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## Functional outcome of arthroscopic reconstruction of chronic anterior cruciate ligament ruptures using single-bundle triple-weaved hamstring tendons in northern Nigeria

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### Abstract

Though anterior cruciate ligament (ACL) is the most commonly reconstructed ligament all over the world, its arthroscopic reconstruction was relatively less frequent in the West African sub region until recently. The patronage of the traditional bone setters in the acute phase of closed knee injuries has made Chronic ACL injury the main form of presentation with significant secondary injuries and degenerative changes from sub-optimal initial care. The aim of this study was to determine functional outcome and patient's satisfaction from Arthroscopic chronic ACL injury repair. Diagnoses were made using clinical parameters and MRI. Lysholm scores were determined preoperatively, and repeated with patient's satisfaction assessment (using the Likert scale) at 3, 6, 12, 24 and 48 months postoperatively. Arthroscopic single-bundle ACL repair using a triple-weaved hamstring tendon (s) was done for all the patients. Debridement and meniscectomy were done for various degrees of degenerative changes and irreparable meniscal injuries respectively. No one was dissatisfied and 91.4% of the patients had well to excellent Lysholm scores at 2 years of follow up. It was concluded that arthroscopic chronic ACL rupture reconstruction using single-bundle triple-weaved hamstring autografts with good rehabilitation offers good to excellent knee function and patients' satisfaction with minimal complications.

**Keywords:** Chronic ACL injury, Arthroscopic repair and outcome

### Introduction

The Anterior cruciate ligament (ACL) is an intracapsular, intrasynovial knee ligament that prevents anterior translation of the tibia<sup>[1, 2]</sup>. It is the most commonly reconstructed ligament in the knee<sup>[3]</sup>. Chronic injuries to this ligament result in knee instability, secondary menisci damage and subsequent osteoarthritis of the knee<sup>[4]</sup>. The goals of treatment of Chronic ACL rupture are to have a pain-free, freely mobile and stable knee joint<sup>[3]</sup>. To achieve these goals, nonoperative treatment is rarely successful especially when there is complete rupture and patient is unwilling to modify his or her active lifestyle<sup>[5]</sup>. Surgical approaches vary, and the decision to choose either open or arthroscopic approach resides with surgeon's preference and skills. Though, Late presentation is the order of the day in the West African sub-region, the patients prefer a more cosmetic procedure with excellent outcome.

Arthroscopic assisted ACL reconstruction is gaining popularity in our environment owing to its promising results of less postoperative pain, reduced morbidity, better surgical scar and better rehabilitation as compared to open technique<sup>[6, 7]</sup>. Various research works in advanced communities have reported good to excellent outcome using similar procedure<sup>[8, 9-12]</sup>, but there is paucity of data in this regard in our environment. The chronicity of ACL injuries in our environment has made it necessary to study the functional outcome and compare the findings to what is obtainable in places with relatively earlier hospital presentations. The aim of our study was to evaluate the functional outcome and patients' satisfaction of Arthroscopic Chronic ACL rupture reconstruction with single-bundle triple-weaved hamstring tendon autografts in Northern Nigeria.

### Methodology

This prospective interventional hospital-based study was conducted at the National Orthopaedic

Hospital, Dala, Kano, Nigeria, between January 2015 and December 2019 following approval from the Hospital Research Ethics Committee (HREC) of NOHD. The patients were recruited as they presented. The study excluded patients with: age less than 18 and more than 50yrs; partial ACL rupture; associated PCL rupture; bilateral ACL rupture; ACL ruptures with advanced tricompartmental OA; revision ACL reconstruction and ACL ruptures with associated tibia or femoral condylar fractures. Patients were recruited following clinical examination using Lachman's test, anterior drawer test and Lelli's test to determine knee instability. The range of knee motion was noted and compared with normal contralateral knee. Patients had magnetic resonance imaging (MRI) evaluations preoperatively. Preoperative Lysholm score was determined for all patients.

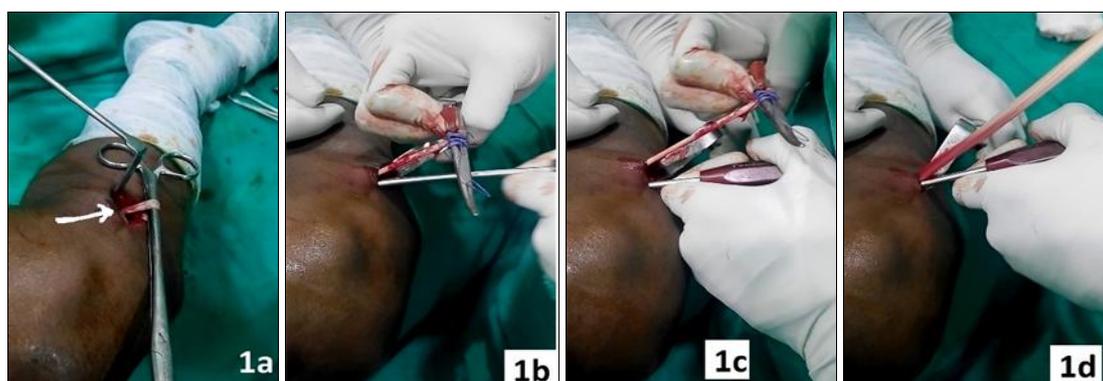
All surgeries were done in supine position, under spinal anesthesia and led by the same surgeon. Examination under anaesthesia (Lachman's test, anterior and posterior drawer tests, Lelli's test and Pivot shift) was done before a diagnostic arthroscopy (using standard anterolateral and anteromedial portals) was performed to confirm the ACL rupture and other likely pathologies. The grafts were harvested without inflating the pneumatic tourniquet already applied to the patient's mid-thigh (fig. 1a-d). The grafts were prepared and triple-weaved under tension (fig. 2a). The grafts were sized and the smaller ends were noted to be the lead-end into the femoral tunnel (fig. 2b-c). Debridement was done using a 4.5mm shaver blade as degenerative changes were often seen from the chronicity of the injuries as seen in fig. 3a-c. Partial meniscectomy was done when indicated (fig 4a-b). We did not repair any meniscus in our study as majority of our patients presented late and the tears were in avascular area.

The femoral tunnel was made using free hand anteromedial anatomic tunnel placement technique (from another anteromedial portal lower than the standard working anteromedial portal) while the tibial tunnel exited in the posteromedial portion of the ACL footprint (on the lateral surface of the medial spine) using the tibial jig positioned externally on the upper portion of the vertical wound used to

harvest the graft (fig 5a-b). The tibial tunnel was drilled through-and-through to the size of the thicker end of the graft, while for the femoral tunnel, only first drill using a 4mm drill bit was through-and-through to allow for shuttle sutures' passage. Subsequently, the femoral tunnel was drilled to the depth of 23 to 28mm depending on the length of the interference screw available to ensure press fit of the graft in the tunnel and prevent screws from cutting out the far cortex (fig. 5c). The graft was transported through the tunnels using shuttle sutures tied to the sutures pulling on the graft (fig. 6a-c).

All the patients had Arthroscopic ACL reconstruction using single-bundle triple-weaved semitendinosus graft (and Gracilis tendon when the semitendinosus tendon is not sufficient) fixed with biodegradable interference screws both at the femoral (intraarticular) and tibial ends (extraarticular). The graft was transported using polyester-5 suture and fixed using appropriate size biodegradable interference screws (mainly sizes 8 to 10mm by 23 or 28mm) by Karl Storz (fig. 7a-c). In the earlier part of the study, titanium screws were used in the first 3 cases, before the availability of the biodegradable screws. Patients left the suit on an adjustable hinged knee brace locked to allow only 0° to 30° of motion.

Isometric exercises were started as soon as the patient recovers from anaesthesia. Gradual increase in range of motion (30° increase every 2 weeks of the postoperative period), protected weight bearing in the first two weeks and partial to full weight-bearing as tolerated subsequently, and other adjunct physiotherapy for ACL rehabilitation were done. All patients were followed up at interval of 1.5, 3, 6, 12, 24 and 48 months at the surgical outpatient department. Bracing was stopped at 6-8 weeks of the postoperative period when the range of motion allowed by the knee brace (120°) would have been achieved. During the follow-up; clinical evaluation using Lachman's, anterior drawer and Lelli's tests was done. Lysholm scoring and patients' satisfaction (using Likert scale) were also done. Data were captured using Microsoft excel worksheet and analyzed using SPSS version 20.0 for windows.



**Fig 1a-d:** through a vertical incision, the semitendinosus was isolated and harvested.



**Fig 2a-c:** show a graft being triple-weaved, with its length and width determination.



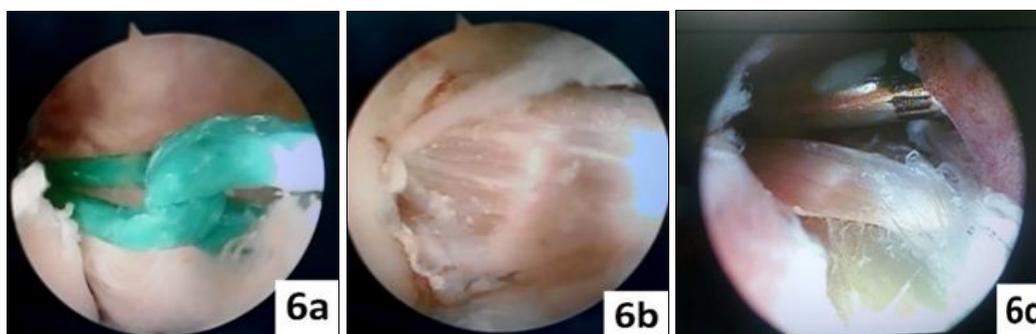
**Fig 3a-c:** (a)Ruptured ACL ( from scoping without tourniquet); (b)Degenerative changes commonly encountered in chronic ACL injuries; (c) debridement using 4.5mm arthroscopic shaver



**Fig 4:** (a) shows meniscal degeneration in the avascular zone been removed; (b) after partial meniscectomy.



**Fig 5:** shows (a)Femoral tunnel being drilled through the ACL foot print; (b)tibial jig mounted for tibial tunnel. (c) femoral tunnel not through-and-through in the diameter of the screw



**Fig 6:** (a) shows shuttle sutures interplay; (b) the graft in the femoral tunnel (c) guide wire placed above the graft in the femoral tunnel.



**Fig 7:** (a)Interference screw for the femoral end passing through the additional medial portal used in creating the femoral tunnel; (b)Tibial end screw being passed with the guide wire under the graft; (c)The reconstructed ACL after fixation.

**Results**

During the study period; a total of 42 patients had ACL repair but only 35 patients met the inclusion criteria and had complete data at 2 years of follow up. The mean age of our patients was  $34.7 \pm 6.8$  years. Table 1 below summarizes the

demographic characteristics of the patients. The 31 to 40 years age group (40%) were the most affected. The male to female ratio was 2: 1. More than half of our patients (54.3%) sustained their injury during amateur football games. Other cause of injury noted were landing on both feet from heights

during military and paramilitary trainings. Most of the patients 27 (77.1%) had initial traditional bone-setter's treatment before presenting to us. Only 10 (28.6%) of our patients had isolated ACL rupture; 18 (51.4%) patients had associated medial meniscal tear (mostly in the avascular zone); 6 (17.1%) patients had lateral meniscal and 1 (2.9%) patient had both lateral and medial meniscal tears. It was not clear if the meniscal tears were concurrently sustained with the ACL injury or were secondary injuries. None of studied patients presented earlier than 4 months after the injury; 19 (54.3%) of the patients presented within the period of 5-12 months. Others presented 2 to 7 years after injury. Ten (28.6%) of the patients were students; and 8 (22.9%) were civil servants. Others were military and paramilitary personnel, secondary school teachers and a trader (fig. 8). Preoperatively, all patients had positive Lachman (grade 4), anterior drawer and Lelli's tests. Pivot shift was done under anaesthesia to avoid inflicting pain on the patients. Pivot shift

was positive for all. The mean preoperative Lysholm score was  $41.7 \pm 20.1$ . Postoperatively, there was progressive increase postoperative Lysholm score with time (fig. 9). The mean score at 3, 6, 12 and 24 months postoperative were  $85.1 \pm 8.3$ ,  $92.3 \pm 4.9$ ,  $95.5 \pm 2.9$  and  $98.9 \pm 1.3$ . Table 2 compares the preoperative and postoperative Lysholm score grades of the patients and there was significant statistical difference ( $p < 0.001$ ) between the two scores even at 3 months of the postoperative period. One (2.9%) patient developed postoperative knee stiffness that resolved with physiotherapy, 1 (2.9%) patient had transient tourniquet palsy and 1 (2.9%) developed superficial surgical site infection (fig. 10).

At the last follow up of this study (2 years postoperative), 32 (91.4%) patients were at least satisfied with the outcome of the surgery using Likert scale (Figure 11). This was done by a third party who did not participate in the management of the patients.

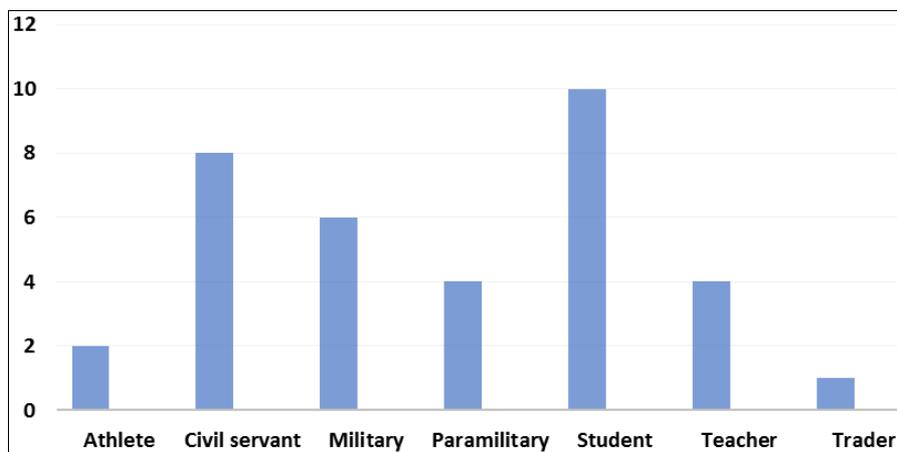


Fig 8: Patients' Occupation

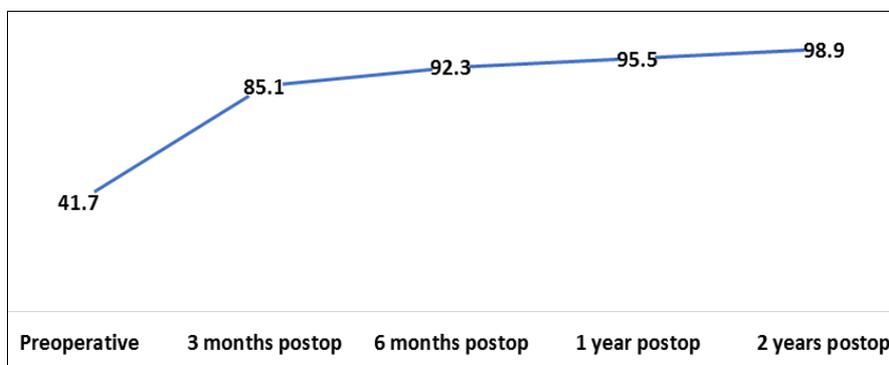


Fig 9: Progressive Postoperative Functional Improvements of the knee

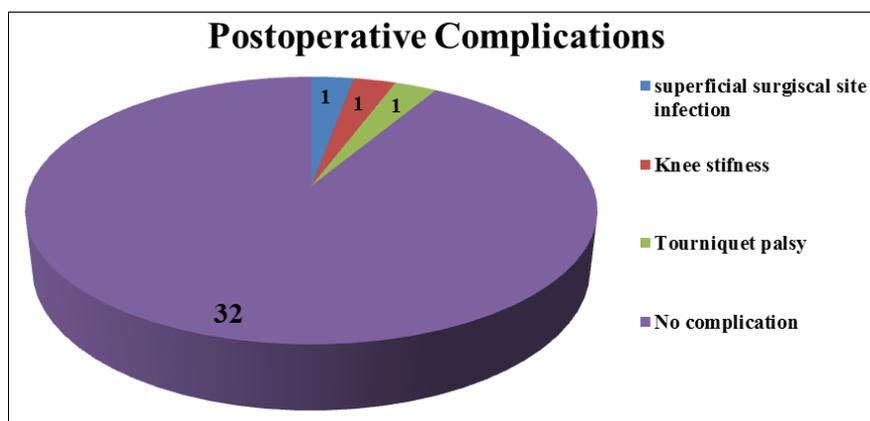


Fig 10: Postoperative Complications

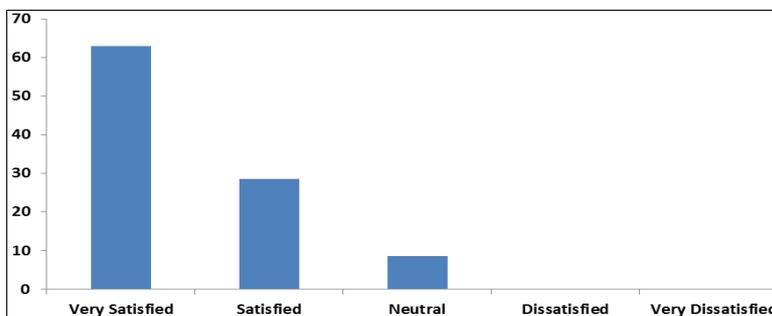


Fig 11: Patients' Satisfaction

Table 1: Demographic Characteristics of the patients

Age Distribution	Frequency	Percentage
18 – 30	13	37.1
31 – 40	14	40.0
41 – 50	8	22.9

Sex Distribution	No. of patients	Percentages
M	23	65.7
F	12	34.3

Mechanism of Injury	No. of patients	Percentages
Fall from height	2	5.7
Road traffic crash	6	17.1
Amateur Football	19	54.3
Slip& fall	1	2.9
Military/Paramilitary training	7	20

Initial Traditional Care	No. of patients	Percentage
Yes	27	77.1
No	8	22.9

Associated Injury	no. of patients	percentage
Medial meniscal	18	51.4
Lateral meniscal	6	17.1
Medial + Lateral	1	2.9
Nil	10	28.6

Duration before presentation	No. of patients	Percentage
< 6 months	6	17.1
7 – 12 months	19	54.3
12 – 24 months	4	11.4
24 – 36 months	3	8.6
> 36 months	3	8.6

Laterality	No. of patients	Percentage
Right	23	65.7
Left	12	34.3

**Discussion**

The outcome of the ACL reconstruction depends not so much on the type of graft, but on the technique of placing the graft in the correct position, the fixation of the graft, and the postoperative rehabilitation [13, 14]. Considering the proven minimal harvest-site morbidity and the main surgeon’s preference, the most common graft used in our hospital for arthroscopic reconstruction is the hamstring graft and this was used for all the patients in this study. Our graft sizes ranged between 8mm to 10mm in thickness for this study. Our

technique was however the same for all the patients as well as our rehabilitations. Over 90% of the patients achieved similar good to excellent outcome (Table 2).

The mean preoperative Lysholm score in this study was  $41.7 \pm 20.1$ . This was a poor grade for knee function. At 3 months postoperatively, this sharply rose to  $85.1 \pm 8.3$  which connotes a good knee function. By 6 postoperative months, the score has progressively risen to  $92.3 \pm 4.9$  which is an excellent knee function (figure 9). This is similar to the study by Umar *et al.* [7] who used BPB graft and reported mean preoperative Lysholm score of  $58.19 \pm 20.0$  and 6 months postoperative score of  $88.23 \pm 12.17$ . Other studies whose researchers have found similar results include Bhati *et al.* [15] and Chodavarapu *et al.* [16]

Our study utilized triple-weaved hamstring graft but Bhati and colleagues, and Chodavarapu *et al* used quadruple-weaved semitendinosus and gracilis grafts with similar outcomes [15, 16]. Other studies have used horizontal hamstring grafts and some have compared it with patella tendon graft. All have shown similar good to excellent outcomes [17-19]. This may further emphasize the fact that the outcome of reconstruction does not significantly depend on the graft option but on the technique and adequacy of the rehabilitation postoperatively.

The complications encountered in our study included a transient tourniquet palsy in one (2.9%) patient. Attempts at addressing all the degenerative changes in his knee prolonged the use on pneumatic tourniquet on him to 3 hours against our usual duration of 1.5 to 2 hours. This was sciatic neuropraxia which was managed with medication and physiotherapy. By the end of second postoperative week, the patient had recovered completely from the neuropraxia. Another patient (2.9%) had knee stiffness with  $0^\circ$  to  $95^\circ$  knee range of motions at 3 months postoperatively due to lack of regular physiotherapy in his state of residence outside Kano. He was however not dissatisfied as the knee was painless and stable. He was followed up at physiotherapy clinic and subsequently regained full range of motion at 12 months of his postoperative period. The last patient (2.9%) had superficial surgical site infection at 2nd to the 3rd week of the postoperative period at the graft harvest point. It resolved with antibiotics. There was no any graft failure at the last follow-up (2 years post-operative period) as documented by some authors [7, 15, 20]. Our study also evaluated patients reported outcome using Likert scale and found that 32 (91.4%) of the patients were at least satisfied with the outcome of the surgery and none was dissatisfied. So far, there has been no case of revision.

Table 2: Comparing preoperative and postoperative Lysholm scores

Lysholm Score:	Pre-op.	6-months post-op.	1-yr post-op.	2-yrs post-op.
Mean score $\pm$ S.D:	$41.7 \pm 20.1$	$92.3 \pm 4.9$	$95.5 \pm 2.9$	$98.9 \pm 1.3$
Grade:	Poor	Excellent	Excellent	Excellent

**Conclusion**

Arthroscopic Chronic Anterior cruciate ligament rupture reconstruction using single-bundle triple-weaved hamstring autografts with good rehabilitation offers good to excellent knee function and patients' satisfaction with minimal complications.

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**Conflict of interest:** None to declare

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