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ANATOMICAL MEDIAL COLLATERAL LIGAMENT RECONSTRUCTION IN PATIENTS WITH MEDIAL KNEE INSTABILITY

By

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ABSTRACT

Background: The medial collateral ligament is the most frequently injured ligament of the knee, but it infrequently requires surgical treatment. In cases of multiple ligament injury or severe medial collateral ligament lesion, non-operative treatment of the medial collateral ligament lesion may lead to chronic valgus instability or rotatory instability.

Objective: To study a new technique of medial collateral ligament and posterior oblique ligament reconstruction in patients with medial knee instability.

Patients and Methods: This was a prospective descriptive clinical study contained twenty patients aged 19 – 35 years old with medial knee instability and followed up at the orthopedic department, AL-Azhar university hospital over the period from January 2019 to November 2019.

Results: Before surgery, the Lysholm knee score was poor in all patients (100%). After surgery, the Lysholm knee score was excellent in 5 patients (25%) ,good in 12 patients (60 %), and 3 patients (15%) was classified as fair, while no one was poor.

According to sressvulgus test, there was a significant postoperative reduction in degree of gapping after reconstruction in both extension and in 30° flexion positions.

Conclusion: Acceptable clinical results with the combined medial collateral ligament and posterior oblique ligament reconstruction technique were achieved in patients suffering from chronic valgus instability.

Keywords: Medial collateral ligament injury, Posteromedial corner, Posterior oblique ligament.

INTRODUCTION

The Superficial collateral ligament (sMCL) is the most frequently injured ligament of the knee and most of its injuries are treated non-operatively. Recommendations for treatment differ when non-operative treatment fails or when surgical treatment is acutely required *(Coobs et al., 2010).* The diagnosis and treatment of medial-sided knee injuries has evolved from an aggressive surgical approach for most injuries to a no operative phase to the present trend of non-operative and operative management that is tailored to the specific nature and setting of the injury. The challenge of treating these injuries has been in defining the location and extent of the injury before deciding how to best manage it in a particular

clinical setting. Accurate characterization of each component of the injury helps to define appropriate treatment guidelines *(Dong et al., 2015).*

Anatomically imprecise graft placement and suboptimal reconstruction, graft fixation methods can lead to over constraint, residual instability, or graft loosening. Studies have attempted to optimize the surgical technique for the medial knee structures by providing thorough descriptions of the quantitative anatomic and biomechanical features. These findings stress on the importance of an anatomic restoration so that the native relationships within the knee can be fully reestablished *(Laprade et al., 2012)* and *(Dong et al., 2015).*

This study aimed at assessing a new technique of medial collateral ligament and posterior oblique ligament reconstruction in patients with medial Knee instability.

PATIENTS AND METHODS

This current study was a case series study done between January 2019 and November 2019 at the orthopedic department, AL-Azhar university hospital on twenty patients with age ≥35 males and females with medial Knee instability who were treated with reconstruction of the sMCL and posterior oblique ligament.

Patients were evaluated before operations regarding to history taking, clinical assessment, lab investigations and knee radiographies included stress valgus plain X-ray , MRI , and Rating scales including Lysholm knee score and international Knee Documentation Committee score (IKDC).Patients with misalignment, that needed corrective osteotomy, were not included in this study. All patients were assented about the surgery, possible complications, risks and follow up plan.

A hinged knee brace was applied for 6 weeks after operations. All patients were evaluated after surgery every two weeks up to the second postoperative month, monthly up to 6 months. Postoperative evaluation included examination for tenderness, irritation, and presence of abnormal sensation of the skin surrounding it. Stress valgus X-rays was done in full extension, and 30° flexion after 6 months, and the difference with the contralateral normal limb was documented. After clinical and radiographic evaluation, the postoperative rating scales were calculated. The Lysholm knee score was used for subjective evaluation, the IKDC scoring system (knee examination form) was used for objective evaluation.

Statistical Methods: The analysis was done using SPSS v22.0 IBM statistical package for the social sciences & Microsoft Office 2016. The significance level was set at $p<0.05$ & marked with S, while highly statistical significance was set at $p<0.01$ & marked with HS. The statistical insignificance was set at $p>0.05$ & marked by NS. The categorical data were subjected to descriptive analysis using frequency and mean percentage and compared by chi-square test while for quantitative data, mean ± SD and range were compared by Wilcoxon Signed-Rank test.

RESULTS

This present study was a prospective descriptive study conducted on twenty patients with medial Knee instability managed by reconstruction of the sMCL and posterior oblique ligament. The studied cases were 15 males and 5 females. Their ages ranged from 19 to 35 with an average age of 23.62 ±3.67 years old **(Table 1)**.

Table (1): Age and sex distribution of the studied cases (N= 20)

Cases / Parameters	N	%
Sex		
Males	15	75
Females	5	25
Age (years)		
Mean ±SD	23.62 ±3.67	
Range (Minimum– Maximum)	(19 – 35)	

Nearly, two-thirds (60%) of the studied cases had injury in the Rt. Side, while 40% had injury in the Lt. Side. Causes of injury were sport in 60% of cases, and in 40% were other causes not related to sport injuries. Majority of the studied cases (75%) had no associated injuries, three cases had MCL/ACL injuries, and only two cases had medial meniscus injury. Regarding duration before operation, it ranged from 1 to 8 months with an average duration of 4.65 ±2.18 months **(Table 2)**.

Table (2): Pre-operative Clinical Assessment of the studied cases (N=20)

Cases / Parameters	N	%
Affected Side		
Rt. side	12	60
Lt. side	8	40
Cause of Injury		
Sport	12	60
Non-Sport	8	40
Associated Injuries		
No	15	75
MCL/ACL	3	15
Medial Meniscus	2	10
Duration before Operation,(Months)		
Mean ±SD	4.65 ±2.18	
Range (Minimum– Maximum)	(1 – 8)	

All studied patients were scored for Lysholm score subjective parameters before and after surgery. There were statistically significant differences in all scores when compared to pre-operative values $p<0.05$ **(Table 3)**.

Table (3): Analysis of patient's complaint according to Lysholm score evaluation before and after operation (N= 20)

Mean±SD / Parameters	Pre-Operative	Post-Operative	p-value
Limp	1.95 ±1.4	4.70 ±0.7	**0.001**
Support	1.10 ±1.0	4.10 ±1.4	**0.001**
Locking	7.30 ±3.2	13.30 ±2.8	**0.001**
Instability	3.10 ±2.6	8.80 ±1.9	**0.001**
Pain	14.00 ±4.2	24.00 ±2.1	**0.001**
Swelling	6.75 ±4.4	22.00 ±4.1	**0.001**
Stair climbing	4.10 ±2.2	8.80 ±1.9	**0.001**
Squatting	1.70 ±0.9	4.80 ±0.4	**0.001**
TOTAL Score	40.00 ±9.6	90.50 ±7.3	**0.001**

Wilcoxon Signed-Rank Test

Before surgery, there were 7 patients (35.0%) had severe and constant limp, while 13 (15.0%) had slight or periodical limp. After surgery, there were 3 patients (15.0%) had periodical limp, 17 patients (85.0%) had no limp and no patient had constant limp **(Table 4)**.

Table (4): Limp Factors pre and post-operative among studied patients.

Time / Factors	Pre-Operative		Post-Operative		p-value
Score	N	%	N	%	
None (5)	0	0.00	17	85.0	**0.001**
Slight or periodic (3)	13	15.0	3	15.0	
Severe and constant (0)	7	35.0	0	0.00	

Chi-Square Test.

Before surgery, 9 patients (45.0%) had impossible weight-bearing, and used an ambulation support, and 11 patients (55.0 %) were walking with stick or crutch support, and no patients were walking freely. After surgery, there were 14 patients (70%) walking freely, and 6 patients (30.0%) were walking with stick or crutch support, while no patients had impossible weight-bearing (Table 5).

Table (5): SupportFactors pre and post-operative among studied patients

Time / Factors	Pre-Operative		Post-Operative		p-value
Score	N	%	N	%	
None (5)	0	0.00	14	70.0	**0.001**
Stick or crutch (2)	11	55.0	6	30.0	
Weight-bearing impossible (0)	9	45.0	0	0.00	

Chi-Square Test.

Before surgery, 11 patients (55%) had catching sensation but no locking, 7 patients (35%) had occasional locking, 2 patients (10%) had frequently locking, while no patient was locked on examination. After surgery, there were 14 patients (70%) had neither locking nor catching sensation, 5 patients (25%) had catching sensation, but no locking (Table 6).

Table (6): LockingFactors pre and post-operative among studied patients

Time / Factors	Pre-Operative		Post-Operative		p-value
Score	N	%	N	%	
No locking/catching sensations (15)	0	0.00	14	70.0	**0.001**
Catching sensation but no locking (10)	11	55.0	5	25.0	
Locking: occasionally (6)	7	35.0	1	5.00	
Locking: frequently (2)	2	10.0	0	0.00	
Locked joint on examination (0)	0	0.00	0	0.00	

Chi-Square Test.

Before surgery, giving way had occurred occasionally in daily activities in 9 patients (45%), and frequently in severe exertion in 6 patients (30%) while rarely during athletics or other severe exertion in 5 patients (25%). After surgery, 16 patients (80%) had never got giving way of the knee, 4 patients (20%) got giving way rarely in severe exertion **(Table 7)**.

Table (7): InstabilityFactors pre and post-operative among studied patients

Time / Parameter	Pre-Operative		Post-Operative		p-value
	N	**%**	**N**	**%**	
Never giving-way (25)	0	0.00	16	80.0	**0.001***
Rarely during athletics or other severe exertion (20)	5	25.0	4	20.0	
Frequently during athletics or other severe exertion (or incapable of participation) (15)	6	30.0	0	0.00	
Occasionally in daily activities (10)	9	45.0	0	0.00	
Often in daily activities (5)	0	0.00	0	0.00	
Every step (0)	0	0.00	0	0.00	

Before surgery, 4 patients (20%) had constant pain, marked pain after 2 Km were in 6 patients (30%), and marked pain on walking more than 2 Km in 9 patients (45%), and only 1 patient (5%) pain during severe exertion. After surgery, 12 patients (60%) had no pain, 4 patients (20%) had slight pain during severe exertion and 4 patients (20%) had marked pain during severe exertion and no patient had constant pain **(Table 8)**.

Table (8): PainFactor pre and post-operative among studied patients

Time / Parameters	Pre-Operative		Post-Operative		*p-value*
	N	**%**	**N**	**%**	
None (25)	0	0.00	12	60.0	**0.001**
Inconstant and slight during severe exertion (20)	0	0.00	4	20.0	
Marked during severe exertion (15)	1	5.00	4	20.0	
Marked on or after walking >2 km (10)	9	45.0	0	0.00	
Marked on or after walking <2 km (5)	6	30.0	0	0.00	
Constant (0)	4	20.0	0	0.00	

Chi-Square Test.

Before surgery, 1 (5%) had constant swelling, 8 patients (40%) had swelling with ordinary exertion and 11 patients (55%) had swelling with severe exertion.After surgery, 14 (70%) patients had no swelling while only 6 patients (30%) had swelling only with severe exertion **(Table 9)**.

Table (9): Swelling Factor pre and post-operative among studied patients

Time / Parameters	Pre-Operative		Post-Operative		p-value
Score	N	%	N	%	
None (10)	0	0.00	14	70.0	**0.001**
On severe exertion (6)	11	55.0	6	30.0	
On ordinary exertion (2)	8	40.0	0	0.00	
Constant (0)	1	5.0	0	0.00	

Chi-Square Test.

Before surgery, stair climbing was impossible among 5 cases (25%), one step at a time in 8 patients (40%) and slightly impaired in 7 patients (35%). After surgery, there were no problem in 14 patients (70%); stair climbing was slightly impaired in 6 patients (30%) **(Table 10)**.

Table (10): Stair-climbingFactors pre and post-operative among studied patients

Time / Parameters	Pre-Operative		Post-Operative		p-value
Score	N	%	N	%	
No problems (10)	0	0.00	14	70.0	**0.001***
Slightly impaired (6)	7	35.0	6	30.0	
One step at a time (2)	8	40.0	0	0.00	
Impossible (0)	5	25.0	0	0.00	

Chi-Square Test.

Before surgery, squatting was impossible in 4 cases (20%), not beyond 90 degree in 15 patients (75%) and there were slight impairment in 1 patient (5%). After surgery, there were no problem in 16 patients (80%), slightly impaired in 4 patients (20%) **(Table 11)**.

Table (11): SquattingFactors pre and post-operative among studied patients

Time / Parameters	**Pre-Operative**		**Post-Operative**		***p-value***
	N	**%**	**N**	**%**	
No problems (5)	0	0.00	16	80.0	**0.001**
Slightly impaired (4)	1	5.00	4	20.0	
Not beyond 90 degrees (2)	15	75.0	0	0.00	
Impossible (0)	4	20.0	0	0.00	

Chi-Square Test.

Before surgery, the Lysholm knee score was poor in all patients (100%). After surgery, the Lysholm knee score was excellent in 5 patients (25%) and good in 12 patients (60 %) and 3 patients (15%) was classified as fair while no one was poor **(Table 12)**.

Table (12): Total Lysholm knee Evaluation pre and post-operative among studied patients

Time / Parameters	Pre-Operative		Post-Operative		*p-value*
	N	%	N	%	
Excellent	0	0.00	5	25.0	**0.001**
Good	0	0.00	12	60.0	
Fair	0	0.00	3	15.0	
Poor	20	100.0	0	0.00	

Chi-Square Test.

According to International Knee Documentation Committee score (IKDC), before surgery, no effusion was detected in 5 patients (25%), mild effusion in 10 patients (50%), and moderate effusion in 5 patients (25%). After surgery, no effusion was noted in 15 patients (75%); while mild effusion was noted in 5 patients (25%) **(Table 13)**.

Table (13): Grades of knee effusion pre and post operatively

Time / Grades	Pre-Operative		Post-Operative		*p-value*
	N	%	N	%	
Normal (A)	5	25.0	15	75.0	**0.003**
Near normal (B)	10	50.0	5	25.0	
Abnormal (C)	5	25.0	0	0.00	

Chi-Square Test.

Regarding lack of extension passive motion, before surgery, 15 patients (75%) were graded as normal, 5 patients (25%) were graded as nearly normal. After surgery, 17 patients (85%) were graded as normal, 3 patients (15%) were graded as nearly normal with no statistically significant difference between before and after surgery evaluation **.** Regarding lack of flexion passive motion, before surgery, 4 patients (20%) were graded as normal, 13 patients (65%) were graded nearly normal and 3 patients (15%) were graded abnormal. After surgery, 15 patients (75%) were graded as normal and 5 patients were graded as nearly normal (25%) **(Table 14)**.

Table (14): Lack of extension and flexion pre and post operatively (N= 20)

Time / Parameters	Pre-Operative		Post-Operative		*p-value*
	N	%	N	%	
Lack of extension					
Normal (A)	15	75.0	17	85.0	0.347
Near normal (B)	5	25.0	3	15.0	
Abnormal (C)	0	0.00	0	0.00	
Severe abnormal (D)	**0**	**0.00**	**0**	**0.00**	
Lack of flexion					
Normal (A)	4	20.0	15	75.0	**0.002**
Near normal (B)	13	65.0	5	25.0	
Abnormal (C)	3	15.0	0	0.00	
Severe abnormal (D)	0	0.00	0	0.00	

by Chi-Square Test.

Regarding to Lachman test before surgery 16 patients (80%) were graded as abnormal and 4 (20%) were severely abnormal. After surgery; 11 patients (55%) were graded as normal, 8 patients (40%) were graded nearly normal, and 1 patient (5%) were graded abnormal

Regarding to valgus test, Before surgery; 4 patients (20%) were graded near normal, 14 patients (70%) were graded abnormal, and 2 patients (10%) was graded severely abnormal. After surgery, 13 patients (65%) were graded as normal and 7 patients (35%) were graded as nearly normal **(Table 15)**.

Table (15): Ligament examination in the studied patients pre and post-operatively (N= 20)

Time / Tests	Pre-Operative		Post-Operative		*p-value*
	N	%	N	%	
Lachman test					
Normal (A)	0	0.00	11	55.0	**0.001**
Near normal (B)	0	0.00	8	40.0	
Abnormal (C)	16	80.0	1	5.0	
Severe abnormal (D)	**4**	**20.0**	**0**	**0.00**	
Valgus test					
Normal (A)	0	0.00	13	65.0	**0.001**
Near normal (B)	4	20.0	7	35.0	
Abnormal (C)	14	70.0	0	0.00	
Severe abnormal (D)	2	10.0	0	0.00	

Chi-Square Test.

Stress valgus x-ray was performed to assess the difference between degree of gapping of medial compartment in mm in relation to normal side pre and postoperatively. There was a highly significant postoperative reduction in degree of gapping after reconstruction in both extension and in 30° flexion positions (p <0.001, <0.001 respectively) **(Table 16)**.

Table (16): Pre-operative and post-operative Stress valgus x-ray of group among studied patients (N=20)

Mean ±SD / Parameters	Pre-Operative	Post-Operative	*p-value*
Stress valgus x-ray difference			
In extension	6.40 ±1.6	1.75 ±0.4	0.001
In flexion	7.30 ±1.5	1.85 ±0.4	0.001

Wilcoxon Signed-Rank Test.

DISCUSSION

The medial collateral ligament is the most commonly damaged ligamentous structures of the knee joints *(Wijdicks. et al., 2015). Chung et al (2013)* reported that most of medial injuries requiring operation had an associated injury to the posterior oblique ligament, which was overlooked.

Injuries to the medial side of the knee have traditionally been treated conservatively with bracing and early motion, achieving satisfactory results in most patients *(Tandogan et al., 2016),*

Several forms of surgical treatment have been described for chronic medial instability of the knee, including proximal advancement or reconstruction of the medial collateral ligament *(Kim et al., 2019).*

The posterior oblique ligament has a key role in the medial stability of the knee, and it has been reported that treatment of medial compartment ligaments without repair of the posterior oblique ligament often fails to achieve static stability *(Haimes et al., 2013).*

Non-anatomical reconstruction of the medial collateral ligament has been carried out using the medial head of gastrocnemius or pesanserinus. Bosworth described anterior translation of the semitendinosus tendon and its implantation on the medial femoral condyle, which resulted in slight laxity during flexion in half of the cases.

Subsequently, these non-anatomical reconstructions proved to be unsatisfactory *(Pouderoux et al., 2020) (Mouarbeset al., 2019)* so in our method, anatomical reconstruction was considered to avoid post-operative laxity.

Laprade et al., described anatomical reconstruction of both superficial medial collateral ligament and posterior oblique ligament using 2 separate grafts which were fixed in the native origins and insertions of the superficial medial collateral ligament and posterior oblique ligament after exposing them. Although it is anatomical method, but it requires massive dissection which increases the morbidity of the patients, the follow up period was short and the presence of 4 tunnels with 4 tools of fixation is too much with the risk of overriding of the tunnels *(Laprade et al., 2012).*

Our technique described is inspired by anatomy but driven by isometry. The aim is to correct the valgus laxity without altering flexion-extension or rotation, which is more significant in flexion than extension. *(Imbert et al., 2017)* This percutaneous reconstruction procedure is easy to carry out and minimally invasive since the subcutaneous layers are not dissected.

Regarding to the surgical technique in this study, the use of distally based hamstring tendon put away the need of fixation at the tibia. The use of image intensifier during making the tunnel of the posterior oblique ligament provides more accurate tunnel positioning. The minimally invasive way of reconstruction decreases the morbidity of the patient especially that it is usually associated with other ligaments injuries *(Selim et al 2019).*

Our study is limited by number of factors. First, the average follow up is short and further long-term follow up is necessary to ensure instability does not recur over time. Second, the majority of the surgical procedures are not for isolated medial knee reconstructions. Finally, this procedure could only be performed on a knee with an intact tibial attachment of the semitendinosus.

CONCLUSION

All patients with symptomatic IKDC grade 3 or 4 valgus laxity had the full reconstruction that involved both the medial collateral ligament structure and the posterior oblique ligament.

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إعادة بناء التشريحي للرباط الداخلي الأنسي في حالات عدم ثبات الجهة الداخلية للركبة

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خلفية البحث: الرباط الداخلي الأنسي للركبة أكثر اربطة الركبة عرضة للإصابة, إلا أن معظم الحالات لا تحتاج الي تدخل جراحي. ولكن في حالات الاصابة الشديدة أو حالات الاصابة المتعددة للأربطة عدم التدخل الجراحي يؤدي إلي عدم ثبات للجهة الداخلية للركبة.

الهدف من البحث: إعادة بناء الرباط الداخلي الأنسي و الخلفي المائل, ومعرفة دورهما في حالات عدم ثبات الجهة الداخلية و معرفة نتائج هذه الطريقة.

المرضى وطرق البحث: تم عمل البحث في قسم العظام بمستشفى الأزهر الجامعي في المدة ما بين شهر يناير 2019 الي شهر نوفمبر 2019 علي عشرين من المرضى الذين خضعوا لإعادة بناء الرباط الداخلي الأنسي والرباط المائل الخلفي باستخدام وتر العضلة النصف وترية لعلاج حالات عدم الثبات الجهة الداخلية للركبة, تم إختيار جميع المرضى وفقا للمعايير و هي المرضى الناضجون هيكليا, تكون إصابة الرباط الداخلي معزولة أو كجزء من إصابة بأربطة عديدة بالركبة, ألا يوجد تقوس يحتاج لعمليات تصحيحية و أن تكون أوتار المأبض الخلفية للركبة سليمة في الطرفين.

و تم تقييم المرضى قبل و بعد العملية بالاستخدام بالعوامل التالية وهي أخذ التاريخ المرضي بدقة, تحليل شكوي المرضى و الفحص الاكلينيكي و الفحص بالآشعة السينية و آشعة الرنين المغناطيسي و التقييم الاكلينيكي قبل العملية وفقا لمقياس ليشلوم و مقياس الجنة وثيقية الدولية للركبة.

نتـــائج البحـــث: بلــغ متوســط الدرجــة الكليــة علــى مقيــاس ليشــلوم91.25نقطــة, و درجــة الفجــوة أثنــاء عمــل اختبارثبــات الجهــة الداخليــة للركبــة بالأشــعة الســينية أصــبحت طبيعية في 65% من المرضى و قريب من الطبيعي في 35% من المرضى.

الاســتنتاج: تــم اســتخدام طريقــة جديــدة لإعــادة بنــاء الربــاط الــداخلي الأنســي و الربــاط المائــل الخلفــي, وجــد أن نتــائج هــذه الطريقــة مرضــية فــي حــالات عــدم الثبــات للجهــة الداخليــة للركبــة مــع وجــود مضــاعفات قليلــة و مقبولــة مثــل إلتهــاب ســطحي للجــرح, و قليــل مــن المرضــى يعــانون مــن مشــاكل بســيطة فــي مــدى حركــة الركبــة, و للحصــول علــى نتــائج أفضــل يوصــى بعمــل دراســة مقارنــة لحــالات عــدم ثبــات الجهــة الداخليــة للركبة ولفترة متابعة أطول.

الكلمــات الدالــة: الربــاط الجــانبي الأنســي, الربــاط المائــل الخلفــي, عــدم ثبــات الجهــة الداخلية.