

Outcome of Single-Stage Multiligamentous Reconstruction Surgery in Patients with Multiligament Knee Injury

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Abstract

Background: Multiligament knee injury (MLKI) is a complex orthopedic injury leading to the tear of at least two of the major knee ligaments. However, there is no consensus on the optimal management of this debilitating condition. Regarding this, the present study was performed to evaluate the outcomes of single-stage multiligament reconstruction surgery in patients with MLKI.

Material & Methods: Cross-sectional hospital-based study done on Multicenter in a period of 7 months from March 2021. A total 20 male and female patients their age ranges from 20 years to 69 years the mean age 30 years having MLKI confirmed by clinical examination and MRI scan were included in this study. Patients' check list detailed demography including age, sex, causes of injury and duration of symptoms pre-operative were recorded after written consent from every patient. Lachman, anterior drawer, posterior drawer, dial test, valgus and varus stress tests were performed before surgery. All patients filled subjective Lysholm Knee form before surgery and at final follow up post-operative. The injured ligaments were reconstructed using auto-graft.

Results: There were 19 (95%) males and 1(5%) females. Right knee was injured in 14(70%) cases and left knee 6(30%) cases. At final follow-up, 70% patients achieved full ROM flexion, all of them have no giving way symptoms after 2 to 3months post-operative. There was significant improvement in Lysholm score. Out of 20 patients, 4 (20%) patients developed post-operative infection.

Conclusion: MLKI reconstruction yields a significant improvement from pre-operative to post-operative Lysholm scores. This suggests that surgical intervention provides benefit to patients in this population. Failure to treat all injured structures can lead to changes in knee kinematics and hence poor outcomes and an increased risk of graft failure.

Key words: single-stage; multiligament; reconstruction; knee; injury

List of abbreviations

Abbreviations	Description
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MLKI	Multiligament knee injury
ACL	Anterior cruciate ligament
PCL	Posterior cruciate ligament
MCL	Medial collateral ligament
LCL	Lateral collateral ligament
PLC	Posterolateral corner
PMC	Posteromedial corner

RTP	Return to play
PMB	Posteromedial bundle
ALB	Anterolateral bundle
AMB	Anteromedial bundle
PLB	Posterolateral bundle
KD	Knee dislocation
ABPI	Ankle brachial pressure index
MRI	Magnetic resonance imaging
IKDC	International knee documentation committee

BPTB	Bone patella tendon bone
POL	Posterior oblique ligament
DVT	Deep vein thrombosis
RTA	Road traffic accident
SMSB	Sudan medical specialization board
VAS	Visual analog scale
EDC	Educational development center
OPL	Oblique popliteal ligament
POL	Posterior oblique ligament
LFC	Lateral femoral condyle
MFC	Medial femoral condyle

Introduction

Multiligament knee injury (MLKI) is a complex orthopedic injury that usually occurs as a result of traumatic knee injury. The MLKI is referred to the tear of at least two major knee ligaments, including anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), posteromedial ligamentous complex (corner) including the medial collateral ligament (MCL), posterior oblique ligament, posteromedial capsule and posterolateral ligamentous complex (corner) (PLC) including the lateral collateral ligament, popliteofibular ligament, popliteus tendon, and posterolateral capsule.

The multiligament knee injury can be further complicated by the concurrence of fracture and vascular or nerve damage [1, 2]. Vascular injury occurs in 30-35% of the cases in forms of arterial rupture or thrombosis, which may lead to the limb amputation in case of inadequate management [3]. Therefore, the vascular injury should be inspected in all cases. The neural damage, especially peroneal nerve injury, is also a potential consequence of knee dislocation. Neurovascular injuries are commonly seen in PLC injuries [4, 5].

The multiligament knee injury is associated with considerable morbidity affecting the life of the patient by incapacitating in his daily life activities and affecting directly his quality of life. In this regard, the affected patients may experience pain and instability even several years after the initial injury. Given the serious consequences of a neglected injury, a high index of suspicion should be devoted to MLKI diagnosis [6].

Although a clinical examination is the cornerstone of determining the extent of the injury and formulating the treatment plan, it is not always reliable. Stress radiographs could be used to aid in the diagnosis of ligament injuries [7]. Moreover, multiligament knee injury therapeutic options vary from conservative management to acute or chronic repair/reconstruction of the injured structures. Nonetheless, there is a paucity of high-level evidence on the optimal surgical management of this uncommon but debilitating condition. Despite the lack of a clear consensus regarding the superiority of either single-staged or staged surgery of multiligament knee injury, some surgeons opt for the staged procedure in cases with concomitant injuries, such as fractures, vascular injuries, and life-threatening head, thoracic, or abdominal injuries [8].

Problem statement

Patients with multiple ligaments injuries of the knee become disabled for a long period. This disability arises from the pain, stiffness and instability which eventually leading to development of early osteoarthritis. A disability that might be associated with increased frequencies of sick leave from work, or much more dire consequences, such as quitting a job or being relieved of duty.

Justification

Multi-ligament knee injuries are relatively rare, not much data has been done on it. This study would help surgeons to guide them better result following reconstruction of injured knee ligaments. It will also help patients with the knowledge of how to deal with a multi-ligament knee injury (in the short term). Due to lack data about same study in Sudan, we want to contribute to increasing the knowledge and lighting that type of injures which mainly affect young peoples

General Objectives: Short-term Outcome of late Multi-ligament Knee Injury Reconstruction

Specific Objectives:

1. To assess clinical outcome following reconstruction
2. To determine ROM post-operative
3. To compare the knee joint stability pre-operative and post-operative

Methodology

Cross-sectional hospital-based study were conducted in multiple centers. All these centers had operating rooms, well equipped with arthroscopy tower and its accessories. In the period from March 2021 to October 2021, Patients, who diagnosed with multi-ligament knee injury, confirmed by MRI and diagnostic arthroscopy, underwent arthroscopic reconstruction and follow the same post-operative rehabilitation program within the study period.

Inclusion Criteria

All patients with multiligament knee injury (at least 2major ligaments)

Delayed presentation more than 6wks

Patient compliance with postoperative physiotherapy protocols

Exclusion Criteria

Presence of malalignment

Patients with around knee fracture

Presence of severe osteoarthritis

Patients with partial ligament tear

Total patient's coverage is selected as a sampling technique, due to the rareness of this type of injury and its management during the period of the study. Therefore, a total of 20 patients have proved to satisfy the inclusion criteria. All of them underwent ligament reconstruction by our senior surgeon, with pre- and post-operative hospital care and same post hospital follow up. Data Collection Tools and Techniques was collected using a quantitative method by a pre-structured checklist questionnaire including: Demographic information: age and sex.

Lysholm knee score system, which is a score to measure the knee function in a scale of maximum value of 100 point, summed up from 8 partial questions about the knee functions pre- and post-operative, from 3 to 12 months duration.

VAS score for pain which is score measure the degree of pain in digital standard starting from 1 to 10, used pre- and post-operative.

Duration symptom before operation and the cause of MLKI. Post-operative data: complication, returning back activity, flexion range, using support or brace, satisfaction.

Results

This study covered 20 patients all of them have same pre- and post-operative process all of them full filled both check list questionnaire and

Lysholm score about their problems by direct contact with patients, the results of their data which collected in 2021 and is used The SPSS 23 software in presenting, describing and analyzing the data. 20 patients, the majority of them, 19 (95%) are males, while only 1 (5%) is female.

The age results show a range of maximum 69 years and the minimum 20 years, mean age 30.6 years, standard deviation 9.7 years, as shown in Table (1) which shows majority of patients (10), their age were between 20-29yrs, followed by 9 patients ranging between (30-39yrs) and only one patient was above 40yrs old.

Injury pattern	N	%
ACL + LCL	10	50
ACL + PCL + MCL	4	20
ACL + MCL	2	10
ACL + PCL + PLC	2	10
ACL + PLC	1	5
ACL + PCL + LCL	1	5

Table 1. Reflecting Patient injury pattern

The most frequent combination of ligament injury was the combined lesion of the ACL + LCL rupture found in 10 patients (50%), followed by the ACL + PCL + MCL in 4 patients (20%), the ACL + MCL in 2 patients (10%), the ACL + PCL + PLC in 2 patients (10%) and those of the ACL + PLC, ACL + PCL + LCL, each with one patient, and individual

ligament involved in which ACL has highest percentage 100%, followed by LCL 55%, PCL 35%, MCL 30%, and PLC 15%.

Regarding the side of the injury, the majority of cases were right sided injury 14 patients (70%), followed by 6 patients with left sided injury (30%) as shown in figure (1).

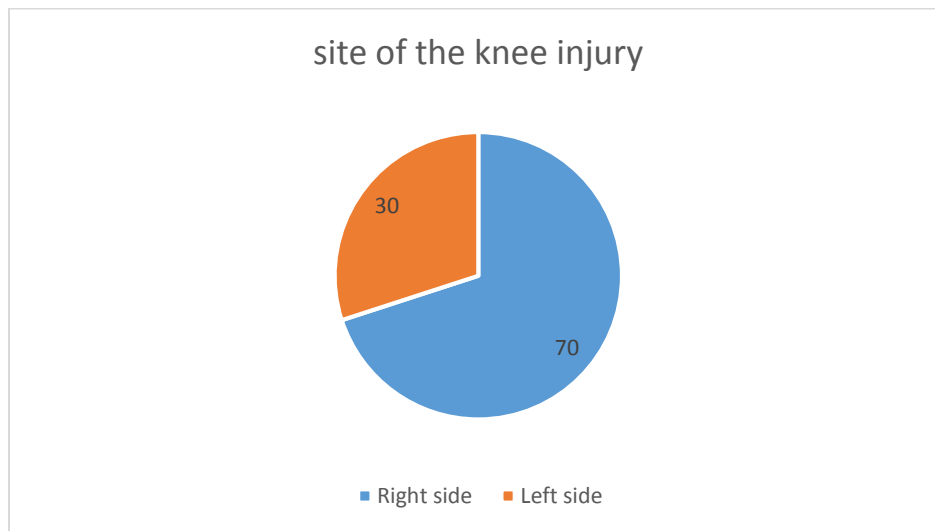


Figure 1. Shows the site of injury

Presenting Symptoms: Giving way is major presenting symptoms 20 (100%), pain is second presenting symptoms usually associated with exertion 15 (75%), locking is third symptoms 11 (55%) of total number of patients.

Pain data was collected by the VAS scale from 0 (No pain at all) to 10 (Severe Pain), and the analysis below showed pre-operative severity of the pain, 50% score for severe pain, 30% show moderate pain, 20% show mild pain.

Then we analyzed all that symptoms post operatively to observed their response to the operation, we found most of them 19 (95%) patients they have total disappearance of giving way unless 1 (5%) patients still has giving way, we found all of the patients have no locking symptoms post-

operative 20 (100%), and we compared between pre and post-operative values.

Pain scores were measured by the VAS scale of pain from 0 to 10 post-operative we found 45% they have no pain , 40 % they have mild pain with exertion(1-3 score), 10% have moderate pain with exertion(4,5,6 score), 5% have severe pain with exertion (7,8,9 scores).

A comparison is done between the results of the pain scores pre- and post-operative, with a one missing value. Pre-operative mean was 3.3 of the scale, while the post-operative mean value was 1.2.

The scores of the VAS pain scale pre- and post-operative were analyzed statistically to evaluate the statistical significance of the effect of operation, i.e., to judge whether this variation in the pre- and post-scores is significant or due to chance, using the WILCOXON Singed Ranks test,

which is a Non-Parametric test used to examine paired or related sets of data. The Wilcoxon test variables are listed, and resulting a p-value of < 0.0005 is found.

Duration of the symptoms till the operation is ranging from less than one year to maximum of 9years, mean value 5 years and the standard deviation 3.94.

Contact sport injury was the most common mechanism of injury accounting (75%), followed by road traffic accident about (25%).

Post-operative Data:

Regarding postoperative complications, it's found to be: postoperative infection 4 patients (20%), stiffness in 2 patients (10%) and there were no DVT or re-rupture of the graft.

Regarding time to return back to the normal life activity, it ranges from 2-8 months with mean of 3.45 months, and the standard deviation 1.6.

At final follow up, active range of motion were assessed as follows: 14 patients (70%) has full flexion of 120 degrees, 4 patients (20%) has 90 degree flexion and only two patients (10%) has ROM less than 90 degrees as shown in figure 2.

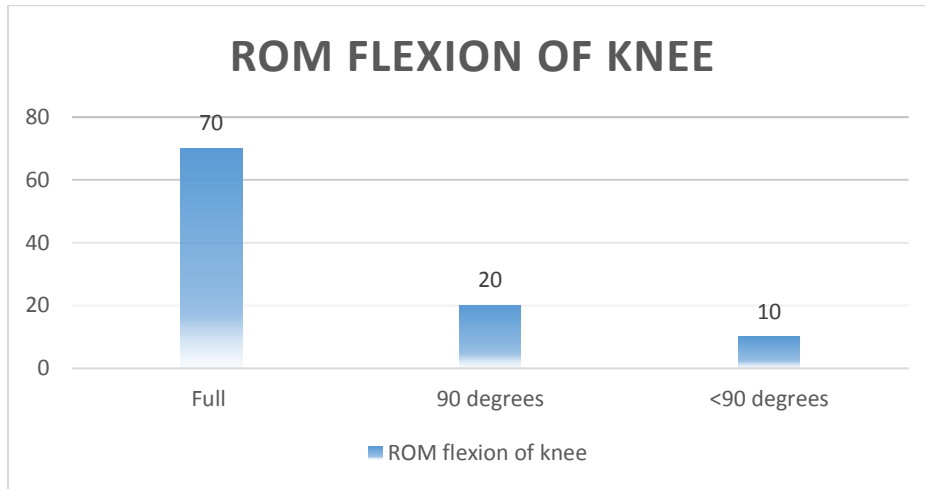


Figure 2. ROM Flexion of the Knee

Self-satisfaction of the patients after the operation measured 46 (95%) fully satisfied, and only one (5%) with partially satisfaction, as in Figure 3.

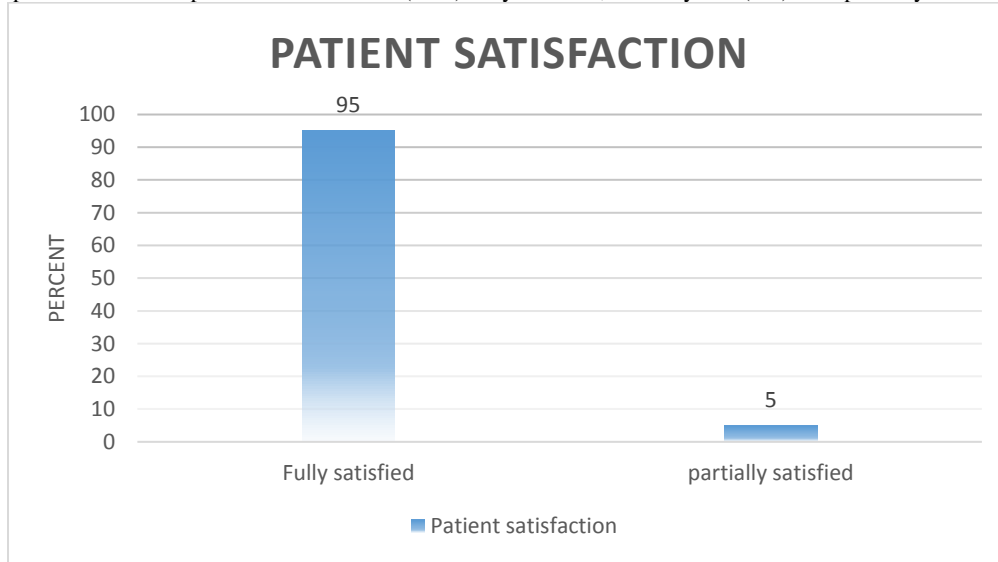


Figure 3. The Patient Satisfaction

Subjective outcome:

Lysholm Scoring System to evaluate the function of the knee by points maximum (100).The total score attained is classified to 4sections, which are Excellent (100 to 95), Good (94 to 84), Fair (83 to 65), and Poor (less

than 65). The scoring points of the patients pre-operative and post-operative were found. The lysholm score mean value pre-operatively was (58.5), with a standard deviation of 8.2. Post-operative Lysholm score mean value of 93.6 and standard deviation of 3.2. Figure 4.

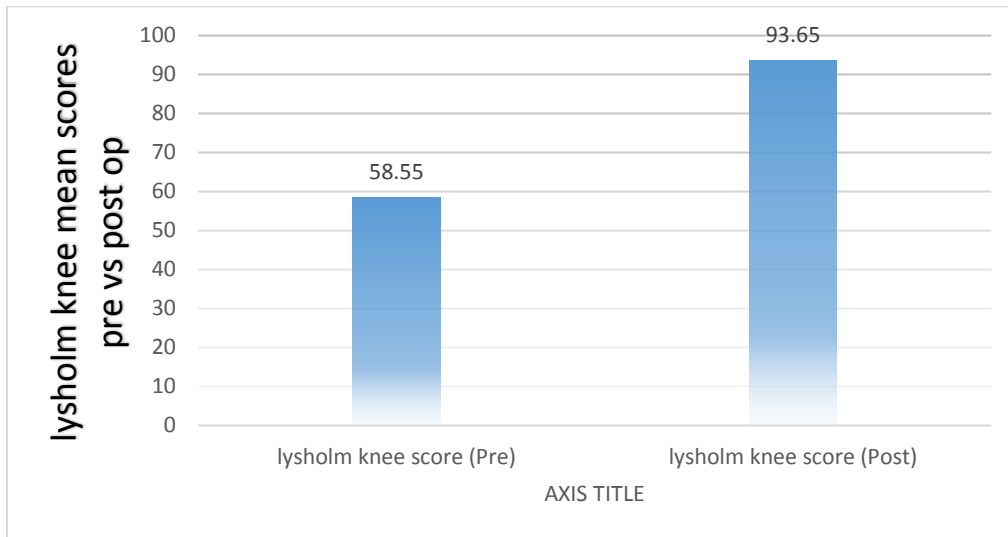


Figure 4. Lysholm scoring Compare Pre- & Post-operative.

Show these values with a few other statistics. Significant difference between pre and post lysholm scores.

Regarding the effect of postoperative infection on lysholm scores was analyzed, we found, those patients who developed postoperative infection has lower score than others in the study.

In table 2, we analyzed the impact of high preoperative lysholm score on postoperative scores, we found, high postoperative lysholm scores has relation with preoperative scores.

Lysholm score preoperatively	Preop lysholm mean	Preop lysholm standard deviation	Postop lysholm mean	Postop lysholm standard deviation
Lysholm score <40	38	1.0	89	6.0
Lysholm score 40-60	57.3	2.3	93.5	2.42
Lysholm score 60-80	65.3	2.9	94.9	0.78

Table 2: Shows improvement of lysholm scores postoperatively.

Discussion

The current study involved the investigation of the outcome of single-staged surgical reconstruction in the patients with MLKI.

The study aims generally to assess the clinical outcome of all patients underwent MLKI reconstruction, specifically to assess the outcome determined by the function of the knee post-operative using Lysholm Knee scoring scale and the ROM flexion level of the knee, and also to compare stability pre- & post-operative.

Most of our subjects were males, roughly 95%. Again, this is because of the nature of injury; women are not fully allowed to participate in sport practice due to cultural issues, this reflects the the lower percentage of female who participated in our study. All our female subjects had their ligaments torn from road traffic accidents.

With regard to sex, the prevalence was higher in men, which is similar to that reported in the literature. Gender effect on the functional outcome of multi-ligament knee injury is not yet clear; due to having a very small female subject (5%) it is rather compelling to find out whether females have a better outcome than males, or not [9].

In our findings we noticed that most of our patients were between the second or the third decade of life; this is mainly due to the nature of the injury.

The most frequent injured ligament was ACL in all patients (100%), and most combined ligament was LCL in (50%) of patients. The group of ACL injury and other combined ligament injuries was more affected during sports practice. The groups involving PCL injuries with other associated ligament disruptions were related to traffic accidents. In the literature; Helgeson et al, concluded the same result in their study [10].

Most of our participants sustained their MLKI while practicing sport followed those injured by accident, and in Sudan younger men tend to play football (soccer). However, it may be due to lack of proper warm up exercises.

In the literature; the injuries caused by sports practice exceeded those caused by traffic accidents, which corroborates some articles. On the other hand, some authors quote traffic accidents in their articles as being the most frequent cause, followed by sports accidents. In our “sports injuries” case series soccer practice generated most occurrences of multiple ligament disruptions in the knee [11].

In this study, we found the main presenting symptoms is giving way (100%) followed by pain (75%): this agree with Mayo Clinic Jeff Houck et al their conclusions that the main presenting symptoms of patients with MLKI are instability and pain [12].

In this study, it was ranging from less than 1 year to 9 years with mean value of 5 years and standard deviation of 3.94. This is against literature, most authors performed at least 3 weeks after injury to avoid arthrofibrosis as; Shelbourne et al, their conclusion that there are significant potential complications associated with both early and delayed surgical reconstruction of the MLKI, which can negatively affected clinical outcomes, this is not defect in our data collection or our study , but that means too late presentation to arthroscopic clinic this point need more work by teaching the athletes and nonathletic the important of this issue [13].

Postoperative infection rate was high in this study (20%), and may be attributed factors related to sterilization methods, postoperative surgical wound care and hygiene. These patients underwent early debridement with resolution of infection with no need for graft removal.

In the literature; Postoperative infections have been reported to occur in 0% to 17.4% of surgical procedures to treat knees with multiligament injuries. Risk factors include increased surgical time, prolonged tourniquet use, introduction of foreign material, hematoma formation, and medical comorbidity [14].

Regarding knee stiffness post-operatively, it was found to be (10%) in our study which is not low and may be, the lack of compliance of patients for rehabilitation protocols to be the major cause.

In the literature; arthrofibrosis is common, requires surgical treatment in 29% of patients, and is more common after more severe injuries, medial-sided repair or reconstruction, and acute surgery. Cook et al. noted that injuries that included more than two ligaments and acute surgery increased the risk of stiffness requiring a manipulation under anesthesia. Delayed reconstruction has been advocated to decrease the risk of this occurrence [15].

The knee is maintained in ROM brace in 30 degree flexion with partial weight bearing for 4-6weeks. Postoperative rehabilitation started immediately in day one of surgery aiming for quadriceps strengthening exercises, gradual increase of flexion range and preventing the lack of full extension.

In the literature; regardless of the surgical technique, postoperative rehabilitation plays an important role in the final outcome in knees with multiligament injuries.

A balance must be found between immobilizing the knee to allow healing of the soft tissue and early motion to avoid arthrofibrosis. In general, patients are fitted with a hinged knee brace to be worn for the first six weeks at all times. For the first two to six weeks postoperatively, patients are kept either non-weight-bearing or toe touch weight-bearing. For some therapy protocols, therapy begins on postoperative day one with prone active and passive range of motion. If the PCL was reconstructed, then active quadriceps exercises are avoided for six weeks. Other protocols, such as the one established by Fanelli and Edson, recommend immobilization in extension for three weeks. For athletes, straight-ahead running is gradually allowed, followed by cutting and then sports-specific therapy, and full release to sport participation around nine months [16].

As far as patient satisfaction is concerned, in my research, Self-satisfaction of the patients after the operation measured 19 (95%) fully satisfied, and only one (5%) with partially satisfaction.

In the literature, by Mook et al., the percentage of patients who had excellent or good subjective outcomes in the single late stage treatment group was significantly greater than that in the acute treatment group [17].

The descriptive of pain post-operatively show that 45% have no pain, 40% have mild pain with exertion, only 10% have moderate pain with exertion, and 5% also have severe pain with exertion. That suggests there is an obvious relieving of pain post-operative as compared with pre-operative results, which showed almost 50% presented with severe pain and 30% presented with moderate pain and 20% showed mild pain. The Wilcoxon's Signed Rank Test has proved a very high significant result difference in the pain scores pro- and post-operative, (p-value < 0.0005).

The Lysholm scores for both pre- and post-operation were tested for Normality, the Wilcoxon's Signed Rank Test (Non-Parametric test) was applied to examine the significance pre- and post-operation scores of the Lysholm, where the result proved a very high significant difference between the pre- and post-scores, with p-value < 0.0005, there is a very obvious improving in the knee function.

Based upon the weighted mean improvement of Lysholm scoring from 58.5 to 93.65 it appears that patients are able to obtain near normal restoration of functional outcomes.

Interestingly it's paramount to highlight that the presence of low lysholm scores preoperatively, this will continue postoperatively despite improvement of the score dramatically following surgery, and likewise; the postoperative infection has direct impact on the lysholm scores postoperatively.

In the literature; Briggs et al. systematically reviewed acceptable functional outcome following the surgical management of MLKI, they concluded that an improvement in Lysholm outcome scoring in operative group when compared to non-operative group. Surgical intervention to regain knee stability has potential risks. However, it demonstrates that functional outcomes measured by Lysholm scoring improve following surgery [18].

Conclusion

Multiligament knee injuries are complex and a high level of suspicion is required when treating these patients review of the current literature concludes that surgical ligamentous repair and/or reconstruction of the MLKI yields a significant improvement from pre-operative to post-operative Lysholm scores. This suggests that surgical intervention provides benefit to patients in this population. Failure to treat all injured structures can lead to changes in knee kinematics and hence poorer outcomes and an increased risk of graft failure. According to all found results, which has proved an obvious improving of the patients post-operatively.

The researcher believes that this type of remedy of MLKI, which is arthroscopic technique, gives much more flexibility intraoperative for placing the graft anatomic position, which results in a greater effect on functional outcome, and gives a very good improvement in ROM and flexion, as the results of the analyses found in the study, in both the pain relief levels and the Lysholm score.

Recommendations

- In general, non-operative management of multiligament knee injuries is not recommended because of high rates of residual instability, which may lead to increased rates of future knee osteoarthritis.
- We recommend to increase the sample size to include a larger group.

- Increase awareness of importance of early presentation of MLKI patients to the health facilities to decrease a negative impacts related to delayed presentation.
- Education of junior doctors, paramedics and nurse staff to deal with highlighted complications in this study, particularly postoperative infection.
- Strict bound to the sterilization process is paramount important for prevention of infection.
- Strict bound to physiotherapy and post-op follow up for patients who underwent MLKI reconstructions as this play a major part for their recovery and regaining good functional outcome.
- Patients should be counselled that outcome following surgery depend on preoperative early presentation and good physiotherapy thereafter.

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