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Short-Term Outcome of Multi-Ligament Knee Injury among Sudanese Patients

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Keywords: Sports medicine; Multiligament knee injury; ACL; PCL; MCL; LCL; Sudanese knee reconstruction outcome

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Abstract

BACKGROUND: Multi-ligament knee injury is the state of having two or more of the major knee ligaments, namely: the anterior cruciate ligament (ACL), the posterior cruciate ligament (PCL), the medial collateral ligament (MCL), the lateral collateral ligament (LCL), the posteromedial corner (PMC), and the posterolateral corner (PLC). The knee is a hinge joint; this dictates two direction movements on the y-axis plane. The knee joints carry the weight load of the body uniquely. The role of the knee ligaments is not conserved only to maintain knee in a rigid position while standing, but also orchestrates the biomechanics of knee motion in harmony. Multi-ligament knee injury is very rare (incidence < 10:10,000 of trauma cases). Patients with multiple ligaments injuries of the knee become disabled for a long period. This disability rises from the pain and stiffness of the knee joint. 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.

AIM: To assess the functional outcome of the knee of patients with a multi-ligament knee injury after treatment using a standard scoring system and to determine the recovery rates of each treatment option to a multi-ligament knee injury.

METHODS: it is a cross-sectional study conducted from January 2018 to January 2019. All patients with multi-ligament knee injuries that were diagnosed by MRI, and underwent reconstruction surgeries or on the waiting list, at Ribat University Hospital and Alyaa Specialized Hospital, Alkuwiti specialised hospital, and Haj Alsafi Hospital for the past 2 years were included. Lyshlome knee scoring scale was used to assess the functional outcome of each patient.

RESULTS: 24 patients were enrolled in this study (16 had reconstruction surgery, 8 did not). 3 had excellent outcome (LKSS = 95 – 100), 8 of them had good score (LKSS = 84-94), 5 had fair outcome (LKSS = 65-83). All those who did not have reconstruction had a poor score (LKSS < 64).

CONCLUSION: Reconstruction of multi-ligament knee injury shows a good outcome than it was left alone. Post-operative physiotherapy increases the potential of reconstruction. While our data is limited because of the rare condition, we plan to expand our study area to include a larger sample size. We also recommend extending the post-operative physiotherapy to improve the outcome of a multi-ligament knee injury.

Introduction

Multi-ligament knee injuries are not uncommon; they are intimately related to knee dislocations [1]. Also, multi-ligament knee injuries are highly associated with popliteal artery injuries and nerve injuries – due to the close relationship of the knee joint to the popliteal artery [1], [2]. Unlike single knee ligament injuries, multi-ligament knee injuries are difficult to treat, and there are few studies on multi-ligament knee injuries. Hitherto, contradictions appear on the management and outcomes of such phenomenon [2]. This proposal is dedicated to helping orthopaedic surgeons in their future directions when approaching a patient with multi-ligament knee injuries.

Anatomy of the knee ligaments

Multi-ligament knee injury is the state of having two or more of the major knee ligaments,

namely: the anterior cruciate ligament (ACL), the posterior cruciate ligament (PCL), the medial collateral ligament (MCL), the lateral collateral ligament (LCL), the posteromedial corner (PMC), and the posterolateral corner (PLC) [3]. The knee is a hinge joint; this dictates two direction movements on the y-axis plane [3]. The knee joints carry the weight load of the body in a unique manner [3]. The role of the knee ligaments is not conserved only to maintain knee in a rigid position while standing, but also orchestrates the biomechanics of knee motion in harmony [3] (Figure 1).

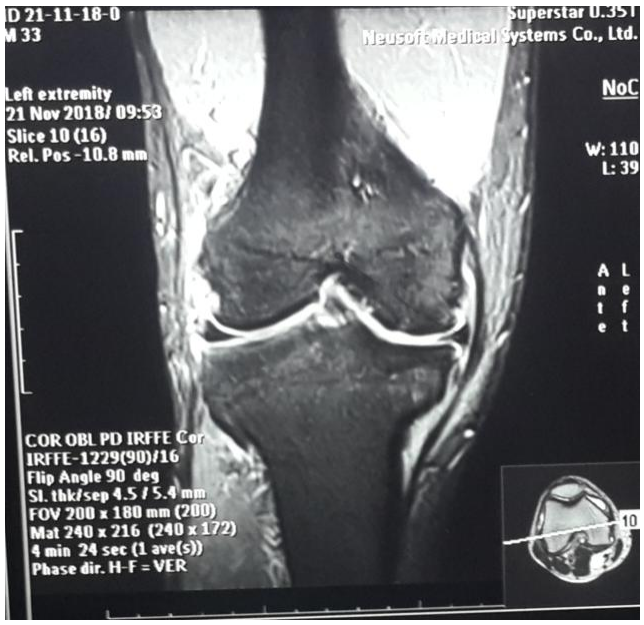

Figure 1: MRI of the knee (Coronal view). Shows multi-ligament knee injury. Shows: Torn anterior cruciate ligament (ACL), torn medial collateral ligament and posterior cruciate ligament (PCL)

An anterior cruciate ligament (ACL)

Originates from the proximal tibia, it coarse upward, backwards, and laterally; where it is attached to the medial aspect of the lateral femoral condyle. It has two bundles crossing each other; hence, the name (cruciate) [4]. It provides plain sagittal stability and prevents posterior translation of the femur on the tibia while preventing anterior protrusion of the tibia under the femur. This function is essential in various weight shifting motion of the knee, for example, when stepping down on the stairs [4].

A posterior cruciate ligament (PCL)

Originates from the lateral aspect of the medial femoral condyle, it coarse downwards, forward, and laterally. It crosses with the anterior cruciate ligament on the way [5]. It has two bundles as well. However its main function is in the opposite direction of the ACL, that is to say, preventing anterior shifting of the distal femur and preventing posterior migration of the proximal tibia [5]. Again, certain positions would put this ligament at strain such as climbing the stairs [5].

Medial collateral ligament (MCL)

Attached at the medial aspect; between the proximal tibia and distal femur [6]. It has a superficial layer and a deep layer. Is assist in preventing valgus force applied to the knee, in addition to the posterior oblique tendon and semimembranosus [7].

Lateral collateral ligament (LCL)

Covering the lateral aspect of the knee, between the proximal tibia and distal femur [8]. Works with the iliotibial band to prevent varus force on the knee [8].

Posteromedial corner (PMC)

Consists of the posterior oblique ligament, semimembranosus, and the posterior horn of the medial meniscus [9]. It assists the medial collateral ligament (MCL) in preventing valgus forces from the posteromedial side [9].

Posterolateral corner (PLC)

Composed of the fibular collateral ligament, iliotibial band, popliteal muscles and tendon [10]. They assist the lateral collateral ligament (LCL) in resisting varus forces at the posterolateral aspect [10].

Mechanism of injury

They are usually caused by high-velocity traumas [11]. For example, direct trauma to the knee by a speeding mini truck [11]. In sports, a violent tackle to the knee by render it dislocated, with multiple ligaments torn [11]. However, in obese individuals, multi-ligament knee injuries might be caused by very low-velocity trauma [12]. Multi-ligament knee injuries are almost always associated with knee dislocations [1]. However, based on Schenck's classification of knee dislocation, there could be a knee dislocation from single cruciate ligament and collaterals tear (as in KD I). That is to say; not all knee dislocations are due to a multi-ligament knee injury. However, all multi-ligament knee injuries have some degree of knee dislocation [1].

The direction of the force applied on the knee dictates which ligaments are affected; anterior translation would tear the ACL, followed by MCL and LCL – posterior translation would affect the PCL only – varus force would tear the LCL, then, ACL and PCL, while valgus force would affect the MCL, then, ACL and PCL [10]. Interestingly, when the femur is

immobile, and internal rotation is applied, this leads to LCL tear followed by PCL and capsule tear, on the other hand, forcing external rotation on an immobile thigh would rupture the MCL then PCL and capsule. Hyperextension would first rupture the PCL, then ACL and posterior capsule [13]. A different mechanism of injury for the knee in males and females. In males, only one sagittal plane force is required, while in females multiplane forces are applied [14].

Signs and symptoms

Besides the excruciating pain that a patient with a multi-ligament knee injury, they might complain of loss of sensation of the leg or foot [15]. These are warning symptoms of underlying neurological or vascular injury [1], [15]. Multi-ligament knee injuries might be associated with popliteal artery injuries in one-third of its patients, while 14 to 40% might develop common peroneal nerve injuries [15]. Indeed, careful monitoring of peripheral tissue perfusion is a must [1]. This can be carried out: by checking the capillary refill on both feet (if a single knee is involved), and/or monitoring the ankle brachial pressure index (ABPI) – if both knees were involved [1], [15].

Diagnosis

Magnetic resonance imaging (MRI) is the gold standard to diagnose multi-ligament knee injuries; it shows the disruption in the affected ligaments [16]. Disruption of the ACL and PCL usually appears on the sagittal view, while disruption in the PMC and PLC commonly appear on the coronal view [16].

Some orthopaedic surgeons use radiographic stress studies [17]. In this kind of studies, x-ray imaging is done with valgus, varus, or kneeling stress, then, the instability of knee joint is measured (based on the available index grades) [17]. This test is usually painful; that is why it is usually done on the chronic phase of multi-ligament knee injury [17]. Clinical examination specific tests can be used to diagnose multi-ligament knee injury [17]. Examples of clinical index tests are Lysholm knee scoring scale and the international knee documentation committee form (IKDC) [17].

Treatment

Can either surgical or non-surgical. While most surgeons prefer to intervene with their hands, some would leave the conservative option to those who cannot tolerate surgery [1]. Ligament repair was corroborated to be better than reconstruction [18]. There have been some contradictions, regarding whether conservative management is better in certain cases [1]. However, what matters most, is the prognosis of each management. It is not yet known whether a single ligament repair or multiple ligaments repair would have the same result – to the researcher's knowledge.

It is worth to mention that, some authors use the term conservative treatment of knee ligaments tear. However, this term has many contradictions; some would refer to it as a state of not having reconstruction surgery – either due to contraindications for surgery such as infection on the skin, or simply, refusal of the patient to do surgery or inability of the surgeons to conduct the surgery [19] – Other authors corroborate conservative management as a treatment for some knee ligaments tears [20]. Perhaps in our endeavour, it is compelling to test whether non-interventional methods' outcome would be.

Surgical treatment

Surgical options would involve the repair of the torn ligament – using strong, absorbable sutures [21] – or reconstruction of the ruptured ligament [22]. Knee ligament reconstruction was previously done using a bone patellar tendon bone (BPTB) graft. However, recent studies would favour using quadruple hamstring tendons as an autograft [23]. Alternatively, allografts and synthetic grafts can be used to repair multi-ligament knee injuries [24].

Physiotherapy

It is undeniable that physiotherapy is indispensable to any orthopaedic surgery intervention [25]. It is one of the core principles of proper management; shines in the progress of early mobilisation and rehabilitation [25]. Nowadays, physiotherapy has been recommended preoperatively; to optimise the knee functions, and postoperatively; to shorten the time of rehabilitation [25].

The target of physiotherapy gradually progresses from decreasing pain, followed by increasing range of motion, then strengthening the joint's muscles. These plans can be achieved by many modalities, such as, infrared treatment, shockwave therapy [26], hydrotherapy, physical message, and active exercise; achieving simple and complex tasks [27].

Recovery

All orthopaedic surgery patients share one question (when will I get to walk back again). Generally, the recovery of a single ligament injury would require 6 to 9 months of rehabilitation [1]. Then, return to active sport would take, roughly, from 9 to 12 months. Multidisciplinary team, including the patient, orthopaedic sports surgeon, physiotherapist, physiatrist, and the sports coach, decides against full

recovery. It can be tested by many techniques: the agility tests (Illinois agility test, zig zag agility test), standing vertical jump test, Heiden hop test, and the isokinetic test [1], [2]. These tests, not only provides data on the success of the ligament repair but also proves that the knee can withstand complex and strenuous movements[2].

Problem statement

Patients with multiple ligaments injuries of the knee become disabled for a long period. This disability rises from the pain and stiffness of the knee joint. 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

Furthermore, because multi-ligament knee injuries are relatively rare, not much data has been done on it. This is the first study to be conducted on multi-ligament knee injuries in Sudan. This study would help surgeons to decide which management technique is better for each patient group. It will also help patients with the knowledge of how to deal with a multi-ligament knee injury (in the short term). Of course, this study would help the health system in decreasing the days of disability for each.

The general objectives of this research are: To assess the short-term outcome of multi-ligament knee injury among Sudanese patients in Khartoum state hospitals.

The specific objectives of this research are: to assess the functional outcome of the knee of patients with a multi-ligament knee injury after treatment using a standard scoring system; and to determine the recovery rates of each treatment option to a multi-ligament knee injury.

Patients and Methods

Study design: Descriptive cross-sectional hospital-based study.

Study period: From February 2018 to February 2019.

Study area: Because multi-ligament knee injuries are rare, it is wise to conduct this study on multi-centre hospitals that provide sport medicine services in Khartoum state – to achieve a larger number of subjects.

Four hospitals were included in the study: Al-Kuwaiti Specialized Hospital; Ribat University hospital; Haj alsafi hospital; and Alyaa specialised hospital.

All patients with multi-ligament knee injuries were included.

Inclusion criteria: Sustaining the knee injury for at least 12 weeks; All ages above 15 years old; All patients with diagnostic MRI confirming multi-ligament knee injury; All genders.

Exclusion criteria: Multi-ligament knee injury more than 2 years ago; children; morbidly ill patients (ASA class IV and above) [American Society of Anesthesiologists class 4 (A patient with severe systemic disease that is a constant threat to life); Examples include (but not limited to): recent (< 3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis]; patients with active knee infection; and Patients undiagnosed by MRI

Sample size: Total coverage; this is a very rare condition. Twenty-four cases were obtained.

Data collection: Personal interview conducted by the researcher, using a standard questionnaire from modified Lysholm knee scoring scale. Each patient is approached after sustaining the knee injury for at least 12 weeks.

Study variables: Age, gender, BMI, ligaments involved, mode of trauma (sport, RTA, physical assault), MRI date, preoperative physiotherapy, mode of treatment (conservative, reconstruction, repair), post-operative physiotherapy, knee function.

Dependent variables: age, occupation, BMI, mode of trauma, ligaments involved, mode of treatment, knee function, preoperative physiotherapy, postoperative physiotherapy.

Independent variables: gender, ligaments involved, MRI date.

Ethical considerations: Approval from the Sudan Medical Specialization Board. Approval from the research and ethical committee; Approval from the hospitals and consultants in the selected hospitals; Verbal or written informed consent is used for subjects in the study.

Data analysis: Data were entered into a computer, and SPSS (version 23) for Windows was used for data analyses. Continuous data were checked for normality using the Shapiro -Wilk test. Data were expressed as proportions: mean (SD) and median (interquartile). Correlation (Pearson and Spearman) were performed. $P < 0.05$ was considered statistically significant.

Results

A group of 24 subjects were enrolled in the study: 22 males, 2 females. The mean age was 32.9 ± 7.3 years. Male gender was 92% while the female was 8% of the total volunteer's population. Lysholm knee scoring scale (LKSS) was calculated among subjects: mean was 75.8 ± 17.

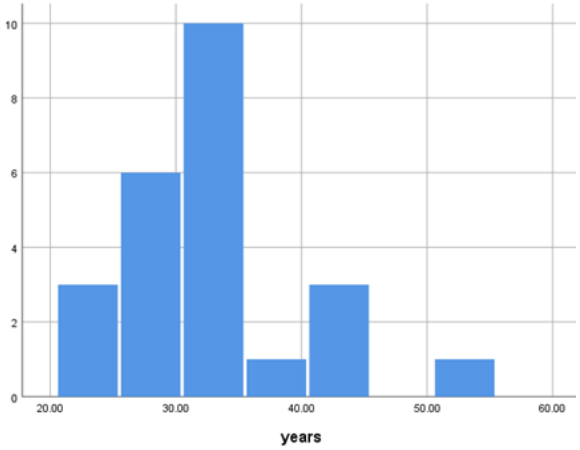

Figure 2: Histogram, reflecting the distribution of age among subjects, the mean is 32.9 ± 7.3 years

The mean BMI was between 18 and 24. As for ligaments involves 92% ACL, 41% PCL, 41% PLC, 16% LCL, and 12% had MCL injuries.

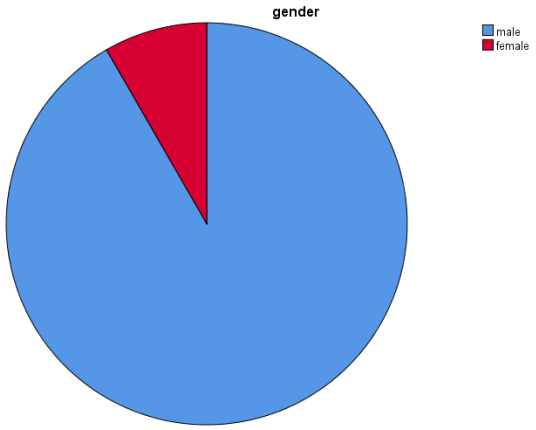

Figure 3: Pie chart, reflecting gender distribution among subjects; 92% males, 8% females

We plotted the Lysholm knee scoring scale against the age of each patient; we found out that younger patients would have a better outcome than older patients. We could not find whether the gender might affect the outcome because we had a small sample size of female subjects. The body mass index, on the other hand, does not affect the functional outcome. Of course, patients who underwent reconstruction were, by far, with a better outcome than those who did not have any surgical intervention.

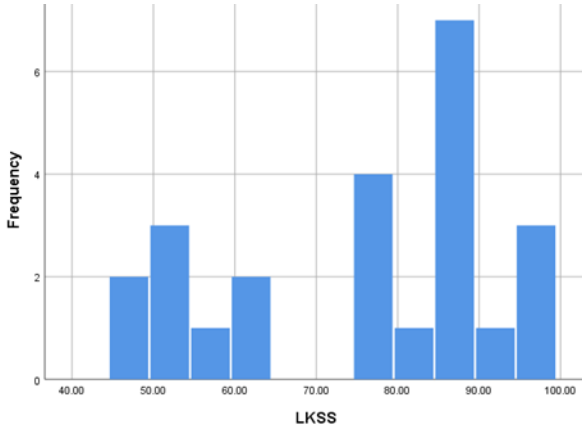

Figure 4: Histogram, reflecting Lysholm knees scoring scale (LKSS) among subjects. The mean was 75.8 ± 17. Good score (LKSS = 84-94), Fair score (LKSS = 65-83) and Poor score (< 64)

We also tested whether physiotherapy affects the functional outcome of a multi-ligament knee injury. We could not find a significant correlation between preoperative physiotherapy and LKSS. However, post-operative physiotherapy had a profound effect on the functional outcome of a multi-ligament knee injury.

Table 1: Histogram, reflecting Ligaments involved and Lysholm knees scoring scale (LKSS) among subjects. The mean was 75.8 ± 17. Excellent score = 95 – 100 Good score= 84-94, Fair score= 65-83 and Poor score (<64). An anterior cruciate ligament (ACL), the posterior cruciate ligament (PCL), the collateral ligaments (MCL), (LCL), the posteromedial corner (PMC), and the posterolateral corner (PLC) m knee scoring scale (LKSS)

Patient No	ACL	PCL	MCL	LCL	PLC	PMC	LKSS
1**	✔	✔					48
2**		✔			✔		55
3**	✔	✔		✔			52
4**	✔	✔					50
5*	✔				✔		86
6*	✔				✔		87
7*	✔				✔		87
8*	✔				✔		78
9*	✔			✔			79
10*	✔	✔					76
11*	✔				✔		78
12*	✔				✔		89
13**	✔			✔			53
14**	✔	✔					64
15*	✔			✔			89
16*	✔	✔					98
17*	✔	✔					94
18*	✔				✔		82
19*	✔				✔		95
20*	✔		✔				95
21*	✔	✔					88
22**		✔			✔		47
23**	✔		✔				64
24*	✔		✔				87

*Underwent reconstruction surgery; **Did not have any surgical intervention.

Concerning the most problematic symptoms among patients in the LKSS questionnaire; we noticed that the majority of patients suffer from pain and instability. After surgery, some symptoms such as pain, limp, locking, and squatting do not recover 100% during the short-term.

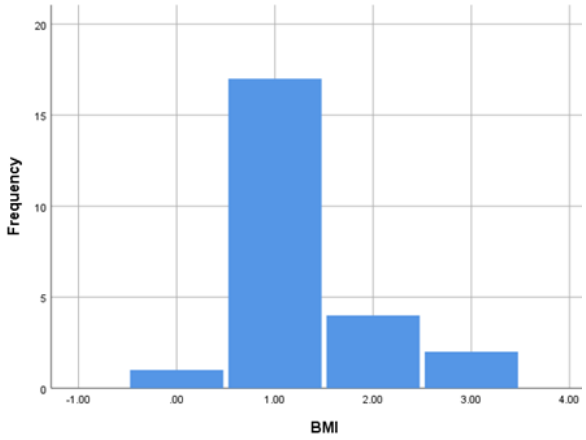

Figure 5: Histogram, reflecting body mass index (BMI) among subjects. 0 ≤ 18, 1 = 18 - 24, 2 = 25 - 30, 3 ≥ 30

Discussion

In our findings we noticed that most of our patients were between the third or the fourth decade of life; this is mainly due to the nature of the injury. Most of our subjects sustained their MLKI while practising sport, and in Sudan younger men tend to play football (soccer). However, it is due to their lack of proper exercise, in addition to having harder ligaments than younger football players they become more vulnerable to rupturing their knee ligaments.

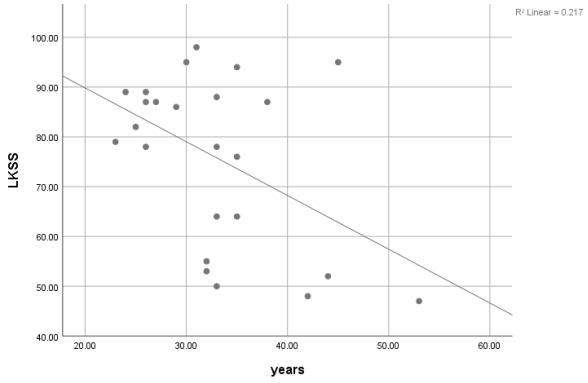

Figure 6: Simple scatter with the fit line, Lysholm knees scoring scale (LKSS) against the age of subjects. P = 0.02

Most of our subjects were males, roughly 90%. Again, this is because of the nature of injury; due to cultural reasons, women refrain from practising contact sports. All our female subjects had their ligaments torn from road traffic accidents. However, this is not a strict line, some females might sustain ligament injuries associated with proximal tibia fracture – but without a discerning eye – it might become underdiagnosed when treating a Schatzker type >III fractures.

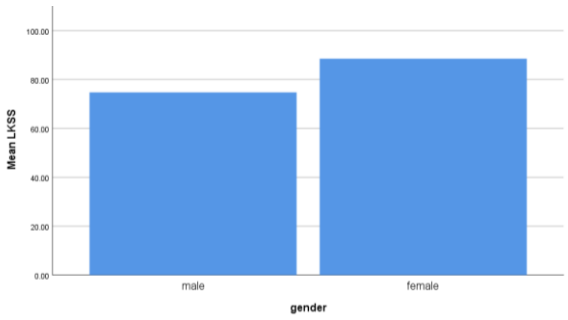

Figure 7: Histogram, Lysholm knees scoring scale (LKSS) among different gender groups. P = 0.3

The contradictions are nascent whether to fix the bone without having a diagnostic MRI or delaying the fracture healing couple of weeks to diagnose a ligament tear – on top of – a fractured tibial plateau. It is becoming mandatory to do an arthroscopic assisted fixation of proximal tibia fracture to diagnose and treat MLKI. That is to say; our small sample size might be indeed due to underdiagnosed cases rather than a limited number at presentation.

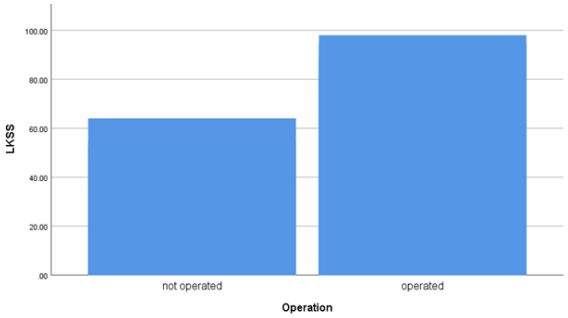

Figure 8: Bar chart, Lysholm knees scoring scale (LKSS) among patients who had reconstruction surgeries and ones who did not have surgeries. P < 0.01

The Lysholm knee scoring scale of our subjects who had reconstruction surgeries was by far better than those who didn't have any intervention. It is mainly because the ruptured ligaments do not heal due to the biological and mechanical factures rendering them widely apart.

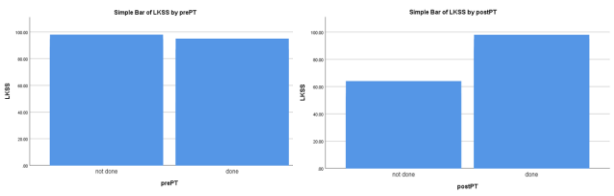

Figure 9: Bar chart, On the left: Lysholm knees scoring scale (LKSS) among patients who had pre-operative physiotherapy (prePT) p = 0.6; On the right: Lysholm knees scoring scale (LKSS) among patients who had post-operative physiotherapy (postPT) p < 0.01

Adding to that, chronic instability would lead to more dire consequences such as joint stiffness – the patient becomes afraid to use the unstable joint –

and secondary osteoarthritis; consequential from the unequal load on the joint, not to mention, associated meniscal tears. All these reasons further worsen the functional outcome of the affected knee [28].

Table 2: Lysholm knees scoring scale (LKSS) details among all subjects enrolled in the study. 1 = Limp, 2 = using cane, 3 = Locking, 4 = Giving away, 5 = Pain, 6 = Swelling, 7 = Stairs climbing, 8 = Squatting

Patient No.	1	2	3	4	5	6	7	8	LKSS
1**	3	5	6	15	5	10	0	4	48
2**	3	5	6	15	10	10	6	0	55
3**	0	5	15	15	0	10	6	1	52
4**	3	5	6	10	10	6	6	4	50
5*	5	5	10	25	20	6	10	5	86
6*	3	5	10	25	20	10	10	4	87
7*	5	5	15	25	20	6	6	5	87
8*	3	5	10	20	20	10	6	4	78
9*	3	5	10	25	20	6	6	4	79
10*	3	2	6	20	25	10	6	4	76
11*	3	5	10	25	15	6	10	4	78
12*	3	5	15	25	20	6	10	5	89
13**	3	2	6	15	15	6	2	4	53
14**	3	5	15	5	15	10	6	5	64
15*	3	5	15	25	20	6	10	5	89
16*	3	5	15	25	25	10	10	5	98
17*	5	5	10	25	25	10	10	4	94
18*	5	5	6	25	20	10	10	1	82
19*	5	5	15	25	20	10	10	5	95
20*	5	5	15	25	20	10	10	5	95
21*	3	5	6	25	25	10	10	4	88
22**	0	5	15	10	5	2	6	4	47
23**	3	5	6	20	20	10	0	0	64
24*	5	2	15	20	20	10	10	5	87

*Underwent reconstruction surgery; **Did not have any surgical intervention.

On the other hand, those undergoing reconstruction surgeries, they are exposed to preoperative physiotherapy to achieve an acceptable range of motion – followed by replacing the torn ligaments with proper size and strength ligament graft to maintain stability – then, after a reasonable time of immobilization, post-operative physiotherapy helps to facilitate pain relief and decreasing swelling. All mentioned factors led to having a better Lysholm knee scoring scale among MLKI reconstruction group.

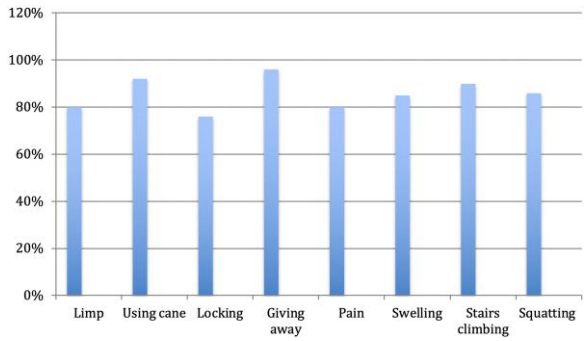

Figure 10: Bar chart showing the functional improvement among patients who underwent reconstruction of multi-ligament knee injuries. From 0 – 100%; 100% means complete recovery. Limp 80%, using cane 92%, Locking 76%, Giving away 96%, Pain 80%, Swelling 85%, Stairs climbing 90%, Squatting 86%

Concerning the affected ligaments, the anterior cruciate ligament is by far, the most affected one; it is, perhaps, to the mechanism of injury – rendering a frontal impact during a road traffic accident, or multiple forces affecting the knee, as in a twisted knee in sport's (tackling). It is also worth to mention that: sagittal plain tore ligaments (for example ACL and PCL) would have a better outcome than the oblique plain tore ligaments (for example ACL and PLC). Perhaps, due to the nature of having two ligaments reconstructed is better than having a reconstruction of one ligament and repair of the group of soft tissue labelled as the posterior corner of the knee.

Young patients would have a better prognosis in MLKI reconstruction that older one; mainly, due to the eagerness of young ones to return to their daily lifestyle – and the fear of older ones from reinjures on top of pre-existing comorbidities such as osteoarthritis made such difference clear[28]. In contradiction, maybe it is due to the small sample size in our population; having most of our subjects in the fourth decade of life (mean = 37 years) is indeed, the reason why our data is suggestive of such finding, that is to say, unequal representation of age groups. Gender effect on the functional outcome of multi-ligament knee injury is not yet clear; due to having a very small female subject (8%) it is rather compelling to find out whether females have a better outcome than males, or not. Body mass index (BMI), and nutritional status do not affect the outcome of ligament injuries. Thus, nutrition has no strict role in the healing process of the torn ligament; due to the mechanical and biological factors directly influencing the fate of the ligament and joint. Our findings were favouring physiotherapy as a major role in treatment; because after ensuring stability with a proper graft, one might need rehabilitation courses to decrease pain, to improve the range of motion, and to strengthening surrounding muscles for simple and complex physical tasks [29].

Improvements in the knee functions are variable; of course, many pre-existing factors might be indeed the reason. However, we noticed the most common complaint among patients after reconstruction was locking symptoms; this leads to the facts that meniscal injury in association with multi-ligament knee injury perplexing and requires additional intervention. Also, some silent meniscal injuries such as hypermobile lateral meniscus [30] might indeed become the reason of such locking symptoms.

We can conclude that: males are subjected to multi-ligament knee injuries more than females; reconstruction of MLKI has better functional outcome than conservative management; post-operative physical therapy further improves the outcome of MLKI reconstruction; younger patients have better prognosis than older ones; BMI has no effect on the healing process of MLKI; the most common complaint in our findings was locking symptoms, due to associated meniscus tear.

We can recommend: increasing the sample size to include larger group; increasing duration of postoperative physiotherapy; active management of coexisting meniscal injuries; and studying biological difference among subjects concerning healing.

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