Epsilateral Versus Contralateral Usage of Cane in Elders with Hip Osteoarthritis

Yehia N. Abd Elhafz*, Aly Al Dali, Samiha M. Abd Elkader**, Haya Mohammed AL-Maawei*****
*Department of musculoskeletal physical therapy, Faculty of physical, Cairo University, Giza, Egypt.
**Department of Rehabilitation Sciences, Collage of applied Medical Sciences, King Saud University, Riyadh, KSA.
***Al Naqaha Hospital Riyadh, KSA.

ABSTRACT

Background and Purpose: *Hip pain is a common problem affects hip join, people suffering from painful hip or Osteoarthritis (OA) often walk slowly, take shorter steps and lean to the side of the painful hip during the weight bearing phase (stance Phase) to reduce stresses on the hip joint. However, this pattern of walking would result in excessive loading on other joints (lumbar vertebrae). Therefore, physiotherapists have to work toward this problem by advising the patients to how such gait pattern could be avoided and also prolong the life span of arthritic joint. This could be achieved through the use of a walking aid (cane, crutch or walking frame). Therefore, the purpose of this study was to determine the effect of using cane ipsilaterally and contralaterally on some gait parameters of elderly people with hip pain.* ***Subjects and methods:*** *Fifty Saudi subjects were randomly collected. Twenty five were the patients group with hip OA and other twenty five were healthy control group their age ranged between 60-75 years old. Patient group was 16 female and 9 male. However, control group was 18 female and 7 male. Gait parameters were measured by using foot print method. The measured parameters were step and stride length, velocity and cadence.* ***Results:*** *Statistical analysis showed that walking with cane ipsilaterally and contralaterally have a significant effect in improving step length, stride length and velocity, however, there was a significant reduction of cadence. Also, there was a significant improvement of gait parameters with using cane contralaterally compared to ipsilaterally.* ***Conclusion:*** *It was concluded that gait parameters were significantly improved with using a cane both on the same side of pain and on the opposite side. However, using cane contralaterally was more effective in improving gait parameters.*

Key Words: *Hip pain, hip Osteoarthritis, cane, gait parameters, foot print.*

INTRODUCTION

The hip joint is the most important joint of the lower limb as it is the most proximal joint that provides stability and gross control in space for reminder of the leg[1]. It is the second link in the chain of weight transfer from the trunk to the ground. The structure of this joint allows for wide ranges of limb movement. These characteristics are necessary because of the mechanical conditions of normal daily activities place on the joint. The hip joint must distribute body weight and contribute to smooth, efficient ambulation. Therefore, physical therapists commonly see patients with problems related to the hip joint due to repetitive loading with resultant degeneration of the articular structure[2].

Patients with hip problems tend to assume postures that diminish the force through the joint. For example, to avoid pain, the patient tends to lean the body weight towards the affected side during walking to reduce the force upon the affected hip. This relatively extreme motions require high energy expenditure and in turn results in excessive wear and tear in the lumbar spine[3,4,5]. It was found that nearly 16% of people, whose age was 65 years and older reported that their activities were limited because of OA. This number is likely to grow proportionally as elderly people increasing. OA affects at least 6% of adults older than 30 years. Radiographic evidence of this disease is present in the majority of persons by 56 years of age and in about 85% of persons more than 75 years of age[6,7,8,9].

Osteoarthritis (OA) now is one of the most prevalent disabling diseases affect hip joint. Patients with hip OA often have gait abnormalities such as asymmetry in weight bearing and in step length. Patients with hip

OA often adapt an antalgic type of gait as their disease progress. However, adaptation protects the hip, it may influence the mobility of the lower back and other joints of the lower extremities[10,11].

Assisstive devices such as cane is often used in patients with hip OA to decrease joint loading on a hip joint, reduce pain and activity limitations associated with this condition[12].

Using cane ipsilaterally by putting the cane close to the floor on the ground with slight leaning on the cane can entirely remove the load from the leg. This increasing the vertical loading on the cane and hence reducing the load on the leg to relieve the pain[13].

However, other researchers reported that the most effective method of protecting the hip while walking appears to be to use only the cane held contralateral to the hip they described also, that using the cane is the preferred method of joint protection when considering the average muscular demand across both right and left hips[14,15].

Therefore, the purpose of this Study was to investigate the effect of using cane on some gait parameters in elderly people suffering from hip pain and to determine which side is effective (ipsilateral or contralateral)in improving these parameters.

MATERIALS AND METHOD

Subjects

This study was conducted on fifty Saudi subjects, who were collected randomly. Twenty five were patients group with unilateral hip OA and twenty five were control group for comparison. Patients were collected from outpatient clinic and physiotherapy department in King Abdulaziz University hospital and Riyadh Medical Complex.

The patient group was 16 female and 9 male. Their age ranged between 60 and 75 years old with an average of 64.16 ± 4.75. Their height was between 159 and 168 cm and the average of 163.5± 4.5 cm. Their weight was between 61 and 91 kg and the average weight was 76 ± 15 kg.

The control group was 18 female and 7 male. Their age was ranged between 60 and 75 years old and the average was 62.76 ±3.74 years. Their height was between 152 and 171 cm and the average height was 161.5 ± 9.5 cm. Their weight was between 56 and 97 kg with an average of 76.5 ± 20.5 kg.

The patients inclusion criteria were, male and female, cause of hip pain was limited to arthritic changes in one hip joint, ankle and knee were free from OA or any deformity and the hip OA severity was ranged between mild to severe. The patient was excluded if there was a history of Rheumatoid arthritis or generalized neuromuscular problems, and subjects who are unable to communicate.

Patients and control groups were given an explanation of the study and the experimental protocol before conducting the experiment, then they asked to sign a consent form.

Material and Instruments

1. Stop watch.
2. Tape measure.
3. 10 meters of absorbent paper used for foot print analysis.
4. Inked pad to be attached to the bottom of the subject shoes.
5. Scissors.
6. Adjustable aluminum cane with rubber tip.
7. Stadiometer.
8. Index of severity of OA of the hip:
   Self administered lequesne–algo functional osteoarthritis (LISOH)[16]. The index includes an item of pain or discomfort, duration of morning stiffness, if pain occurs after standing certain period or walking for a certain distance, maximum distance can be walked and activities of daily an put on socks by bending forward, going up a standard flight of stairs and going in and out of car.

Procedure

1. Personal data of each subject: age, height, weight, health status, affected limb, was collected by direct interview with the participants.
2. Leg length: leg length was measured for the participants from anterior superior iliac spine to lateral malleolus [17].
3. Degree of hip OA severity was determined as follows, > 14: extremely severe,

11,12,13: very severe, 8,9,10: severe, 5,6,7: moderate and 1-4: minor19.

Data collection

Gait parameters were measured by using foot print method. It is an easy to apply, inexpensive and less time consuming. The data were obtained by this method: velocity, cadence, foot angle, B.O.S, stride length, and step length[4,18]. Each subject was instructed to walk at his or her natural walking speed with the inked pad adherent to his or her shoes. The time taken by the patient to traverse the walkway was recorded starting from the third heel strike to the line drawn at the far end (about one meter) to eliminate the factors of acceleration and deceleration. There were at least three sets of footprints.

Control group was asked to walk once without cane. However, patients were asked to walk 3 times, without cane, with cane ipsilaterally and contralaterally with allowed period of rest 10 minutes between each trial and the other.

Analysis and calculations of recorded parameters

1. Step length: It was calculated in centimeters by measuring the perpendicular distance from the heel strike of one foot to the next heel strike of the opposite foot.
2. Stride length: It was calculated in centimeters by measuring the perpendicular distance from the heel strike of the one foot to the next heel strike of the same foot.
3. Velocity: dividing the total walking distance in centimeters by the elapsed time recorded by using the stopwatch.
4. Cadence: dividing the number of steps taken during the timed sequence by the elapsed time.

Statistical analysis

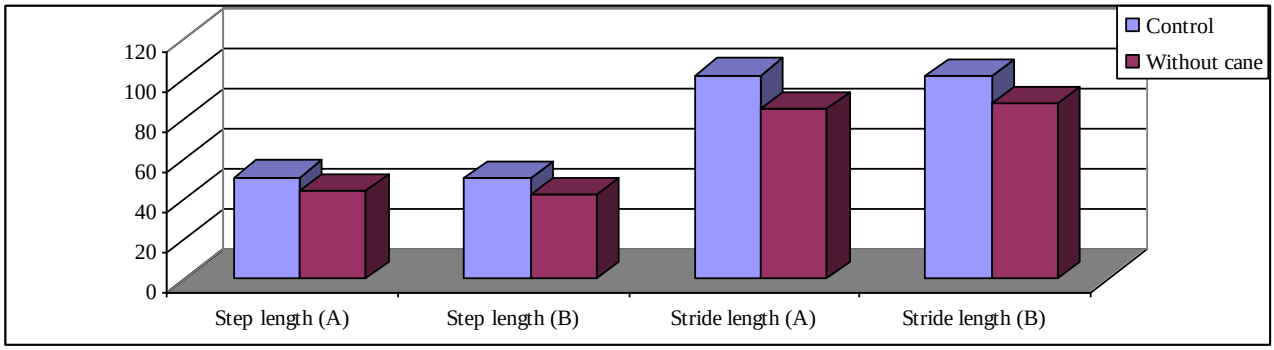
The mean and standard deviations of gait parameters in both groups were calculated. Student t-test was calculated on changes for each variable to determine if there was a significant differences in both groups and also in patients group without cane and using cane ipsilaterally or contralaterally. Significance for all statistical tests was accepted at 0.05 level of probability.

RESULTS

Table (1) and figure (1) show Comparison between the mean values of the different gait parameters of the control group and hip OA group walking without using cane. From the table, it can be seen that, there were a significant difference ($P<0.05$) of all measured gait parameters between control and patients groups.

Table (1): Comparison between control group and hip OA group walking without cane.

Variables	Control		Without Cane		P-value
Step length (cm)	Right	50.90±5.4	Sound	44.24±5.87	< 0.05
	Left	50.66±5.29	Affected	42.44±5.69	< 0.05
Stride length (cm)	Right	101.90±11.28	Affected	85.36±12.61	< 0.05
	Left	101.76±11.34	Sound	87.68±12.85	< 0.05
	Left	1. 33±0.20	Sound	1.11±0.16	< 0.05
velocity (m/min)	37.95±11.45		30.19±11.36		< 0.05
cadence (steps/ min)	29.60±6.65		35.52±10.70		< 0.05



A: right side of control group and sound side of patients group.
B: left side of control group and affected side of patients group.

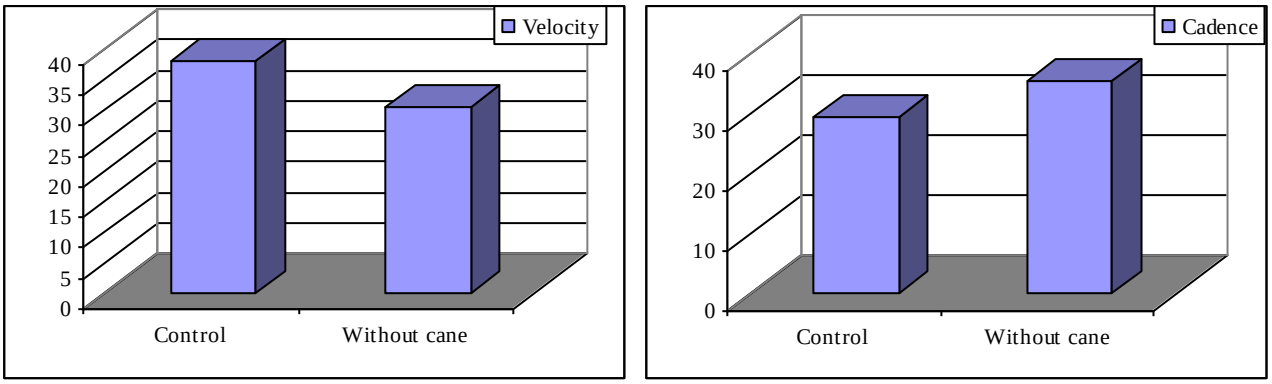


Fig. (1): Multiple graphic presentation of the measured gait parameters in control group and patients with hip osteoarthritis walking without cane.

Table (2) and figure (2) show Comparison between the mean values of the different gait parameters of the hip OA group walking without cane and walking with using cane ipsilaterally. From the table, it can be seen that, the step length and stride length of affected and sound sides were significantly (P<0.05) increased with using cane ipsilaterally. Velocity was significantly (P< 0.05) increased with using a cane ipsilaterally, however, cadence was significantly (P< 0.05) decreased.

Table (2): Comparison between hip OA group walking without cane and walking with cane ipsilaterally.

Variables		Without cane	Cane Ipsi.	P-value
Step length (cm)	Affected	42.44 ± 5.69	46. 08±5.49	< 0.05
	Sound	44.24 ± 5.87	47.80±5.41	< 0.05
Stride length (cm)	Affected	85.36 ± 12.61	91.68±9.14	< 0.05
	Sound	87.68 ± 12.85	94.54±9.05	< 0.05
	Sound	1.11 ± 0.16	1.20±0.11	< 0.05
Velocity (m/min)	30.19±11.36		36.19±8.05	< 0.05
Cadence (steps/ min)	35.52±10.70		28.88±7.18	< 0.05

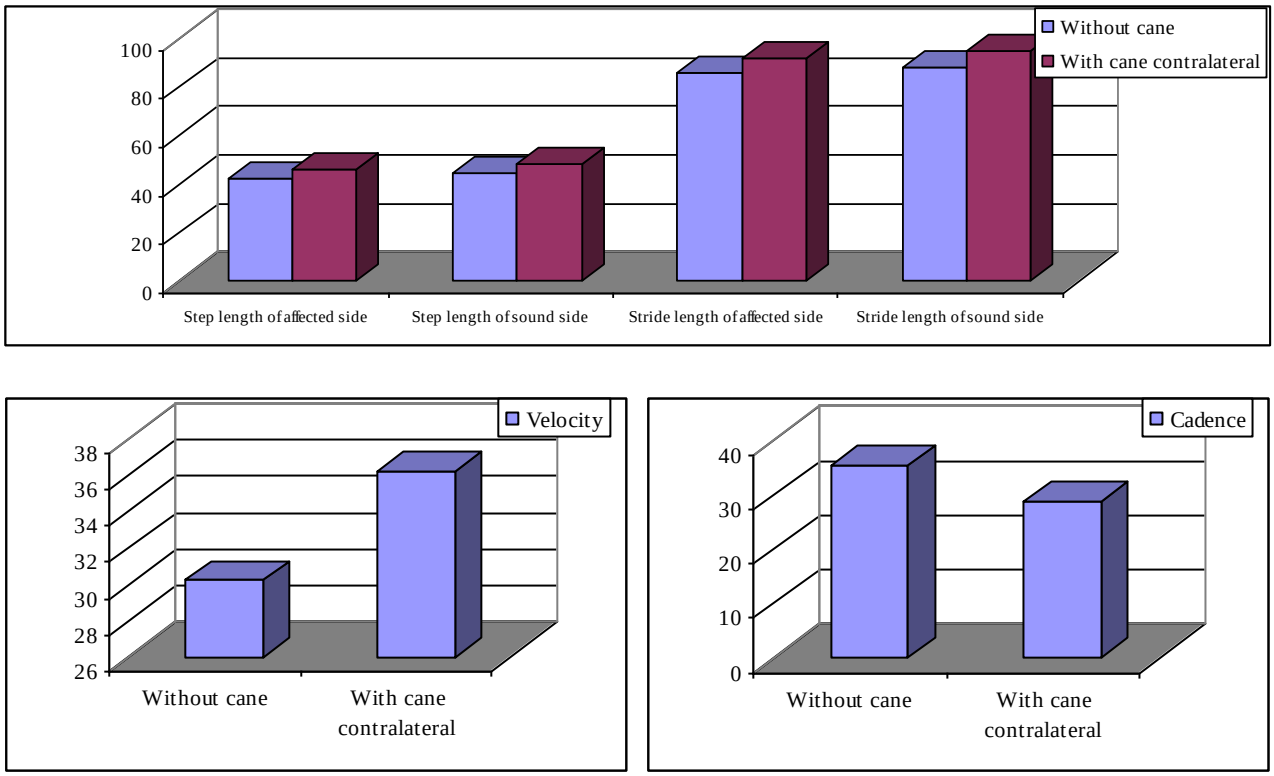
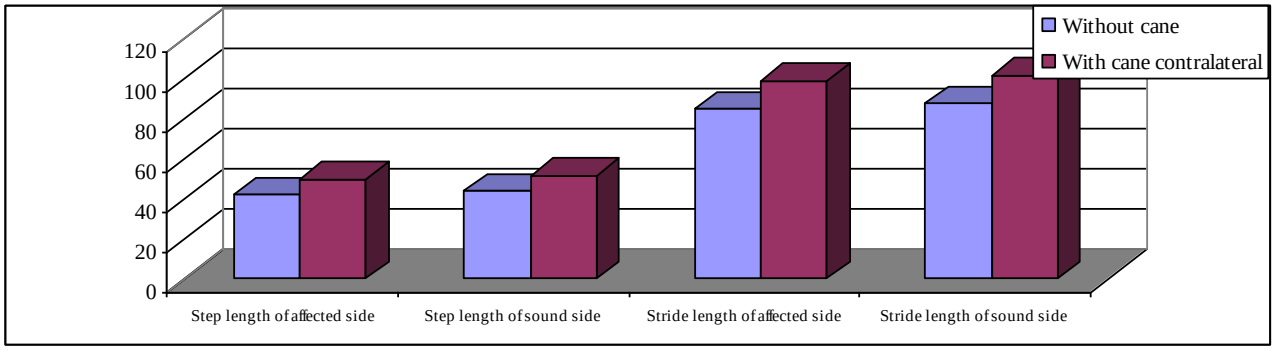


Fig. (2): Multiple graphic presentation of the measured gait parameters in patients with osteoarthritic hip without cane and with cane ipsilaterally.

Table (3) and figure (3) show comparison between the mean value of the different gait parameters of the hip OA group walking without cane and walking with cane contralaterally. From the table, it can be seen that, the step length and stride length of affected and sound sides and velocity were significantly (P< 0.05) increased with using a cane contra laterally. However, there was a significant (P< 0.05) decrease of cadence.

Table (3): Comparison between hip OA group walking without cane and walking with cane contralaterally.

Variables		Without cane	Cane Ipsi.	P-value
Step length (cm)	Affected	42.44±5.69	49.84±4.65	< 0.05
	Sound	44.24± 5.87	51.74±4.79	< 0.05
Stride length (cm)	Affected	85.36±12.61	99.12±8.95	< 0.05
	Sound	87.68±12.85	101.9 2±9.09	< 0.05
Velocity (m/min)	30.19±11.36		41.92±7.69	< 0.05
Cadence (steps/ min)	35.52±10.70		25.32±3.41	< 0.05



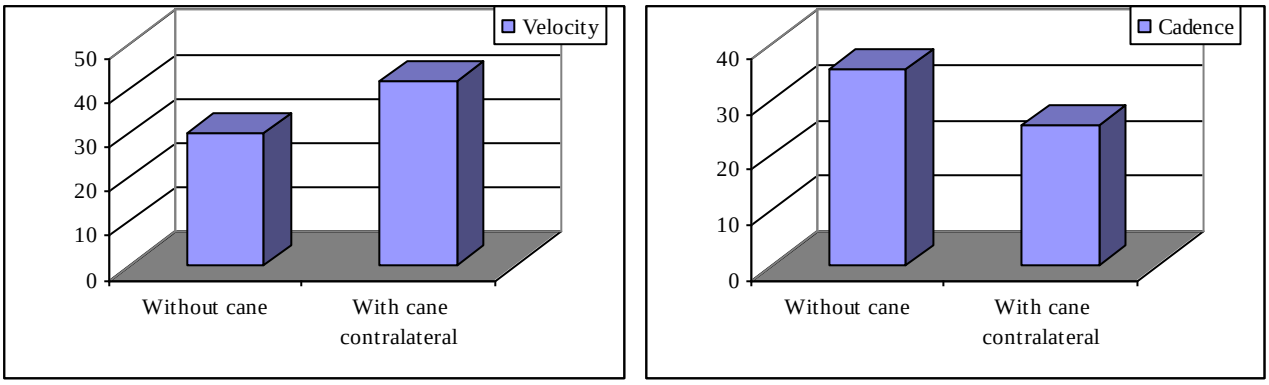
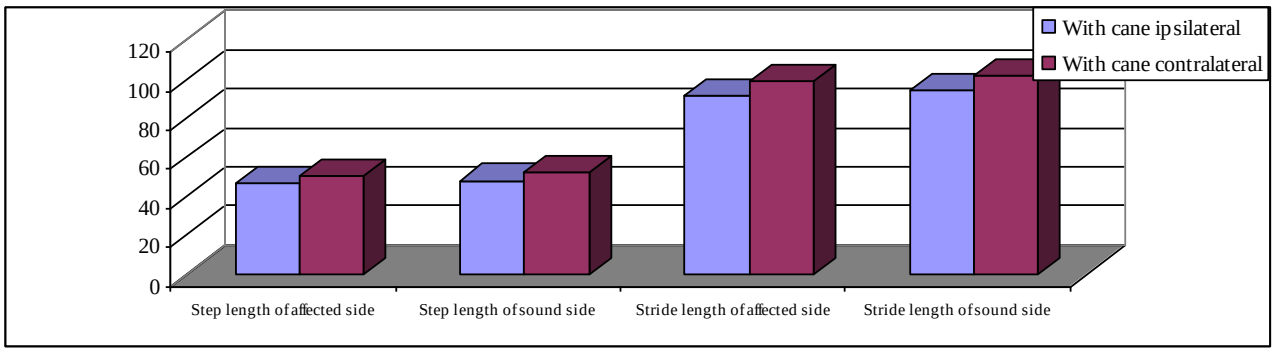


Fig. (3): Multiple graphic presentation of the measured gait parameters in patients with osteoarthritic hip walking without cane and walking with cane contralaterally.

Table (4) and figure (4) show comparison between the mean values of the different gait parameters of the hip OA group walking with using cane ipsilaterally and walking with cane contralaterally. From the table, it can be noticed that, using a cane contralaterally significantly causes a significant (P< 0.05) increase of step length, stride length of affected and sound sides and velocity. There was a significant (P< 0.05) decrease of cadence with using a cane on the opposite side of pain.

Table (4): Comparison between hip OA group walking with cane ipsilateraly and walking with cane contralateraly.

Variables		Without cane	Cane Ipsi.	P-value
Step length (cm)	Affected	46.08±5.49	49.84±4.65	< 0.05
	Sound	47.80±5.41	51.74±4.79	< 0.05
Stride length (cm)	Affected	91.68±9.15	99.12±8.95	< 0.05
	Sound	94.54±9.05	101.92±9.09	< 0.05
Velocity (m/min)		36.19±8.05	41.92±7.69	< 0.05
Cadence (steps/ min)		28.88±7.18	25±3.41	< 0.05



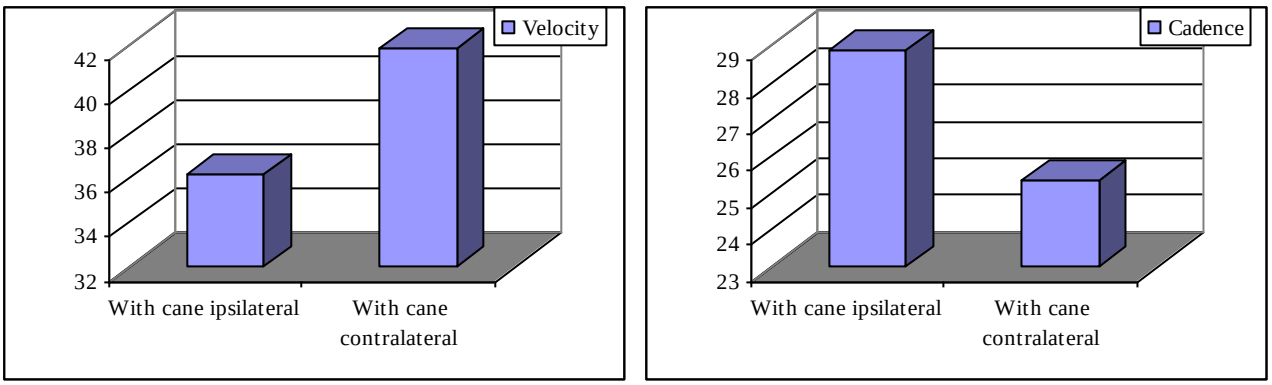


Fig. (4): Multiple graphic presentation of the measured gait parameters with cane used ipsilaterally and contralaterally.

DISCUSSION

The results of this study showed that the measured gait parameters were significantly lower in values than that obtained from the healthy group who were studied for the comparison with the patients group.

Decrease in gait parameters in patients with hip pain come in agreement with Berman et al. (1991)[19], who found that patients took shorter steps with involved limb when examined 41 patients with degenerative hip arthritis compared with control subjects. They also noted that the velocity of patients group decreased. This may be an attempt to reduce force on femoral head to decrease the pain.

Decreased stride length in hip OA patients was noted by Hurwitz et al. (1997)[20]. They found that mean stride length was 0.58 meters (m) for patients with hip OA when walking in comparison with 0.73 m in the control group when walking at their normal speed which agrees with the results of this study.

The results of the present study were also supported by Hulet et al. (2000)[21] who noted that the step length was decreased in 26 hip OA patients. Temporal differences between the stance, swing, and double support phases of gait also exists in hip OA patients. In addition, there were significant differences in the cadence of gait in those with hip OA compared to the control group. The authors suggested that the differences in temporal parameters may be attributed to walking with significantly decreased hip extension, adduction, and internal rotation and external rotation moments.

Watelain et al. (2001)[22] found that decrease in walking speed was significantly among 17 patients with early stage of hip OA and 17 controls. The decreasing of speed in hip OA group was in agreement with this study results.

The results of the previous study was supported by Kyriazis and Rigas (2002)[23] who noted a decrease in walking velocity of 0.84 m/s compared to 1.36 m/s for OA and control group respectively. They also found decrease in the stance phase and increasing in double support phase as a percentage of gait cycle in OA patients compared to controls at the normal gait speed for each subject.

Analysis of the results in case of using a cane demonstrated that using of a cane ipsilaterally and contralaterally showed increasing of step length, stride length and velocity, however, foot angle, B.O.S. and cadence were decreased. Using a can contrallaterally had a significant improvement of measured parameters when compared with using it ipsillaterally.

The improvement of gait parameters may explained by Mcgibbon et al. (1997)[15] who stated that using a cane is the preferable method of joint protection when considering the average muscular demand across both hips as it can decrease muscular activity demand on the affected hip especially HA muscles. Decreasing muscular activity demand and large percentage of the load on the affected hip by using the cane decrease pain and allow satisfactory feeling in patients with hip OA. Consequently, decreasing pain will give the patient the confidence and ability to perform their activities easier than before.

Using the cane ipsillaterally may supported by Whittle (1991)[13] who reported that, using a cane ipsilaterally, can entirely remove the load from the leg, by putting the cane close to the foot on the ground with slight leaning over a cane to increase the vertical loading on it and hence to reduce the load on the leg and relieve pain.

In addition, Norkin and Levangie (1992)[3], mentioned that pushing downward on a cane held in the hand on the side of pain would reduce the superimposed body weight by the amount of downward thrust (about 15%), that is some of the weight of the of head, arms and trunk (HAT) would follow the arm to the cane, rather than arrieving on the sacrum and the supporting hip joint.

Significant improvement of gait parameters with using can in the opposite side of hip pain may be explained by Lehman et al. (1992)[24] who stated that cane should be held in the hand contralateral to the affected limb and move together with it as this will decrease the load on the hip joint by approximately 60%.

Increase in step length, stride length, velocity and decrease in B.O.S, stride length /LEL, foot angle, and cadence with using a cane contralaterally in the present study was in agreement with Neumann (1999)[25] who conducted a study on 24 patients with unilateral prosthetic hip aged 40-86 years. The author suggested that the most effective method of reducing demand on the HA muscles was using the cane contralateral to the prosthetic hip. Decrease in HA activity may explain the improvement in gait parameters.

Conclusion

It can be concluded that, measured gait parameters were significantly lower in old age people with hip osteoarthritis than values obtained from control group. Both modes of using cane ipsilaterally and contralaterally had a significant effect in improving gait parameters with patients group. However, using a cane contralaterally was more effective than ipsilaterally.

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الملخص العربى

استخدام العصا الساندة على الناحية المصابة فى مقابل الناحية السليمة عند كبار السن الذين يعانون من التهاب عظمى مفصلى فى مفصل الفخذ

الخلفية و الاهداف: الم الورك هى مشكلة شائعة تؤثر على مفصل الفخذ والاشخاص الذين يعانون من الام بالورك او خشونة بالمفصل غالبا يمشون ببطء ' يتخذون خطوات اقصر ويميلوا ناحية الجانب المؤلم للحد من الضغوط على مفصل الورك . غير ان هذا النمط من المشى ينتج عنه الافراط فى التحميل على المفاصل الاخرى(فقرات أسفل الظهر) . لذلك يجب على اخصائيين العلاج الطبيعى العمل على هذه المشكلة عن طريق تقديم المشورة للمرضى كيف يتجنبوا مثل هذا النمط من المشى و ايضا اطالة العمر الافتراضى للمفصل و يمكن تحقيق ذلك من خلال استخدام أداة مساعدة للمشى (عصا' عكاز او مشاية)0 لذلك اجريت هذه الدراسة لبيان تاثير استخدام العصا الساندة على بعض مقومات حركة المشى عند كبار السن الذين يعانون من الم فى مفصل الفخذ. الطريقة: و قد اشتملت الدراسة على 50 شخص سعودى . 25 شخص كونوا مجموعة المرضى الذين يعانون من الم فى احد مفصلى الفخذ نتيجة اصابتهم بالتهاب عظمى مفصلى و 25 من الاشخاص الاصحاء الذين كونوا مجموعة المقارنة و تراوحت اعمار المجموعتين بين 60 و 75 عاما. مجموعة المرضى كانت 16 من النساء و 9 من الرجال بينما مجموعة المقارنة كانت 18 من النساء و 7 من الرجال. تم قياس مقومات حركة المشى باستخدام طريقة طابع القدم. مقومات المشى التى تم قياسها كانت طول الخطوة، السرعة و عدد الخطوات فى الدقيقة. النتائج: و قد اظهرت التحاليل الاحصائية ان استخدام العصا الساندة على الناحية المصابة و الناحية السليمة له تاثير ملحوظ على جميع المتغيرات التى تم قياسها و كان هناك تحسن ملحوظ فى مقومات حركة المشى مع استخدام العصا فى الناحية المصابة اكثر من استخدامها على الناحية السليمة.الخلاصة: و قد استخلص من هذه الدراسة تحسن ملحوظ فى مقومات حركة المشى مع استخدام العصا الساندة سواء على الناحية المصابة او على الناحية السليمة بينما استخدامها على الناحية المصابة كان له تاثير اكثر فى تحسن المشى عن استخدامها على الناحية السليمة.