

Our Experience on Peroneus Longus as Graft for Arthroscopic ACL Reconstruction

DR. S RAJ KUMAR¹, DR K SOWMYA SRAVANTHI², DR KOTI SATISH³, DR. B. MOHAMMED GHOUSE⁴
^{3RD} YEAR ORTHOPAEDIC POST GRADUATE^{1,2}, PROFESSOR OF ORTHOPAEDICS³, ASSISTANT PROFESSOR OF ORTHOPAEDICS⁴
 KURNOOL MEDICAL COLLEGE, AP

Abstract:-

Background-The knee joint is one of the most commonly injured joint in our body and the most commonly injured ligament in knee is the anterior cruciate ligament. Due to the ever-increasing Road traffic accidents and increased participation in sporting activities, there is an increase in incidence of ligament injuries of the knee. Arthroscopic reconstruction of the injured ACL has become the gold standard. In our study we used peroneus longus as autograft for ACL reconstruction.

Methods: This was a prospective study that included patients who underwent ACL reconstruction using Peroneus longus tendon autograft. Results were assessed via physical examination. Donor site morbidity of the foot and ankle after tendon harvesting was assessed using Medical Research Council (MRC) grading of ankle and foot movements. Post-operative knee function was evaluated by the International Knee Documentation Committee (IKDC) scoring.

Results: In this study sample of 20 patients, the ankle functions at the donor site are grossly preserved in almost all the patients, which was elucidated by grading the power of foot eversion. Post operatively knee function (IKDC scoring) were rated as normal in 90% (18 cases).

Conclusions: Peroneus longus is an appropriate autograft source for ACL reconstruction in view of ease of harvest, adequate size, cosmetically appealing, considering excellent post-operative knee scores. And removing the Peroneus longus tendon has no effect on gait parameters and does not lead to instability of the ankle. So, it can be used as an autogenous graft in orthopaedic surgeries.

Keywords:- Anterior cruciate ligament(ACL) injury, Arthroscopy, Peroneus longus graft, Reconstruction, MRC scoring & IKDC scoring.

I. INTRODUCTION

The knee joint is one of the most commonly injured joint in our body and the most commonly injured ligament in knee is the anterior cruciate ligament. Due to the ever-increasing Road traffic accidents and increased participation in sporting activities, there is an increase in incidence of ligament injuries of the knee.

The incidence of ACL injury in general population is 1: 3000. The ACL along with other ligaments, capsule is the primary stabiliser of knee and prevents anterior translation, and restricts valgus and rotational stress to a certain degree. When an ACL injury occurs, the symptoms of knee instability, pain and a decrease in joint function occur. Although conservative treatment with intensive physiotherapy, bracing and lifestyle modification can be tried in some patients with less anticipated knee function, in symptomatic young active individuals, ACL reconstruction is necessary. Also ACL injuries are mostly associated with injury of the meniscus which need to be addressed, else the person can develop early onset of osteoarthritis of the knee.

Arthroscopic reconstruction of the injured ACL has become the gold standard. Open reconstruction of ACL which was done earlier is not practised nowadays due to the complications associated such as increased post op pain, stiffness and a lengthy rehabilitation phase. The “ideal graft” for ACL reconstruction is still a topic of debate. The most commonly used grafts are bone patellar tendon bone graft and hamstring graft. Several studies have demonstrated comparable functional outcomes for both the grafts. Some other grafts are – quadriceps, patellar tendon, fascia latae etc.. . Each graft have its own advantages and disadvantages. In our study we used peroneus longus over others because for the following reasons:

- Hamstring muscles prevents anterior translation of tibia over femur , when we prepared graft from hamstring it will sacrifice the above mentioned function
- Comparatively peroneus longus graft is longer ,so we can make it thicker while during graft preparation (triple folding)
- Harvesting graft is easier
- Distal cut end of Peroneus longus tendon sutured with intact peroneus brevis muscle to prevent retraction

II. METHODS AND MATERIALS

This study was conducted in the department of Orthopedics, KURNOOL Medical College, Kurnool, Andhra Pradesh between January 2022 to December 2022. Patients attending OPD and casualty are selected for the study. Thorough clinical examination was done (Lachman test, anterior drawer test and pivot shift test). Tests were also done to exclude tear of the Posterior Cruciate Ligament (PCL) and the Postero-Lateral Corner (PLC). Patients are evaluated with x-rays of knee and confirmed by MRI studies.

A. Inclusion criteria:

- Clinical and MRI evidence of symptomatic individuals with anterior cruciate ligament insufficiency
- Patients between age 20 to 40 (skeletally matured patients)
- No history of previous surgery in the knee
- A normal contralateral knee

B. Exclusion criteria:

- Asymptomatic individuals
- Multi-ligamentous injury.
- Patients with pre-existing flat foot, ankle deformity, paralytic conditions, poliomyelitis or previous significant injuries to ankle.
- Patients with systemic diseases compromising their pre-anaesthetic fitness
- Associated with PCL tear
- Patient with osteoarthritic knee
- Patients with associated fracture of tibial plateau
- Patients with local skin infections

A total of 20 patients are enrolled into the study, of which 15 are males and 5 females. On an acute ACL injury, prior to reconstruction surgery patient is treated with knee immobilizer, physiotherapy with goals of achieving near full range of motion, symmetric quadriceps strength and to decrease joint effusion. Once the inflammatory period is resolved patient is posted for surgery.

C. Surgical technique

Surgery was performed in supine position under spinal anesthesia. Pneumatic tourniquet was used in all cases. The peroneus longus tendon was harvested through a 2 cm incision along the posterior border of the distal fibula, just above the superior peroneal retinaculum .



Fig. 1: Skin Incision

The peroneus longus tendon was exposed on its posterolateral surface through the incision after carefully incising the fascia . Distal cut end of Peroneus longus tendon sutured with intact peroneus brevis muscle to prevent retraction.



Fig. 2: Exposing Peroneus Longus Tendon and Harvesting

The tendon was sutured with No. 2 of heavy non-absorbable suture and cut with a scalpel and harvested using a long tendon stripper .Incision was closed using absorbable subcutaneous sutures and staples. Pre-tensioning of the harvested graft was done on a tendon board.

then looped to constitute a triple graft. Femoral fixation device was attached to one end of the graft. Graft was passed through cylindrical sizers to determine the exact size of the triple graft to be matched with the needed femoral and tibial tunnel.

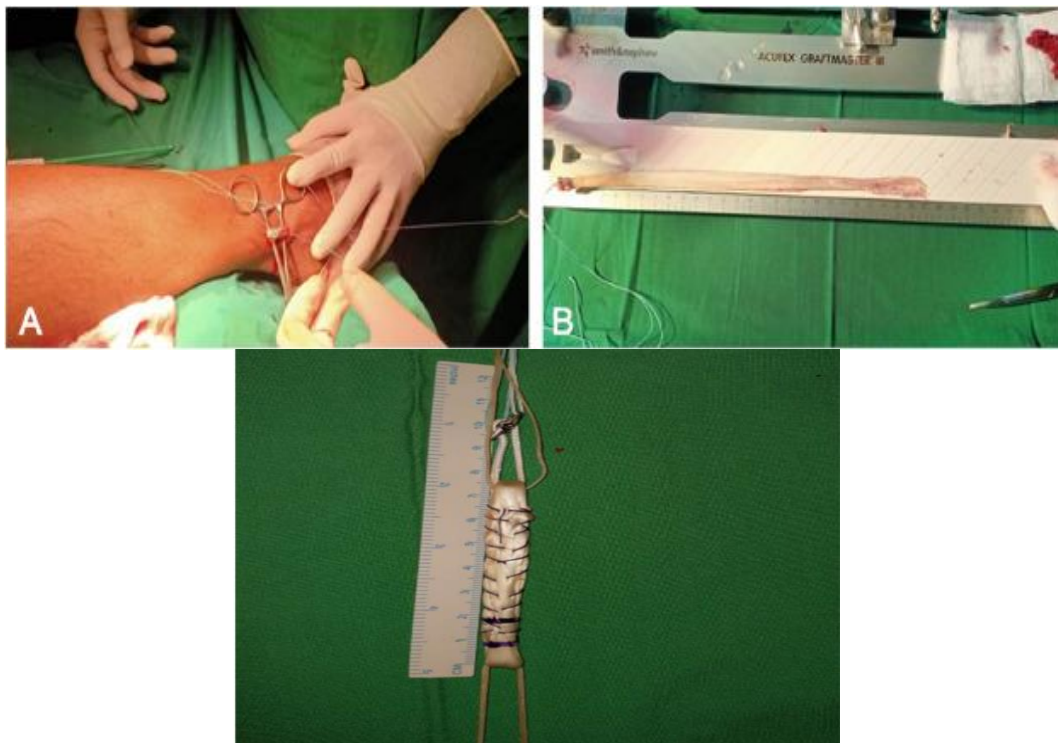


Fig. 3: Graft Preparation

Standard arthroscopic portals were established and through which arthroscopic survey was done. With the help of femoral offset aimer, a guide wire was placed into the posteromedial corner of the lateral femoral condyle. Using an appropriately sized reamer, femoral tunnel was made. The knee was flexed 70-90°, and then the tip of the tibial

drill guide was placed into position through the anteromedial portal with the angle of drill guide set to 45 to 55°. The drill sleeve was placed against the medial tibial cortex, and a guide wire was drilled into place emerging at the tibial plateau.



Fig. 4: Making Arthroscopic Portals

A cannulated tibial reamer of the size as determined by the thickness of the harvested graft was used to make the tibial tunnel. Appropriate markings were made on the graft and was rail-roaded into the femoral tunnel through the tibial tunnel under arthroscopic guidance. The knee joint was taken through the full range of flexion and extension (cycling of the knee joint up to 25 times) to remove any

kinks in the graft. Maximal traction was applied on the graft and guide wire was passed into the tibial tunnel over which biodegradable screw was tightened until achieving satisfactory purchase. Patient was given antibiotics, analgesics and knee immobilizer. Post-operative x-ray was done to ensure proper placement of the tunnels and the position of the trans-fixation device.

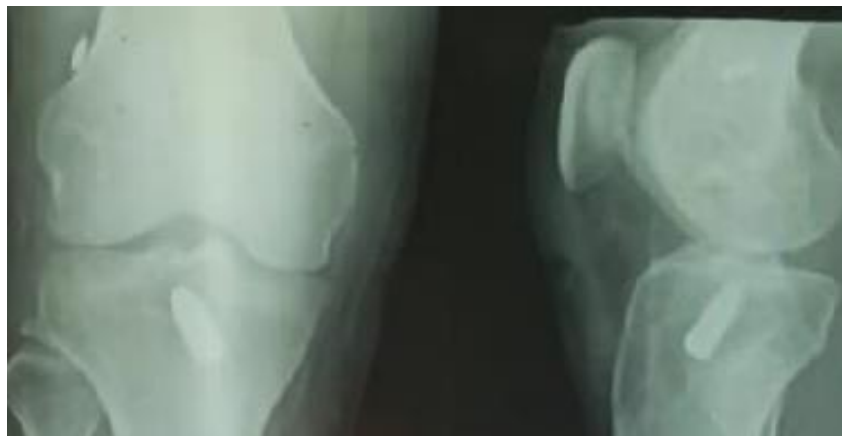


Fig. 5: Post Operative X-Ray

D. Follow up and assessment

On postoperative day 1, Continuous passive motion was initiated. Extension exercises (passive extensions, heel props, prone hangs and active assisted extension), flexion exercises (passive flexion and wall slides), quadriceps exercise (isometric contractions and straight leg raises), hamstrings exercise (curls), ankle exercises (dorsiflexion and plantar flexion, passive toe movements, inversion and eversion movement), hip abduction, adduction and extension were also advised. Wound inspection was done on the fourth postoperative day and check the suture line, any swelling, effusion, skin condition and range of movement of knee and ankle.

Patient was discharged with knee immobilizer, antibiotic, analgesics and advised to continue exercises at home. Patients were reviewed on day 13, wound inspected and all sutures removed. The following parameters were looked for: Suture line, swelling or effusion if any, surrounding skin and range of movement of knee and ankle. Knee immobilizer was continued till one month post operatively. The following exercises were advised after 2 weeks: partial squats, toe raises, stationary bicycling, wall slides, hand assisted heel drags and inclined leg-press machine. In the period between 1st and 3rd post-operative month, knee immobilizer was discontinued.

Tread mill was introduced (flat only). Leg curls, leg presses and outdoor bike riding on flat road was advised to the patient. After the third postoperative month, the following exercises were introduced: jogging, light running, leg raising with application of sandbags as counterweights,

one and two leg jumping, swimming etc. Post-operative knee function was evaluated by the International Knee Documentation Committee (IKDC) and assessment of MRC scoring for donor site ankle and foot done at 2 weeks, 1 month and 3-month follow-ups.

MRC GRADE	MUSCLE STATE
0	NO CONTRACTION
1	FLICKER OR TRACE OF CONTRACTION
2	ACTIVE MOVEMENT WITH GRAVITY ELIMINATED
3	ACTIVE MOVEMENT AGAINST GRAVITY
4	ACTIVE MOVEMENT AGAINST GRAVITY AND RESISTANCE
5	NORMAL POWER

Table 1: Medical Research Council (MRC) – grading of muscle power

III. RESULTS

Study sample of 20 patients consists of 15(75%) males and 5(20%) female. Road traffic accidents are the most common mode of injury in 60% (12 cases) followed by sport related injury in 30% (6 cases) and fall from height in 10% (2 cases). We have done arthroscopic ACL reconstruction on 15(75%) right and 5(25%) left knees. Mid

substance tear of ACL noted in 15 patients, 2 patients had ACL avulsion from tibial attachment and 3 patient had avulsion from the femoral attachment. The length of the Peroneus longus graft harvested in the study ranged from 270-315 mm. The minimum length was 270 mm and maximum length was 315 mm. The mean length was 292.5 mm.

Length of graft in mm (range)	No of patients	Percentage
270-280	3	15%
280-290	5	25%
290-300	6	30%
300-310	4	20%
310-315	2	10%

Table 2: Length of Peroneus Longus graft

The mean thickness of the Peroneus longus graft obtained in this study was 8.5 mm. The maximum thickness of the graft was 9.3 mm and minimum thickness was 7.6 mm. In 50% (10 cases) graft of 8 mm thickness was harvested.

Thickness of graft in mm(range)	No of patients	Percentage
7.6-8.0	3	15%
8.0-8.5	8	40%
8.5-9.0	6	30%
>9.0	3	15%

Table 3: Thickness of Peroneus Longus graft

Post operatively, knee joint stability was assessed using Lachman test and pivot shift test. The results in this study was assessed by IKDC criteria at the end of 3 months. According to the IKDC, 18 cases were rated as normal or nearly normal (90%) and 2 cases (10%) cases were rated as abnormal. The mean IKDC score was 99. There was no flexion or extension loss at the end of 3 months of follow up. In the evaluation of ankle ROM, author assessed MRC grading of flexion/extension, inversion/eversion, and rotation of ankle in the operated ankle and compared with opposite normal ankle. In the operated ankle, MRC grading of flexion /extension, inversion/ eversion, and rotation of ankle were grade 5. In this study author found that the ankle functions were grossly preserved in almost all the patients which was elucidated by grading the power of the muscles of the foot particularly the eversion movement on a scale of five and comparing it with the normal ankle.

IV. DISCUSSION

Knee joint stability is mainly contributed by ligaments around it, most importantly cruciate ligaments (anterior and posterior cruciate). Anterior cruciate ligament is usually injured during road traffic accident and sports activities, in which forceful valgus and external rotation movement of knee is the most common mechanism. Injury to ACL is now reconstructed arthroscopically using autografts and allografts. There are multiple graft options available like, bone-patellar tendon-bone complex, hamstring tendon autograft, and allografts. But controversy exists about the most suitable graft for ACL reconstruction.

The gold standard for ACL reconstruction is BPTB graft (Bone-patellar tendon-bone graft) because of its strength, consistency, size of the graft, ease of harvesting and most importantly because of bone to bone healing within the tibial and femoral tunnel. Complications of bone patella tendon bone graft include patellar tendon rupture,

patellar/tibial fracture, quadriceps weakness, loss of full extension, anterior knee pain, difficulty in kneeling and numbness due to injury to the infra-patellar branch of saphenous nerve. Hence it is to be avoided in patients whose occupation or lifestyle requires frequent kneeling.

The hamstring tendon grafts have greater mechanical strength than a bone-patellar tendon-bone graft. Patients treated with hamstring tendon grafts are less likely to suffer patella / femoral pain and extension loss. Using the hamstring tendon can cause a significant change in hamstring muscle strength. Hamstring function is very important after ACL reconstruction in order to protect the reconstructed ACL from anterior drawer force, which is exerted by quadriceps contraction.

The advantages of the allograft are shorter operation and anesthetic time and good cosmetic results, however high costs, less availability, disease transmission and immunological reaction have limited their use. The enthusiasm surrounding the introduction of synthetic graft materials stemmed from their lack of donor morbidity, their abundant supply and significant strength of these devices. Several artificial biomaterials are available like Carbon, Dacron, polyester and polypropylene etc. Disadvantages are early breakage and tendency to elongate (wear and tear), deposition of carbon, inflammatory synovitis, cross-infections, immunological responses, tunnel osteolysis, femoral and tibial fractures, foreign-body synovitis and knee osteoarthritis.

For these reasons we used the Peroneus Longus Tendon (PLT) in ACL reconstruction in patients. Peroneus longus is one of the main ankles evertors. So, one of the main concerns about Peroneus longus tendon is ankle instability. The highlight of this study is the donor ankle morbidity in whom Peroneus longus tendon is used for ACL reconstruction. Primary action of Peroneus longus is to plantar flex the first ray of foot, while plantar flexion and eversion of foot at ankle are the other actions. The primary concern of a donor ankle is the deficit of first ray plantar flexion while the patient is in the stance phase of gait. The other concern is the ankle instability.

In view of cosmetic concerns, the harvesting of a PLT graft conceals the tendon harvesting scar behind the lateral malleolus and also the scar around the tibial tunnel is significantly smaller. Hence it provides a cosmetic advantage to athletes who often need to have their legs exposed in their profession.

Biomechanically, Peroneus longus tendon is as strong as native ACL. The maximum tensile load of the native ACL is 1725N and the maximum tensile load of single strand Peroneus longus tendon in the study by Kerimoglu et al, was 1950N. The mean thickness of the graft obtained in this study was 8.5 mm which was way far satisfactory than the thickness obtained in most of the hamstring grafts. There was no extension or flexion loss in this patient. Furthermore, no patella or femoral pain was reported by the patients. The results of this study were better than that done by Kerimoglu et al, and Anghong et al, with better IKDC score. There was

no ankle dysfunction related to graft harvest, pressure pain could be elicited in only 2 patients. Cao also found the Peroneus longus a good substitute of anterior cruciate ligament reconstruction and its resection has no major influence for ankle joint.

The limitation of this study was that the MRC grading of muscle power was used for assessment of the ankle function. Newer devices such as arthrometers which measure ankle functions objectively were not used. The results are very encouraging, but long term follow up and large number of patients are needed further to conclude these results and observations.

V. CONCLUSION

This study concluded that peroneus longus is an appropriate autograft source for ACL reconstruction in view of ease of harvest, adequate size, cosmetically appealing, considering excellent post-operative knee scores. And removing the Peroneus longus tendon has no effect on gait parameters and does not lead to instability of the ankle. So, it can be used as an autogenous graft in orthopedic surgeries.

REFERENCES

- [1.] Miller SL, Gladstone JN. Graft selection in anterior cruciate ligament reconstruction. *Orthopedic Clin North Am.* 2002 Oct;33(4):675-83.
- [2.] Freeman JW, Kwansa AL. Recent advancements in ligament tissue engineering: the use of various techniques and materials for ACL repair. *Recent Patents Biomed Enginee.* 2008 Jan 1;1(1):18-23.
- [3.] Nazem K, Barzegar M, Hosseini A, Karimi M. Can we use peroneus longus in addition to hamstring tendons for anterior cruciate ligament reconstruction?. *Advan Biomed Res.* 2014;3.
- [4.] Zhao J, Huangfu X. The biomechanical and clinical application of using the anterior half of the peroneus longus tendon as an autograft source. *Am J Sports Med.* 2012 Mar;40(3):662-71.
- [5.] Kerimoğlu S, Aynaci O, Saraçoğlu M, Aydin H, Turhan AU. Anterior cruciate ligament reconstruction with the peroneus longus tendon. *Acta Orthopaedica Traumatologica Turcica.* 2008;42(1):38-43.
- [6.] Gohil S, Annear PO, Bredahl W. Anterior cruciate ligament reconstruction using autologous double hamstrings: a comparison of standard versus minimal debridement techniques using MRI to assess revascularisation: a randomised prospective study with a one-year follow-up. *J Bone Joint Surg.* 2007 Sep;89(9):1165-71.
- [7.] Pearsall IV AW, Hollis JM, Russell Jr GV, Scheer Z. A biomechanical comparison of three lower extremity tendons for ligamentous reconstruction about the knee. *Arthroscopy: J Arthroscop Related Surg.* 2003 Dec 1;19(10):1091-6.
- [8.] Coupens SD, Yates CK, Sheldon C, Ward C. Magnetic resonance imaging evaluation of the patellar tendon after use of its central one-third for anterior cruciate ligament reconstruction. *Am J Sports Med.* 1992 May;20(3):332-5.

- [9.] Tashiro T, Kurosawa H, Kawakami A, Hikita A, Fukui N. Influence of medial hamstring tendon harvest on knee flexor strength after anterior cruciate ligament reconstruction: a detailed evaluation with comparison of single-and double-tendon harvest. *Am J Sports Med.* 2003 Jul;31(4):521-9.
- [10.] Batty LM, Norsworthy CJ, Lash NJ, Wasiak J, Richmond AK, Feller JA. Synthetic devices for reconstructive surgery of the cruciate ligaments: a systematic review. *Arthroscopy: J Arthroscop Related Surg.* 2015 May 1;31(5):957-68.
- [11.] Kobayashi A, Higuchi H, Terauchi M, Kobayashi F, Kimura M, Takagishi K. Muscle performance after anterior cruciate ligament reconstruction. *Int Orthop.* 2004 Feb;28(1):48-51.
- [12.] Anghong C, Chernchujit B, Apivatgaroon A, Chaijenkit K, Nualon P, Suchao-In K. The anterior
- [13.] cruciate ligament reconstruction with the peroneus longus tendon: a biomechanical and clinical evaluation of the donor ankle morbidity. *J Med Assoc Thai.* 2015 Jun 1;98(6):555-60.
- [14.] 13. Shi FD, Hess DE, Zuo JZ, Liu SJ, Wang XC, Zhang Y, et al. Peroneus longus tendon autograft is a safe and effective alternative for anterior cruciate ligament reconstruction. *J Knee Surg.* 2019 Aug;32(08):804-11.
- [15.] 14. Cao HB, Liang J, Xin JY. Treatment of anterior cruciate ligament injury with peroneus longus tendon. *Zhonghua yi xue za zhi.* 2012 Sep;92(35):2460-2

ANNEXURE 1

IKDC subjective knee evaluation form

2000 IKDC SUBJECTIVE KNEE EVALUATION FORM

Name: **Date:**
First Last

Physician: **Date of Injury:**

SYMPTOMS*:

*Grade symptoms at the highest activity level at which you think you could function without significant symptoms, even if you are not actually performing activities at this level.

1.What is the highest level of activity that you can perform without significant knee pain?

- Very strenuous activities like jumping or pivoting as in basketball or soccer
- Strenuous activities like heavy physical work, skiing or tennis
- Moderate activities like moderate physical work, running or jogging
- Light activities like walking, housework or yard work
- Unable to perform any of the above activities due to knee pain

2.During the past 4 weeks, or since your injury, how often have you had pain?

- 0 1 2 3 4 5 6 7 8 9 10
 Never Constant

3.If you have pain, how severe is it?

- 0 1 2 3 4 5 6 7 8 9 10
 No pain Worst pain imaginable

4.During the past 4 weeks, or since your injury, how stiff or swollen was your knee?

- Not at all
- Mildly
- Moderately
- Very
- Extremely

5.What is the highest level of activity you can perform without significant swelling in your knee?

- Very strenuous activities like jumping or pivoting as in basketball or soccer
- Strenuous activities like heavy physical work, skiing or tennis
- Moderate activities like moderate physical work, running or jogging
- Light activities like walking, housework or yard work
- Unable to perform any of the above activities due to knee swelling

6.During the past 4 weeks, or since your injury, did your knee lock or catch?

- Yes No

7.What is the highest level of activity you can perform without significant giving way in your knee?

- Very strenuous activities like jumping or pivoting as in basketball or soccer
- Strenuous activities like heavy physical work, skiing or tennis
- Moderate activities like moderate physical work, running or jogging
- Light activities like walking, housework or yard work
- Unable to perform any of the above activities due to giving way of the knee

Page 2 – 2000 IKDC SUBJECTIVE KNEE EVALUATION FORM

SPORTS ACTIVITIES:

8.What is the highest level of activity you can participate in on a regular basis?

- Very strenuous activities like jumping or pivoting as in basketball or soccer
- Strenuous activities like heavy physical work, skiing or tennis
- Moderate activities like moderate physical work, running or jogging
- Light activities like walking, housework or yard work
- Unable to perform any of the above activities due to knee

9.How does your knee affect your ability to:

		Not difficult at all	Minimally difficult	Moderately Difficult	Extremely difficult	Unable to do
a.	Go up stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b.	Go down stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c.	Kneel on the front of your knee	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d.	Squat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e.	Sit with your knee bent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f.	Rise from a chair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g.	Run straight ahead	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h.	Jump and land on your involved leg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i.	Stop and start quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

FUNCTION:

10. How would you rate the function of your knee on a scale of 0 to 10 with 10 being normal, excellent function and 0 being the inability to perform any of your usual daily activities which may include sports?

FUNCTION PRIOR TO YOUR KNEE INJURY:

0 1 2 3 4 5 6 7 8 9 10

Couldn't perform No limitation in daily activities

CURRENT FUNCTION OF YOUR KNEE:

0 1 2 3 4 5 6 7 8 9 10

Cannot perform No limitation in daily activities

IKDC Score

Print Form

Submit