

Original Research Article

Knee stiffness post anterior cruciate ligament reconstruction- factors to worry about

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ABSTRACT

Background: Knee stability is affected by integrity of anterior cruciate ligament (ACL). Knee stiffness is a worrying postoperative complication, preventing patients from returning back to pre-injury sport level. In this study, we analyzed incidence of knee stiffness post ACL reconstruction and possible associated risk factors.

Methods: This is retrospective study, was held in Royal Medical Services/Jordan–Queen Alia Military hospital/Arthroscopic and Sport injuries division. We analyzed 250 patients' data using computerized patients record system (CPRS) called Hakeem complaining of knee stiffness post ACL reconstruction between July 2022 and July 2023, whom ACL reconstructive surgeries were performed between March and September 2022.

Results: Incidence of knee stiffness post ACL reconstruction is about 1.5% (4 out of 250). All of those 4 patients were males, 3 of them had limited flexion (75%), while 1 of them had limited extension (25%). All of the 3 patients having extension contracture had an associated medial meniscus tear, repaired at time of ACL reconstruction, while flexion contracture patient had an isolated ACL tear.

Conclusions: Incidence of knee stiffness post ACL reconstruction is about 1.5%. 75% of patients were associated with medial meniscus tear, who underwent meniscus repair and hinged knee brace was applied. We conclude that ACL patients having an associated meniscus tear managed by meniscus repair and hinge knee brace are at higher risk to develop knee stiffness. Therefore, we recommend limiting the usage of knee brace for ACL reconstruction with meniscus repair only.

Keywords: Knee stiffness, ACL reconstruction, Meniscus repair, Knee brace

INTRODUCTION

Knee joint stability is highly affected by the integrity of anterior cruciate ligament (ACL). And as it is well known and well described in several studies. ACL injuries are considered to be one the most common knee injuries.^{1,2}

During the last 2 decades, arthroscopic ACL reconstruction has dramatically improved and proven to be much more safe and effective method than open manners.¹

Even though, knee stiffness still contributes widely in big portion of postoperative complications, in which it leads to severely preventing patients from returning back to their pre-injury athletic or sport level.^{6,11}

Postoperative knee stiffness can be identified as insufficient achieved range of motion which can be caused by multiple risk factors as gender, poor graft position, arthrofibrosis and cyclops lesions, concomitant meniscal injuries and other associated knee injuries and the time interval from trauma to surgery.²

In this study we will be analyzing the incidence of knee stiffness post ACL reconstruction and determine the possible associated risk factors, in addition we will concentrate on the follow up and management plan for the cases of knee stiffness we have faced.

METHODS

This is a retrospective study, which was held in Royal Medical Services/Jordan – Queen Alia Military Hospital/Arthroscopic and Sport injuries division. We have analyzed the data of patients retrieving to our post-operative clinic between July 2022 and July 2023 using our computerized patients record system (CPRS) called Hakeem for patients complaining of knee stiffness post knee sports injury surgery, whom surgeries were performed between March and September 2022. Selection criteria was based on revising our ACL operated patients in the mentioned above period selecting those ACL patients who developed knee stiffness post operatively. Exclusion criteria included those who developed stiffness due to ligamentous injuries other than ACL like MPFL tear reconstruction, PCL reconstruction, direct trauma, stress fractures, degenerative causes like osteoarthritis or metabolic causes like osteomalacia or osteoporosis.

Regarding procedure of patients' selection, after reviewing the data of 250 ACL patients through our CPRS, who underwent ACL reconstruction between March and September 2022, we have found 4 patients who apply to our inclusion criteria which develop knee stiffness post ACL reconstruction regardless to be isolated ACL tear or associated with other ligamentous or meniscal injuries. 1 patient was excluded due to the fact that he developed knee stiffness post ACL tear associated with progressive proximal tibia stress fracture managed with proximal tibia LCP.

ACL reconstruction procedure can be described starting from patient in supine position on table with knee in 90 degrees flexion supported with lateral thigh post and distal foot post. We start with anteromedial 3 cm skin incision over proximal tibia to harvest our ACL graft consisting of cracilis and semitendinosus muscles tendons. Graft then to be sutured and repaired through having and endo button end over the femur side and a suspensory screw fixation through the tibia. During graft preparation, we start our knee scope by preparation of femoral and tibial foot print of ACL. After foot print preparation is done, we ream femur and tibia tunnels according to graft size. Graft then to be applied and tensioned under knee full extension. Knee stability and range of motion are checked after ACL graft was applied. Then we end with wound closure.

This study is ethically approved by Royal Medical Services-Directory of professional training and planning under the IRB number 18-6/2023, and a copy of the ethical approval is attached within sent files.

Regarding statistical analysis, our statistics belong to be descriptive statistics in terms of frequency, percentage and mean which were used to describe associated risk factors and sociodemographic characteristics of the sample to identify incidence of knee stiffness post ACL reconstruction. Excel program version 2018 was used to summarize, analyze and organize the data.

RESULTS

250 patients of ACL reconstruction were operated between July 2022 and July 2023 in our institute, we retrospectively observed our post-operative clinic to identify patients complaining of knee stiffness either limited extension and flexion as well in the above-mentioned time period.

The demographic distribution for those 250 patients regarding mean age of patients, gender, and side of injury can be described to have all patients who developed stiffness post ACL reconstruction were males (100%), with having mean age of 28 years for them, and with regard to the affected side, 75% of the showed to have right sided injury (Table 1).

Among those 250 ACL underwent reconstruction surgery being followed up in our post-operative clinic, we have found 4 out of them who developed knee stiffness, making the incidence of knee stiffness post ACL reconstruction about 1.5% (Table 2).

Regarding patients complicated with knee stiffness post ACL reconstruction, 3 out of 4 were complaining of limited flexion (75% of all knee stiffness post ACL reconstruction) gaining about 90-110 degrees of flexion, while 1 out of 4 was complaining of limited extension (25%) lagging about 10-15 degrees of extension (Table 3).

All the 3 patients diagnosed to have extension contracture patients were found to have an associated medial meniscus tear which was repaired at time of ACL reconstruction surgery. In addition to the medial meniscus repair, a hinged knee brace was applied to all of those 3 patients for about 4 to 8 weeks, while the flexion contracture patient was found to have an isolated ACL tear without any associated meniscal or other knee ligamentous injuries, and no brace was applied for him (Table 4).

The 3 patients with limited knee flexion were managed through manipulation under anesthesia (MUA), after which all of them have achieved full range of motion. And this number of patients showed that the rate for using MUA to solve knee stiffness complication is about 1.2%.

About the extension lag patient, arthroscopic cyclops debridement has achieved a full range of motion for this patient, making the rate for using arthroscopic cyclops release as low as 0.4% (Table 5).

The time interval from trauma to surgery for all patients who didn't develop knee stiffness complication was about

3 to 6 months, which is the same period for those who developed knee stiffness. So, there was no much more

delay to surgery for patients complicated with stiffness. ACL graft position was not analyzed in our study.

Table 1: Demographic distribution regarding mean age of patients, gender, and side of injury.

Gender	Developed knee stiffness post ACL reconstruction		Did not develop knee stiffness post ACL reconstruction		Total
	Male	Female	Male	Female	
Mean age (years)	28	NA	26	24	-
Right side	3	0	95	51	149
Left side	1	0	70	30	101
Total	4	0	165	81	250

Table 2: Incidence of knee stiffness post knee injuries surgeries.

Parameters	ACL reconstruction	Stiffness post ACL reconstruction
No.	250	4
%	-	1.5

Table 3: Distribution of flexion and extension deficit among knee stiffness cases.

Parameters	Knee stiffness	Flexion deficit	Extension deficit
No.	4	3	1
%	-	75	25

Table 4: Associated meniscus injury and hinged knee brace usage.

Parameters	Knee stiffness	With meniscus injury, repair and brace	Isolated ACL injury and reconstruction
No.	4	3	1
%	-	75	25

Table 5: Knee stiffness management.

Parameters	Type of knee stiffness	Flexion deficit	Extension deficit
	Type of management	MUA	Cyclops debridement
No.	4	3	1
% out of knee stiffness cases	4	75	25
% out of all ACL cases (rate of usage)	250	1.2	0.4

DISCUSSION

Although there is no consensus over knee stiffness definition, but regarding our study we have agreed that

knee stiffness can be identified as insufficient achieved range of motion which can be caused by multiple risk factors which were discussed above in this study.

Knee stiffness is a fearful complication post ACL reconstruction, one of the most significant concerns in the mind of any sport surgeon is gain full knee extension.

Regarding demographic analysis of the data, due to the fact of lack of female gender patients who developed knee stiffness post ACL reconstruction, in other words the male gender homogeneity, our results showed that all our patients who developed knee stiffness post ACL reconstruction were males. 75% of patients showed to have right sided injury, and the mean age of those who developed knee stiffness post ACL reconstruction was 28 years old.

Regarding analysis of results and possible risk factors, our results were comparable with other worldwide results, such as having the incidence of knee stiffness post ACL reconstruction to be about 1.5% (while comparing results with worldwide results it was about 2-3%), and by comparing our incidence result with the results worldwide.¹ Wang et al study showed an incidence of 3%, we interpretate our decrement in the stiffness incidence due to the fact of having excellent collaboration of physiotherapy department being a vital part in our management plan. Our first step of management of an ACL torn patient is to concentrate on a time period of ACL preconditioning physiotherapy. This preoperative period of physiotherapy has an excellent role in achieving the preinjury range of motion of the patient, thus giving us high degree of grantee to avoid any risk of preoperative knee stiffness. Moreover, our physiotherapy department is highly qualified and professional in giving the postoperative instruction and keep rehabilitation follow up to assure gaining full range of motion and to early recognize and sort of knee stiffness to manage it as early as possible.

We also find for those patients who developed knee stiffness that our result was in agreement and comparable with studies held internationally, in which we have an incidence of 75% to develop knee stiffness post ACL reconstruction for those having ACL tear associated with

meniscus injury who underwent repair and knee brace was applied then, while 25% only who developed knee stiffness post isolated ACL tear and reconstruction.³ Again, this result goes consistently with worldwide results, making the notice that Huleatt et al in their study that associated meniscus injury and repair had an incidence of knee stiffness to be about 40%, because keeping the knee in a full extension manner with limited allowed flexion range of motion for a period about 4 to 8 weeks enhances the risk of knee stiffness.

75% of patients who developed knee stiffness found to have flexion knee stiffness. All of those patients responded well to MUA and with results reaching to a degree near to full range of motion post MUA.^{3,10} Huleatt et al showed that the rate of using MUA for knee stiffness was about 5% for their patients. This result is not against our results, because they report the rate of using MUA for patients who need to undergo such procedure post ACL reconstruction, and in comparison with our results, the rate of using MUA for our patients would be about 1.2% (3 out of 250 patients) which is a little bit lower than Huleatt et al result, and this goes back due to the extensive enrollment of physiotherapy role in our management protocols, in which it aids in decreasing the incidence of knee stiffness and rate of using MUA for knee stiffness patients as well.

Regarding extension loss, it was very negligible, and we face only one case which needed to undergo arthroscopic cyclops excision, and it was shown in 25% of patients (one patient) who developed knee stiffness post ACL reconstruction.^{4,10,7,12,13} This patient regained full range of motion after arthroscopic cyclops excision, and the rate of using this method of management was as low as 0.4%.¹⁴ By comparison with worldwide results, Ekhtiari et al demonstrated that arthroscopic cyclops excision showed a great improvement regarding extension loss knee stiffness, with a rate of 1% for using such method of management.^{4,7} Again, this decrement in our number was due to the fact of extensive physiotherapy follow up applied in our institute.

And as mentioned above regarding time elapsed from trauma to surgery, there was no much more delay to surgery for patients complicated with stiffness in comparison to patients who didn't develop stiffness, keeping in mind that this 3–6-month delay period is consumed in doing physiotherapy precondition period in which it highly collaborates in decreasing the incidence of knee stiffness.^{8,9}

On the other hand, following up patients with physiotherapy in the post-operative period led to decrease the incidence of knee stiffness hand to hand in leading to early detection of stiffness cases.

We need further study to compare association between: knee brace usage and precondition elapsed period and their contribution to stiffness.

Limitations

One of the most important limitations for our study is being a retrospective study, in which it has some sort of limitation in data collection. Another limitation was the way of identifying knee stiffness. Stiffness was measured by different doctors, so there is interindividual differences in identifying the degree of stiffness. Another limitation is the need to identify stiffness by using more objective measures than individual assessment.

CONCLUSION

The incidence of knee stiffness post ACL reconstruction is about 1.5%. Regarding risk factors, all of our patients were males (male gender 100%), 75% of patients were associated with medial meniscus tear, all of them underwent meniscus repair and hinged knee brace was applied to all patients underwent meniscus repair. Patients who developed knee stiffness didn't face more time delay to surgery than those who didn't have knee stiffness post ACL reconstruction.

So, we conclude that male gender, associated meniscus tear managed by meniscus repair and applying a hinge knee brace for those patients are highly associated with the development of knee stiffness post ACL reconstruction. Therefore, we highly recommend to limit the usage of knee brace for the required cases post ACL reconstruction with meniscus repair.

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