Gait Analysis and Lysholm Knee Score are Complementary in Assessing Functional Outcome after Arthroscopic Partial Menisectomy

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ABSTRACT

Objective: *The purpose of this study was to investigate the correlation between objective (gait analysis) and subjective measurements (Lysholm knee score) in the evaluation of patients undergoing arthroscopic partial menisectomy.* ***Background:*** *The Lysholm knee score is a condition-specific outcome measure that contains eight domains: limp, pain, use of support, stair climbing, instability, swelling, squatting, and thigh muscle atrophy. This score was designed to document the patient's evaluation of function and it has been proven to be valid, reliable and responsive in evaluating patient with meniscal injury. Walking performance can be objectively be assessed by systems of biomechanical gait analysis which are also an objective measure to evaluate the clinical efficacy of surgical procedures and rehabilitation of the lower extremity, especially to quantify the improvement after arthroscopic partial menisectomy. Although, Lysholm knee score is valid and reliable, there are no studies supporting that it reflects the actual performance of gait.* ***Design:*** *Twenty six consecutive patients (20 men and 6 women) were included in this study with age ranged from 18 to 45 years with unilateral meniscal injury of the knee undergoing arthroscopic partial menisectomy. Kinematic gait analysis and assessment of function using Lysholm knee score were performed at 1 and 6 week postoperatively.* ***Results:*** *Both groups achieved improvement in the measured gait parameters and Lysholm knee score. Immediately after operation within the first week, the association between gait parameters and lysholm knee score was fair to good in three parameters with correlation coefficient ranged from 0.44 to 0.58 and poor in three parameters with r=0.35 or less). The association between gait parameters and Lysholm knee score including its subscore, was remarkably poor at week 6 postoperatively with absolute coefficients of correlation of r=0.32 or less.* ***Conclusion:*** *Lysholm knee score might not reflect walking performance. The addition of gait analysis is recommended to gain objective information about the quality of gait.*

INTRODUCTION

A torn meniscus is one of the most common reasons why patients undergo arthroscopic surgery. Various instruments have been used to measure the outcomes of treatment of meniscal injuries of the knee. These have been included the Tapper and Hoover system, Knee Injury and Osteoarthritis Outcome Score (KOOS), Lysholm knee score, International Knee Documentation Committee (IKDC) subjective knee form, Cincinnati Knee rating scale, and Tegner activity scale[10,14,17,20,25,26].

The Lysholm knee score was the most common used knee score. It assess mainly symptoms, activity and can be administrated by the patient himself, so it could be considered an easy system to use. Hoher et al.,[8] stated that the most widely used knee score is the Lysholm score and found 106 publications from 1982 up to 1997 that used the Lysholm score in knee injuries. The Lysholm score and the Tegner activity scale had been adequately tested, and were easy to use, making them ideal as (the golden standard) to which future measures can be compared[12].

The Lysholm knee score is a condition-specific outcome measure that contains eight domains: limp (5 points), pain (30 points), use of support (5 points), stair climbing (10 points), instability (30 points), swelling (10 points), squatting (5 points), and thigh muscle atrophy (5points)[14]. An overall score of 100 points is calculated with 95 to 100 points indicating an excellent outcome; 84 to 94 points, a good outcome; 65 to 83 points, a fair outcome; and less than 65 points, a poor outcome. Originally designed for assessment of ligament injuries of the knee, the Lysholm knee score has been used for a variety of knee conditions[13,14,18]. The Lysholm score was designed to document the patient's evaluation of function[2] and it has been proven to be valid, reliable and responsive in evaluating patient with meniscal injury[2].

Walking performance can be objectively be assessed by systems of biomechanical gait analysis[1] which are also an objective measure to evaluate the clinical efficacy of surgical procedures and rehabilitation of the lower extremity, especially to quantify the improvement after arthroscopic partial menisectomy[3]. The temporal and spatial parameters of gait, such as gait speed, step length, stride length, width of base of support, knee flexion are estimated by reflective markers attached to the lower limb and recorded by infrared cameras. The purpose of this study was to investigate the correlation between objective (gait analysis) and subjective (Lysholm knee score) measurements in the evaluation of patients undergoing arthroscopic partial menisectomy.

METHODS

Subjects

Patients between the ages of 18 and 45 years with unilateral meniscal injury of the knee undergoing arthroscopic partial meniscectomy were recruited from Kasr El-Einy Hospital. Exclusion criteria comprised any post surgical complications, associated ligamentous knee injury (e.g. ACL injury), previous injury or surgery to the lower limb, any obvious deformities and mal alignments of the lower limb. Twenty seven consecutive patients (21 men and 6 women) were included in this study. Of these, one subject who refused to participate in the gait analysis after 6 weeks, was excluded from the study. The remaining 26 patients (20 men and 6 women, mean age 43±6.21; mean weight 80.16±12.64) completed all tests.

All patients received unilateral partial arthroscopic meniscectomy by the same orthopedic surgeon. During their stay in hospital all patients received general instruction and exercise program to be followed at home for six weeks; the exercise focused mainly on the quadriceps strengthening and knee range of motion exercises in the form of straight leg raising, heel back ward slide, ankle exercise. Ice application and elevation were also included in the program.

Kinematic gait analysis and assessment of function were performed at the motion lab in the faculty of physical therapy 1 week after surgery and 6 weeks later at the same location, when the patients returned for check up.

Gait analysis was perfomed using a Qualysis instrumented motion analysis system. The level of confidence of the system is 98.8 with a very little percentage of error. Data collection was performed at a sampling rate of 50 Hz. Six infrared light cameras with resolution of 4 mega pixel (ProReflex camera system) recorded three dimensional positions of reflective markers placed over the superior border of the patella when the knee is extended, mid-lateral point over the knee joint line, the tibial tuberosity, the tip of the lateral

malleolus, the foot between the 2nd and 3rd metatarsal bones, 10-15 mm proximal to the metatarsal heads, the heel, and the posterior aspect of the calcaneus. The gait phases were determined from precise moments of heel strike (initial foot contact) and toe-off (terminal foot contact). Every temporal parameter of a gait cycle was computed as a percentage of this gait cycle. Gait speed was estimated as mean of left and right leg's velocity, and stride length as mean of left and right leg's stride length. Stance phases were normalized by gait cycle duration and presented as percentage of it. In addition, the peak angle of knee flexion of the affected and non affected leg was documented. A change of performance after six weeks was calculated as the absolute difference between pre and post measurement. The patients were asked to walk at a selected area with a free speed walking according to his ability and tolerance. During examination the patient started to walk before the calibrated area by one meter and continue after calibrated area by one meter. The length of the calibrated area is 2 meters.

Functional outcome was assessed using Lysholm knee score designed to document the patient's evaluation of function. It probes for the dimensions of limp (5 points), pain (30 points), use of support (5 points),stair climbing (10 points), instability (30 points), swelling (10 points), squatting (5 points), and thigh muscle atrophy (5points).

Data Analysis

The following kinematic gait variables of free speed walking testing were correlated to the total and subscore of Lysholm knee scale: Stride length, cadence, speed, cycle time, the affected side stance percentage, and peak knee flexion of affected side.

Means values and standard deviation were calculated over all parameters. The significant level was set to alpha=5%. All P-values presented are two sided. Correlations between parameters were calculated by spearman's coefficient of correlation. Absolute values of the correlation coefficients were a priori classified as poor (<0.40), fair to good (0.40-0.75) and excellent (>0.75). The data were analysed using SPSS version 13.

RESULTS

All gait parameters including gait speed, stride length, cadence, cycle time, affected side stance percentage except the peak angle of affected knee flexion, improved after 6 weeks (P= 0.01 or less, Table 1). In addition, an improvement of the sum score of Lysholm and in all its subscores except atrophy could be demonstrated (P=0.003 or less, Table 2).

Comparing the peak knee flexion of the affected knee at 1 week and 6 weeks with that of the non affected knee revealed no significant difference between the affected and non affected side at both 1 week and 6 week with p=0.33 and p=1.36, respectively.

Immediately after operation within the first week, the association between gait parameters and lysholm knee score was fair to good in three parameters (cadence, gait speed, cycle time, with correlation coefficient ranged from 0.44 to 0.58 and poor in three parameters (Stride length, the percentage of stance phase of the affected side and the peak flexion of the affected knee, with r=0.35 or less). The association between gait parameters and Lysholm subscores was poor with r=0.36 or less for all subscores except gait speed which has a fair to good correlation with subscore of squatting, knee instability and pain.

The association between gait parameters and Lysholm knee score including its subscore, was remarkably poor at week 6 postoperatively. Absolute coefficients of correlation of r=0.32 or less were calculated

(Table 3). The only variable which had a fair to good correlation is gait speed with pain subscore of Lysholm knee score (r=0.40).

Table (1): Gait analysis at 1 week and 6 weeks after arthroscopic partial menisectomy (n=26).

Variable	Week	Mean	SD	t-value	P-value
Stride length (m)	1	1.04	0.17	3.33	0.003*
	6	1.16	0.15		
Cadence (step/mn)	1	83.5	11.11	5.0	0.0001*
	6	92.38	8.41		
Speed (m/s)	1	0.75	0.19	4.21	0.0001*
	6	0.9	0.14		
Cycle time (s)	1	1.43	0.19	4.16	0.0001*
	6	1.3	0.12		
Affected stance %	1	65.15	2.03	2.8	0.01*
	6	63.84	1.91		
Affected Peak flex (degree)	1	61.46	7.85	1.76	0.08**
	6	65.53	7.03		
Non affected knee flex (degree)	1	59.92	9.09		
	6	63.65	6.36		

*Significant difference **Not significant

Table (2): Lysholm knee score at 1 week and 6 weeks after arthroscopic partial menisectomy (n=26).

Variable	Week	Mean	SD	t-value	P-value
Limping	1	2.65	1.46	4.17	0.0001*
	6	3.57	1.62		
Support	1	4.0	1.01	3.33	0.003*
	6	4.61	0.8		
Stair climb	1	3.53	1.98	7.5	0.00001*
	6	6.3	2.24		
Squatting	1	1.61	1.13	7.23	0.00001*
	6	3.3	1.34		
Knee instability	1	16.34	9.11	5.49	0.0001*
	6	26.15	7.39		
Pain	1	14.42	8.75	6.53	0.0001*
	6	22.88	6.95		
Swelling	1	4.11	2.43	7.57	0.00001*
	6	7.73	2.63		
Atrophy	1	3.61	0.94	0.25	0.79**
	6	3.53	1.42		
Total score	1	50.23	17.37	10.44	0.00001*
	6	77.96	19.31		

*Significant difference **Not significant

Table (3): Correlation between gait parameters and Lysholm knee score at week 1 postoperative (n=26).

	Lysholm knee score 1 week postoperative								
	Sum-score	Limp	support	Srair climb	Squatting	Knee instability	Pain	Swelling	Atrophy
SL	0.35	0.13	-0.13	0.36	0.32	0.29	0.2	0.2	0.059
C	0.44	0.045	0.07	0.21	0.29	0.53	0.25	0.015	0.19
GS	0.58	0.12	0.016	0.38	0.42	0.53	0.42	0.23	0.059
CT	0.45	-0.09	0.185	-0.163	-0.242	-0.464	-0.312	-0.19	-0.155
AS	-0.33	-0.374	0.155	-0.245	-0.185	-0.051	-0.367	-0.37	0.175
APF	0.11	0.09	-0.021	0.19	0.04	0.11	0.003	-0.165	0.37

SL Stride length, C cadence, GS gait speed, CT Cycle time, AS affected leg stance, APF affected peak flexion

Table (4): Correlation between gait parameters and Lysholm knee score at week 6 postoperative (n=26).

	Lysholm knee score 6 week postoperative								
	Sum-score	Limp	support	Srair climb	Squatting	Knee instability	Pain	Swelling	Atrophy
SL	0.2	0.01	-0.135	0.07	0.11	0.18	0.32	0.04	0.25
C	0.22	-0.00	0.12	0.12	-0.145	-0.09	-0.06	-0.22	0.015
GS	0.32	0.12	-0.00	0.16	0.172	0.18	0.40	-0.03	0.19
CT	-0.22	-0.06	-0.086	-0.15	-0.08	0.06	-0.06	0.29	0.18
AS	-0.17	-0.14	0.18	-0.18	-0.039	-0.00	-0.15	0.13	-0.078
APF	0.05	0.02	-0.14	-0.03	0.19	0.10	0.06	0.01	-0.26

SL Stride length, C cadence, GS gait speed, CT Cycle time, AS affected leg stance, APF affected peak flexion

DISCUSSION

In the presented study, the immediate postoperative status of the patients undergoing arthroscopic partial menisectomy improved after 6 weeks. This is demonstrated by the improvement rating of the self-perceived function status (Lysholm knee score) in the total score which was changed from 50.23±17.37 (poor) to 77.96±19.31 (fair) and in all subscores except atrophy which indicated the quadriceps weakness and extensor deficit[4,7,23]. This reflects the need of a supervised early and intensive physiotherapy program to decrease swelling and to strengthen quadriceps as it was proved by Moffet et al.,[16] in their randomized controlled study to accelerate recovery post-arthroscopic meniscectomy.

The improvement of parameters describing the walking performance after six week post-arthroscopic meniscectomy was also documented. However, the peak flexion of the affected knee was not significantly changed after six weeks because it was already normal assured by the comparison with the non affected limb. This was in agreement with the results reported by Duran and Richard (1993)[4] and Goodwin et al. (2003)[6], who found no differences in knee range of motion during stair ascent and descent for a group of subjects with meniscectomy in comparison with a group of normal subjects. Another study supporting our results is that of Sturneiks et al.,[24] who found no significant difference in peak knee flexion angle between controls and affected and non affected side between one and three months post meniscectomy. In contrast to our results, Magyar et al.,[15] found a significant reduction of knee flexion during walking when compared with the non affected side after partial arthroscopic meniscectomy.

The correlation between Lysholm knee score and the measured gait parameters of cadence, gait speed and cycle time was fair to good at week1, indicating that Lysholm knee score is able to measure the early changes of some and not of all gait parameters measured in this study post-arthroscopic meniscectomy. The Lysholm knee scale is a patient-reported measure of knee function that has been frequently used in earlier studies[9,22]. However, it has since been found to be insensitive to both patient-related symptoms and function[20] as well as sports related function[19]. Furthermore, pain and instability account for more than 50% of the total score of Lysholm knee score making the results largely dependent on these symptoms which were greatly obvious 1 week postoperative.

Although pain is an important reason for most patients having arthroscopic meniscectomy; functional impairment associated with meniscal injury might be equally or even more important to some patients. Pain and physical function are usually

seen to be closely related, but in certain phases they develop in different directions. In the early postoperative phase pain is reduced, while the functional capacity might be diminished compared with preoperative period. Despite expecting that the Lysholm knee score would demonstrate this decline in functional status, it did not.

Gait speed has fair to good correlation with subscore of instability, pain and squatting, indicating that Lysholm knee subscore of instability, pain and squatting could be a measure of gait speed at early stage post-arthroscopic meniscectomy because the decreased gait speed is mainly due to pain, instability (giving way) and squatting.

Although, both measure of Lysholm knee score and gait parameters were improved at 6 weeks post-arthroscopic meniscectomy, the correlation between these tools was poor except pain, indicating that both tools couldn't assess the same aspect (walking performance). Lysholm knee score is a subjective assessment of function which measure patient satisfaction not the true status of the patient[21]. The change observed in Lysholm subcore ranged from 15% to 100% and the change in the total score is 55%, while the change in gait parameters ranged from 9% to 20%. This means that the patient overestimate the actual performance achieved in function and their satisfaction about the change is higher although gait alteration is still present. This was in agreement with Duran et al.,[11] who analyzed spatiotemporal kinematic and EMG parameters of gait in meniscal injured patients preoperatively, and at two, four, and eight week post arthroscopic partial meniscectomy and found a significant persistence of reduced gait velocity and cadence at eight week post-surgery. Maximum improvement in knee function in lateral arthroscopic partial meniscectomy patients, assessed by Lysholm score, was found by Jaureguito et al.,[11] to occur at five months post-surgery with an average score of 92.3. However, our results reached only an average score of 77.96 but at six weeks postoperative and changing percentage was 55% from week one to week 6 in contrast to the maximum change in gait parameters which ranged from 9% to 20 %.

Originally, we would have expected a high correlation between gait parameters and Lysholm knee score and its subscore. However, the correlation is remarkably poor and especially after six weeks postoperatively. This implies that the self-perceived physical function score does not reflect actual performance.

Conclusion

Lysholm knee score might not reflect walking performance. The addition of gait analysis is recommended to gain objective information about the quality of gait.

REFERENCES

1- Aminian, K., Najafi, B., Bula, C., Leyvraz, P.F. and Robert, P.: Spatio-temporal parameters of gait measured by an ambulatory system using miniature gyroscopes. J Biomech., 35: 689-699, 2002.

2- Briggs, K.K., Kocher, M.S. and Rodkey, W.: Reliability, validity and responsiveness of the Lysholm knee score and Tegner activity scale for patients with meniscal injury of the knee. J Bone Joint Surg Am., 88: 698-705, 2006.

3- Bulgheroni, P., Bulgheroni, M., Ronga, M. and Manelli, A.: Gait analysis of pre- and post-meniscectomy knee: A prospective study. The Knee, 14(6): 472-477, 2007.

4- Duran, A. and Richard, C.L.: Motor recovery after arthroscopic partial meniscectomy. Analyses of gait and the ascent and descent of stairs. JBone Joint Surg Am., 75: 202-214, 1993.

5- Duran, A., Richards, C.L. and Malouin, F.: Strength recovery and muscle activation of the knee extensor and flexor muscles after arthroscopic meniscectomy. A pilot study . Clin Orth., 262: 210-226, 1991.
6- Goodwin, P.C., Morissey, M.C., Omar, Z.R., Brown, M. and Southhall, K.: Effectiveness of supervised physical therapy in the early periods after arthroscopic partial menisctomy. Phys Ther., 83(6): 520-535, 2003.
7- Hamberg, P., Gillquist, J. and Lysholm, J.: A comparison between arthroscopic meniscectomy and modified open meniscectomy. A prospective randomized study with emphasis on postoperative rehabilitation. J Bone Joint Surg Br, (2): 189-192, 1984.
8- Hoher, J., Bach, T., Munster, A., Bouillon, B. and Tiling, T.: Does the mode of data collection change results in a subjective knee score? Self-administration versus interview. Am J Sports Med.; 25(5): 642-647, 1997.
9- Hoser, C., Fink, C., Brown, C., Reichkendler, M., Hackl, W. and Bartlett, J.: Long term results of arthroscopic partial lateral meniscectomy in knee without associated damage. J Bone Joint Surg Br, 83(4): 513-516, 2001.
10- Irrgang, J.J., Anderson, A.F., Boland, A.L., Harner, C.D., Kuroska, M., Neyret, P., Richmond, J.C. and Shelborne, K.D.: Development and validation of the international knee documentation committee subjective knee form. Am J Sport Med., 29: 600-613, 2001.
11- Jaureguito, J.W., Elliot, J.S., Lietner, T., Dixon, L.B. and Reider, B.: The effects of arthroscopic partial lateral meniscectomy in an otherwise normal knee : a retrospective review of functional, clinical, and radiographic results. Arthroscopy. 11(1): 29-36, 1995.
12- Johnson, D.S. and Smith, R.B.: Outcome measurement in the ACL deficient knee-what's the score? Knee. 1(8): 51-57, 2001.
13- Kocher, M.S., Stedman, R.J., Briggs, K.K., Sterett, W.I. and Hawkins, R.J.: Reliability, validity, and responsiveness of the Lysholm knee scale for various chondral disorders of the knee. J Bone Joint Surg Am. 86: 1139-1145, 2004.
14- Lysholm, J. and Gillquist, J.: Evaluation the knee ligament surgery results with special emphasis on use of scoring system. Am J Sport Med., 10(3): 150-154, 1982.
15- Magyar, O.M., Illyes, A., Knoll, Z. and Kiss, R.M.: Effect of medial meniscectomy on gait parameters. Knee Surg Sports Traumatol Arthrosc., 16(4): 427-433, 2008.
16- Moffet, H., Richards, C.C. and Malouin, F.: Early and intensive physiotherapy accelerates recovery post arthroscopic meniscectomy. Arch Phys Med Rehab, 75: 415-426, 1994.
17- Noyes, F.R., Barber, S.D. and Mooar, L.A.: A rationale for assessing sports activity levels and limitations in knee disorders.Clin Orthop Relat Res., 246: 238-249, 1989.
18- Paxton, E.W., Fithian, F.C., Stone, M.L. and Silva, P.: The reliability and validity of the knee specific and general instruments in assessing acute patellar dislocation outcomes. Am J Sports Med., 31(4): 487-492, 2003.
19- Risberg, M.A. and Ekeland, A.: Assessment of functional tests after anterior cruciate ligament surgery. J Orthop Sports Phys Ther., 19(4): 212-217, 1994.
20- Roos, E.M., Roos, H.P., Lohmander, L.S., Ekdhal, C. and Beynnon, B.: Knee injury and Osteoarthritis Outcome Score (KOOS): Development of a self-administered outcome measure. J Orth Sports Phys Ther., 78: 88-96, 1998.
21- Sagaglione, N., Del Pizzo, W., Fox, J.M. and Friedman, M.J.: Critical analysis of knee ligament rating systems. Am J Sports Med., 23(6): 660-667, 1995.
22- Scheller, G., Sobau, C. and Bulow, J.U.: Arthroscopic partial lateral meniscectomy in an otherwise normal knee:Clinical, functional and radiographic results of a long-term follow up study. Arthroscopy 17(9): 946-952, 2001.
23- Stam, H.J., Binkhorst, R.A., Kuhlman, P. and Van Nieuwenhugzen, J.F.: Clinical progress and quadriceps torque ratios during training of

meniscectomy patients. Int.J Sports Med 13(2): 183-188, 1992.
24- Sturnieks, D.L., Besier, T.F., Mills, P.M., Achkland, T.R., Maguire, K.F., Stachowiak, G.W., Podsiadlo, P. and Lloyd, D.G.: Knee joint biomechanics following arthroscopic partial meniscectomy . J Orthop Res. 20(10): 1-7, 2008.
25- Tapper, E.M. and Hoover, N.W.: Late results after meniscectomy. J Bone Joint Surg Am. 151: 517-526, 1969.
26- Tegner, Y. and Lysholm, J.: Rating systems in the evaluation of knee ligament injuries. Clin orthop Relat Res. 198: 43-49, 1985.

الملخص العربي

تحليل المشي و مقياس ليسهولم للركبة مكملين لبعض في تقييم النتائج الوظيفية بعد عمليات الإستئصا ل الجزئى للغضروف الهلالي بالمنظار

الهدف من هذه الدراسة هو معرفه العلاقة بين بعض المتغيرات في تحليل المشي الكينامتيكي ومقياس ليسهولهم للركب ة في حالات ما بعد الاستئصال الجزئي للغضروف الهلالي بالمنظار. الخلفية العلمية : أن مقياس ليسهولهم للركبة ينقسم إلى ثمن مجالات لقياس العرج ، الألم ، استخدام وسائل مساعدة فـي المشي ، صعود الدرج ، عدم الاتزان ، الورم ، القرفصاء ، وضمور عضلات الفخذ . وهذا يعبر عن رأى المريض في حالته الوظيفية ولقد اثبت صلاحيته وقدرته على ثبات قيمته في حالات ما بعد الاستئصال الجزئي للغضروف الهلالي بالمنظار . وهناك أيضا قياس إيجابي للمتغيرات في أداء المشي . وبالرغم من صلاح مقياس ليسهولهم للركبة في قياس الأداء الوظيفي إلى انه لا توجد دراسة تدعم انه يعكس الوضع الحالي في أداء المشي للركبة في حالات ما بعد الاستئصال الجزئي للغضروف الهلالي بالمنظار . تصميم الدراسة : تتكون الدراسة من مجموعه واحده مكونه من ست ة وعشرون مريض تتراوح أعمارهم بين 21-41 سنه خضعوا للعملية وتم فحصهم بمقياس ليسهولم وتحليل المشي الكينامتيكي خلال الأسبوع الأول بعد العملية وبعد ستة أسابيع من تاريخ العملية . النتائج : قد أظهرت النتائج تحسنا ذو دلاله إحصائية في المرضى حسب مقياس ليسهولهم وأيضا حسب تحليل الحركة الكيناماتيكي خلال الفترة مابين الأسبوع الأول والأسبوع السادس بعد العملية ، لكن لم تكن هناك علاقة إحصائيا ما بين مقياس ليسهولم وتحليل الحركة عند القياس بعد ستة أسابيع . الاستنتاج : يظهر من هذه الدراسة أن مقياس ليسهولم لا يعكس أداء المشي الحقيقي للمريض بالنسبة للمتغيرات التي تم قياسها فـي هذه الدراسة ولذلك ينصح بإضافة تحليل المشي للحصول على معلومات إيجابية عن جودة المشي لدى المرضى الذين أجريت لهم عملية استئصال جزئي للغضروف الهلالي بالمنظار .