CLINICAL AND RADIOLOGICAL EVALUATION OF TROCHLEOPLASTY IN CASES WITH TROCHLEAR DYSPLASIA

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Abstract

Background: Recurrent patellar instability is a disabling condition that can lead to articular cartilage injuries, osteochondral fractures, pain, decreased activity, and patellofemoral osteoarthritis (OA).
Aim of the work: To evaluate Clinical and Radiological evaluation of Trochleoplasty in cases with trochlear dysplasia.
Patients and Methods: In between2018 and2020 a prospective comparative study of cases suffered from recurrent patellar dislocation with trochlear dysplasia at knee surgery, sports medicine and arthroscopy unit-Mansoura University. The patients were divided in to two group, group 1treated by Trochleoplasty combined with MPFLR versus cases treated by MPFLR (group 2). All patients were trochlear dysplasia type (B, D).
Results: In our study13 cases had treated by MPFLR only one case needed tibial tubercle transfer, they had a minimum follow-up period of2years and were able to show an improvement in Kujala scores from (59.0±9.29) to (75.53±9.61) p≤0.001. The visual analogue scale decreased from (6.92) to (2.66±0.61) p≤0. 001.NO dislocation rates were reported. In our study j sign was observed in 7 cases preoperative and one case had persistent g sign postoperative due to weak vmo muscle. In which the sulcus angle decreased from 150.5±6.91preoperative to 143.4±8.19 (p=0.003) at the final follow up, the congruence angle decreased from46 preoperative to 9(p=0.013), patellar tilt angle decreased from 14.5 to 7(p≤ 0.001), tibial tuberosity trochlear groove distance decreased from 2.25to 1.9(p≤0.001).
Conclusion: The clinical significance of the present study indicates that the combinatory treatment concept of trochleoplasty and MPFLR may serve as a valuable option not only as salvage therapy but also as primary procedure regarding treatment for chronic PFI.

Keywords: Trochleoplasty, trochlear dysplasia, and Patellar dislocation

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1. INTRODUCTION

Recurrent patellar instability is a disabling condition that can lead to articular cartilage injuries, osteochondral fractures, pain, decreased activity, and patellofemoral osteoarthritis (OA).it is common in younger and more active populations [(1)].
Patellar dislocation is a multifactorial problem, which depends on limb alignment, the osseous structure of the patella and trochlea, and the integrity of the static and dynamic soft-tissue constraints [(2)].
The medial patellofemoral ligament acts as the major restraint to lateral patellar translation from full extension through the first 20°–70° of knee flexion [(3)] and considered as an integral part in patellar stability.
The morphology of the trochlea is important for normal patellofemoral tracking and to maintain patellar stability [(4)]. Trochlear dysplasia involves an abnormality of the shape and depth of the trochlear groove and has been found in 85% of individuals with recurrent patellofemoral instability [(5)].
Trochleoplasty aims to change the shape of the trochlea in order to stabilize an unstable patella, Sulcus deepening trochleoplasty is the most popular technique according to Dejour in order to decrease the prominence of the trochlea and create a new "V-shaped" groove with a normal depth [(6)].
Trochleoplasty is an effective patellar stabilization procedure; however, it is associated with a risk of complications that cannot be ignored., particularly the long-term results of lateral elevation trochleoplasty [(7)] so, trochleoplasty is a technically demanding operation.our hypothesis is whether to do trochleoplasty or neglect IT in patient with trochlear dysplasia. Some authors recommend performing both trochleoplasty and MPFL reconstruction in all

dysplastic knees associated with another procedure according to the anatomical abnormalities [8].

2. PATIENTS AND METHODS

(A) Patients population

In between2018 and2020 a prospective comparative study of cases suffered from recurrent patellar dislocation with trochlear dysplasia at knee surgery, sports medicine and arthroscopy unit- Mansoura University. The patients were divided in to two group, group 1treated by Trochleoplasty combined with MPFLR versus cases treated by MPFLR (group 2). All patients were trochlear dysplasia type (B, D)

Ethical approval;

The study was accepted by the ethical committee of Mansoura University (reference; MD). 19. 06. 189 and a written consent was taken from every patient

B. Methods:

1) Preoperative:

Clinical and Radiological;

Preoperative objective clinical evaluation included the apprehension test, lateral patellar glide test, and patellar tracking. Subjective findings included the presence of feeling of instability more than two episodes of dislocation. Kujala score and visual analogue scale were evaluated preoperative and post-operative.

Radiological evaluations were done, dead lateral x ray to assess signs of trochlear dysplasia, patellar height. CT SCAN:AT O and 30 flexion to measure the trochlear sulcus angle Congruence angle, The patellar tilt angle. Tibial tuberosity trochlear groove distance. MRI was done to assess tibial tuberosity trochlear groove distance, Patellar height. trochlear groove spur.

(11) Operative

(1) Mpflr Reconstruction;

The classical technique uses a semitendinosis tendon autograft with two Suture anchor and femoral fixation at the schottle point guided by image intensifier.

(2) trochleoplasty and mpflr technique

Sulcus deepening trochleoplasty was done according to DEJOUR technique

(3) Postoperative rehabilitation

Rehabilitation after trochleoplasty and mpflr. Patients should remain non–weight bearing for 6 weeks. A continuous passive motion (CPM) machine is used to cycle the knee from 0" to 30" of flexion in order to minimize the risk of arthrofibrosis and to maintain articular cartilage viability. Passive range of motion should be limited from 0" to 90" of flexion for the first 2 weeks and increased as tolerated thereafter. Return to normal levels of activity generally occurs after 6 to 9 months

Rehabilitation after MPFLR consisted of total weightbearing with crutches and no postoperative brace. Full range of motion exercises were performed immediately after surgery. Progressive strength and proprioceptive training were allowed after 6 weeks. Return to sports was allowed at 6 months after surgery.

STATISTICAL ANALYSIS:

Data were analyzed using the Statistical Package of Social Science (SPSS) program for Windows (Standard version 24). The normality of data was first tested with one-sample Kolmogorov-Smirnov test.

Qualitative data were described using number and percent. Continuous variables were presented as mean ± SD (standard deviation) for normally distributed data and median (min-max) for non-normal data. The following tests were used;

Fisher exact test and Monte Carlo test: Compare qualitative variables when excepted cell count less than 5.

Mc nemar test: Compare qualitative variables before and after.

Independent t test: Compare two quantitative variables.

Paired t- test: Compare two quantitative variables pre and post in the same group.

Mann Whitney test: Compare two quantitative variables (Non parametric).

Repeated measured ANOVA test: Compare more than two means at different follow up periods (parametric).

Friedman test: Compare more than two medians at different follow up periods (Non parametric).

For all above mentioned statistical tests done, the threshold of significance is fixed at 5% level. The results was considered significant when $p \leq 0.05$. The smaller the p-value obtained, the more significant are the results.

3. RESULTS

At the end of follow up which ranged from 24m to 36m, the patients were divided into two groups; group 1 (trochleoplasty and MPFLR) the numbers of patients were 12 cases 4 cases missed follow up, while in group 2 (MPFLR) the numbers of patients were 15 case 2 cases missed follow up.

Table (1): Sociodemographic data among the studied groups

Demographic data	Group (1) (n=8)	Group (2) (n=13)	P value
Age (years) **Mean ± SD**	17.87±2.69 14-22	23.23±8.34 14-38	0.097
Gender **Male**	3 (37.5%)	4 (30.8%)	1.0

Female	5 (62.5%)	9 (69.2%)	

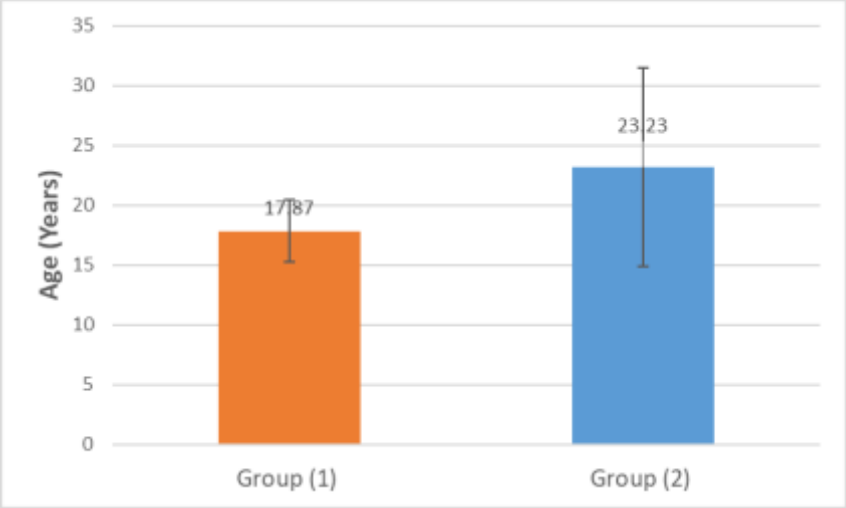


Figure (1): Age distribution among the studied groups

Table (2): show side affected among studied group

	Group (1) (n=8)	Group (2) (n=13)	P value
Side affected RT LT Bilateral	 3 (37.5%) 5 (62.5%) 0 (0%)	 8 (61.5%) 4 (30.8%) 1 (7.7%)	0.471
Contra lateral side Symptomatic Asymptomatic Dislocated once	 1 (12.5%) 7 (87.5%) 0 (0%)	 1 (7.7%) 10 (76.9%) 2 (15.4%)	0.745

Table (3): show side affected among studied group

Risk factors	Group (1) (n=8)	Group (2) (n=13)	P value
Trochlear dysplasia B D	 2 (25.0%) 6 (75.0%)	 10 (76.9%) 3 (23.1%)	0.032*
Patella alta	2 (25.0%)	2 (15.4%)	1.0
↑ TTTG	2 (25.0%)	0 (0%)	0.13

(1) Clinical results;

In group 1(combined trochleoplasty and MPFLR)

At the final follow-up, there was a statistically significant improvement in Kujala scores between pre- and postoperatively (61.42±14.57to 77.28±10.02, P≤0.001*) visual analogue scale decreased from from (7.28±1.11 to 3.0±0.58 P=0.033*)

There was improvement in the post apprehension test in all caseses (p=0.002*), patellar gliding test (p= 0.008*), in The MPFL group no redislocation rate was observed .2 caseses had persistent femoral sided pain due to prominent screw which was removed. The preoperative KUGALA SCORE Increased from (59.23±9.96 to 75.38±10.02, P≤0.001*), the visual analogue scale decreased from (6.92±0.64to2.61±0.65, P=0.002*)

Table (4): comparison of clinical results among the studied group.

		Group (1) (n=8)	Group (2) (n=13)	P value
A test	Preoperative	8 (100%)	13 (100%)	-
	Postoperative	0 (0%)	0 (0%)	-
$P_{pre\text{-}post}$		P=0.002*	P≤0.001*	
PGT	Preoperative	8 (100.0%)	13 (100%)	
	Postoperative	0 (0%)	0 (0%≤0.001*)	-
$P_{pre\text{-}post}$		P=0.002*	p≤0.001*)	

J sign	Preoperative	6 (75.0%)	2 (15.4%)	0.02*
	Postoperative	1 (12.5%)	0 (0%)	0.381
$P_{pre-post}$		P=0.062	0.5	
VAS	Preoperative	7.28±1.11	6.92±0.64	0.363
	Postoperative	3.0±0.58	2.61±0.65	0.207
$P_{pre-post}$		P≤0.001*	P≤0.001*	-
K. S	Preoperative	61.42±14.57	59.23±9.96	0.693
	Postoperative	77.28±10.02	75.38±10.02	0.691
$P_{pre-post}$		P≤0.001*	P≤0.001*	-

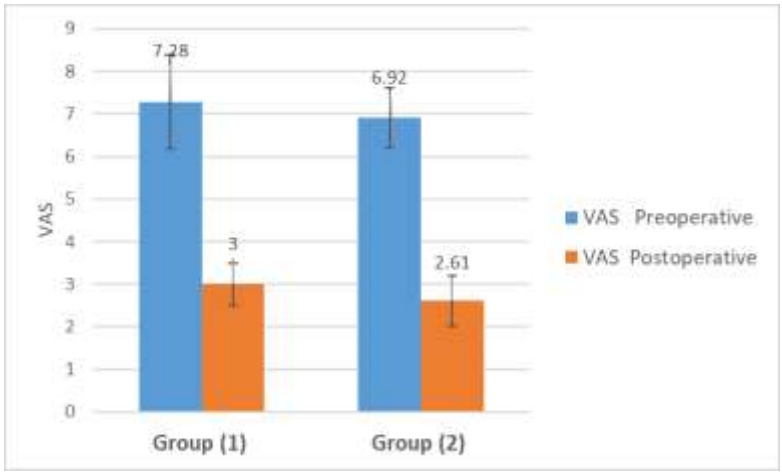


Figure (2): VAS pre- and post-operative among the studied groups

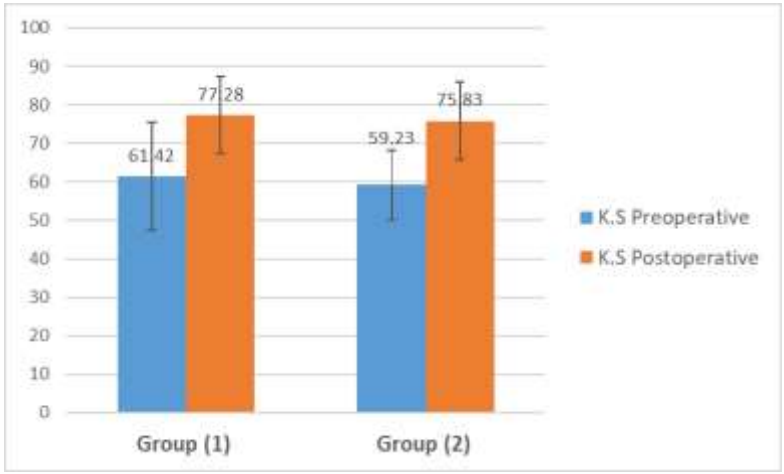


Figure (3): K.S pre- and post-operative among the studied groups

Radiological Result

In group (1)

At the final follow up the sulcus angle measured with CT at 0extension decreased from 150.5±6.91to143.4±8.19 (p=0.003*), the congugerence angle decreased from 46 to 9 (p=0.013)

The patellar tilt angle decreased from 14.5 (5-60) to 7 (4-25) (p=≤0.001*)

The tibial tuberosity trochlear groove distance decreased from2.25 (1.3-16) to 1.9 (1-1.9 (1-14) (p=≤0.001*) While the sulcus angle measured with CT at 30 flexion decreased from 148.4±9.44to138.0±4.27 (p=0.008*). The Congruence angle decreased from (p=.008* 11 (-23-22) to9.0 (4-15)

The patellar tilt angle decreased from 8.0 (5-12) to 6 (4-10) (p= 0.392)

In dead, lateral X ray, the caton Deschamps index Decreased from 1.15±0.16 to0.97±0.14 (p= 0.033*)

In-group (2)

AT 0 EXTENSION, the congruence angle decreased from37 (9-81) to24 (4-70) (p ≤0.001*), the patellar tilt angle decreased from 6 (3-28) to5 (3-20) (p=0.001*)

The tibial tuberosity trochlear groove distance decreased from 2 (1.2-3) to 1.8 (1-3)(p= 0.006*) AT CT AT 30 FLEXION; ≤0.001*) the congruence

angle decreased from decreased from15.5 (3-54) to 12 (2-54)(p 6 (3-28) to 5 (3-20)(p= 0.001*), The patellar tilt angle decreased from Deschamb index decreased from caton I n dead lateral xray 1.05±0.13to0.93±0.14(P=0.002*).

Table (5): Radiological data CT AT 0 EXTENSION at different follow up periods among group (1)

	Group (1) (n=8)					P value
	Preoperative	**After 1 m**	**After 6 m**	**After 12 m**	**Final follow up**	
SA	150.5±6.91	143.4±8.19	143.4±8.19	143.4±8.19	143.4±8.19	0.003*
CA	46 (64-60)	10 (-40-24)	9 (-30-24)	9 (-30-24)	9 (-30-24)	0.013*
PTA	14.5 (5-60)	8.0 (5-35)	7 (4-24)	7 (4-25)	7 (4-25)	≤0.001*
TTTG	2.25 (1.3-16)	1.9 (1-14)	1.9 (1-14)	1.9 (1-14)	1.9 (1-14)	≤0.001*

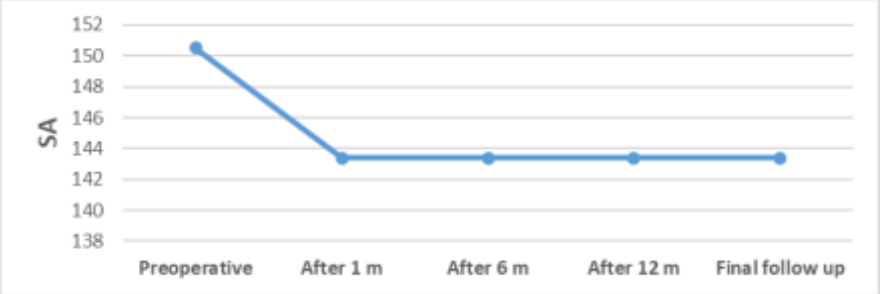


Figure (4): sulcus angle improvement at different follow up periods

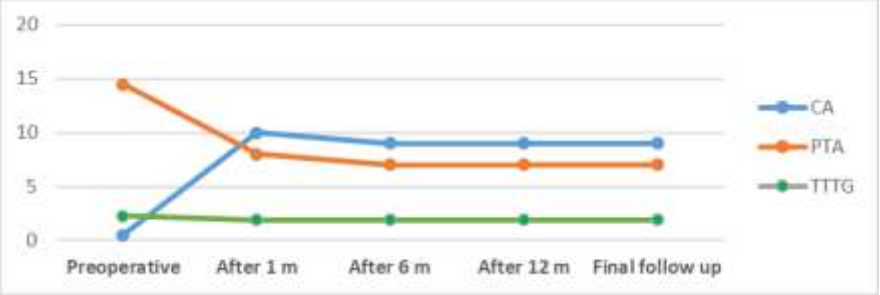
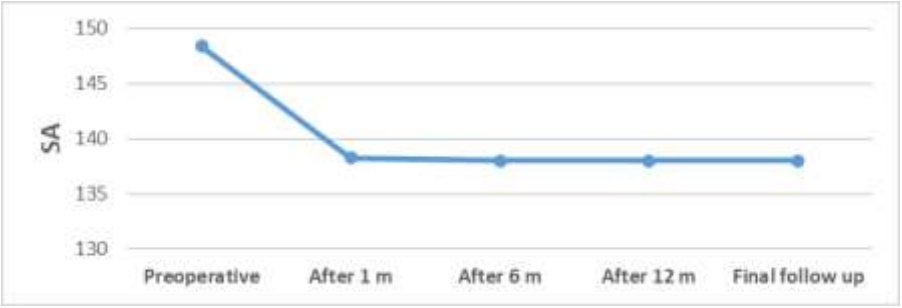


Figure (5): congruence angle, patellar tilt angle ,tibial tuberosity trochlear groove distance improvement at different follow up periods

Table (6): Radiological data CT AT 30 FLEXION at different follow up periods among group (1)

	Group (1) (n=8)					P value
	Preoperative	**After 1 m**	**After 6 m**	**After 12 m**	**Final follow up**	
SA	148.4±9.44	138.25±4.33	138.0±4.27	138.0±4.27	138.0±4.27	0.008*
CA	11 (-23-22)	9.5 (4-15)	8.5 (-5-15)	9.0 (4-15)	9.0 (4-15)	0.008*
PTA	8.0 (5-12)	6 (5-10)	6 (5-10)	6 (4-10)	6 (4-10)	0.392



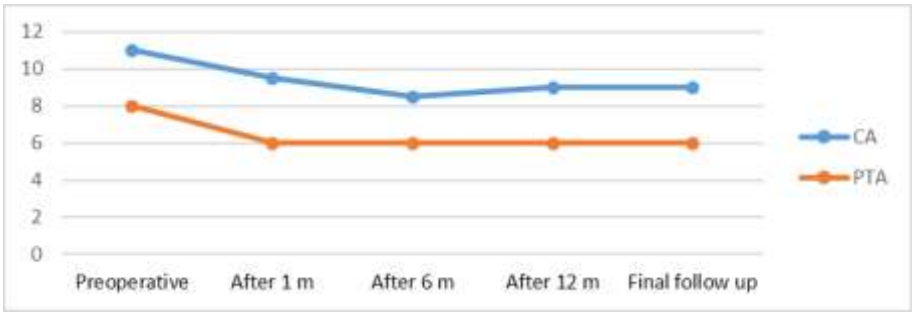
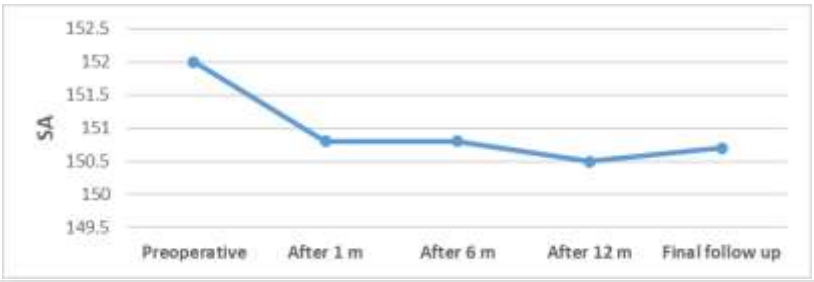


Table (7): Radiological data CT AT 0 EXTENSION at different follow up periods among group (2)

	Group (2) (n=13)					**P value**
	Preoperative	After 1 m	After 6 m	After 12 m	Final follow up	
CA	37 (9-81)	27 (5-70)	27 (4-70)	21 (4-70)	24 (4-70)	≤0.001*
PTA	6 (3-28)	5 (3-20)	5 (3-20)	5 (3-20)	5 (3-20)	0.001*
TTTG	2 (1.2-3)	1.8 (1-3)	1.8 (0.8-3)	1.8 (0.8-3)	1.8 (1-3)	0.006*



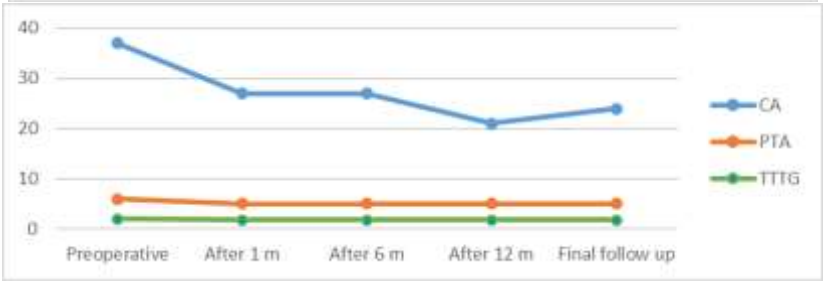
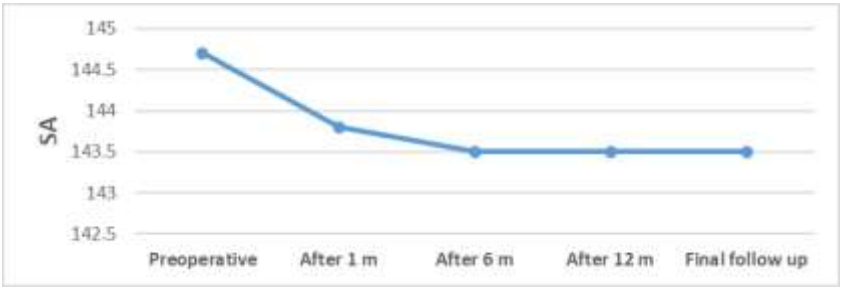


Table (8): Radiological data CT AT 30 FLEXION at different follow up periods among group (2)

	Group (2) (n=13)					**P value**
	Preoperative	**After 1 m**	**After 6 m**	**After 12 m**	**Final follow up**	
CA	15.5 (3-54)	10 (2-54)	13 (2-54)	12 (2-54)	12 (2-54)	≤0.001*
PTA	5 (3-50)	4.0 (3-50)	4.0 (3-50)	4.0 (3-50)	4.0 (3-50)	0.112



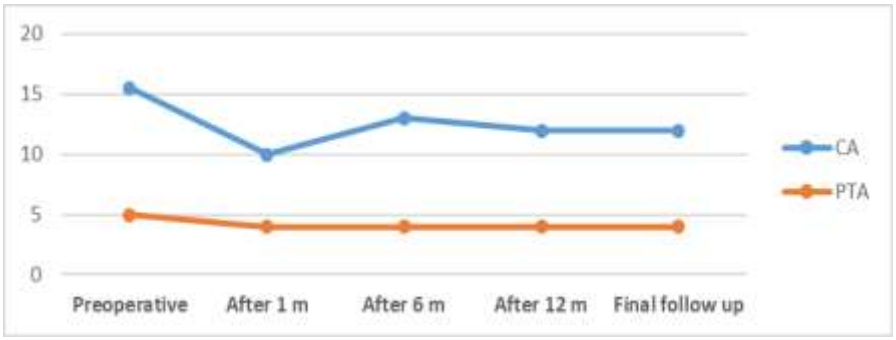


Table (9): Comparison between group (1) and (2) regarding radiological data CT AT 0 EXTENSION

		Group (1) (n=8)	Group (2) (n=13)	P value
CA	Pre	46 (-46-60)	37 (9-81)	0.019*
	Post 1m	10 (-40-24)	27 (5-70)	0.036*
	Post 6m	9 (-30-24)	27 (4-70)	0.014*
	Post 12m	9 (-30-24)	21 (4-70)	0.01*
	Final follow up	9 (-30-24)	24 (4-70)	0.015*
PTA	Pre	14.5 (5-60)	6 (3-28)	0.037*
	Post 1m	8.0 (5-35)	5 (3-20)	0.184
	Post 6m	7 (4-24)	5 (3-20)	0.318
	Post 12m	7 (4-25)	5 (3-20)	0.318
	Final follow up	7 (4-25)	5 (3-20)	0.350
TTTG	Pre	2.25 (1.3-16)	2 (1.2-3)	0.213
	Post 1m	1.9 (1-14)	1.8 (1-3)	0.253
	Post 6m	1.9 (1-14)	1.8 (0.8-3)	0.265
	Post 12m	1.9 (1-14)	1.8 (0.8-3)	0.235
	Final follow up	1.9 (1-14)	1.8 (1-3)	0.312

Table (10): Comparison between group (1) and (2) regarding radiological data CT AT 30 FLEXION

		Group (1) (n=8)	Group (2) (n=13)	P value
CA	Pre	11 (-23-22)	15.5 (3-54)	0.180
	Post 1m	9.5 (4-15)	10 (2-54)	0.367
	Post 6m	8.5 (-5-15)	13 (2-54)	0.115
	Post 12m	9.0 (4-15)	12 (2-54)	0.258
	Final follow up	9.0 (4-15)	12 (2-54)	0.258
PTA	Pre	8.0 (5-12)	5 (3-50)	0.731
	Post 1m	6 (5-10)	4.0 (3-50)	0.604
	Post 6m	6 (5-10)	4.0 (3-50)	0.618
	Post 12m	6 (4-10)	4.0 (3-50)	0.618
	Final follow up	6 (4-10)	4.0 (3-50)	0.618

Complications

In group (1) one case develop arthrofibrosis which was treated by arthroscopic arthrolysis,another case had persistent j sign and pain

In group (2) two cases had persistent femoral sided pain, one case had patella infera and stiffness which had been resolved by vigorous physiotherapy

No redisclocation rate occurred in both group

Table (11): complication among studied group.

Complications	Group (1) (n=8)	Group (2) (n=13)	P value
Arthrofibroses	1 (25.0%)	1 (7.7%)	0.026*
Re dislocation	0 (0%)	0 (0%)	-
Persistent femoral pain	0 (0%)	2 (15.4%)	0.045*

4. DISCUSSION

Recurrent patellar dislocation is a multifactorial phenomenon. Factors that contribute to it include patellar and femoral morphology and lower limb alignment in three Planes [9].

In our study trochlear dysplasia was the main risk factor in all cases and two cases had patella alta, treament of patellar instability is challenging so

It is imperative to provide an individualized treatment regimen based on critical evaluations of the patient's plain radiographs and advanced imaging. MPFL reconstruction is the procedure of choice if the patient experiences patellofemoral dislocation despite adequate, non-surgical rehabilitation following a primary patellofemoral dislocation.patients with severe trochlear dysplasia with supratrochlear spur requires trochleoplasty with concomitant medial patellofemoral ligament reconstruction as suggested by many authorsHowever, only two clinical outcome studies found worse clinical outcomes in high-grade trochlear dysplasia when MPFL reconstruction was performed without trochleoplasty. One study found a higher rate of recurrent dislocation and a lower rate of satisfaction in patients with type C and D trochlear dysplasia; the second reported improved objective outcomes on Kujala scores when trochleoplasty was performed in patients with type B and D trochlear dysplasia, compared with MPFL reconstruction alone [10].

In our study13 cases had treated by MPFLR only one case needed tibial tubercle transfer, they had a minimum follow-up period of2years and were able to show an improvement in Kujala scores from (59.0±9.29) to (75.53±9.61) $p \leq 0.001$. The visual analogue scale decreased from (6.92) to (2.66±0.61) $p \leq 0.001$.NO dislocation rates were reported. 1 patient in the study by Schöttle et al. [11] and 10 patients from the study by Sappey-Marinier et al. were classified as failures, that is, these patients reported recurrent patellar instability even after the surgery.

Sappey-Marinier et al. conducted a study in 2019 [12] that evaluated 211 cases of isolated MPFL reconstruction. They had a minimum follow-up period of 3 years and were able to show an improvement in Kujala scores postoperatively (56.1 pre-operative to 88.8 post-operative). [12]

In 2004, Schöttle et al. assessed both the clinical and radiological outcomes of linear MPFL reconstruction in 12 patients (15 knees) using semitendinosus graft after a follow-up of 4 years. [11] Out of 15 knees (12 patients), 8 needed medializations of the tibial tuberosity. They also found their patients to have improved Kujala scores (53.3 points pre-operative to 85.7 post-operative).

Our study supports the use of isolated MPFLR as a safe and effective technique. This is consistent with the research of Liu et al, [13] who demonstrated satisfactory clinical efficacy of MPFLR even in a population with PFI and severe trochlear dysplasia. MPFLR, alone or with tibial tubercle transfer, presents obvious improvement in knee function, confirming the effectiveness of the procedure, Zaffagnini et al [14] concluded that in a population with recurrent patellar dislocation and moderate trochlear dysplasia, isolated MPFLR is as effective as combined MPFLR and trochleoplasty

This study's main outcome was that most patients who underwent isolated reconstruction of MPFL with a minimum follow-up of two years had a high degree of satisfaction, returned to sports, and had few symptoms. This indicates that the surgery could sufficiently restore patellar stability and knee function in these patients, with low morbidity the discrepancy between radiologic characteristics and clinical examination findings such as the J sign demonstrates the clinical value of a comprehensive physical examination. [15]

In our study j sign was observed in 7 cases preoperative and one case had persistent g sign postoperative due to weak vmo muscle Zhang et al [16] also suggested that a positive J sign brings more postoperative patellofemoral laxity.

Moreover, for cases of severe trochlear dysplasia, although the redislocation rate is lower in the combined group, the clinical outcomes are comparable.

Trochleoplasty is ademanding operation, so additional trochleoplasty brings a higher risk of limited postoperative knee range of motion,.only one case had developed post-operative stiffness which improved by arthroscopic lysis and regular physiotherapy . Banke et al. [17] Performed arthroscopic arthrolysis in 2 out of 18 knees (11.1%) following Bereiter-type trochleoplasty.

No dislocation rate was observed (0 (0%)

The redislocation rate in a mean follow-up of 54 months was low (2 % in both groups) as well as the reported rate of subjective instability according study done by. Testa EA et al [18]. With the combined treatment for trochleoplasty and MPFLR, it was possible to not only improve the clinical findings but also improve static (sulcus angle, TTTG without tibial tuberosity transfer) and dynamic (patellar tilt and shift, and patellar height) radiological parameters leading to more normal anatomy.

This improvement was consistent with our study

In which the sulcus angle decreased from 150.5±6.91preoperative to 143.4±8.19 ($p=0.003$) at the final follow up, the congruence angle decreased from46 preoperative to 9($p=0.013$),patellar tilt angle decreased from 14.5 to 7($p \leq 0.001$),tibial tuberosity trochlear groove distance decreased from 2.25to 1.9($p \leq 0.001$). The measured decrease in average sulcus angle after trochleoplasty (150° preoperatively to 138° postoperatively) is similar to those found by other authors [15, 17]. Dejour [2] considered 145° as the pathological limit

Our findings are similar to European outcomes following trochleoplasty and mpflr the six knees evaluated at the University of Iowa were seen at an average follow-up time of 68 months, and the average bony sulcus angle decreased from 149° to 128°, indicating deepening of the trochlear groove. In this study, success rate was defined as both subjective patient satisfaction as well as the absence of post-operative patellofemoral instability [(19)].

5. CONCLUSION

The clinical significance of the present study indicates that the combinatory treatment concept of trochleoplasty and MPFLR may serve as a valuable option not only as salvage therapy but also as primary procedure regarding treatment for chronic PFI.

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