were advised to utilize the handrails for support as necessary while ascending or descending. The time taken to complete the task was recorded in seconds.

6-Minute Walking Test (6MWT): The 6MWT was conducted indoors within a 30-meter long corridor featuring a flat and firm surface. Throughout the test, participants were directed to walk at a pace suitable for their physical capabilities, with the option to pause or reduce speed if necessary, resuming walking promptly. Encouragement was provided when needed, using standardized phrases such as "You're doing great" and "Keep up the good work." The number of laps completed and any additional distance covered were documented, and the 6MWT results were computed accordingly [22].

Knee Joint Proprioceptive Sensory Measurements: Knee joint proprioceptive measurements were conducted using a digital goniometer (2176-300 Insize Digital Angle Meter) with a sensitivity of one degree. The goniometer was affixed to the patient's knee joint using EMG bandages. Subsequently, four specific angle targets (15°, 30°, 45°, and 60°) were established for the measurements. Initially, the goniometer was calibrated with the patient lying prone, eyes closed, hips in a neutral position, and both knees fully extended. The target angle was verbally communicated to the patient, who was instructed to concentrate on this angle and maintain the knee in that position for 5 seconds to fully perceive it. The patient then adjusted the knee to match the target angle. This process was repeated three times for each target angle, and the average angular errors of the measurements were calculated. Furthermore, all procedures were replicated with the patient lying supine, and the test was performed for both knees.

Assessment of Pain and Functional Level

WOMAC: The WOMAC questionnaire is a 5-point Likert-type scale that assesses pain with 5 questions, joint stiffness with 2 questions and limitation and physical function with 17 questions. The total score was obtained after summing the answers given to each subscale. It was then multiplied by 100. The result was divided by 96 to obtain the total score percentage.

Lower Extremity Functional Scale (LEFS): The LEFS is designed to assess the functional status of patients experiencing musculoskeletal dysfunction in their lower extremities in a straightforward manner. It comprises 20 items, each offering five numerical response options (ranging from 0 to 4). The total score spans from 0 to 80, with higher scores indicating a more favorable functional status.

Berg Balance Scale (BBS): The BBS is a tool designed to evaluate functional balance performance in adults through 14 tasks. The highest achievable score is 56, indicating normal balance. Each task is scored from 0 (unable to perform) to 4 (normal performance).

Knee Injury and Osteoarthritis Outcome Score-Physical Function Shortform (KOOS-PS): KOOS-PS form is a 4-point Likert-type scale consisting of 7 items. The minimum score is 7 and the maximum score is 28. An increase in the score value will mean that the difficulty experienced by the patients in performing physical functions will increase.

Short Form Health Survey (SF-12): The Medical Outcomes Study Short Form 12 questionnaire (SF-12) was utilized to evaluate overall health status. The SF-12 comprises 12 questions

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that address physical and social functioning, emotional and mental well-being, and general health perception. From this scale, physical (SF-12 physical component summary [PCS] score) and mental (SF-12 mental component summary [MCS] score) summary scale scores were derived. Both scores range from 0 to 100, with higher scores indicating a superior health status [23].

Oxford Knee Score (OKS): There are 12 items pertaining to daily activities that the patient must independently answer, without assistance from the researcher. Each item is rated on a scale from 1 (indicating normal function) to 5 (reflecting extreme difficulty). The total score is derived from the sum of the 12 item scores, with the best possible score being 12 and the worst score being 60.

Visual Analogue Scale (VAS): The assessment of Knee Osteoarthritis (KOA) involved using the Visual Analog Scale (VAS), which comprises a 10 cm horizontal line. One end of the line represents "no pain," while the opposite end represents "worst pain imaginable." Patients were instructed to indicate the point on the line that best represented their pain intensity. Numerical values on the VAS were recorded based on the location marked by each patient along the line.

Foot Posture Index (FPI-6): The FPI-6 observes the posture of the hindfoot and forefoot in multiple planes. Its validity and reliability for the assessment of foot posture under static load has been proven in the literature for adults and children [24]. In the assessment, palpation and observations were made while the feet were shoulder-width apart and an equal load was transferred to both feet. It was evaluated with 6 parameters as the position of the talus head, observation of the supra/infra malleolar slope, position of the calcaneus in the frontal plane, medial folds of the talonavicular joint, observation of the medial arch, and adduction/abduction of the forefoot compared to the hindfoot. Each item was scored using a scale between -2 and +2, with a score of zero indicating a neutral foot posture.

Foot Function Index (FFI): FFI was developed to measure the effect of foot pathology on function in terms of pain, disability and activity limitation. It consists of 23 items with 3 subgroups: pain, disability and activity limitation. Higher scores indicate more pain, disability and activity limitation [25]. Turkish validity and reliability was performed by Yalıman et al. [26]. The score obtained after summing the scores of all questions from the patients was divided by the total maximum score that these questions can get. Then, the total score of the index was calculated by multiplying the obtained number by 100.

Navicular Drop Test (NDT): This test was used to assess the height of the medial longitudinal arch of the participants. Each participant was asked to put full weight on his/her bare foot and in this position, the distance between the tubercle of the navicular, which is the attachment site of the tibialis posterior muscle, and the ground was measured [27]. This distance was recorded as the navicular height value of the individuals and the participants were asked to sit. In the subtalar neutral position, the distance between the navicular tubercle and the ground was measured without putting any weight on the feet [28]. The difference between this distance and the amount of navicular height was recorded as navicular drop (mm).

Statistical Analyses

Statistical analyses were performed using SPSS 21 (IBM Inc., Chicago, Illinois). Descriptive data were presented as mean, standard deviation, median, minimum and maximum. Data were checked for normality using the Shapiro-Wilk test and analysed for kurtosis and skewness. Paired sample t-test or Wilcoxon rank tests were used to compare the healthy and KOA sides. Comparisons of the healthy and KOA sides at three different stages were performed by ANOVA or Kruskall-Wallis H tests. Duncan test was used for multiple comparison tests. Furthermore, as a basic assumption, we tested for an interaction between time and group. Significance was set at $P<0.05$ with associated 95% confidence intervals.

Results

Table 1 shows that the mean ages in different grade groups were 49.73±11.95 for Grade 1, 54.80±7.00 for Grade 2 and 55.00±8.99 for Grade 3. The mean BMIs in the groups were 30.90±5.27 for Grade 1, 32.87±4.81 for Grade 2 and 33.88±4.51 for Grade 3.

Table 1. Descriptive data

	Grade 1 (n=30)		Grade 2 (n=30)		Grade 3 (n=30)	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Age (year)	49.73	11.98	54.80	7.00	55.00	8.99
Length (cm)	168.70	7.95	163.40	5.99	156.28	30.94
Weight (kg)	87.87	15.80	87.90	15.02	88.86	12.21
BMI (kg/m²)	30.90	5.27	32.87	4.81	33.88	4.51

SD: standard deviation, Min: minimum, Max: maximum, BMI: body mass index

In Table 2, although inter-grade differences were observed in various scale scores evaluated in different grade groups, significant differences were found in all scales ($P<0.05$). Especially in WOMAC scores, there was a difference between all grades ($P<0.05$).

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Table 2. KOA sides of the patients constituting the subject group

	Grade 1	Grade 2	Grade 3	P value
	Mean±SD	Mean±SD	Mean±SD	
VAS	5.57±2.63[b]	7.54±2.20[a]	8.53±1.40[a]	<0.001*
KOOS-PS	14.80±12.55[b]	20.20±7.65[ab]	23.86±12.54[a]	0.009*
OKS	15.33±8.37[b]	23.60±6.17[a]	26.93±8.74[a]	<0.001*
LEFS	44.40±15.41[a]	32.47±10.65[b]	26.24±15.01[b]	<0.001*
BBS	54.57±2.37[a]	53.63±3.21[a]	48.10±6.14[b]	<0.001*
SF-12 PCS	39.71±12.02[a]	32.28±9.97[b]	28.24±8.52[b]	<0.001*
SF-12 MCS	50.08±9.73[a]	43.16±10.61[b]	42.73±11.88[b]	0.016*
WOMAC P.	5.30±3.33[c]	8.17±3.21[b]	11.41±3.72[a]	<0.001*
WOMAC S.	2.67±2.25[b]	2.03±1.85[b]	4.24±2.36[a]	<0.001*
WOMAC F.	20.53±11.27[c]	32.40±8.35[b]	43.55±12.38[a]	<0.001*
WOMAC T.	29.59±16.05[c]	44.41±12.75[b]	61.67±17.63[a]	<0.001*

*P<0.05, SD: standard deviation, abc: multiple comparison results, VAS: visual analogue scale, KOOS-PS: knee injury and osteoarthritis outcome score-physical function shortform, OKS: oxford knee score, LEFS: lower extremity functional scale, BBS: berg balance scale, SF-12 PCS: short form healthy survey physical, SF-12 MCS: short form healthy survey mental, WOMAC P.: womac pain, WOMAC S.: womac stiffness, WOMAC F.: womac physical function, WOMAC T.: womac total

In Figure 2, some functional test results in different grade groups showed a significant decrease in test performance in 6MWT and SCT tests as the grade level increased (P<0.05). In TUG and 5STS tests, a significant decrease in performance was detected only in Grade 3 compared to other grades (P<0.05). There was no significant difference between grade 1 and 2 in these tests (P>0.05).

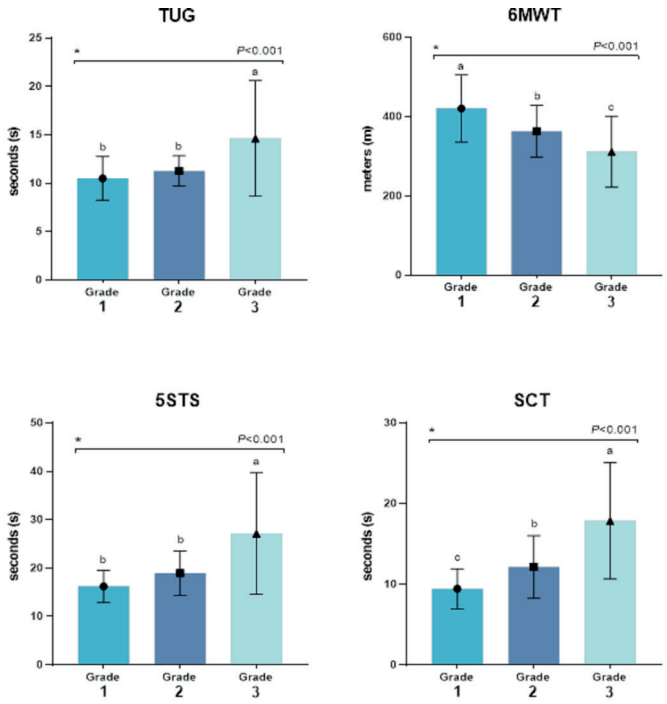

Figure 2. Comparison of functional test results between grades

There was no difference in TH, malleus, In-ever, TNJ, Medial arch, ABD/ADD and Total FPI-6 values between KOA and healthy legs in all grades (P<0.05). Patients in the Grade 1 group had lower TH values on the KOA sides than those in Grade 3 (P=0.034). In contrast, the ABD/ADD values on the KOA sides of the patients in the Grade 2 group were lower than those in Grade 1 (P=0.048). The healthy side ABD/ADD values of patients in the Grade 3 group were lower than those in Grade 1 (P=0.028) (Table 3).

When KOA and healthy legs in all grades were compared, a significant difference was observed in S 30 (P=0.023) in Grade 1, S 60 (P=0.032) in Grade 2 and P 45 (P=0.017) in Grade 3 (P<0.05). The P 45 values of the KOA sides of the patients in the Grade 1 group were lower than those in Grade 2 and III (P=0.027). The P 60 values of the KOA sides of the patients in the Grade 2 group were lower than those in Grade 1 and 3 (P=0.015). The healthy side S 15 values of patients in Grade 1 group were lower than those in Grade 2 and 3 (P=0.002). The S 60 values of the KOA sides of the patients in the Grade 1 group were lower than those in Grade 2 and 3 (P=0.031) (Table 4).

When KOA and healthy legs in all grades were compared; FFI P. (P=0.027) in Grade 1, FFI P. (P=0.018), FFI I. (P=0.017), FFI L. (P=0.042) and FFI P. (P=0.003), FFI I. (P=0.005) and FFI L. (P=0.017) in Grade 3 (P<0.05). FFI P. (P=0.036) and FFI I. (P=0.008) values of the KOA sides of the patients in the Grade 1 group were lower than those in Grade 3. Likewise, the healthy side FFI I. value of the patients in the Grade 1 group was lower than that of Grade 3 (P=0.046) (Table 5) (Figure 3).

Table 3. Comparison of KOA and healthy side evaluations of FPI-6 test in grade 1, 2 and 3 patient groups

	Grade 1			Grade 2			Grade 3			KOA	Healthyealthy
	KOA Mean±SD	Healthy Mean±SD	P value	KOA Mean±SD	Healthy Mean±SD	P value	KOA Mean±SD	Healthy Mean±SD	P value	P Value	P value
TH	0.47±0.51[b]	0.53±0.73	0.683	0.57±0.57[ab]	0.63±0.49	0.670	0.670	0.93±0.75a	0.114	0.034*	0.860
Malleus	0.53±0.51	0.60±0.72	0.593	0.63±0.56	0.57±0.63	0.694	0.694	0.55±0.51	0.782	0.790	0.636
In-ever	0.67±0.76	0.87±0.68	0.058	0.43±0.57	0.6±0.62	0.166	0.166	0.69±0.66	0.564	0.253	0.163
TNJ	0.13±0.43	0.10±0.48	0.705	0.2±0.41	0.13±0.35	0.157	0.157	0.10±0.31	0.317	0.614	0.826
Medial arch	0.80±0.76	0.80±0.76	0.999	0.7±0.92	0.63±0.85	0.414	0.414	0.97±0.91	0.132	0.630	0.577
ABD/ADD	1.23±0.73[a]	1.20±0.71[y]	0.564	0.83±0.38[b]	0.97±0.56[yz]	0.157	0.157	1.00±0.71[ab]	0.074	0.048*	0.028*
Total FPI-6	3.83±2.17	4.13±2.60	0.602	3.47±1.46	3.67±1.54	0.468	0.468	4.28±2.8	0.177	0.532	0.120

*P<0.05, SD: standard deviation, KOA: knee osteoarthritis, abc: multiple comparison results in KOA group, xyz: multiple comparison results in healthy group, TH: talar head palpation, Malleus: curves above and below the lateral malleolus, In-ever: inversion/eversion of the calcaneus, TNJ: prominence in the region of the talonavicular joint, Medial Arch: congruence of the medial longitudinal arch, ABD/ADD: abduction/adduction forefoot on rearfoot

Table 4. Comparison of KOA and healthy side evaluations of proprioception test in grade 1, 2 and 3 patient groups

	Grade 1			Grade 2			Grade 3			KOA	Healthyealthy
Degree (°)	KOA Mean±SD	Healthy Mean±SD	P Value	KOA Mean±SD	Healthy Mean±SD	P Value	KOA Mean±SD	Healthy Mean±SD	P value	P value	P value
P 15	5.13±4.13	5.21±3.39	0.921	5.38±3.69	5.53±3.22	0.832	6.58±4.11	5.5±3.77	0.260	0.330	0.923
P 30	6.64±3.09	5.39±2.68	0.115	6.83±5.2	5.65±3.71	0.217	5.89±4.79	6.06±5.9	0.890	0.697	0.835
P 45	4.17±2.31[b]	4.78±3.46	0.333	7.13±5.66[a]	6.78±4.89	0.740	7.02±5.47[a]	4.6±4.59	0.017*	0.027*	0.107
P 60	5.24±4.76[b]	6.52±3.80	0.266	4.39±3.92[b]	5.89±4.64	0.115	8.31±6.84[a]	6.21±5.16	0.082	0.015*	0.865
S 15	4.66±4.19	3.82±2.14[y]	0.269	5.31±4.38	5.22±3.18[y]	0.913	7.74±7.71	7.78±6.36z	0.971	0.093	0.002*
S 30	6.32±4.65	4.25±3.45	0.023*	5.15±2.93	6.67±7.22	0.206	8.57±7.93	6.15±4.98	0.053	0.061	0.203
S 45	5.50±3.82	4.99±4.43	0.654	6.95±5.98	6.99±4.99	0.972	7.57±5.59	5.75±2.92	0.080	0.295	0.186
S 60	4.86±3.19[b]	4.91±3.75	0.962	7.73±5.61[a]	5.25±3.57	0.032*	8.27±6.46[a]	6.41±5.52	0.151	0.031*	0.387

*P<0.05, SD: standard deviation, KOA: knee osteoarthritis, abc: multiple comparison results in KOA group, xyz: multiple comparison results in healthy group, P: prone, S: supine

Table 5. Comparison of KOA and healthy side assessments of NDT and FFIs in grade 1, 2 and 3 patient groups

	Grade 1			Grade 2			Grade 3		
	KOA Mean±SD	Healthy Mean±SD	P Value	KOA Mean±SD	Healthy Mean±SD	P Value	KOA Mean±SD	Healthy Mean±SD	P Value
NDT	11.30±6.99	10.10±5.57	0.339	10.17±4.73	10.33±5.81	0.572	9.62±5.50	11.03±5.43	0.437
FFI P.	11.40±17.10[b]	10.03±16.13	0.027*	16.00±16.54[ab]	9.07±11.01	0.018*	22.14±19.83[a]	16.17±14.73	0.003*
FFI I.	10.70±17.20[b]	10.90±18.51[z]	0.785	20.73±20.24[ab]	13.23±15.05[yz]	0.017*	32.03±29.69[a]	24.07±24.08[y]	0.005*
FFI L.	3.83±6.88	3.43±6.55	0.157	5.73±9.95	3.5±6.16	0.042*	7.41±9.12	6.28±7.72	0.017*

*P<0.05, SD: standard deviation, KOA: knee osteoarthritis, abc: multiple comparison results in KOA group, xyz: multiple comparison results in healthy group, NDT: navicular drop test, FFI P.: foot function index pain, FFI I.: foot function index insufficiency, FFI L.: foot function index activity limitation

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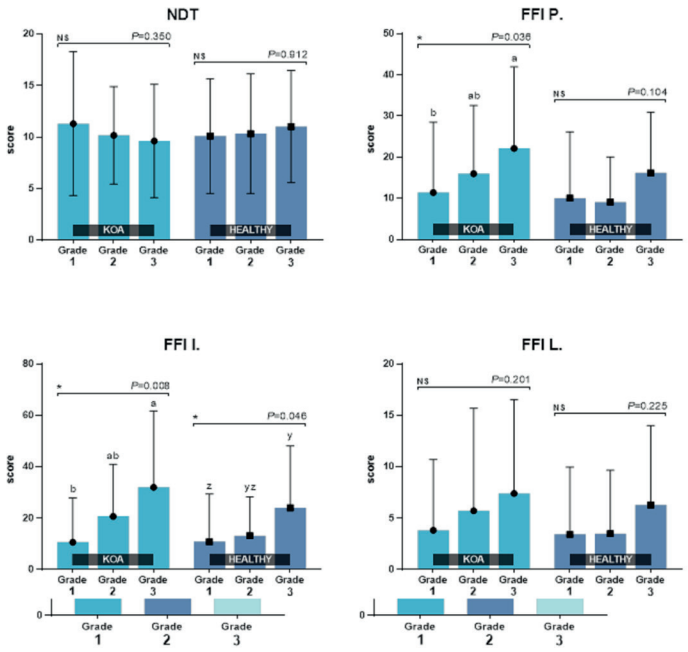

Figure 3. Comparison of KOA and healthy side assessments of NDT and FFIs between grade 1, 2 and 3 patient groups

Discussion

In this study, various parameters such as knee scores, pain and knee function were compared in patients diagnosed with unilateral KOA at three different grades. Several major findings emerged in the study in which evaluations were made between different grades of KOA. Scores on different knee and pain scales showed increasing averages for pain level and decreasing averages for knee functionality with increasing KOA grade. Similarly, in various functional tests related to the knee, a decrease in test performance was observed as KOA levels increased.

In the literature, many different pain, function and quality of life scales such as KOOS-PS, WOMAC, VAS, OKS, SF-12 and LEFS are used in the evaluation of OA, and these studies are generally evaluated by making comparisons with healthy control groups [29-33]. In our study, comparisons were made between individuals with knee OA at different grades and it was determined that the scores in all of the VAS, KOOS-PS, OKS, LEFS, BBS, SF-12 and WOMAC scales were negatively affected due to the increase in the level of OA.

Various researchers and institutions have recommended performance-based tests to analyze physical function in addition to scales in the assessment of KOA and emphasized the importance of objective measurements in the evaluation of functional capacity [34,35]. The results of functional tests such as TUG, 5STS, SCT, 6MWT and FFI in our study showed decreases in performance due to increasing KOA level, similar to the scales. However, there were contradictory results in proprioception averages, another assessment of functional capacity. It has been reported that various factors such as pain, muscle weakness and joint restriction may lead to decreased proprioceptive sensation in individuals with KOA [36]. Various studies have also revealed differences in proprioception between subjects with KOA and healthy subject groups and reported increasing proprioceptive impairments depending on the level of KOA [36,37]. In addition, it has been emphasized that proprioceptive impairment occurs not only on the affected side but also in the healthy extremity in unilateral KOA [38]. In support of this in our study, there were similar averages between the KOA side and the healthy side in all groups. However, the results were not sufficient to reveal proprioceptive differences especially between the grades.

In contrast, there is evidence to suggest that abnormal foot posture, combined with the onset of KOA, can affect force distribution across the entire lower limb and potentially affect the alignment of the knee joint [39,40]. Therefore, comprehensive foot posture assessment is important to understand the development of KOA and to contribute to the selection of the appropriate intervention method [9]. Several studies have reported a more pronated foot posture in patients with KOA [41,42]. In our study, the averages obtained as a result of NDT used for the evaluation of foot posture showed the presence of pronated foot posture similar to some studies in the literature. However, in total FPI-6 scores, no pronated or supinated foot posture was found in any group with KOA or healthy subjects, and the averages were within normal ranges. In addition, NDT and total FPI-6 scores were similar between the groups despite different KOA levels. These contradictory results are in line with a previous study emphasizing the uncertainty of the relationship between KOA and abnormal foot posture [43].

When the results of our study, which specifically included comparisons between grades in KOA, were evaluated, it was seen that differences between grades were clearly revealed especially in various scales and functional tests, but contradictory results were found in other tests such as FPI-6, NDT and proprioception. This suggests that not all scales and tests included in our study show similar results in understanding the differences between KOA grades. Nevertheless, our study yielded important results regarding KOA, especially in terms of including comparisons between grades.

This study had some limitations such as the high age differences of the individuals in the subject group and the gender distribution with a female predominance. Therefore, focusing specifically on limited age ranges in future studies and keeping gender distributions at similar levels may contribute to revealing the differences related to KOA more clearly. In order to understand the differences between KOA and KOA grades more clearly, it is important to evaluate similar test and scale types with comparisons between different age and gender groups in future studies. An important limitation of our study was whether or not all patients underwent Rosenberg radiography during K/L classification. In order to determine the grades clearly, it is recommended to perform the classifications with Rosenberg radiography in future studies. It is recommended to conduct

prospective studies on KOA using any intervention. In addition, focusing on the discrimination of the tests included in our study specifically on KOA in future studies will contribute to increasing the predictability of KOA development.

Conclusion

The results of this study elucidated noticeable variations in pain perception, knee scoring, quality of life measures and functional assessments between different stages of KOA patients. However, discordant results were observed in foot posture examinations and proprioceptive assessments, hindering a comprehensive understanding of stage-related disparities in KOA. Prospective research that systematically examines between-stage differences in various measurement scales and testing methods will increase our insights into the nuanced effects of these assessments on KOA.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
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Ethical Approval
Gümüşhane University, Human Research Ethics commitiee, Approved Number: E-95674917-18.99-222916

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