Research Article

Reliability and responsiveness of lysholm knee scoring scale and knee outcome survey activity of daily living scale (ADLS) for patients with anterior cruciate ligament reconstruction

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ABSTRACT

Objective: To Find out the Reliability and Responsiveness of Lysholm Knee scoring scale and Knee Outcome Survey Activity of Daily Living Scale in patients with Anterior Cruciate Ligament Reconstruction .

Study design : Prospective and Observational study with Repeated Measures

Method: 30 Patients were included. The study included an initial assessment and a follow up assessment. On the initial assessment (24 to 48 hrs) after reconstruction, with the help of Lysholm Knee Scoring Scale and Activity of Daily Living Scale, score were recorded. Second assessment was done after one day in order to estimate the test retest reliability and the follow assessment was done every month for consecutively 3 months .Data was analysed using spearman correlation coefficient and standard error of measurement.

Results: Both the scales was statistically significant .but there was a higher value for activity of daily living scale (0.97 to 0.99) as compared to Lysholm knee scoring scale (0.78 to 0.88) and Activity of daily living scale had higher standard error of measurement (1.11) than Lysholm knee scoring scale

Conclusion: The results obtained from the study shows that Activity of Daily Living Scale appears more useful instrument for measurement of functional limitations.

Key words: Scales, Anterior cruciate ligament, functional measurements

INTRODUCTION

Anterior cruciate ligament injury is common in knee joint, accounting for 40% of sports injury[1]. Sports injury is common, ranking the second highest (21%) in terms of cause of injury[2] and leading to long term disabilities and handicaps especially in patients with knee injuries[3].Among all sport related knee injuries, one fifth (20%) consist of anterior cruciate ligament injury, the most traumatized structure[4]. Anterior Cruciate Ligament ruptures results in knee instability[5], prohibits the athlete from going back to sports and resulting in early retirement[6].

Anterior cruciate is a font crossing ligament attaching the femur to tibia through the knee; this ligament keeps the knee from hyperextension or being displaced back from femur[7]. The primary function of anterior cruciate ligament is to control anterior

translation of the tibia. The Anterior Cruciate Ligament is also a secondary restraint to tibial rotation as well as varus or valgus stress[8,9] This ligament ruptures causes joint laxity, especially on rotational movement and often causes disability to practice sports and joint wear off[10].

The Anterior cruciate ligament is rather large ligament that can withstand 500 lb (20kg) of pressure. If it is torn or becomes detached it remains that way and surgery is indicated[7]. In most severe cases, graft to the ligament is necessary to reattach it to the bone. The surgery can use tissue from the patient called as autograft[7].

The prognosis for a partially torn Anterior cruciate ligament instability symptoms is sometimes favourable with the recovery and rehabilitation period usually at least 3 months[11].

In United States there are between 10,000 and 20,000 ACL ruptures per year, with an annual incidence in the general population of approximately 1 in 3500, although the actual incidence must be higher[12, 13]. Women are nearly three times more likely to have anterior cruciate ligament injuries than men. This is due to difference in hormone levels or ligament strength and stiffness, neuromuscular control, lower limb biomechanics ligament strength and fatigue[14].There are several areas of controversy regarding the management of anterior cruciate ligament injuries. These include the relative merits of conservative versus surgical management[15]Whether or not the patient performs pivoting sports

A minor anterior cruciate ligament injury is like any other soft tissue injury and should be treated accordingly. This involves the application of RICE -R. Rest, ice, compression, elevation and obtaining a R - referral for appropriate medical treatment[16].There is always a chance of developing stiff knee after surgery and loss of motion, especially loss of extension. Loss of knee extension has been shown to result in a limp, quadriceps muscle weakness and anterior knee pain[17].

Preoperative Rehabilitation Phase[17]
Goals: Control pain and swelling
* Restore normal range of motion

* Develop muscle strength sufficient for normal gait and ADL
* Mentally prepare the patient for surgery

Restore normal range of motion
- Quadriceps isometrics exercises, straight leg raises, and range of motion exercises should be started immediately.(PETER J. MILLET, MD, Msc ACL rehabilitation protocol)

Full extension is obtained
Bending (Flexion) is obtained
Heel slides are used to gain final degrees of flexion.
- Pull the heel toward the buttocks, flexing the knee. Hold for 5 seconds.
- Straighten the leg by sliding the heel downward and hold for 5 seconds.

In later stages of rehabilitation, do heel slides by grasping the leg with both hands and pulling the heel toward the buttocks.

Develop muscle strength
Postoperative Days 1 – 7[17]
IT IS EXTREMELY IMPORTANT THAT PATIENT WORK ON EXTENSION IMMEDIATELY.
Goals:
* Control pain and swelling
* Care for the knee and dressing
* Early range of motion exercises
* Achieve and maintain full passive extension
* Prevent disuse atrophy of the quadriceps muscles
* Gait training

Postoperative Days 8 – 10[17]
Maintain full extension
Return to work
1) Schedule an office follow-up.
2) After 3 weeks, patient may apply vitamin E oil or another emollient to

the incisions, as this will improve their appearance.

3) The appearance of patient incision can be improved further by avoiding the direct sunlight for one year. When exposed to the sun the incisions can be covered with a bandage.

Achieve full Extension
Develop Muscular Control
Control Pain and Swelling
Postoperative Weeks 3 – 4[17]
Goals:
* To achieve full range of motion
* To gain the strength of muscles through exercise
Expected range of motion is from full extension to 100 – 120 degrees of flexion.
1) Continue straight leg raises with holds for 10 counts progressing to 30 counts.
2) Continue partial squats and toe raise.
Postoperative Weeks 4 – 6[17]
Goals:
* To achieve 125 degrees of flexion pushing toward full flexion
* strengthening of the muscle should continue.
Postoperative Weeks 6 – 12[17]
By week 6, patient range of motion should be full extension and at least 135 degrees of flexion.
Goals:
* 135 degree of flexion
* Maintainence of strength
Postoperative Weeks 12 – 20[17]
Goals:
* Maintain strength
* Jogging and light running should be taught to the patient
* Determine need for ACL functional brace
24 Weeks Postoperative (6 months) [17]
Goals: * Return to sports
To return to sports patient should have: [17]
- Quadriceps strength at least 80% of the normal leg
- Hamstring strength at least 80% of the normal leg
- Full motion
- Good stability

Disablement after anterior cruciate ligament reconstruction can be categorised according to International Classification of the Impairment, Disability and Handicap as either physical impairment or disabilities related to injury[18, 19]
Impairments after Anterior ligament injury are anatomic (anterior or displacement of tibia relative to femur) and physiologic (range of motion, muscle performance, pain) [20]
Disabilities outcome related to Anterior cruciate ligament injuries has traditionally been measured with questionnaire such as Lysholm Knee Scoring Scale, Activity Of Daily Living Scale and Functional knee test[21,22]
Studies have shown a moderate correlation between quadriceps muscle performance (impairment) and lower limb performance during functional knee test (disability)[23].
Impairment was measured by various means:
Goniometer to record active and passive ROM. Extension deficit was a major impairment after the ACL reconstruction[24, 25].
Measures of functional limitations and disabilities include performed based clinical assessment – such as one leg hop test and patient reported assessment [26].
The difference with use of performance based measures of function in the clinical setting and dearth of normative data for interpretations have it. The practitioner to consider alternatives such as patient reported measure of function also[26].
There are many rating scale available to measure outcome in patients with disorders of the knee[28].
Specific patient reported measures of functions of the knee include Lysholm Knee Scale[29], Cincinnati Knee Scale[30], Western Ontario and Mc Master Universities Osteoarthritis Index (WOMAC)[31], Activity of Daily Living Scale, patellofemoral joint evaluation scale.
The available patient reported measure of function of the knee were developed for specific pathological conditions such as OA and injuries of ligament[29, 30, 31].
The majority of instruments were developed, 8 instruments were evaluated in patients with range of knee problems[27].
Modified Lysholm Scale is an 8 item questionnaire originally designed to evaluate patients after knee ligament surgery[28]. The scale is scored on a 100 point scale, with 25 points attributed to knee stability, 25 to pain, 15 to locking, 10 each to swelling and stair

climbing and 5 to each limp, use of a support and squatting. It has adequate test retest reliability and good construct validity [28].

The American academy of orthopaedics surgeons (AAOS) sports knee rating scale was included in the musculoskeletal outcomes data evaluation and management system (MODEMS) for athletic patients with disorder's of the knee[28]

The activity of daily living scale of the knee outcome survey was published with the evaluation of its reliability, validity and responsiveness. This scale was developed on the foundation of the relevance of the instrument and the clinical input[28].

The single assessment numeric evaluation (SANE) was devised to evaluate college age patients following ACL reconstruction. The single assessment numeric evaluation asks the patient how they would rate their knee, from zero to 100, with 100 being normal[28].

The development of knee injury and osteoarthritis outcome score (KOOS) was the outcome of the feedback from the patients who were subjected to remote meniscal surgeries, and was found to be satisfactory on a sample size of 21 patients with anterior cruciate ligament reconstruction, through five separate scores based on pain, symptoms, daily activity, sports and recreation and knee related issues [28]

The quality of life outcome measure for chronic ACL deficiency was developed by Mohatadi.

Since outcome measures forms the important part of any research study as it is necessary that these outcome measures should have sound psychometric properties, it is the need of time to evaluate & establish the effectiveness of them. This study is an attempt to re-establish the basic qualities of some not so extensively studied scales used in the rehabilitation of patients with ACL injury.

Hence the purpose of the study is to find out the reliability and responsiveness of Lysholm Knee Scoring Scale and Knee Outcome Survey Activity of Daily Living Scale in patients with anterior cruciate ligament reconstruction

MATERIAL AND METHODS

Study Design

Prospective and observational study with repeated measures of patients with anterior cruciate ligament reconstruction, consisting of scales to measure functional abilities of the patient.

Study Setting

A 950 bedded tertiary care teaching hospital (Jawaharlal Nehru Medical College & Hospital, Wardha) with well equipped medical and surgical intensive care unit and a musculoskeletal department.

Sample and Sampling Method

Purposive sampling technique was used to select 30 patients with anterior cruciate ligament reconstruction.

Inclusion criteria

- Patients with unilateral anterior cruciate reconstruction
- Both sexes included
- Preserved cognition

Exclusion criteria

- Concurrent musculoskeletal condition example back , hip and ankle injury
- Patients with concomitant posterior cruciate ligament reconstruction , medial collateral or lateral collateral and meniscal injury
- Neurological condition affecting lower extremity

ALTERNATE HYPOTHESIS- Lysholm Knee Scoring Scale and Knee Outcome Survey Activity of Daily Living Scale are reliable and responsive in Anterior Cruciate Ligament Reconstruction patients.

NULL HYPOTHESIS- Lysholm Knee Scoring Scale and Knee Outcome Survey Activity of Daily Living Scale are not reliable and responsive in anterior cruciate ligament reconstruction patients.

RESEARCH HYPOTHESIS – Does these two scales are reliable and responsive in patients with anterior cruciate ligament reconstruction?

Methodology

The synopsis of the study was submitted to the Institutional Ethical Committee (IEC) for approval. After obtaining the approval patients were taken for the study based on the inclusion and exclusion criteria. The purpose of the study was explained to the patients and they were informed about their right to opt out of

the study anytime during the course of the study without giving reasons for doing so. A signed informed consent (Vernacular language) was obtained from all the patients who willingly volunteered for the study.

Initially patients were managed in the orthopaedics ward and in musculoskeletal department after reconstruction. The treatment approach were designed to meet the individuals need of the patients ,all the patients were asked to come for follow up with the treating therapist regularly every 15 days after their discharge from the orthopaedics department .

The assessment tool used in our study included Lysholm Knee Scoring Scale and Knee Outome -Activity of Daily Living Scale. Both of these are well established and with reliable measures.

The study included an initial assessment and a follow up assessment. On the initial assessment (24 to 48 hrs)after reconstruction , with the help of Lysholm Knee Scoring Scale and Knee Outcome Survey – Activity Of Daily Living Scale , scores were recorded .Second assessment was done after one day in order to examine test retest reliability and then follow up assessment was done every month for consecutively 3 months .The patients were interviewed about their performance on the scales, that is the Lysholm Knee Scoring Scale and Knee Outcome Survey Activity Of Daily Living Scale , the scores were recorded as the outcome measures .

Data Collection

The study conducted from December 2009 to September 2010 a prospective and observational study with repeated measures was carried out in patients with anterior cruciate ligament reconstruction as per the inclusion and exclusion criteria and data was collected and was subjected to appropriate statistical analysis .

Data Analysis

Data from all patients were entered into a computer data base analyzer with SPSS statistical package (version 14.0). Intra class correlation coefficient (ICC) was used to estimate test retest reliability. Reliability of both the scales was also measured using standard error of measurement (SEM). Spearman correlation coefficient was used to examine the relationship between the prognostic rating and change in the following

functional status score at monthly interval for 3 months.

OBSERVATIONS AND RESULTS

Table 1: Age wise distribution of patients

| Age Group(yrs)	No. of patients	Percentage (%)
20-30	11	36.67
31-40	19	63.33
Total	30	100.00
Mean	33.56 yrs	
SD	7.09	
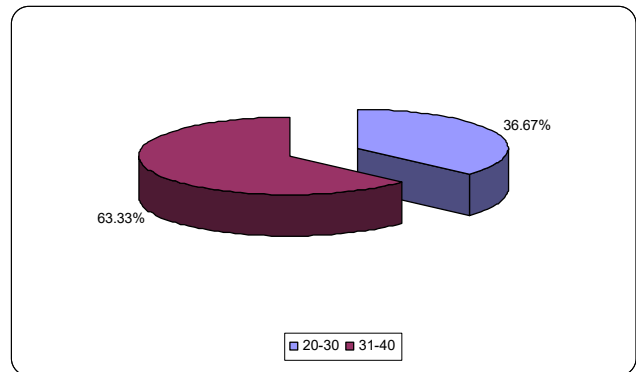
Graph 1: Age wise distribution of patients

Table 2: Comparison of Lysholm knee Scoring scale at 24-48 hrs, 1 day, 1 month, 2nd month and 3rd month
Descriptive Statistics

	Mean	N	Std. Deviation	Std. Error Mean
24-48 hrs	15.33	30	2.29	0.41
1day	17.53	30	2.54	0.46
1 month	46.83	30	2.76	0.50
2 month	49.70	30	3.45	0.63
3 month	70.83	30	8.27	1.51

Students paired t test

	Paired Differences					t	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
1day	-2.20	1.58	0.28	-2.79	-1.60	7.60	29	0.000 S,p<0.05
1 month	-31.50	3.09	0.56	-32.65	-30.34	55.77	29	0.000 S,p<0.05
2 month	-34.36	3.89	0.71	-35.81	-32.91	48.38	29	0.000 S,p<0.05
3 month	-55.50	8.40	1.53	-58.63	-52.36	36.17	29	0.000 S,p<0.05
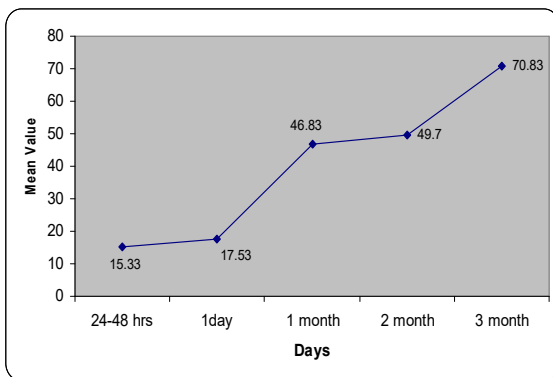
Graph 2: Comparison of Lysholm knee Scoring scale at 240-48 hrs, 1 day, 1 month, 2nd month and 3rd month

Mean Lysholm knee scoring scale at 24 – 48 hours was 15.33+-2.29 , at 1 day was 17.53 +-2.54, at 1 month was 49.70+- 3.45 and at 3 months was 70.83+-8.27. Significant difference is found at 1 day (t=7.60 , p =0.000) at 1 month (t=55.77 , p = 0.00), at 2 months (t=48.38 , p = 0.00) , and at 3 months (t= 36.17, p=0.00)

Table 3: Reliability Analysis of Lysholm knee scoring scale
- F-value=8.34,p-value=0.000, Significant
- Alpha(Reliability Coefficient) = 0.78 to 0.88
- Intra class correlation = 0.88, Significant
- Standard Error of measurement = 0.83
- Confidence interval = -0.25 to 0.91

Table 4 Comparison of Activity of daily living scale at 24-48 hrs, 1 day, 1 month, 2nd month and 3rd month
Descriptive Statistic

	Mean	N	Std. Deviation	Std. Error Mean
24-48 hrs	20.33	30	3.11	0.56
1day	21.36	30	2.99	0.54
1 month	48.73	30	2.53	0.46
2 month	51.06	30	3.35	0.61
3 month	72.86	30	7.70	1.40

Students paired t test

	Paired Differences					t	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
1day	-1.03	0.49	0.08	-1.21	-0.85	11.54	29	0.000 S,p<0.05
1 month	-28.40	4.12	0.75	-29.93	-26.86	37.70	29	0.000 S,p<0.05
2 month	-30.73	5.24	0.95	-32.69	-28.77	32.09	29	0.000 S,p<0.05
3 month	-52.53	6.65	1.21	-55.01	-50.04	43.21	29	0.000 S,p<0.05
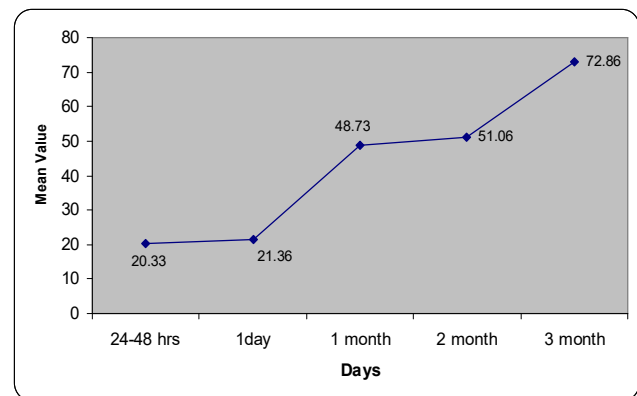
Graph 4: Comparison of Activity of daily living scale at 24-48 hrs, 1 day, 1 month, 2nd month and 3rd month.

Mean of Activity Of Daily Living Scale at 24 – 48 hours was 20.33+-3.11, at1 day 21.36+-2.99 , at 1 month 48.73+-2.53 , at 2 month 51.06+-3.35 and at 3month 72.86+- 7.70 . By using student paired t test significant difference was found at 1 day (t = 11.54, p = 0.00). At 1 month (t=37.70, p = 0.00), at 2month (t = 32.09 , p = 0.00) , at 3 month (t= 43.21 , p = 0.00)

Table 5: Reliability Analysis of Activity of daily living scale
- F-value=154.49,p-value=0.000, Significant
- Alpha(Reliability Coefficient) = 0.97 to 0.99
- Intra class correlation = 0.99, Significant
- Standard error of measurement = 1.11
- Confidence interval = 0.05 to 0.99

Table 6: Correlation between Lysholm knee Scoring scale and Activity of daily living scale at 24-48 hrs, 1 day, 1 month, 2nd month and 3rd month

	Lysholmknee Scoring scale	Activity of daily living scale	Correlation	p-value
24-48 hrs	15.33±2.29	20.33±3.11	0.12	0.51 NS,p>0.05
1 day	17.53 ± 2.54	21.36 ± 2.99	0.04	0.81 NS,p>0.05
1 month	46.83 ± 2.76	48.73 ± 2.53	0.90	0.00 S,p<0.05
2 month	49.70 ± 3.45	51.06 ± 3.35	0.98	0.00 S,p<0.05
3 month	70.83 ± 8.27	72.86 ± 7.70	0.94	0.00 S,p<0.05

Responsiveness was demonstrated by Spearman correlation for Lysholm Knee Scoring Scale and Activity of Daily Living Scale was ranging from (r =0.12 to 0.94) at 24 – 48 hours was 0.12 which is a weak correlation , on 1 day it was 0.04 which also states a weak correlation , 1 month it was 0.90 which means it had a strong correlation, 2 month it was 0.98 ,3 month 0.94 (which means at 2 month and 3month it had a strong correlation with each other)

DISCUSSION

The present study was undertaken in an attempt to find out the reliability and responsiveness of Lysholm knee scoring scale and Knee outcome survey activity of daily living scale .In this study it is suggestive of that activity of daily living scale was superior to Lysholm knee scoring scale in assessing functional limitations in the wide range of patient affected by anterior cruciate ligament injury[26]. Both the scales appears to be reliable, and responsiveness for the measurement of function related to anterior cruciate ligament reconstruction. The main hypothesis in the study was supported (MAY ARNA et al [34])

The procedure used in this study was derived from the study done by JILL M MINKLEY et al (1999) activities of daily living scale is relevant instrument designed for patients ranging from anterior cruciate ligament injury (ACL) to arthosis[32].

Lysholm knee scoring scale is a 8 item questionnaire that was designed to evaluate patients after knee ligament surgery and it has been widely used for clinical research studies[27].

JAMES J IRRAGANG et al (1998) did a study on development of a patient reported measure of function of the knee, there main aim was to demonstrate responsiveness, reliability and validity of activities of daily living scale of the knee outcome survey, a patient reported measure of functional limitations imposed on patients with pathological disorder and impairments of knee[26]. The scale was administered four times during an eight week period, at the time of initial evaluation and after one, four, and eight week of therapy . They took additional 52 patients just to establish the test retest reliability and they finally made an conclusion that the scale was reliable, valid and responsive for the assessment on the patients with disorder and impairments of the knee[26].

In the present study the subjects were taken for assessment after anterior cruciate ligament reconstruction and was measured with the help of Lysholm knee scoring scale and activities of daily living scale. The scale was administered five times in a 3 month period , at the initial evaluation that is after 24 to 48 hours after reconstruction , one day , 1 month , 2 month , 3 month respectively .

In the present study the results were analysed upon the scores obtained from the assessment and correlation was taken out between the two scales and with an additional Prognostic Rating Scale to find out the sensitivity of the scale.

The present study demonstrated that both scales were reliable, responsive but there was a higher value for activity of daily living scale (0.97 to 0.99) as compared to the Lysholm Knee Scoring Scale (0.78 to 0.88)

Though both the scales were statistically significant but the Activity Of Daily Living Scale had a higher coefficient alpha (0.97 to 0.99) with higher standard error of measurement (1.11).The patient score was significantly better after 1months of treatment in Activities of Daily Living scale as compared after 1 months of Lysholm Knee Score

This suggest that the Activities Of Daily Living Score was better in assessing functional limitations in the wide range of patients

affected by anterior cruciate ligament reconstruction[26]. The Activity of Daily Living Scale did not demonstrate acceptable concurrent reliability and responsiveness in relationship with Prognostic Rating Scale. There was a weak correlation between the scores on Activity Daily of Living Scale and Prognostic Rating Scale.

In a previous study by HEVARD MOKSNES et al (2008) et al studied on individuals with anterior cruciate ligament deficient knee classified as noncopers may be candidates for nonsurgical rehabilitation and this was evaluated by using single legged hop test , the knee outcome survey activities of daily living scale , the global rating of knee function , and the number of episodes of giving way with this concluded that 70 % of the subjects were potential noncopers over true copers after one year following non operative treatment .But the patients with ACL reconstruction showed excellent knee function and were highly active at one year follow up and there prognostic accuracy with the screening examination was also significant[35].

At present there is lack of literature to estimate test retest reliability in patients who have a disorder that is truly stable over a longer period of time, such as those who have a chronic slowly progressive condition. Both the scales are useful in detaching problems in the patients suffering from disorders of knee but not in any other condition other than those affecting knee.

In future studies the additional testing should be done to demonstrate test retest reliability over a longer period of time and to determine the usefulness of the scale in the other population[26].

In our study ,we also used a rating of expected change as the theory for change .Spearman correlation coefficient between the rating of change and the physical function changes scores obtained at 3 months interval varied from (0.21 to 0.20) for Lysholm Knee Scoring Scale and (-0.02 to 0.20) for Activity Of Daily Living Scale. The present study results coupled with those of WESTAWAY et al, he also provided support for evaluating a measure's of sensitivity to change. The results of the studies suggest that a correlation coefficient of approximately 0.20 can be

expected at the end of 3 months .This information is also useful for estimating sample size for future studies, where this scale is used for theory for change.

The above outcome of the present study are showing that activities of daily living scale has a greater capability in assessing the functional limitation in the wide range of patients affected by ACL injury . Though at end of the first day it was found that there was no significant difference of scores between the scales but with multiple repeated assessment at 1st, 2nd month, 3rd month have shown that activities of daily living scale was more effective in assessing the functional limitations of the patient

To summarize that the Activities of Daily Living Scale is much more reliable, and responsive to changes in an individual's level of function and the levels remain stable with the level of function is unchanged.

CONCLUSION

The present study was conducted to find out the reliability and responsiveness of Lysholm knee scoring scale and Activities of Daily Living Scale over the course of 3 months.

The results obtained from this study shows that the Activities of Daily Living Scale appear to be useful instrument for measurement of functional limitations during activities of daily living experienced by individuals who have undergone Anterior Cruciate Ligament Reconstruction.

The relation observed between Prognostic Rating Scale with Activity Of Daily Living Scale was found to be non significant which implies that the rating by these three different scale are not associated measure responses with period of time even though the reliability of Activity Of Daily Living Scale(0.98) was higher .

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