Original Article

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Evaluation of Pivot Shift under Anesthesia in Anterior Cruciate Ligament (ACL) Deficient knees

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Abstract

Background: Knee injuries are common injuries sustained in sports or accidents (domestic, road traffic, etc.).These injuries affect the different structures of the knees, affecting the skin, muscles, bone, ligaments, tendons, etc. Some of the structures are extra-articular and others are intra-articular. There are a lot of different ways that the anterior cruciate ligament (ACL) can be torn. The most common are low-speed, non-contact, deceleration, and contact injuries with a rotational component. Contact sports can also cause twisting, valgus stress, or hyperextension from direct contact or collision-related ACL secondary injuries. The pivot is one of these injuries. The shift test for anterolateral stability of the knee It is a painful test, so most of the patients will not cooperate if not under anesthesia.

Objective: This study evaluates the angle of displacement of the tibia in relation to the femur at 30-degree knee flexion, knee extension, and the difference between knee flexion and knee extension. It also determined the angular estimation as outlined above after reconstruction. To compare the angular displacement in the pivot shift before and after reconstruction in an ACL-deficient knee.

Methods: This study was conducted in the department of orthopedics, arthroscopy, and sports medicine at Aware Global Hospital, Hyderabad, India. The study was initiated from January 2015 to March 2015. Through inclusion criteria, 15 patients with knee instability were included in the study.

Results: After completing the pivot shift test using spinal anesthesia, the knee was flexed to 30 degrees. Three K-wires are placed in three key locations. Compared to the affected knee, the angular displacement in flexed and extended knees is a more reliable and sensitive method for screening anterior instability of the knee due to ACL tear. It is also a low-cost method when specialized medical diagnostic tests are not available. Compared to MRI, it is a dynamic modality and has proven to be just as reliable in diagnosing ACL injuries.

Keywords: ACL, Knee, Anesthesia, Pivot shift test

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Introduction

One of the most common injured ligaments in the knee is the anterior cruciate ligament.

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Young and sports-active populations are vulnerable to injuries. While taking a thorough patient history who has a complaint of the knee, the first step to be performed is a clinical knee examination. An examination of the knee can distinguish pathologies and often provide the information needed for a definitive diagnosis (1, 2). Injuries lead to changes in the mechanics of the knee. This mechanical deficiency can

increase the risk of meniscal injury. The incidence of osteoarthritis increases sharply when the meniscus is injured (3). The anatomy of the ACL is extremely complex. The ligament is intra-articular but extra synovial. It is described as being composed of the following three main bundles: anteromedial, posterolateral, and intermediate. The ACL really acts as a continuum, with one part being tightened through all ranges of knee flexion. Oblique: The ligament runs from the tibia in front and to the femur in back and to the sides. The microstructure of the ligament is composed of collagen fiber bundles grouped into fascicles. Accounting for more than 90% of total collagen, type I collagen is the main collagen type. Types III and VI are also available. Elastin is found in significant quantities and provides some of the elastic properties of the ligament. The ACL acts as the primary restraint on anterior tibial translation and guides the screw-home mechanism associated with knee extension. In the extended knee, varus and valgus are secondarily prevented by it. Arthroscopically assisted and endoscopic anterior cruciate ligament reconstruction is now the preferred technique compared to conventional. The aim of treating patients with anterior cruciate ligament (ACL) injuries is to prevent recurrent instability and associated meniscus injuries. Activity levels can include sporting or work-related activities. Daniel defined patients at the highest risk as those who have participated in more than 50 hours of high-level activity per year prior to injury and have marked instability (4,5). Surgical intervention in these cases can be supported, as these patients have been found to be at the highest risk of requiring further surgery. A non operative management plan with comprehensive physical therapy and activity avoidance can be undertaken. Consider surgery if patients experience ongoing instability or are reluctant to change activity levels. In chronic cases, the main indication for surgical reconstruction is recurrent instability. Other types of surgery may be needed to deal with the other problems, like arthroscopy, partial meniscectomy, or meniscal repair. Correcting varus alignment may also require a high tibial osteotomy, especially in cases where the bone has worn down and the joints are unstable. Early surgery is indicated in the active and professional population because it ensures future stability and negates the possibility of future giving-way episodes, protecting the menisci. Surgical contraindications are limited and include the following: Several considerations exist regarding the development of arthritis and pain. Bone bruising occurs in up to 70% of cases. This phenomenon has been detected only with the advent of magnetic resonance imaging (MRI), and its long-term effects are unknown. There may be an association with ongoing pain and poor results. A loss of flexion can be associated with anterior femoral tunnel placement. This can also lead to recurrent instability, as the graft is ineffective. This is the most commonly performed defect in ACL surgery. Proper tunnel placement in the tibia and femur and adequate debridement of tissue around the tibial tunnel can reduce the incidence of these problems.

Aims & Objective:

To evaluate the angular displacement in the pivot test in ACL deficient knees under anesthesia.

a. To determine the angle of displacement of the tibia in relation to femur at 30 degree knee flexion.
b. To determine the angle of displacement of the tibia in relation to femur at knee extension.
c. To estimate the difference in the angular displacement between a & b above.
d. To repeat angular estimation as outlines above after reconstruction.

Materials and methods

This study was taken in the department of orthopedics, arthoscopy and sports medicine at Aware Global Hospital, Hyderabad, India. The study was initiated from January 2015 to March 2015. 15 Patients with knee instability was included in the study through inclusion criteria. After completing Pivot shift test through using spinal anesthesia, knee was flexed to 30 degree. Patients were positioned supine on operating theatre table. After spinal anaethesia pivot shift test was done. After painting and draping knee was flexed to 30^0. Three K-wire were placed at 3 locations as follows. Most prominent part of

lateral femoral epicondyle (This is point A). Gerdys' tubercle of tibia (This is point B) Central prominent part of head of fibula. (This is point C). After marking length of AB, AC and BC distance were taken and recorded. Then K-wire from point "A" was removed and the knee extended. At 0^0, the most prominent part of lateral femoral epicondyle was identified and K-wire was passed, the point marked as" A_1.Measurements are taken after joining the new triangle A_1B, A_1C and BC distance. Patients were positioned on supine on operating theatre table. After spinal anesthesia, pivot shift test was done. After painting and draping knees was flexed to 30 degree.3 key wire placed on 3 locations.
Firstly lateral femoral epicondyle. Then Gerdystubercele of tibia. Lastly Central prominent part of head of fibula.

Technique for measurement of angle:

Figure-1: Technique

After drawing the triangle measurement at flexion and extension of the knee on white paper by the help of geometric box and with help of measured chanda angle measurement done at flexion.

Figure-2: Technique

Figure-3: Technique

Figure-4: Technique

<u>TECHNIQUE OF MEASUREMENT OF ANGLE:</u>

After drawing the triangle measurement at flexion and extension of the knee on white paper by the help of Geometric box and with the help of measured chanda angle measurement done at flexion <BAC, <ABC and <BCA ; at extension $<BA_1C$, $<A_1BC$ and $<BCA_1$

Figure-5: Identification of semitendinosus Tendon

Figure-1: Latchman test

Figure-2: Anterior drawer test

INCLUSION CRITERIA:

1. Anterior cruciate ligament injury (isolated)
2. Age 18 to 55 yrs
3. Chronic injuries(>3 week)
4. Non operated knees
5. Pivot shift positive knee

EXCLUSION CRITERIA:

1. Multiligamentous injury
2. Bicruciate injury
3. Acute injury(less than 3 weeks)
4. Age < 18 yrs
5. Post op, failure or revision cases of ACL reconsruction
6. Associated bony injuries
7. Open injuries
8. Collagen disorders
9. Pivot shift negative knee

Type of Study: The study was an observational study which was done objectively to compare angular displacement clinical assessment and finally co-relate with arthroscopic findings. It was majorly study which definitely considers observation and follow up.

Data Collection &analysis: A questionnaire was developed to collect demographic and others clinical and non-clinical data. During data collection, the Objective of the study and overview was shared. An informed consent form was filled up by guardian/patients/caregiver of the patients. Data was collected and identified error if had anything's and retake data from Patients.

Ethical Consideration: The study was approved by the department of Aware Global Hospital, Hyderabad, India.

Results

This Study was done objectively to compare angular displacement clinical assessment and finally correlate with arthroscopic findings. A sample of 17 patients was included in this study.

Table 1: Age distribution

Variable	Obs	Mean		Std. Dev.	Min	Max
Age	17	31.64706		6.594896	22	45

The mean age of the patients in this study was 31.6 years. The youngest patient was 22 years and oldest 45 years of age.

Table 2: Flexion & Extension angle for surgical procedure

	Variable	N	Mean	Std. Dev.	Min	Max
Flexion Angle in Degree	<BAC	17	42.94118	6.749728	28	55
	<FACB	17	66.94118	11.16619	44	86
	<ABC	17	69.23529	13.37689	55	102
Extension Angle in degree	<BA1C	17	45.11765	7.218746	28	56
	<A1CB	17	53.05882	16.16892	32	90
	<A1BC	17	82.58824	19.07242	37	104

Side Distribution:

In this series 52 % patients had Right knee anterior instability and 48 % had left.

Table 3: Surface

	Surface		
Sex	Left	Right	Total
Female	1(5.88%)	1(5.88%)	2 (11.76%)
Male	7 (41.18%)	8 (47.06%)	15 (88.24%)
Total	8 (47.06%)	9 (52.94%)	17(100%)

In this series 88.24% were Male and 11.76% are Female All the patient in this study anterior drawer test positive. Anterior translation between 5-10 mm. (picture attached)

Discussion

Fetto and Marshall's study of 25 fresh cadaver knees revealed that they were able to selectively sever the ACL and induce the pivot shift phenomena, leading them to conclude that the pivot shift was a pathognomonic sign of ACL insufficiency in the knee. It is common in ACL deficient knees to experience the pivot shift phenomenon, which can range from a grinding or slipping sensation to audible or palpable slipping, or even to a locking sensation. Gravity causes the femur to be subluxed relative to the tibia in the extended position of the ACL deficient knee, and the iliotibial band is located anterior to the immediate centers of motion in this posture. After flexing the knee to approximately 20° to 25°, the pivot shift phenomena occurs when the knee is shortened as the knee is reduced.

This observational study included all the patient in this study underwent pivot shift test positive under anaesthesia. Among physical examination tests, the pivot shift is the only one that has been shown to be associated with this subjective impression of instability and with patient satisfaction (6, 7). It has become clear that it is necessary to objectively measure the pivot-shift in order to accurately measure results in ACL surgery.

In this study the mean age of the patients in this study was 31.6 years. The youngest patient was 22 years and oldest 45 years of age.

In our evaluation of pivot shift we have started with drawing the triangle measurement at flexion and extension of the knee on white paper by the help of Geometric box and with the help of measured chanda angle measurement done at flexion <BAC, <ABC and <BCA ; at extension <BA_1C, <A_1BC and <BCA_1. After drawing the triangle measurement at flexion and extension of the knee on white paper by the help of geometric box and with help of measured chanda angle measurement done at flexion. . After completing Pivot shift test through using spinal anesthesia, knee was flexed to 30 degree. Patients were positioned supine on operating theatre table. Three K-wire were placed at 3 locations as follows. Most prominent part of lateral femoral epicondyle (This is point A). Gerdys' tubercle of tibia (This is point B) Central prominent part of head of fibula. (This is point C). After marking length of AB, AC and BC distance were taken and recorded. Then K-wire from point "A" was removed and the knee extended. At 0^0, the most prominent part of lateral femoral epicondyle was identified and K-wire was passed, the point marked as" A_1.Measurements are taken after joining the new triangle A_1B, A_1C and BC distance. Patients were positioned on supine on operating theatre table. After spinal anesthesia, pivot shift test was done. After painting and draping knees was flexed to 30 degree.3 key wire placed on 3 locations.

Firstly lateral femoral epicondyle. Then Gerdystubercele of tibia. Lastly Central prominent part of head of fibula.

Conclusion

Anterior instability of the knee owing to anterior cruciate ligament damage can be detected by angular displacement in flexed and extended knees compared to the affected knee. It is a low-cost option for developing countries where specialist medical diagnostic tests are not yet available and where economics demand a better cost-benefit ratio. It is a dynamic modality, unlike MRI, and is equally as reliable in identifying anterior cruciate ligament damage. Unlike MRI, it also aids in grading the injury's laxity. .

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