

EFFECT OF CANE USAGE ON CLINICAL AND GAIT CHARACTERISTICS OF PATIENTS WITH OSTEOARTHRITIS OF KNEE

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SUMMARY

This study was designed to investigate the effects of cane usage, for three weeks, on pain severity, stiffness, physical functioning and gait characteristics of patients with osteoarthritis of knee.

Fifteen patients (9 women, 6 men) with an average age of 53.1 ± 9.7 years, having osteoarthritis of knee but free of symptoms from their hips or ankle joints were enrolled into the study. Sociodemographic and clinical characteristics were documented. The outcome parameters, measured before and after three weeks' cane usage, were Western Ontario and Mc Master University Osteoarthritis Index and time-distance (walking velocity, step time, step length), kinematic (joint rotation angles of knee in sagittal and coronal planes) and kinetic (adductor and extensor moments of knee and scaled vertical ground reaction forces) characteristics of gait using a three-dimensional computerized gait analysis system. After the first assessment, all the patients were instructed to use a standard adjustable aluminum cane for three weeks.

There was not a significant difference in assessed parameters after the usage of cane. A slight decrease in walking velocity was observed after the usage of a cane from 1.0 ± 0.06 m/sec to 0.96 ± 0.04 m/sec. However, the adductor and extensor moments, and vertical ground reaction forces which are the major determinants of knee loading did not differ with cane usage.

In conclusion, this study could not show a significant effect of cane usage for three weeks on pain severity, stiffness, physical functioning, and kinematic and kinetic gait characteristics of patients with osteoarthritis of knee.

Key Words: Osteoarthritis, knee, cane, gait analysis, WOMAC.

ÖZET

DİZ OSTEOARTRİTİ OLAN HASTALARDA BASTON KULLANIMININ KLİNİK VE YÜRÜYÜŞ DEĞİŞKENLERİ ÜZERİNE ETKİSİ

Bu çalışma, diz osteoartriti olan hastalarda üç haftalık baston kullanımının, ağrı şiddeti, tutukluk, fiziksel fonksiyonellik ve yürüyüş değişkenleri üzerine etkilerini araştırmak amacıyla planlandı.

Çalışmaya, diz osteoartriti tanısı alıp, kalça ve ayak bileklerinde yakınması olmayan, yaş ortalamaları $53,1 \pm 9,7$ yıl olan 15 hasta (9 kadın, 6 erkek) alındı. Sosyodemografik ve klinik özellikleri kayıt edildi. Ağrı şiddeti, tutukluk, fiziksel fonksiyonellik "Western Ontario and Mc Master University Osteoarthritis Index" ile yürüyüşün zaman-uzaklık (yürüyüş hızı, adım uzaklığı ve süresi), kinematik (sagittal ve koronal planda diz ekleme hareket açıları) ve kinetik (dizin addüktör ve ekstansör momentleri ve dik yer tepkime kuvveti) değişkenleri üç boyutlu bilgisayarlı yürüme analizi kullanılarak tedavi öncesi ve sonrası olmak üzere iki defa değerlendirildi. İlk değerlendirmeden sonra hastalara üç hafta kullanmaları için standart ayarlanabilir alüminyum baston verildi.

Üç haftalık baston kullanımı sonrasında değerlendirilen değişkenlerin hiçbirinde istatistiksel olarak anlamlı değişim olmadığı gözlemlendi. Baston kullanımı ile yürüyüş hızında $1,0 \pm 0,06$ m/sn'den, $0,96 \pm 0,04$ m/sn'ye olacak şekilde hafif bir düşme olduğu izlendi. Dizde yüklenmenin ana göstergeleri olan dizin addüktör ve ekstansör momentleri ve dik yer reaksiyon kuvvetlerinde üç haftalık baston kullanımı ile bir değişiklik oluşmadı.

Sonuç olarak bu çalışmada, diz osteoartriti olan hastalarda üç haftalık baston kullanımının, ağrı şiddeti, tutukluk, fiziksel fonksiyonellik ve yürüyüş değişkenleri üzerine olumlu bir etki gösterilememiştir.

Anahtar Kelimeler: Osteoartrit, diz, baston, yürüme analizi, WOMAC.

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INTRODUCTION

Osteoarthritis (OA) is the most prevalent joint disease in older adults, and knee is the second most commonly afflicted joint of osteoarthritis. According to the American College of Rheumatology (ACR) Guidelines for the Medical Management of Osteoarthritis, the goals of management for patients with OA of the knee are to control pain and other symptoms, maintain/improve joint mobility, minimize disability, and educate patients and their families about the disease and its therapy (1). The Guideline specify ambulatory assistive devices under the "non-pharmacological therapy modalities". Canes are among the most commonly prescribed ambulatory devices. They are helpful in unloading painful joints and in stabilizing the ambulation in patients with impaired balance (2). In physical medicine and rehabilitation clinics, patients with knee OA are usually instructed to use canes to protect the involved joints from mechanical damage and prevent overloading of the knees (3).

In most of the western countries, canes are the symbol of power and aristocracy (4). However, in Turkey, many patients with osteoarthritis are usually psychologically unprepared to accept an ambulatory aid and they usually suggest that they feel older or disabled while using a cane.

Although there are several studies in the literature regarding the effects of cane usage on biomechanics of hip joint, biomechanical characteristics of knee joint has not been investigated before (5-7). This study was designed to investigate the effects of cane usage on pain severity, stiffness, physical functioning and gait characteristics of patients with osteoarthritis of knee.

MATERIAL AND METHOD

Subjects were 15 patients (9 women, 6 men) with an average age of 53.1 ± 9.7 years. Knee radiog-

raphs (weight-bearing, antero-posterior view x-rays) were used to demonstrate the degree of OA in terms of joint space narrowing and osteophyte formation. Entry criteria consisted of, willingness to participate in the study, being older than 40 years of age, and having radiographic evidence of Kellgren and Lawrence grade II-III OA of the knee. Osteoarthritis of the hips, ankles and feet were ruled out during the medical history. The subjects had OA of the knees and associated symptoms (joint pain, tenderness, swelling, crepitus and improved mobility) for more than 2 years. However, none of the subjects had any type of surgery or had been using cane.

Patients were evaluated twice, before and after 3 weeks of cane usage. Canes were the standard adjustable aluminum functional grip canes. Height of the cane was adjusted so that the top of the cane corresponded to the top of the greater trochanter. The lower tip of the cane was placed at a point 15cm. lateral to the little toe (8). After the initial evaluation, all of the patients were trained for three-point walking using cane and for shifting weight to cane, by the same physiotherapist. Patients were instructed to use their cane in the hand, contralateral to the most symptomatic side, for three weeks inside and outside their house.

The outcome parameters, measured before and after the intervention (three weeks' cane usage) were 1) Pain, stiffness and physical functioning subscores of Western Ontario and Mc Master University Osteoarthritis Index (WOMAC) 2) Time-distance, kinematic and kinetic characteristics of gait using a three-dimensional computerized gait analysis system.

WOMAC is a tri-dimensional, disease-specific, self-administered, health status measure. It probes clinically important, patient-relevant symptoms in the areas of pain, stiffness and physical function in

patients with the hip and/or knee. The index consists of 24 questions (5 pain, 2 stiffness, 17 physical function) and can be completed in less than 5 minutes. WOMAC is valid, reliable, and sufficiently sensitive to detect clinically-important changes in health status following a variety of interventions (9-10).

Computerized gait analysis has been used to quantify objectively the changes on biomechanics of walking for patients with knee OA. Sagittal plane knee joint rotation angles, peak extensor and adduction moments and peak scaled vertical ground reaction forces are the most recommended variables for the outcome studies of knee OA (11-16). Fifteen passively reflective markers were placed on standard and specific anatomical landmarks: sacrum, bilateral anterior superior iliac spine, middle thigh, lateral knee (directly lateral to axis of rotation), middle shank (the middle point between the knee marker and the lateral malleolous), lateral malleolous, heel and forefoot between the second and third metatarsal head (17). After the subjects had been instrumented with retro-reflective markers, they were instructed to walk at a self-selected speed over a 10-meter walkway during which data capture was completed. Best data of three trials used in analysis. The trial, in which all the markers were clearly and automatically identified by the system, was determined as best data. Three dimensional gait data were collected with the Vicon 370 system^a and two Bertec forceplates. Concomitant videotape recordings of the subjects' gait were also performed. Five cameras recorded (at 60Hz) the three-dimensional spatial location of each marker as the subject walks. Time-distance (walking velocity, step time, step length), kinematic (joint rotation angle of knee in sagittal and coronal plane) and kinetic (scaled vertical ground reaction forces,

extensor and adductor moments of knee) variables were processed using Vicon Clinical Manager software. Calibration of the motion analysis system was performed daily. Anthropometric data including height, weight, leg length and joint width of the knee and ankle were collected.

Data analysis was performed using SPSS for Windows version 9.0^b. Wilcoxon matched-pairs signed-ranks test was used to determine the differences of pain severity, stiffness, physical functioning and gait characteristics between walking with or without a cane.

RESULTS

Mean \pm SD age of the fifteen patients was 53.1 ± 9.7 years. Nine of them were female, all of the patients had bilateral involvement (7 with grade II, 8 with grade III radiological evidence score) and the average disease duration was 4.6 ± 3.4 years. Mean \pm SD values for WOMAC and gait characteristics were presented in Table I. There was not a statistically significant difference between walking, with and without a cane, in terms of neither pain severity, stiffness, physical functioning, nor time-distance, kinematic and kinetic variables of gait. A slight decrease in walking velocity was observed while walking with a cane from 1.0 ± 0.06 m/sec to 0.96 ± 0.04 m/sec. However, the adductor and extensor moments, and vertical ground reaction forces which are the major determinants of knee loading did not differ with cane usage.

DISCUSSION

In this study we could not find a significant effect of cane usage, for three weeks, on pain severity, stiff-

^a VICON, Oxford Metrics Limited, 14 Minns Estate, West Way, Oxford, OX2 0JB

^b Statistical Package for the Social Sciences (SPSS) for Windows, Version 9.0; SPSS Inc., 444 N. Michigan Avenue, Chicago, IL.

Table I: Mean values \pm SD for WOMAC (pain, stiffness, physical function), walking velocity, step length, step time, excursion of knee in sagittal and coronal planes; vertical ground reaction force (1st peak) of patients with and without cane

	Without cane	With cane	P
WOMAC pain	19.8 \pm 10.2	19.6 \pm 10.0	0.920
WOMAC stiffness	9.5 \pm 5.3	9.6 \pm 5.0	0.891
WOMAC physical function	39.5 \pm 33.0	39.4 \pm 33.5	0.964
Walking velocity (m/sec)	1.0 \pm 0.06	0.96 \pm 0.04	0.873
Step length (m)	0.60 \pm 0.02	0.62 \pm 0.04	0.871
Step time (sec)	58.21 \pm 2.1	60.11 \pm 3.2	0.611
Knee excursion in sagittal plane (in degrees)	64.1 \pm 11.2	64.0 \pm 10.5	0.989
Knee excursion in coronal plane (in degrees)	21.2 \pm 0.8	20.3 \pm 0.9	0.912
Knee extensor moment (Nw/kg)	40.8 \pm 7.1	41.8 \pm 5.6	0.783
Knee adductor moment (Nw/kg)	0.18 \pm 0.16	0.19 \pm 0.11	0.785
Vertical ground reaction force 1 st peak (Newtons/%bodyweight)	89.0 \pm 4.7	89.5 \pm 4.6	0.978

ness, physical functioning, and kinematic and kinetic gait characteristics of patients with osteoarthritis of knee. In previous studies, it has been shown that canes increase stability, augment muscle action and reduce the load on weight bearing structures (18). Decreasing the loads applied to damaged articular surfaces may help decrease the pain associated with osteoarthritis for some patients. Canes are thought to decrease symptoms by decreasing loads on severely involved areas of the joint (2).

Being an objective and reliable tool, computerized gait analysis has been suggested for the outcome studies of knee OA (11-16). In order to document the effectiveness of cane usage on knee joint loading and gait deviations, we used knee excursion in sagittal and coronal plane, extensor and adductor moments of the knee and peak scaled vertical ground reaction forces. Instead of maximum and minimum joint rotation angles, total excursions has been used for kinematic analysis. Carlson et al. suggested to use the total excursion (peak flexion – peak extension joint rotation angles in degree-

es) of pelvis, hip, knee and ankle in the data analysis rather than actual maximum and minimum values to minimize errors inherent in minor changes in marker placement between sessions (19).

It has been shown that higher adductor and extensor moments are the major determinants of the higher loading at the knees with OA (14,15). The patients with knee OA try to reduce internal knee extensor moments to reduce the knee joint loading. Although computerized gait analysis could not measure the loading of knee joint directly, adductor and extensor moments and scaled vertical ground reaction forces are shown to be reliable enough to demonstrate joint loading. Our patients used the cane for three weeks before the second assessment. This period is enough to expect some changes in kinematic and kinetic gait parameters. Besides, at least pain severity should have been improved in the first week, if cane had significant effects on load distribution of joints.

Kuan et al. investigated the effect of cane on gait of stroke patients and suggested that walking with a cane had kinematics more normal than tho-

se of patients without a cane (20). Ashton-Miller and associates studied the use of a cane by peripheral neuropathy patients and concluded that cane use significantly reduced their risk of losing balance on unstable surfaces (21). It is also well known that contralateral cane use can reduce total forces across the hip joint (22). However, the studies of 10 able-bodied subjects by Vargo et al. revealed that contralateral cane use did not result in uniformly decreased muscular activity around the knee joint (23). Contralateral cane usage is advised to maintain a reciprocal gait pattern; however, if this is not effective in reducing pain, a trial of ipsilateral cane usage has been recommended. Vargo et al did not report a difference between contralateral versus ipsilateral cane usage in terms of reducing muscle activity at the knee (23). In their study, cane-assisted ambulation was not found to significantly lower

strain magnitudes; however, tibial strain rates were significantly lowered by both ipsilateral and contralateral cane usage. They conclude that either ipsilateral or contralateral cane usage may be beneficial when lowering tibial strain rate is desired, such as in the treatment of tibia stress fracture or osteoarthritis of the knee. In this study, our patients had bilateral pain and osteoarthritic involvement of the knees, so that, changing the side of the cane would not be meaningful. Patients were instructed to use their cane in the hand, contralateral to the most symptomatic side.

In conclusion, this study could not show a significant effect of cane usage for three weeks on pain severity, stiffness, physical functioning, and kinematic and kinetic gait characteristics of patients with osteoarthritis of knee.

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