Influence of Using Walking Aid on Some Gait Parameters of Patients with Osteoarthritic Hip

Yehia Nassef Abd El Hafaz, Ph.D.* and Mostafa H. Gad, Ph.D.**

* Lecturer Orthopedic Dept., Faculty of Physical Therapy, Cairo University.

** National Heart Institute.

ABSTRACT

The purpose of this study was to investigate the effect of changing the side of using the stick or crutch as a walking aid on the temporal and spatial parameters of the patient s gait as well as the oxygen consumption. The study included 40 males (20 patients with unilateral osteoarthritis of the hip joint and 20 healthy volunteers). Footprint method was conducted to measure temporal and spatial parameters of walking. While oxygen consumption during walking was measured directly. The results of this study indicated that, the measured gait parameters were significantly lower in patients with unilateral osteoarthritis of the hip than values obtained from normal subjects. On the other hand oxygen consumption level was significantly higher in patients group. When the stick was held contralaterally, there was a significant increase in stride length/LEL ratio of affected side, velocity and cadence. However, oxygen consumption level was significantly decreased when the stick was used ipsilaterally. The present study also indicated that, walking with crutch contralaterally significantly improved step length of the involved hip, stride length of the noninvolved hip, stride length/LEL ratio of both legs and velocity. In addition, walking with stick or crutch ipsilaterally produced similar gait parameters with the exception in the 0_2 consumption where using stick significantly reduced 0_2 consumption than walking with crutch. From the above results it can be concluded that the use of a walking stick or crutch contralaterally is effective in increasing walking velocity. However, using either aid ipsilaterally was characterized by a lower level of oxygen consumption. Therefore both mode of use have an advantage. It is the patient condition which ultimately determines the mode of use either contralaterally or ipsilaterally, whereas he want to reduce energy cost or acquire acceleration.

INTRODUCTION

People suffering from painful hip or osteoarthritis of the hip joint often lean during walking to the side of the painful hip during the weight bearing phase (stance phase) in order to minimize the moment created by the abductor muscles and in turn reduces the compressive force between the articular surface of the arthritic hip joint[15]. However, this pattern of walking would result in excessive loading on other joints (lumbar vertebrae) and also higher energy expenditure.

The effect of a cane used in the hand contralateral to the involved hip, on patient s floor reaction forces and on selected time and distance measurements of gait were determined. When the patients walked with a cane, the stride length and swing time were

increased, while the cadence and vertical component of the floor reaction force were decreased[3].

Using the cane on the ipsilateral side of the pathology was not as effective in decreasing joint force and generally was not recommended. In addition, use of cane in the same hand as the diseased hip narrows the patient s base of support and alters the gait pattern by not allowing for contralateral arm swing[11].

On the other hand, Whittle[15] mentioned that using a cane on the same hand as the affected leg, removes some of the load from the leg, as the cane placed on the ground close to the foot. By this way, load-sharing can be achieved between the leg and the cane, even to the extent of removing the load entirely from the leg. The cane follows the movements of the affected leg, being advanced during the swing phase on that side. The person will normally lean sideways over the cane in a lateral lurch, to increase the vertical loading on it, and hence to reduce the load on the leg. A cane may be used in this way to relieve pain in the hip, knee, ankle or foot[15].

Norkin and Levangie[7], 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 head, arms and trunk (HAT) would follow the arm to the cane, rather than arriving on the sacrum and the supporting hip joint. Although a cane used ipsilaterally provides benefits in energy expenditure and structural stress reduction, it is not as effective in reducing hip joint compression as the undesirable lateral lean of the trunk.

Therefore, physiotherapist has to work toward this problem by advising the patient to how such gait pattern could be avoided and also prolong the life span of the arthritic joint. This could be achieved through the use of a walking aid (cane, crutch, walking frame etc). There is still some controversy regarding the most effective mode of using a walking aid.

The purpose of this study was to investigate the effect of changing the side of the walking aid on the temporal and spatial parameters of the patient s gait as well as the oxygen consumption.

METHODS AND PROCEDURES

Subjects:

This study was conducted on 20 male patients suffering from unilateral osteoarthritis of the hip joint. The left hip was the OA hip in six patients and 14 patients had right side OA hip. They were selected from the orthopedic out patient clinic of Kasr El Einy Hospital. Their age ranged between 50 and 60 years with an average age of 54.15 ± 3.48, years. Their average weight was 93.07 ± 16.29 Kg., and ranged between 71 to 148 Kg. The height of these patients ranged between 160 to 190 cm with an average of 172 ± 6.05 cm. The study also included 20 healthy male volunteer whose age ranged between 50 and 60 years old with an average of 55.05 ± 3.2 years. Their average height was 171.55 ± 4.6 cm, and ranged between 163 and 180 cm. The subjects weight ranged between 71 and 92 kg with an average 82.85± 6.29 Kg.

Material:

1. Stop watch.
2. Tape measure.
3. Standard goniometer.
4. Stadiometer.
5. Absorbent paper used to record the footprint of the subjects.

6. Inked pads to be attached to the bottom of the subject s shoes.
7. Adjustable aluminum cane and elbow crutch.
8. A walkway of 8 meters length and 1 meter width demarcated in the lab where the study was conducted.
9. Oxycon-3; to measure oxygen consumption of subjects during walking on treadmill (Tuntori-797).

Procedures:

The personal data of each subject: age, height, weight, affected side, ambulating status and leg lengths were recorded. The leg length was measured with the subject standing (from the upper border of the greater trochanter to the floor bisecting the lateral maleolus). The procedures and purpose of the study were explained to each subject before his inclusion in the study.

Data collection:

Consisted of two main parts: measuring walking parameters and oxygen consumption.

A. Walking parameters:

The measurements in this study were obtained during foot print analysis.

The measurements from the foot print included: velocity, cadence, foot angle, base of support, strides length and step length[9,8]. Each subject was instructed to walk at his natural walking speed across the paper looking straight a head. 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 factor of acceleration at the beginning of the traverse. There were at least three sets of footprints. The first two foot prints up to the third heel strike was cutout as well as the far end of the paper about one meter.

Analysis and calculations of recorded parameters:

1. Velocity: Dividing the total walking distance in centimeters by the elapsed time recorded by using a stopwatch.
2. Cadence: Dividing the number of steps taken during the timed sequence by the elapsed time.
3. Step length: This 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.
4. Stride length: This was calculated in centimeters by measuring the perpendicular distance from the heel strike of one foot to the next heel strike of the same foot.
5. Stride length/lower extremity length ratio (stride length/LEL): stride length divided by lower extremity length.
6. Foot angle: The foot angle was obtained as illustrated in figure (l):
   (a) Drawing longitudinal lines AJ bisecting each foot print. **(b)** Dividing length of one foot print into equal thirds. **(c)** Drawing horizontal line CD through the posterior third of foot print perpendicular to line. AJ measurement from base of heel to line CD for drawing horizontal lines on the other foot prints. And **(d)** Connecting intersections CD and AJ of two ipsilateral feet for line FF. FF is the line of progression.

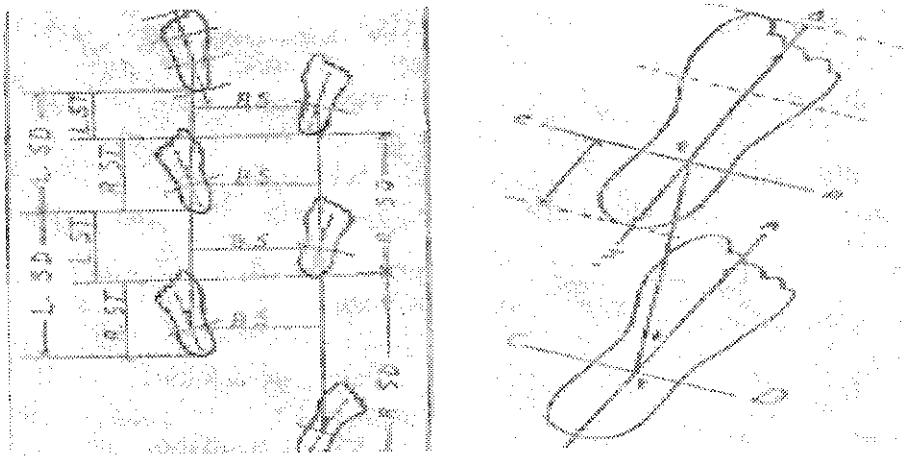

Fig. (1): Illustration of spatial parameters

7. Base of Support: The base of support was obtained as shown in figure (1); by drawing line BS from intersection CD and AJ of contralateral foot perpendicular to line FF.

B. Oxygen consumption:

The subject was connected to the oxygen analyzer Oxycon-3 through the mouthpiece. The subject mouthy breath while applying a noseclip, so the expired air passed through the gas meter and the amount of oxygen consumed was computed and printed out.

Fox et al., protocol[4] was conducted to measure oxygen consumption. The resting VO_2/Kg was determined while the subject stood on the treadmill. The cycling reeve of the treadmill belt was adjusted at the least speed. No oxygen consumption measurements were taken at this time. Since the steady state period has not been reached yet. Once a steady state was reached (usually within 3 to 4 minutes after walking had started). Oxygen consumption was measured over 2 minutes. The difference between the VO_2/kg value at the steady state and the VO_2/kg at the resting state was considered as the amount of oxygen consumption per kilogram per minute (Vo_2/kg/min).

For all patients group, the same procedures of measurements were repeated with allowed period of rest about 15 minutes between each trial: -

a) Walking without stick, **b)** Walking with stick on the affected side, **c)** Walking with stick on the unaffected side, **d)** Walking with elbow crutch on the affected side, and **e)** walking with elbow crutch on the unaffected side.

RESULTS

The aim of this study was to investigate the effect of changing the side of the walking aid on the temporal and spatial parameters of the patient s gait as well as the oxygen consumption.

Table (1) and figure (2) shows comparison between the mean values of the recorded gait parameters of the normal subjects and patients walking without aid. Statistical comparison between the two groups (patients vs. normal subjects) demonstrated a significant ($P<0.05$) difference between the parameters of the two groups. However, with respect to the base of support (BOS). The difference was not significant between the two groups.

Table (l): Comparison between the arithmetic mean of the measured gait parameters of the normal subjects and the patients group while walking without aid device.

Variables	Normal		Patients		P value
Step length (c)	Right	62.15 ± 3.8	Sound	56.18 ± 5.61	< 0.05
	Left	61.15 ± 3.8	Affected	52.77 ± 5.48	< 0.05
Stride length (cm)	Right	123.0 ± 8.9	Sound	111.4 ± 9.86	< 0.05
	Left	1235 ± 7.8	Affected	105.6 ± 101	< 0.05
Stride length/LEL ratio	Right	1.45 ± 0.1	Sound	1.27 ± 0.1	< 0.05
	Left	1.44 ± 0.1	Affected	1.20 ± 0.1	< 0.05
Foot angle (degrees)	Right	11.5 ± 2.0	Sound	12.6 ± 2.3	< 0.05
	Left	9.8 ± 1.7	Affected	127 ± 2.3	< 0.05
Base of support (cm)	30.5 ±3.2		31.24 ± 3.1		> 0.05
Velocity (m/min)	55.8 ± 12.5		32.8 ± 6.6		< 0.05
Cadence (Steps/min)	82.2 ± 15.2		57.6 ± 1.5		< 0.05
0_2cons. (ml/kg/min)	6.2 ± 0.7		8.8 ± 1.5		< 0.05

LEL = Lower Extremity Length. 0_2 Cons = Oxygen consumption.

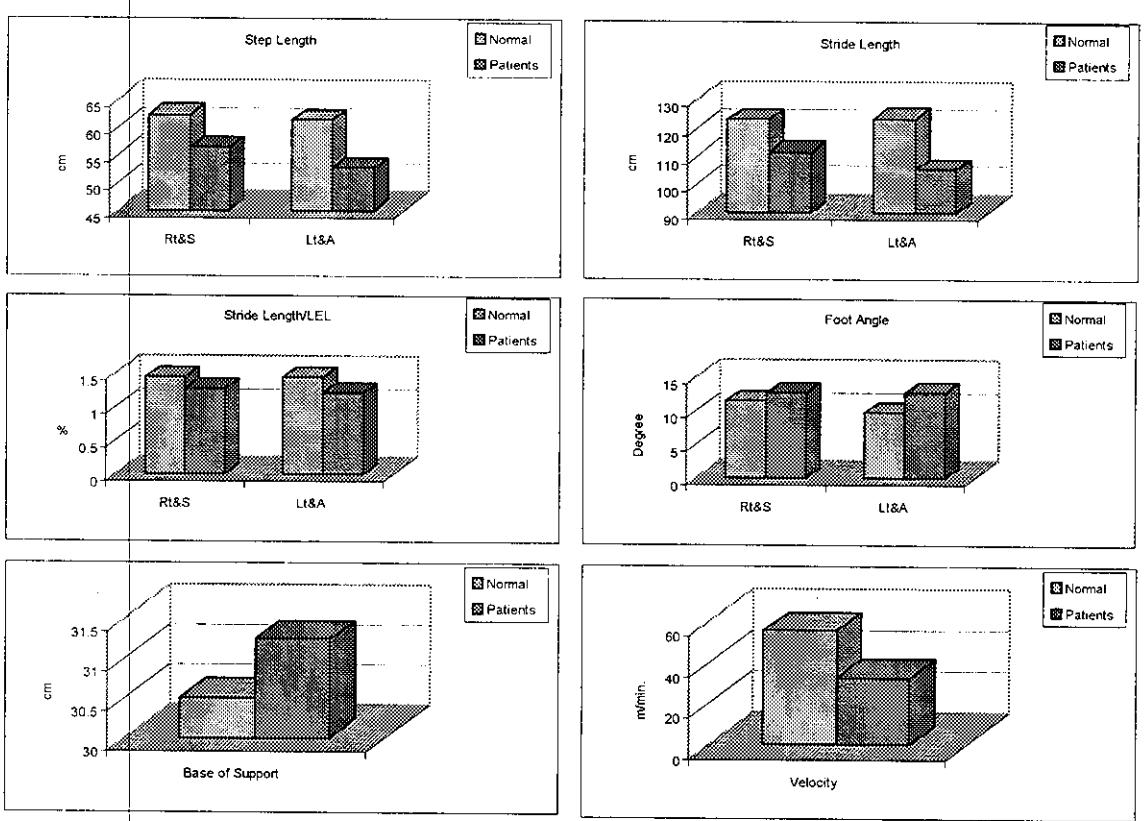

Fig. (2): Multiple graphics Presentation of the Measured gait Parameters of normal subjects and Patients with Osteoarthritic hip.

Table (2): Comparison between the arithmetic mean of the measured gait parameters of patients group while walking with stick ipsilaterally and contralaterally.

Variables		Stick Lips	Stick Cont.	P value
Step length (cm)	Affected	52.73 ± 9.86	55.53 ± 7.67	< 0.05
	Sound	53.75 ± 9.93	55.53 ± 8.69	< 0.05
Stride length (cm)	Affected	103.88 ± 18.06	109.45 ± 15.52	< 0.05
	Sound	1.6 .85 ±17.15	112.05 ± 15.13	< 0.05
Stride length/LEL (ratio)	Affected	1.12 ± 0.26	1.24 ± 0.26	< 0.05
	Sound	1.21 ± 0.17	1.27 ± 0.14	> 0.05
Foot angle (degrees)	Affected	11.65 ± 1.66	11.0 ± 1.38	> 0.05
	Sound	11.8 ± 1.96	10.95 ± 2.11	> 0.05
Base of support (cm)		29.48 ± 4.70	30.0 ± 3.3	> 0.05
Velocity (m/min)		35.32 ± 4.04	39.96 ± 9.51	< 0.05
Cadence (Steps/min)		61.47 ± 9.88	69.04 ± 17.39	< 0.05
0_2 consp. (ml/kg/min)		6.66 ± 0.89	8.41 ± 1.21	< 0.05

Ips = Ipsilaterally. Cont. = Contralaterally

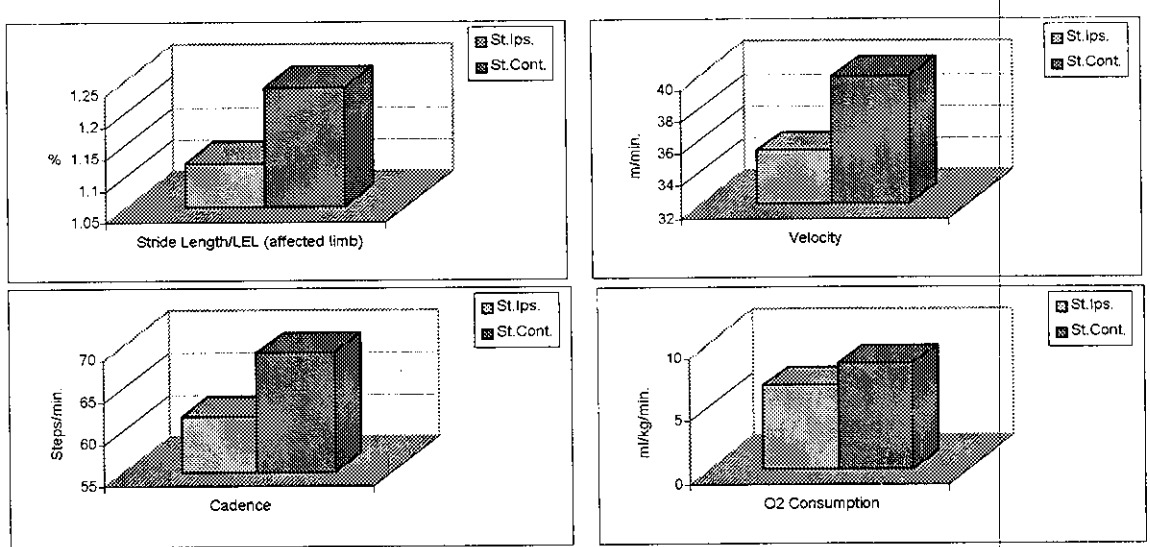

Fig. (3): Multiple graphic presentation of some measured gait parameters with stick used ipsilaterally and contralaterally in patients with osteoarthritic hip.

Table (2) and figure (3) show the mean value of the measured gait parameters in the patients group when they walk with a stick ipsilaterally and contralaterally. The table shows that, the mean value of stride length/LEL of the affected side was 1.12 ± 0.26 for patients walking with stick ipsilaterally and 1.24 ± 0.26 for them walking with stick contralaterally. The difference between the two values was significant ($P < 0.05$). It can also be observed that, the velocity when patients used stick contralaterally was significantly faster ($P < 0.05$). The mean value of velocity was 35.32±8.04 m/min and 39.96 ± 9.51 m/min., when the stick held ipsilaterally versus contralaterally patients used stick ipsilaterally and contrlaterally. The mean value of cadence was 61.47 ± 9.88 steps/min. when the stick was used ipsilaterally, and 69.04 ±17.39 steps/min. when it was used contralaterally. The difference was significant ($P < 0.05$). It can also be noticed that, there was a significant difference ($P < 0.05$) in oxygen consumption between using stick ipsilaterally and contralaterally. The mean value was 6.66 ± 0.89 ml/Kg/min., when patients held stick ipsilaterally, and 8.41±1.21 ml/Kg/min., when they held the stick contralaterally. The difference in other gait parameters (step length, stride length and foot angle of affected and sound sides. Stride length/LEL of sound side and base of support) were not significant.

Table (3) and figure (4) show comparison between the mean values of different gait parameters of the patients when they held elbow crutch ipsilaterally and contralaterally. From the table, it can be seen that, the step length of the affected side, when patients used the elbow crutch contralaterally was significantly longer ($P<0.05$). The mean step length were 53.32 ±9.85 cm with stick ipsilaterally versus 59.99±9.42 cm contralaterally. The table demonstrates that, the stride length of the sound side was significantly longer ($P<0.05$) when patients used elbow crutch contralaterally. The mean values were 104.23±19.18 cm and 114.73±15.28 cm in case of using elbow crutch ipsilaterally and contralaterally respectively. As noticed in the same table, the difference in the stride length/LEL ratio between using elbow crutch ipsilaterally and contralaterally was significant ($P<0.05$) in both affected and sound sides. In the affected side, the mean values were 1.19 ± 0.18 and 1.31 ± 0.15 when the elbow crutch was used ipsilaterally and contralatyerally respectively. In the sound side, the mean value was 1.18±0.18 cm when patients use elbow crutch ipsilaterally and 1.29±0.15 when using it contralaterally. It can be observed that, the velocity was significantly increased ($P< 0.05$) when patients held the elbow crutch contralaterally. The mean value for patients using elbow crutch ipsilaterally was 40.91±10.36 m/min and 48.71±12.13 m/min for those patients using it contralaterally. The other measured parameters revealed not to be significant (step length of the sound sides, stride length of the affected side, foot angle of affected and the sound side, base of support, cadence and oxygen consumption.

Table (3): Comparison between the arithmetic mean of the measured gait parameters in the patients group while walking with elbow crutch ipsilaterally and contralaterally

Variables		Crutch (ipsi)	Crutch (cont.)	P value
Step length (cm)	Affected	53.321 ± 9.85	59.99 ± 9.42	< 0.05
	Sound	52.20 ± 10.24	56.16 ± 8.55	> 0.05
Stride length (cm)	Affected	104.68 + 19.11	114.58 ± 14.82	> 0.05
	Sound	104.23 ± 19.18	114.73 ± 15.28	< 0.05
Stride length/LEL (ratio)	Affected	1.19 ± 0.18	1.31 ± 0.15	< 0.05
	Sound	1.18 ± 0.18	1.29 ± 0.15	< 0.05
Foot angle (degrees)	Affected	11.90 ± 1.48	11.05 ± 1.73	> 0.05
	Sound	12.00 ± 2.46	11.55 ± 2.19	> 0.05
Base of support (cm)		30.10 ±4.07	30.33 ± 2.32	> 0.05
Velocity (m/min)		40.91 ± 10.36	48.71 ± 12.13	< 0.05
Cadence (Steps/min)		69.88 ± 15,15	78.39 ± 18.08	> 0.05
0_2cons. (Ml/kg/min)		7.69 ± 0.98	7.64 ± 1.39	> 0.05

LEL = Lower extremity length. 0_2 Cons = Oxygen consumption.

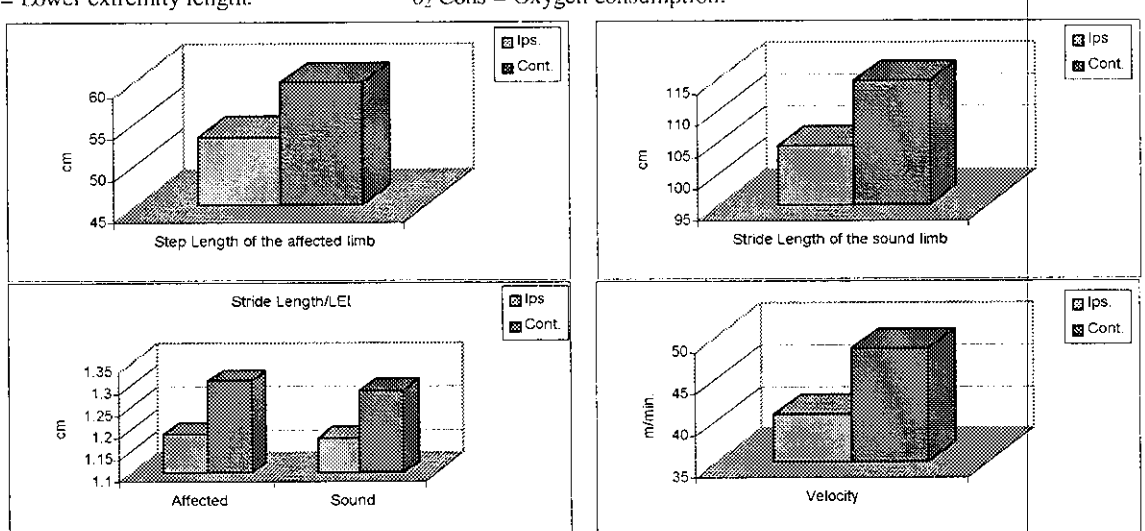

Fig. (4): Multiple graphic presentation of some measured gait parameters in patients group while walking with elbow crutch ipsilaterally and contralaterally.

Table (4) and figure (5) show the mean values of the measured gait-parameters of the patients when walked with stick ipsilaterally and elbow crutch ipsilatyerally. Comparison between these values showed no significant difference in the usage of the stick or the crutch ipsilaterally. However, using the stick ipsilaterally resulted in significant reduction in oxygen consumption ($P < 0.05$). The mean of oxygen consumption in patients walking with stick was 6.66 ± 0.89 ml/kg./min, while for patients walking with crutch 7.69 ± 0.98 ml/kg/min..

Table (4): Comparison between the arithmetic mean of the measured gait-parameters in the patients group while walking with stick and elbow crutch ipsilaterally.

Variables		Stick	Crutch	P value
Step length (c)	Affected	52.73 ± 9.86	53.32 ± 9.85	> 0.05
	Sound	53.75 ± 9.93	52.20 ± 10.24	> 0.05
Stride length (cm)	Affected	103.88 ± 18.06	104.68 ± 19.11	> 0.05
	Sound	106.85 ± 17.15	104.23 ± 19.18	> 0.05
Stride lengthy/LEL (cm)	Affected	1.12 ± 0.26	1.19 ± 0.18	> 0.05
	Sound	1.21 ± 0.16	1.18 ± 0.18	> 0.05
Foot angle (degrees)	Affected	11.65 ± 1.66	11.90 ± 1.48	> 0.05
	Sound	11.80 ± 1.96	12. ± 2.46	> 0.05
Base of support (cm)		29.48 ± 4.70	30.10 ± 4.07	> 0.05
Velocity (m/min)		35.32 ± 8.03	40.91 ± 10.36	> 0.05
Cadence (Steps/min)		61.47 ± 8.03	69.88 ± 15.15	> 0.05
0_2cons. (mL/kg/min)		6.66 ± 0.89	7.69 ± 0.98	< 0.05

Ips = ipsilaterally Cont. = contralaterally

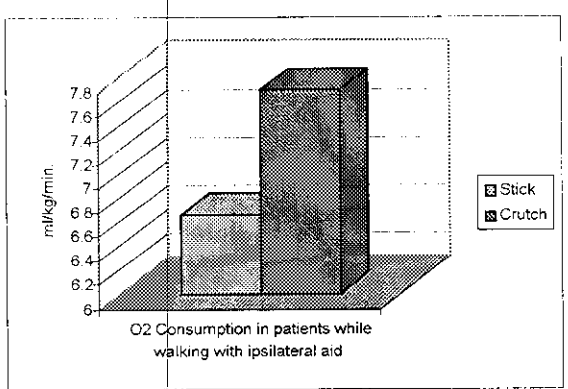

Fig. (5): Graphic presentation of O_2 consumption while the patients walked with stick and elbow crutch used ipsilaterally.

Table (5) and Figure (6) comparison between the arithmetic mean of the measured gait parameters in the patients group while walking with stick and elbow crutch contralaterally. From the table, it can be seen that, the stride length/LEL ratio of the affected side when patients held the elbow crutch contralaterally increased significantly (P<0.05). The mean value for using stick contralaterally was 1.24±0.14 cm and 1.31±0.15 cm with elbow crutch contralaterally.

The table shows that, the mean value of velocity when patients used stick contralaterally was 39.96±9.51 m/min. and 48.71±12.13 m/min., when using crutch contralaterally. The difference was significant (P<0.05). The table also shows that, there was a significant difference (P<0.05) in cadence. The mean values of cadence were 69.04 ± 17.39 steps/min and 78.39 ± 18.08 steps/min, when patients used stick contralaterally and crutch contralaterally.

In respect to oxygen consumption, it was noticed that, the oxygen consumption, when patients held elbow crutch contralaterally was significantly lowered (P < 0.05). The mean value of oxygen consumption for patients using stick contralaterally was 8.41 ± 1.21 ml/kg/min. and 7.64 ±1.39 ml/kg/min when the elbow crutch was used contralaterally.

Comparison between the other gait parameters (step length, stride length, stride length/LEL, foot angle of affected and sound sides and base of support) show a non significant difference.

Table (5): Comparison between the arithmetic mean of the measured gait parameters in the patients group while walking with stick and elbow crutch contralaterally

Variables		Stick	Crutch		P value
Step length (cm)	Affected	55.53 ± 7.67	59.99 ± 9.42	> 0.05	
	Sound	55.33 ± 8.69	56.16 ± 8.55	> 0.05	
Stride length (cm)	Affected	109.45 ± 15.52	114.58 ± 14.82	> 0.05	
	Sound	112.05 ± 15.13	114.73 ± 15.28	> 0.05	
Stride length/LEL (cm)	Affected	1.24 ± 0.14	1.31 ± 0.15	< 0.05	
	Sound	1.27 ± 0.14	1.29 ± 0.15	> 0.05	
Foot angle (degrees)	Affected	11.0 ± 1.38	11.05 ± 1.73	> 0.05	
	Sound	10.95 ± 2.11	11.55 ± 2.19	> 0.05	
Base of support (cm)		30.0 ± 3.30	30.33 ± 2.32	> 0.05	
Velocity (m/min)		39.96 ± 9.51	48.71 ± 12.13	< 0.05	
Cadence (Steps/min)		69.04 ± 17.39	78.39 ± 18.08	< 0.05	
0_2cons. (mL/kg/min)		8.41 ±1.21	7.64 ± 1.39	< 0.05	

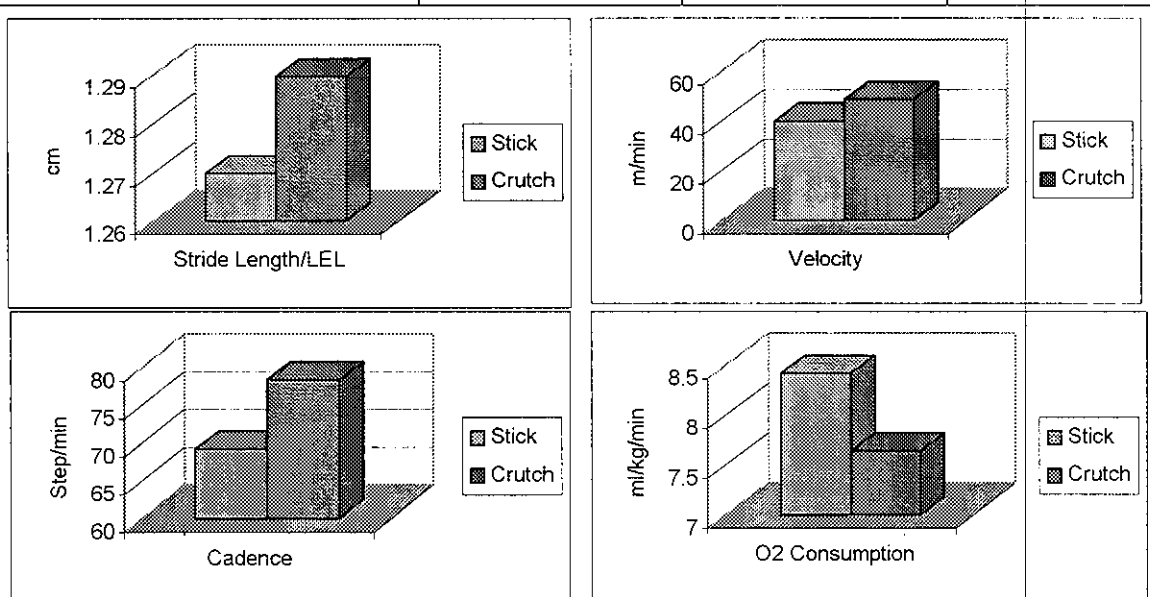

Fig. (6): Multiple graphic presentation of some measured gait parameters of using stick and elbow crutch contralaterally.

DISCUSSION

This study has been conducted to investigate the use of the walking stick or elbow crutch ipsilateral or contralateral on some gait parameters for 20 patients suffering from unilateral osteoarthritis of the hip. Analysis of the results demonstrated that the gait parameters studied were significantly lower in values than that obtained from 20

healthy volunteers studied for the comparison with the patients group. Oxygen consumption which was also measured as an indicator of energy expenditure showed a significantly higher level in the patients than in the healthy group.

The decrease in gait parameters come in agreement with the work of several investigators who studied relevant data to this study. It was found that the cadence, velocity, stride length, swing/stance ratio and stride length/lower extremity length ratio were decreased significantly than previous comparative data which was reported, when twenty seven subjects with hip disease were examined by electrogoniometer and footswitches to record the gait parameters [12].

Smidt and Wadsworth[10]. Studied the gait of ten normal subjects and twenty-one patients severely involved with hip disease using a force plat form, footswitches, recorder and walkway with grid. They found that, cadence, velocity, and stride length for normal subjects twice in value that of the patients with hip disease.

A gait mat was used in evaluating forty patients with degenerative hip arthritis. The study involved a control group of 91 subjects. Step length and velocity were among the measured parameters. It has been found that, patients took shorter steps with the involved limb than the control subjects and demonstrated decreased velocity[1]. The findings of the present study also support Murray et al.,[6] who noted that the walking speed of patients with unilateral hip pain was slower than normal and that this resulted mainly from decreased step length and slower walking cadence, They found that the decrease in step length was attributable to diminished hip extension when either the involved or uninvolved limb was extended backward during the later part of each stance phase.

The decrease in oxygen consumption was confirmed by Brown et al.,[2] who examined 24 patients with unilateral osteoarthritis of the hip prior to total hip arthroplasty. The authors found that, oxygen consumption was higher in osteoarthritic hip patients than normal level.

In a group of patients with severe osteoarthritis of the knee in comparison with a group of osteoarthritic hip patients. The authors observed that the increase in 0_2 consumption in osteoarthritic knee patients was approximately the same as in patients with osteoarthritis of the hip[13].

In comparison of compared oxygen consumption of eleven subjects who had a unilateral arthrodesis of the hip with a group of normal subjects. The authors reported that, the average oxygen consumption of the subjects who had arthrodesis of the hip was significantly greater than that of normal subjects[14].

Gussoni et al.,[5] measured energy cost of walking in 12 patients with hip joint impairment and 10 healthy subjects (control) during unassisted walking (2-6 Kmh^{-1}) on a level treadmill and 5% incline uphill. The energy cost of locomotion in most patients increased up to 50 % and 70 % during level and uphill walking. The authors concluded that abnormal gait patterns and pain may contribute to increased energy cost of locomotion. Also they postulated that, abnormal gait patterns lead to unbalance in the transformation from potential to kinetic energy and consequently an increase in the external mechanical work performed by the unaffected limb.

The work of the above authors. Clearly support the findings obtained in this study with respect to oxygen consumption and other gait parameters studied. That is, when the patients data were compared with the data of healthy subjects.

To investigate the effect of the walking aid (stick or crutch) on the gait parameters measured, analysis of the results in case of using a walking stick ipsilateral or contralateral demonstrated that , the use of the walking stick contralaterally improved mainly velocity and cadence. However, using stick contralaterally increased the level of oxygen consumption than when used ipsilateral. This finding suggests that contralateral use of the stick during walking is more preferable than using it ipsilaterally despite the higher level of oxygen consumption, particularly in situations, where walking speed become a necessity for crossing streets or catching transport meanings . However, where the patients cardiac condition is not satisfactory, the ipsilateral use of the stick could be more preferable because of lower level of oxygen consumption.

In the present study increase in gait velocity and cadence contradicted with that of Wadsworth, et al.,[12] who conducted a study on severely disabled hip disease or previous trauma. Their results demonstrated that walking without any assistive device yielded greater values of cadence, velocity and stride length than the reported values from patients using 2 crutches. The authors concluded that, as the previous values tended to increase, the amount of assistance needed to walk decreased.

The effect of using a cane on the contralateral side on 15 subjects with hip disease, who had limping gait but could walk without an assistive device was examined. The findings demonstrated that, stride length and swing times were increased, while the cadence was decreased and the walking velocity was the same with and without cane[3].

However, in this study it was found that, using a cane on the contralateral side led to increase in cadence and velocity, which is contradicted with the result of the above authors. That could be explained, as using a cane on the contralateral side greatly reduces the load on the affected hip. Consequently some relief of pain occurs during walking, therefore, patients can increase their walking velocity.

Reduction in oxygen consumption observed in this study when the patients walked with the stick ipsilaterally was supported by the view of Norkin and Levangie[7]. Who mentioned that, leaning of osteoarthritic hip patients toward affected side is an extreme movement which requires high energy expenditure. They suggested that, the use of a cane on the ipsilateral side could provide more benefits in respect to energy expenditure.

This view is also supported by Whittle[15] who stated 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. Therefore, it could be argued here that the reduction of load and pain would consequently reduce the level of oxygen consumption.

One of the findings of this study was that, the use of elbow crutch contralaterally substantially increase walking velocity, cadence and reduced oxygen consumption in comparison with using the stick contralaterally. This demonstrates that, elbow crutch is more advantageous in its use over a cane, that is because it provides more stability and allow more leverage to be applied and consequently ease of transfer. This finding also support the view of Whittle[15]. Who stated that, the joints of the hand are relatively small. In addition to, the torque which can be applied to the upper end of the cane is limited by the grip strength. On the other hand, the elbow crutch is able to transmit significant forces.

This is because the cane, is effectively fixed to the body at only a single point, while, the crutch has 2 points of attachment (one at the hand and one higher up the arm), which provides a lever arm for the transmission of the torque.

CONCLUSION

It was concluded that, measured gait parameters were significantly lower in patients with unilateral osteoarthritis of the hip than values obtained from normal subjects. On the other hand oxygen consumption level was significantly higher in patients subject. It can be concluded that using a walking stick or crutch contralaterally is effective in increasing walking velocity. However, using either aid ipsilaterally was characterized by a lower level of oxygen consumption. Therefore both mode of use have an advantage. It is the patient condition which ultimately determines the mode of use either contralaterally or ipsilaterally, whereas he want to reduce energy cost or acquire acceleration.

REFERENCES

1. Berman, A.T.; Quinn, R.H. and Zarro, V.J.: Quantitative Gait Analysis in Unilateral and Bilateral Total Hip Replacements . Arch Phys, Med. Rehabil. 72: 190-194, 1991.
2. Brown, M.; Hislop, H.J.; Waters, R.L. and Porell, D.: Walking Efficiency Before and After Total Hip Replacement . The American Journal of Physical therapy, 60: 1259. L263, 1980.
3. Ely, D.D. and Smidt, G.I.: Effect of cane on variables of gait for patients with hip disorders. Phys. Ther. 57: 5078-512, 1977.
4. Fox, E.I.; Bowers, R.W. and Foss, M.L.: The physiological Basis of Physical Education and Athletics . 4th. Ed. Saunders College Publ. Philadelphia. 1988.
5. Gussoni M.; Margonato, V.; Ventura, R. and Veicsteinas, A.: Energy cost of walking with Hip joint. Impairment . Physical Therapy, 705): 295-301, 1990.
6. Murray, M.P., Gore, D.R. and Clarkson, B.H.: Walking patterns of patients with unilateral Hip pain due to osteoarthritis and A vascular Necrosis . J Bone joint surg. (Am), 53: 259-274, 1981.
7. Norkin, C.C. and Levangie, P.K.: Joint structure, Function: A comprehensive Analysis . 2nd. Ed. F.A. Davis Company, Philadelphia, 1992.
8. Robinson, J.L.f. and Smidt G.L.: "Quantitative gait evaluation in the clinic Phys ther. 61:351-353, 1981.
9. Shores M.: Footprint analysis in gait documentation an instructional sheet format. Phys. Ther. 60: 1163-1167, 1980.
10. Smidt, G.L. and Wadsworth, J.B.: Floor Reaction forces during Gait: Comparison of patients with Hip Disease and Normal subjects . The American Journal of Physical Therapy, 53 (10): 1056-1062, 1973.
11. Soderberg, G.L. Kinsiology Application to pathological Motion . William and Wilkins, Baltimore, 1986.
12. Wadsworth, J.B.; Smidt, G.L. and Jonhnston, R.C.: Gait characteristics of subjects with Hip Disease , The American journal of physical therapy, 52 (8): 829-837, 1972.
13. Waters, R.L.; Perry, U.J.; Conaty, P.; Lunsford, B. and O Meara, P.: The Energy Cost of Walking with Arthritis of the Hip and Knee , Clin. Orth. Op., 214: 278-284, 1987.
14. Waters, R.L.; Barnes, G.; Husserl, T.; Silver L. and Liss, R.: Comparable Energy Expenditure after Arthrodesis of the Hip and Ankle , The journal of Bone and joint surgery, 70 (A) 7: 1032-1037, 1988.
15. Whittle, M,.: Gait Analysis: An introduction . Butterworth Heinman, Oxford, 1991.

الملخص العربي

تأثير استخدام العصى الساندة أثناء السير على مقومات حركة المشي في المرضى المصابين بالتهاب مفصلي في أحد مفاصل الفخذ

أجريت هذه الرسالة بهدف بيان تأثير استخدام (العصى / العكاز) على بعض مقومات المشي وكمية الأكسجين المستهلكة في المرضى المصابين بالتهاب عظمى مفصلي في إحدى الفخذين وقد اقتصرت الدراسة على ٢٠ مريضا و ٢٠ شخصا من الأصحاء تتراوح أعمارهم بين ٥٠ و ٦٠ عاما . قد تمت القياسات على مرحلتين : المرحلة الأولى / قياس بعض مقومات المشي باستخدام طريقة طابع القدم ، المرحلة الثانية / قياس كمية استهلاك الأكسجين باستخدام جهاز سير المشي وجهاز قياس الأكسجين . وقد أسفرت النتائج عن : وجود فرق في المتغيرات الخاصة بالزمن والمسافة أثناء المشي بين الأشخاص الأصحاء والمرضى / بالإضافة إلى استهلاك المرضى كمية أكسجين اكثر من الأصحاء . استخدام (العصى) أو العكاز على الناحية السليمة يؤدى إلى زيادة السرعة ، بينما استخدامها على الناحية المصابة يؤدى إلى قلة استهلاك الأكسجين .