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Original Research Paper

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ASSESSMENT OF PRE-OPERATIVE AND POST-OPERATIVE EXCURSION FOR ANTERIOR CRUCIATE LIGAMENT INJURIES USING KT-1000 INSTRUMENT IN A TERTIARY CARE CENTRE

Dr Pravee Jain — Final year PG resident, Department of Orthopaedics, Sri Aurobindo Institute of Medical Sciences & PG Institute, Indore (M.P).

Dr Arjun Jain — Professor, department of Orthopaedics, Sri Aurobindo Institute of Medical Sciences & PG institute, Indore (M.P).

Dr Aman Jaggi — Final year PG resident, department of orthopaedics, Sri Aurobindo Institute of Medical Sciences & PG institute, Indore (M.P).

ABSTRACT

Background: The cruciate ligaments, and especially the ACL, are among the most commonly injured structures of the knee. Given the increasing injury prevalence, there is undoubtedly a growing need for clinical decision making of health care providers. diagnosis may result in meniscal or chondral injuries. Measurement of knee laxity after anterior cruciate ligament (ACL) injury is crucial for appropriate treatment and rehabilitation decision-making. KT-1000 is a novel digital arthrometer to measure anterior tibial translation. However, there is scarcity of studies evaluating the efficacy and accuracy of same. In advent of same, the present study aimed to assess pre-operative and post-operative excursion for anterior cruciate ligament injuries using KT-1000 arthrometer. **Material & Method:** In this prospective observational study, 30 patients undergoing primary anterior cruciate ligament arthroscopy at Department of Orthopedics, Sri Aurobindo Medical College and PG Institute, Indore and satisfying the inclusion criteria were included after taking a written informed consent. Patients were divided into two groups based on the graft used: Hamstring ligament and Peroneus ligament. Preoperatively, detailed history, local and systemic examinations, and functional score assessments using KT-1000 arthrometer were done. Patients underwent MRI and Xrays for diagnosis. Postoperative evaluation included clinical examination and functional score assessment using KT1000. Postoperative wound healing, complications, and range of motion were recorded. Patients were followed up at 3 and 6 months for functional assessment and clinical evaluation. **Results:** 30 ACL reconstruction patients were included for analysis, with a mean age (±SD) of 34.05± 9.10 years old. The majority of the patients were in age group 25-35 years (33.3%) and were males (76.7%). Most common cause of injury was sports injury (40%) with right side (63.3%) more frequently involved. Only 1 patient reported complication i.e., infection. A statistically significant reduction was observed in the mean difference value of SSD at post durations as compared to pre durations ($P<0.05$; Paired T Test). The mean difference value at Pre-procedure duration 5.687 was significantly reduced to 2.295 and 1.918 at 3 month and 6-month duration respectively. However, graft a statistically non-significant difference in mean difference value at all the durations was observed between type of graft. ($P>0.05$) **Conclusion:** The KT-1000 digital arthrometer can effectively measure knee laxity, pre-operative and post-operative excursion and ACL injuries, providing an objective scientific basis for clinical diagnosis.

KEYWORDS : Anterior crucial ligament injury, Diagnostics, KT-1000 Arthrometer

INTRODUCTION

Injuries of the anterior cruciate ligament (ACL) are commonly associated with sports participation, particularly in sports involving cutting, jumping, and pivoting. [1,2] ACL rupture may leave the patient with knee joint instability during functional activities.

The basic function of the anterior cruciate ligament (ACL) is to limit excessive anterior displacement and valgus rotation of the tibia relative to that of the femur. In the absence of the ACL the task of restraint falls upon secondary ligamentous structures. So, with time, secondary restraints of the ACL deficient knee may also become lax or injured. [2]

Furthermore, the evaluation of knee laxity after ACL injury is important in deciding the treatment plan. [3] Magnussen et al. [4] found that individuals with greater preoperative knee laxity were significantly more likely to undergo ACL revision surgery in the following 6 years. Additionally, knee laxity is associated with a high risk of ACL reconstruction failure [5].

In a study evaluating factors influencing meniscal injury during ACL reconstruction, Nakamae et al. [6] found that the high incidence of meniscal injuries was closely related to the high laxity of the knee joint and was more prevalent in men. Therefore, it is of great clinical importance to develop a simple method that can quantitatively and accurately assess knee laxity after ACL injury.

Surgical treatment, in the form of ACL reconstruction (ACLR), is the preferred treatment choice for athletes, young active patients with high physical demands, patients with multiple knee ligament injuries, and those who remain symptomatic following a trial of nonoperative management.Understanding the excursion of the native anterior cruciate ligament is important for the restoration of physiologic knee motion after anterior cruciate ligament reconstruction. Knee flexion angle can significantly reduce post-surgery. [7]

Physical examination is commonly used to assess knee laxity, although the condition cannot be quantified by physical examination alone. Recently, several devices have been introduced to quantify anterior tibial translation (ATT) that can be widely used to objectively assess knee laxity. For example, the KT1000 (Medmetric Corp, San Diego, CA, USA) device has also been used extensively to assess knee laxity after ACL injury. [8]

The KT1000 is a novel knee arthrometer that was developed by the company MEDMETRIC in the 1980s. Its purpose is to objectively evaluate the anterior cruciate ligament (ACL) by quantifying the antero-posterior displacement of the knee joint.

The KT1000 arthrometer was designed to measure the anterior translation of the tibia while maintain the femur in position.

The results obtained provide an objective diagnostic of the state of the ACL to the medical practitioner. Nowadays, it is considered that a KT1000 test is clinically more accurate and useful when diagnosing ACL instability compared to an MRI scan. This arthrometer can also be used to follow-up post-operative results, but the fact that the forces are applied

manually represents a risk (risk not present with the GNRB arthrometer). [9]
Wiertsema et al. compared the reliability of the KT1000 device with the Lachmann test in individuals with ACL rupture.

The KT1000 had lower reliability, with inadequate intraclass correlation coefficients for both intrarater and interrater reliability. [10] Runer et al. tested the inter- and intrarater reliability of four different knee arthrometers in healthy patients, obtaining ICC ranging from 0.49–0.70. [11]

There is a plethora of published studies in the literature reporting improvement in the functional outcome scores following ACL reconstruction (ACLR) surgery.

Outcome studies enable clinicians to better understand the prognosis and the likely outcome of their treatment choice. Moreover, it enables surgeons to counsel patients undergoing ACLR surgery about expected outcomes of the surgery and set realistic treatment goals.

However, there is scarcity of studies evaluating the efficacy and accuracy of KT-1000, a novel digital arthrometer to measure anterior tibial translation both pre and post operatively. In advent of same, the present study aimed to assess pre-operative and post-operative excursion for anterior cruciate ligament injuries using KT-1000 arthrometer.

MATERIAL AND METHOD

After approval from the institutional ethical committee, this prospective observational study was conducted on 30 patients who underwent primary anterior cruciate ligament arthroscopy at Department of Orthopedics, Sri Aurobindo Medical College and PG Institute, Indore. The patients satisfying the inclusion criteria were enrolled after taking a written informed consent.

Inclusion criteria:

Patients with clinical /MRI evidence of symptomatic individuals with anterior cruciate ligament insufficiency; patients between age 18 to 50 (skeletally matured patients) and patients with no history of previous surgery in the knee were included in the study.

Exclusion criteria:

Patients with systemic diseases compromising their pre-anaesthetic fitness; patients associated with posterior cruciate ligament tear or associated grade III medial collateral ligament and lateral collateral ligament injuries; patient with osteoarthritic knee/cartilage injury; patients with associated fracture of tibial plateau; patients with local skin infections and patients not giving consent for surgery were excluded from the study.

Methodology:

Patients were divided into two groups based on the graft used following the odd/even rule into Group A where Hamstring ligament was used as graft and Group B where Peroneus ligament was used as graft.

Preoperatively, detailed history, local and systemic examinations, and functional score assessments using KT-1000 arthrometer were done. Anterior drawer test, Lachman test, pivot shift test and mcmurray test was undertaken. Patients underwent MRI and X-rays for diagnosis.

Postoperative evaluation included clinical examination and functional score assessment using KT1000. Postoperative wound healing, complications, and range of motion were recorded. Patients were followed up at 3 and 6 months for functional assessment and clinical evaluation.

Figure 1. Pre op clinical images

Statistical Analysis

Data were analyzed using SPSS version 22.0 (SPSS Inc., Chicago, Illinois, USA). Baseline characteristics were analyzed using descriptive statistics such as number, percentage, mean and standard deviation, minimum and maximum. Chi Square test was applied as test of significance on qualitative data and unpaired t test was applied on quantitative data if the final data obtained from the study tends to be normal. A probability value <0.05 will be considered as significant. A p-value less than 0.05 was considered as statistically significant.

RESULTS

Baseline characteristics of the subjects are shown in Table 1. 30 ACL reconstruction patients were included for analysis, with a mean age (±SD) of 34.05 ± 9.10 years old. The majority of the patients were in age group 25-35 years (33.3%) and were males (76.7%). Most common cause of injury was sports injury (40%) with right side (63.3%) more frequently involved. Only 1 patient reported complication i.e., infection.

Table 1. Baseline characteristics of the subjects

Age Group	Frequency	Percent
<= 25 Years	8	26.7
26-35 Years	10	33.3
36-45 Years	9	30.0
46-55 Years	3	10.0
Sex	Frequency	Percent
Female	7	23.3
Male	23	76.7
Side	Frequency	Percent
Left	11	36.7
Right	19	63.3
Complication	Frequency	Percent
Infection	1	3.3
None	29	96.7
Type Of Graft	Frequency	Percent
Hamstring	15	50.0
Peroneus	15	50.0
Mechanism Of Injury	Frequency	Percent
Fall On Ground	6	20.0

RTA	7	23.3
Sports Injury	12	40.0
Twist Injury	5	16.7

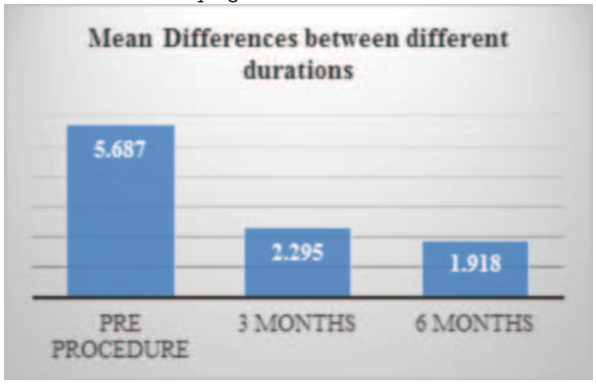
A statistically significant reduction was observed in the mean difference value of KT-1000 readings at post durations as compared to pre durations (P<0.05; Paired T Test). The mean difference value at Pre-procedure duration i.e., 5.687 was significantly reduced to 2.295 and 1.918 at 3 month and 6-month duration respectively. (Table 2, graph 1)

For comparison of Mean value difference of KT-1000 readings between type of graft a statistically non-significant difference in mean difference value at all the durations was observed. (P>0.05) The mean difference value at Pre-procedure duration was 5.687 for Hamstring and was 5.655 for Peroneus graft method which was non-significantly different. Similarly, at 3 Month the mean difference value was 2.507 for Hamstring and was 2.083 for Peroneus graft method and at 6 Month the mean difference value was 1.924 for Hamstring and was 1.911 for Peroneus graft method respectively. (Table 3, graph 2)

Table 2. Pre-Post Comparison of Mean value of Difference Between Different Durations

Durations	N	Mean Differences	Std. Dev	Paired T Test	P Value
Pre Procedure	30	5.687	0.380	21.368	0.000
3 Months	30	2.295	0.730		Sig*
Pre Procedure	30	5.687	0.380	40.514	0.000
6 Months	30	1.918	0.334		Sig*
3 Months	30	2.295	0.730	3.726	0.001
6 Months	30	1.918	0.334		Sig*

*P<0.05: Statistically significant



Graph 1: Pre-Post Comparison of Mean value of Difference Between Different Durations

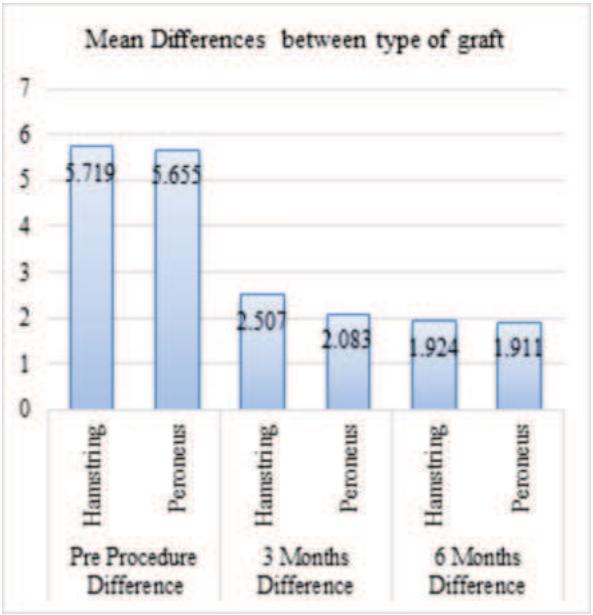
Table 3: Comparison of Mean value of Difference Between Type of Graft

Durations	Type Of Graft	N	Mean Differences	SD	T Test	P Value
Pre op	H	15	5.719	0.414	0.460	0.649
	P	15	5.655	0.353		Non Sig
3 Months	H	15	2.507	0.847	1.637	0.113
	P	15	2.083	0.537		Non Sig
6 Months	H	15	1.924	0.330	0.102	0.919
	P	15	1.911	0.350		Non Sig

***H: Hamstring graft; P: Peroneus graft**

DISCUSSION

Knee laxity after ACL injury can be compensated by muscle strengthening and neuromuscular proprioceptive exercises. Increasing knee laxity may be an early signal of knee decompensation and structural damage when compensatory mechanisms have been triggered. Therefore, a simple and objective approach to following up patients with ACL injuries is by evaluating knee laxity.



Graph 2: Comparison of Mean value of Difference Between Type of Graft

The Lachman test (30° stress physical examination) is a screening tool commonly used by clinicians with high sensitivity (94%) and specificity (83%) [12]. However, the results of the Lachman test can be influenced by the clinical experience of the examiner, as well as their subjective perceptions [13]. Further, the Lachman test does not provide any quantitative indicators. The clinician grip configuration influenced the performance and interpretation of the Lachman test [14].

The KT1000 arthrometer is the most common instrument for measuring ATT and has been reported to be suitable for the diagnosis of ACL injuries because of its high sensitivity (92%) and specificity (95%) [15-18]. In our study, a statistically significant reduction was observed in the mean difference value of KT-1000 readings at post durations as compared to pre durations (P<0.05; Paired T Test). The mean difference value at Pre-procedure duration i.e., 5.687 was significantly reduced to 2.295 and 1.918 at 3 month and 6-month duration respectively. However, Forster et al. found significant inter- and intrarater variability in measurements of ATT and SSD using the KT1000. [19] Sernert et al. used the KT-1000 to compare knee laxity between left- and right-handed dominant physical therapists in patients with ACL injuries. Left-hand-dominant therapists obtained significantly higher values for left knee laxity. The device applied uniformly (3 N/s) through a hand crank at the mainframe, and the test results were not affected by the dominant hand. [20]

However, for comparison of Mean value difference of SSD KT-1000 readings between type of graft a statistically non-significant difference in mean difference value at all the durations was observed. (P>0.05) We infer that K-1000 instruments was efficient in assessing pre-operative and post-operative excursion for anterior cruciate ligament injuries using KT-1000 arthrometer.

The study has limitations, including soft tissue deformation and being limited to simple ACL injuries. Further research is needed to include patients with different types of ACL injuries and differentiate population characteristics, thereby refining diagnostic criteria and obtaining enriched ATT data for more accurate diagnosis.

CONCLUSION

The KT-1000 digital arthrometer can effectively measure knee laxity and ACL injuries, providing an objective scientific basis for clinical diagnosis. It can be used to measure ATT and SSD, making it a valuable tool for clinical practice. Future comparisons with established devices are necessary for further advancements.

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