



Original Article

ACL femoral avulsion repair using suture pull-out technique: A case series of thirteen patients

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ABSTRACT

Purpose: Anterior cruciate ligament (ACL) repair was first described in the mid 1900's. However, due to poorly selected patients led to unsatisfactory early results. We aim to study the outcome of ACL repair in a carefully selected cohort.

Methods: Thirteen consecutive patients of acute Type 1 (proximal ACL avulsion) were treated with arthroscopic ACL repair using a suture pull out technique. At the latest follow-up the patients were evaluated for Lysholm score, KT-1000 measurement and clinical assessment for any laxity.

Results: At a mean follow-up of 31.3 months, none of the patients had any subjective laxity. The mean Lysholm score was 95 and instrumented laxity measurement did not reveal any significant laxity compared to the opposite knee.

Conclusion: The proximal ACL avulsion has healing potential similar to proximal MCL injuries. Performing microfracture of the lateral wall of the notch optimizes the healing environment by negating the effects of the synovial fluid. Performing ACL repair in a carefully selected patient leads to good short term results and saves the patient of a reconstruction procedure, at least in the immediate future.

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Introduction

The earliest mention of anterior cruciate ligament (ACL) repair may be found in the works of Palmer and Campbell.^{1,2} It was however in the mid 1900's that this technique gained further interest in the works of O'Donoghue et al., Feagin & Curl and Marshall et al.^{3–5} With inconsistent mid term results in spite of initial promising results put these techniques to disregard.⁶ It was the study of Sherman et al. that classified the ACL tear type and showed promising results of ACL repair in carefully selected cases (Type 1, proximal avulsion tears).⁷ Availability of better quality MRI now ensures preoperative diagnosis of such cases allowing a better selection of patients, leading to reduced need of further reconstructions.⁸

We present the outcome of 13 patients of ACL femoral avulsion presenting in the acute stage treated with ACL repair using a suture pull-out technique.

Methods

In this Level IV study, we performed a prospective analysis of outcome in 13 consecutive patients of ACL femoral avulsion presenting to us in the acute stage (<2 weeks since injury) between January 2014 to June 2015. Only those patients were enrolled for this study whose MRI suggested a Type I tear (Fig. 1) as per Sherman Classification,⁹ and which was later confirmed on arthroscopy. A well informed consent was taken from each patient for the procedure and for inclusion in the study as well. Since ACL repair is not a new technique, we did not require any clearance from the ethical committee. All patients were evaluated for Lachman & Pivot shift prior to taking up for surgery and were counselled regarding the possible need of ACL reconstruction in case the tissue quality was found poor intra-operatively. Patients with associated arthritis and multiligament injury were excluded from the study. There was no age or sex restriction.

Operative technique

All patients were operated by the same lead surgeon in the supine position with the leg placed in 90° flexion on the table.

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Fig. 1. Pre-operative MRI showing avulsion of ACL from the femoral attachment with the substance remaining intact.

Standard anterolateral and anteromedial portals were created for diagnostic arthroscopy and the ACL femoral avulsion confirmed (Fig. 2), chondral changes and meniscus tear were assessed. On confirmation of the diagnosis a trans-patellar tendon portal was established and a cannula placed. Two differently coloured number 2 non-absorbable high strength sutures were passed through the two bundles of the remnant ACL using a Lasso hook (Fig. 3). At least 2–3 pass were made before the final exit towards the avulsed end. A locking Bunnell type pattern was created at the avulsed end. The sutures were docked in the trans-patellar tendon portal.

Once the ACL remnant was prepared, the femoral foot print was identified using the bony landmarks. The ACL bed was prepared



Fig. 2. Arthroscopic picture confirming femoral avulsion of ACL.

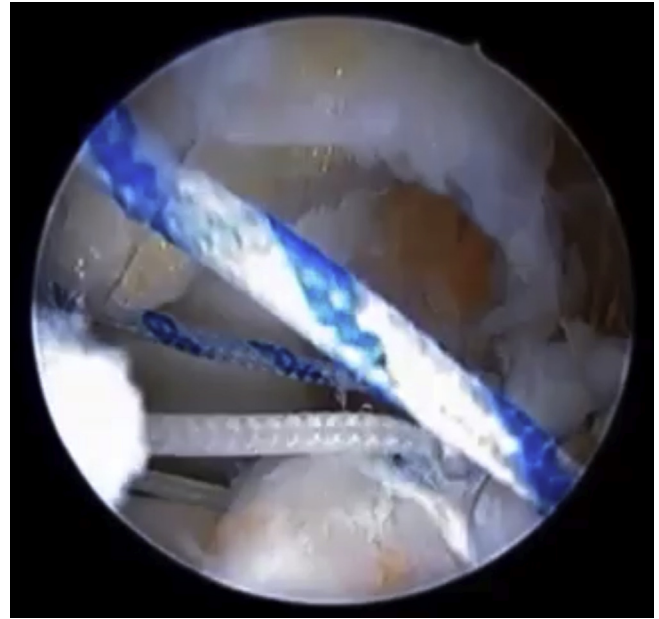


Fig. 3. Two differently coloured high strength sutures passed through the two bundles of ACL.

using a shaver and micro-fracture awl to create multiple micro-fractures around the ACL foot print in order to release stem cells which would enhance the healing process. A 2.4 mm guide wire was passed through the foot print from the AM portal with the knee in about 100–110° of flexion, and over reamed with a 7 mm reamer from outside in. We preferred reaming from outside in to prevent any damage to the remnant ACL tissue by the reamer. A stainless steel wire loop was passed which was used to shuttle the ACL stump suture out from the femoral tunnel (Fig. 4). The 7 mm tunnel was created to allow a few fibres of the ACL to enter the tunnel and allow better healing than would have been achieved by surface healing. The sutures were then tied on the lateral femoral cortex on

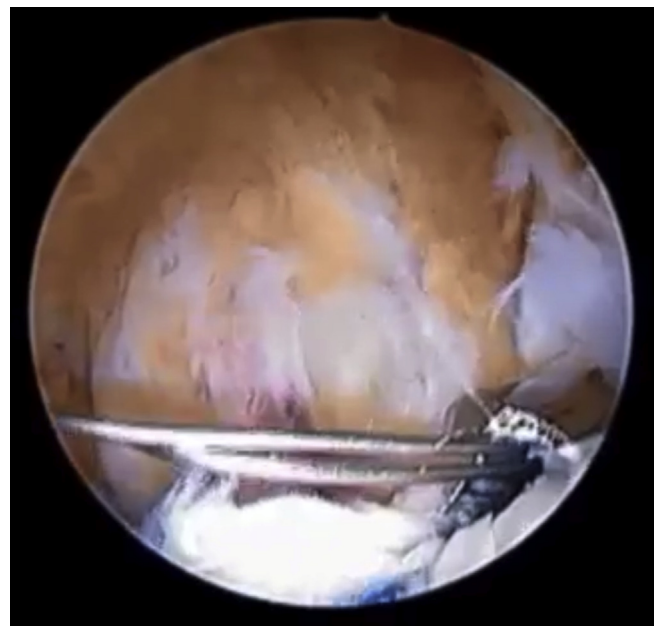


Fig. 4. Stainless steel wire loop passed through the femoral tunnel to shuttle the sutures.

a suture disc with the knee in 30° flexion. Final tension of the ACL rechecked using a probe (Fig. 5) as well as confirmed by a negative lachman on table (Fig. 6).

Post-operative rehabilitation

The patients were put in a brace for 3–4 weeks along with intermittent ice packs in order to control swelling and pain. Full weight bearing was allowed as per pain tolerance and range of motion up to 90° in the first month. Active quadriceps exercises were advised. Sutures were removed at 2 weeks post-operatively. At 4–6 weeks post operatively the brace was weaned and the patients put on standard ACL rehabilitation protocol with the aim of return to sports at 6 months.

All patients were followed up at 3 months, 6 months, 12 months and 24 months. At each follow-up we obtained a KT 1000 reading along with Lysholm score.

Results

All our patients were male between 21 and 40 years of age (mean: 31.3 years). The interval between injury and surgery was

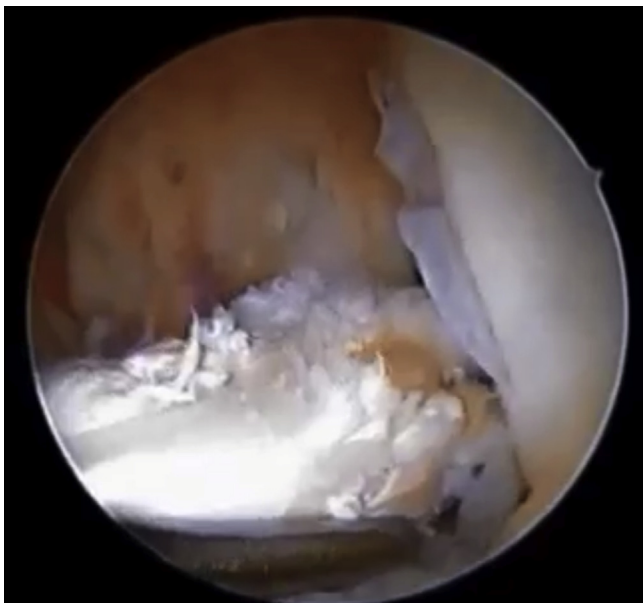


Fig. 5. Probing the repaired ligament to check for final tautness.



Fig. 6. Post-operative radiograph showing position of tunnel and implant.

3–12 days (mean: 7.6 days). Six had injured their knee in a game of football, five while dancing and another two due to fall on stairs. The follow-up ranged from 26 to 38 months (mean: 31.3 months) and none were lost to follow up. Three patients had associated meniscus tear and one had an associated grade 1 medial collateral ligament (MCL) injury which was managed conservatively. None of the patients reported any re-injury between the surgery and latest follow-up.

At the latest follow-up pivot shift was negative in all patients. Two had grade one lachman, while none complained of any subjective laxity. The Lysholm score at latest follow-up ranged between 94 and 96 (mean: 95). The mean difference on KT-1000 compared to the opposite side was less than 3 mm in all our patients (Table 1).

There were no complication in any of the patients and no one required any additional surgical intervention.

Discussion

All our patients with proximal avulsion tears and good tissue quality achieved stability on instrumented laxity and excellent subjective outcome post ACL repair on mean follow-up of 31.3 months. Although primary repair is not a new concept, there are not many takers of this technique citing the poor outcomes in previous literature. Authors opined that the arthroscopic repair may reduce the need for later reconstructions, thus cutting down on cost and patient morbidity, if it produced good long term results.⁸

Sherman and Bonamo¹⁰ suggested against absolute condemnation of Feagin & Curls⁴ results. They asserted that many authors along with Feagin & Curl did not control for factors such as type of tear and quality of tissue which could have affected the outcome.

Analysing previous data it can be argued that selection of the tear pattern rather than the technique was responsible for the high failure rates. Summarising multiple studies show that about half to two-third patients had satisfactory outcomes.^{7,8,11,12} Murray et al. in a recent porcine study demonstrated reduced rates of osteoarthritis following primary repair as against reconstruction.¹³

Healing pattern of proximal ACL avulsion resembling that of proximal MCL has been demonstrated in histologic and immunohistochemical studies. Also, primary repair opposes the stump to the bleeding bone bed at the femoral foot print optimising the healing potential and minimising the negative effects of the synovial fluid environment.⁹ The microfractures and reaming of the femur in our series further exposed the stump to stem cells, thus further enhancing the healing potential.

Another point of consideration is the interval since injury. O'Donoghue et al. demonstrated in a dog model that resorption of

Table 1
Follow-up data of 13 cases of ACL repair using suture pull out technique.

Case	Age (years)	Follow-up (months)	Time since injury (days)	KT- 1000			Lysholm score (0–100)	
				Involved (mm)	Un-involved (mm)	MMD (mm)	Pre-operation	Follow-up
1	21	26	3	18	19	1	42	95
2	32	29	6	13	11	2	47	96
3	28	31	11	15	14	1	36	96
4	40	35	12	18	15	3	32	94
5	33	38	9	14	12	2	35	94
6	23	27	4	15	13	2	37	95
7	23	33	7	18	17	1	30	96
8	37	37	9	19	18	1	36	96
9	35	29	10	13	12	1	35	94
10	22	30	5	13	10	3	30	94
11	40	34	11	17	15	2	32	96
12	32	28	8	16	15	1	42	95
13	34	31	5	17	15	2	30	94

the avulsed stump occurs as early as 2 weeks compromising the results of repair.³ It is thus imperative to repair in the acute stage. Also, using two fibre wires in the two bundles separately in our study ensured maximal purchase of the ACL fibres and a stronger repair.

In conclusion, ACL repair preserves the native ACL, achieving short term good results in a carefully selected patient group with proximal avulsion.

Limitations

Our sample size is small as we purposefully selected only type 1 tears. Also we do not have a comparative study to compare the results of acute repair with that of reconstruction. Credibility is added to our study as all 13 consecutive patients were operated by the same lead surgeon, removing any surgeon bias. No patients were lost to follow up in this series. We however, do not have any follow-up MRI or repeat arthroscopy to ascertain the healing status at the repair site. The follow-up is also a short term one and the maximum follow-up was 38 months. A longer term follow-up is needed.

Ethical clearance

ACL repair is not a new technique; hence no ethical committee clearance was required for this study.

Conflict of interest

The Authors have no conflict of interest. There are no financial disclosures to make.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.cjtee.2018.07.001>.

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