Anterior Cruciate Ligament Reconstruction by Press Fit Technique

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Abstract

Background: The anterior cruciate ligament (ACL) is considered as critical to the normal functioning of the knee. The choice of whether to operate or not is multifactorial and is highly dependent on patient's degree of symptoms and requirements in terms of activity level and participation in pivoting sports. The decision regarding graft choice and its fixation remains one of the most controversial. The graft could be autograft, allograft, or synthetic. There is much literature about differing methods used ACL reconstruction. Much of this is of poor quality and of a low evidence base. **Patients and Methods:** From October 2017 to October 2020, a prospective cohort study was undertaken to assess knee stability after ACL reconstruction using press fit technique for HT graft fixation. 40 patients with completely torn ACL were operated upon by one surgeon, the graft was fixed using press fit bone plug technique. **Results:** The study showed that press fit technique is the least technique with bone defects post reconstruction. All bones harvested during tunnel formation are reapplied into the tunnel. This in turn has many advantageous consequences; First, this facilitate better rehabilitation and faster recovery from the reported osteopenic changes that takes place in the proximal tibia and the distal femur post injury and post reconstruction. Second, in cases of re-rupture or revision, single-staged procedures are possible with decreased costs and faster functional recovery. **Conclusion:** The press fit technique results are promising subjectively, and instrumentally. Press fit technique avoids the tunnel dilatation post -operative unlike the screws that causes tunnel dilatation.

Key Words: Anterior Cruciate Ligament - Press Fit Technique - Hamstrings Tendons.

DOI Number: 10.14704/NQ.2022.20.12.NQ77118 **NeuroQuantology 2022; 20(11): 1393-1403**

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Relevant conflicts of interest/financial disclosures:
The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Introduction

It is one of the most frequently injured ligaments in the human body, commonly torn following twisting injuries. Its rupture affects knee stability, which may cause giving way symptoms, increased risk of meniscal injuries, and early onset of joint degeneration [1, 2].

The choice of whether to operate or not is multifactorial and is highly dependent on patient's degree of symptoms and requirements in terms of activity level and participation in pivoting sports [3].

ACL reconstruction can be performed using a variety of different surgical techniques as well as different graft materials and method of fixation [4].

The original graft-fixation devices were staples, screw -and- washer posts, and sutures tied directly to bone. The most common complication of using these devices was pain over any prominent hardware. More serious were early fixation failures, fractures secondary to a stress riser at the fixation-device site, and damage to surrounding soft tissue structures [5].

Complications associated with this surgery occur in 1.8% to 24% of the procedures, which include joint stiffness, patellar fracture, infection, hardware failure, graft failure, wound complications, deep vein thrombosis and periarticular fractures [6].

AIM OF THE WORK

To evaluate the knee stability, clinical outcome after ACL reconstruction using "femoral and tibial press fit" technique for fixation.

PATIENTS AND METHODS

From October 2017 to October 2020, a prospective cohort study was undertaken to assess knee stability after ACL reconstruction using press fit technique for HT graft fixation. 40 patients with completely torn ACL were operated upon by one surgeon, the graft was fixed using press fit bone plug technique.

- Patient's inclusion criteria:

Active patients, Patients experiencing instability with activities of daily life, Adult patients (18-50) years old and males and females

Subjective evaluation:

Two scoring systems were used to evaluate the patients preoperatively and postoperatively, the IKDC system and Lysholm scoring systems.

- The IKDC scoring system:

IKDC Subjective Knee Form is gaining recognition in the literature. The instrument contains 18 selected items designed to measure symptoms assess pain, stiffness, swelling, joint locking, and joint instability, while other items designed to measure knee function assess the ability to perform activities of daily living. Items purported to measure activity levels assess the respondent's ability to run, jump and land, stop and start quickly, ascend and descend stairs, stand, kneel on the front of the knee, squat, sit with the knee bent, and rise from a chair.

Lysholm scoring: Tegner-Lysholm Knee scoring was also made to assess the patient and compare his preoperative status with his postoperative status.

Surgical Technique, as paragraph:

Preoperatively: All patients are admitted in the hospital at the same day of operation with full preoperative laboratory tests are ready.

Medications: All patients received one gram of 2nd generation cephalosporin antibiotic through intravenous route before tourniquet and 30 minutes just before anesthesia.

Intraoperative:

Anesthesia: 36 (90%) patients had spinal anesthesia and 4 (10%) patients had general anesthesia due to different causes (failed spinal, previous spinal surgeries, patient refusal of spinal anesthesia).

Position: All patients are in supine position with the affected leg flexed on the side of the table and the other leg was well padded and positioned in extension on the table, the arthroscopic tower on the other side of the operated side.

Examination under anesthesia: All patients were examined under anesthesia for passive ROM and ligamentous testing, Pivot, Lachman, ADT, PDT and stress varus valgus tests, to confirm the diagnosis.

Tourniquet: Applied to the upper thigh after well padding of the thigh and inflated after exsanguinations of the limb and recording the time,

and ensure that the tourniquet will not be in the way of our wires on the lateral aspects of the thigh.

Arthroscopic assessment: Routine arthroscopic assessment done first to confirm the diagnosis of ACL tear and to detect any associated meniscal or cartilage pathology.

Notch preparation, **Fig (1 a, b):**

Through the anteromedial portal proper preparation was performed as a routine for all cases to allow visualization of the femoral attachment site and avoid impingement of ACL graft.

During notch preparation the knee is flexed 60-90º to allow anterior notch work, and at 120 º to allow posterior notch work.

The intercondylar notch was exposed by first resecting the ligamentum mucosum, next a full radius motorized shaver blade was used to resect the fat pad until the intercondylar notch and tibial remnant of the ACL were adequately visualized, the notch size and configuration was studied.

Once adequate visualization of the intercondylar notch was obtained the ACL remnant was resected with full radius motorized shaver, only a small stump at the tibial attachment site was left.

Soft tissue from the roof of the notch and the inner margin of the lateral femoral condyle was removed with full radius blade of the motorized shaver.

The soft tissue was removed from the inner margin of the lateral femoral condyle all the way back to the posterior border of the medial wall of the lateral femoral condyle.

- Tendon Graft harvesting, Fig. (2):

The leg is externally rotated and flexed in a figure 2 position. The skin was incised 3-4 cm oblique, at the top of pes anserinus, which is 2 cm distally and 3 cm medially to the tibial tuberosity.

Sharp dissection was carried out down until layer (1) the Sartorius fascia was visualized; the subcutaneous fat was dissected bluntly off layer 1 with a sponge and scissors.

The most superficial layer of pes anserinus, the thin fascia of the Sartorius muscle layer was opened in line with the skin incision at the top of gracilis tendon.

The gracilis and semitendinosus tendons were identified by palpation, blunt dissection was used to sweep the thin filmy fascia between layer 1 and 2 away, the gracilis and the semitendinosus were found on the underside of layer.

A right-angled clamp was placed deep to the Sartorius and posterior to the semitendinosus tendon to deliver it into the wound.

The tendon was further liberated using two right angled clamps.

All connections between the 2 tendons and surrounding soft tissues should be carefully released before any trial to strip the tendons to avoid any premature amputation of the graft.

The tendon was pulled as far as possible out of the wound and tendon stripper (open or closed) was attached to the tendon proximally to all tendon slips to avoid premature amputation by the stripper.

Traction was applied to the tendon and with slowly oscillating (back and forth) motion the tendon stripper was advanced and the tendon was transected.

The gracilis tendon was harvested by the same manner. While the 2 tendons were still attached to their tibial insertion, any excess muscular tissues were removed facial bands and tendinuous connections. Cut of the graft form its tibial attachment with a sleeve of periosteum.

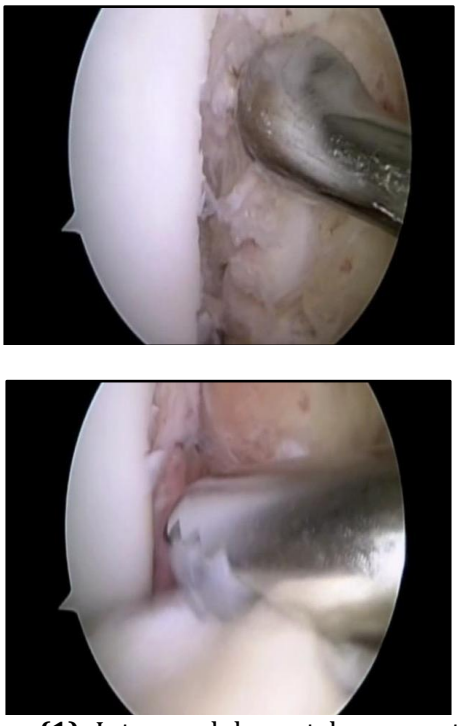

Figure (1): Intercondylar notch preparation.

Figure (2): Tendon graft harvesting.

▪ Harvesting tibial bone plug, **Fig. (3 a, b, c, d):**

1. Through same incision for hamstring harvesting was also used for harvesting a plug from the proximal tibia.
2. After reaming, the extractor was used to extract it and push it out of the extractor by a push rod.

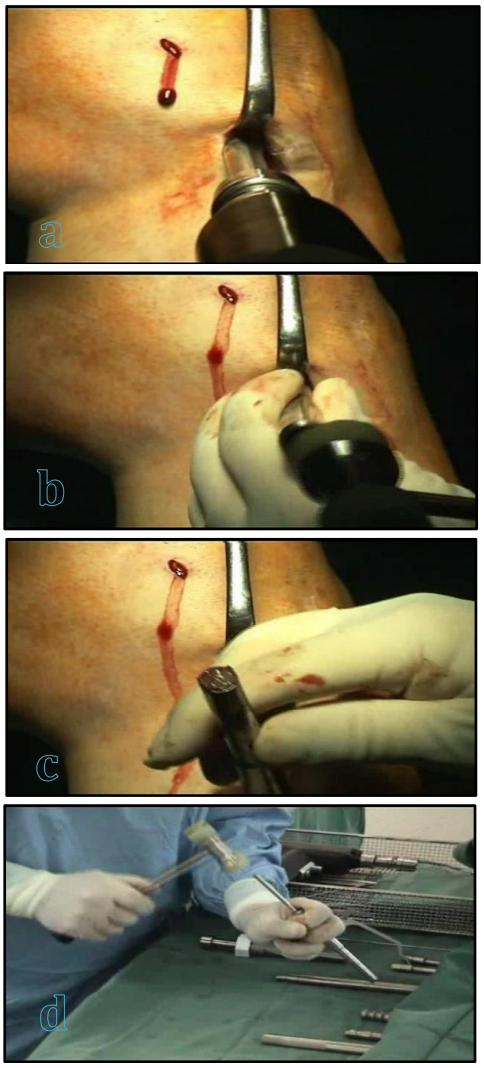

Figure (3): Tibial bone plug harvesting.

▪ Preparation of the graft, **Fig. (4 a, b):**

The graft was folded over NO.5 ethibond suture with 2 equal halves. With No 2/0 vicryl suture a mark put at 15 mm from the proximal (femoral) end of the graft (the minimum distance that should be in the femoral tunnel) and another suture mark at 30 mm from the first suture mark. The both distal ends of the graft are grasped by 2 clamps and separated, the enclose the first plug. The two distal ends of the graft are sutured together around the bone plug by 2 sutures were taken, one just proximal and one just distal to the bone plug, this left two bony windows in which the bone plug was not covered by the two slips of the tendon ends. This was crucial to allow bone to- bone healing afterwards. A trans-osseous suture was taken through the graft and the bone to secure the plug-in place and prevent its slippage during impaction into the tibial tunnel. The excess graft substance distal to the distal suture was removed. Sizing of the graft to determine the diameter of the tibial tunnel.

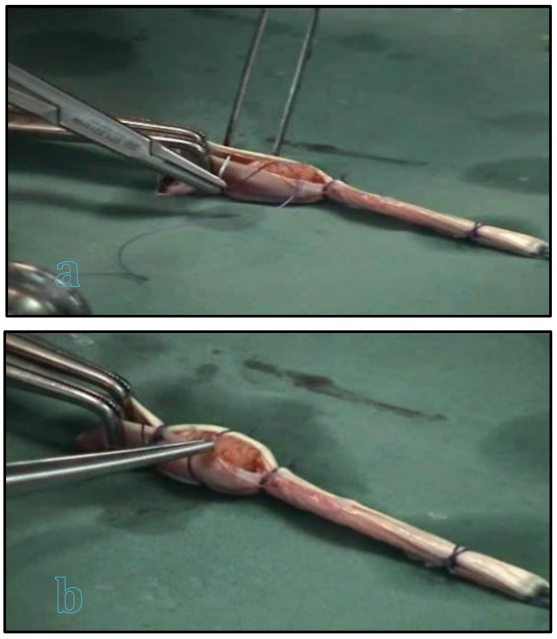

Figure (4): Graft preparation.

▪ Femoral tunnel preparation, **Fig. (5 a, b, c):**

1. Arthroscopically, the femoral target device was inserted through our medial working portal and the knee was then hyper-flexed (120º).
2. A reamer (SDI) was inserted through the target device to ream the femoral tunnel ensuring a 3-mm posterior bony wall.
3. The diameter of the reamer depends on the graft diameter (e.g., an 8- mm reamer used for an 8-mm diameter of tendon graft).

4. The length of the femoral tunnel should be approximately 30 mm avoiding drilling the far cortex of the femur.
5. The femoral target device ensured anatomical positioning of the tunnel guided as well with the resident ridge at the medial wall of the lateral femoral condyle (deeper and lower than the resident ridge) to ensure an anatomical single femoral tunnel position.
6. The reamer and the femoral guide were removed from the portal, and the bone extractor was inserted to remove the bony cylinder (femoral bone plug) after checking the integrity of the posterior wall of the tunnel.
7. The bone cylinder was taken out of the extractor and kept soaked in saline.

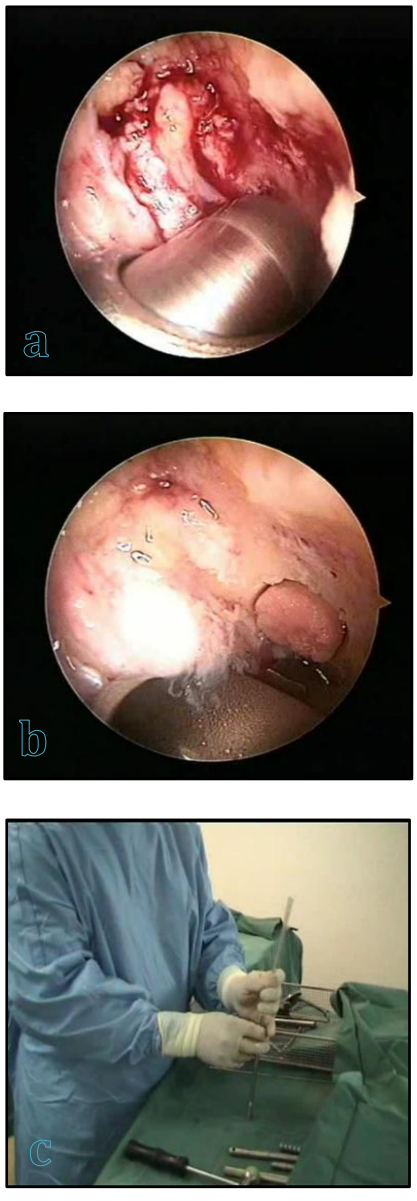

Figure (5): Femoral tunnel preparation.

- Tibial tunnel preparation, **Fig (6 a, b, c):**

1. While the knee in 90 flexion, a C- guide for the tibial tunnel was applied through the anteromedial portal
2. The tip of the tibial C-guide was put at the middle third of the native ACL tibial attachment under arthroscopic view.
3. 8 or 9 mm diameter tibial reamer (depending on the graft diameter) was inserted on the guiding device.
4. After the bone cylinder was completely drilled out the reamer and the guiding device were removed.
5. The bone cylinder was removed from the reamer by a pusher and kept soaked in saline.
6. The distal part of the tibial tunnel was over dilated using a conical trephine drill to enlarge the diameter of the tunnel distally up to 12 mm, distal to the articular surface of the tibial plateau to obtain a funnel-shaped tibial tunnel, **Fig. (7).**

Figure (6): Tibial Tunnel Preparation.

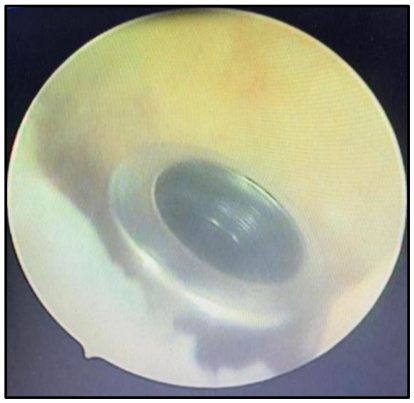

Figure (7): Shows conical dilatation of distal part of tibial tunnel.

- Graft passage, **Fig. (8a, b, c):**

1. By using an eyed guide pine loaded with the sutures connected to the femoral end of the graft, the wire passed from the tibial tunnel to the femoral tunnel out the lateral femoral cortex and the skin.
2. Pulling out the guide wire from the lateral femoral side until the sutures appear out of the skin, pulling out the sutures while the knee in hyper-flexion.
3. After passage of the first parts of the graft inside the femoral tunnel, the distal stump of the graft in which our bone plug is incorporated press-fitted into the funnel shaped tibial tunnel.
4. While maintaining the pull on our graft, the tendon-bone plug composite is further pushed into the tunnel using a push rod and a hammer to ensure a press-fit distal fixation together with the desired near to surface tibial fixation.
5. The bony cylinder extracted from the femoral tunnel is now divided in two pieces and each piece is placed inside the applicator.
6. Now, with the knee still in hyper-flexion, introduce the applicator inside the knee from the medial portal and push the bone plug into the tunnel above the tendon graft.
7. We have now a bone plug of a certain diameter together with the tendon graft of the same diameter inside our femoral tunnel of an equal diameter. Thus, the tendon flattens as the plug is introduced in a press-fit manner taking a crescentic semilunar shape with 2 bundles orientation with complete bundle continuity rather than a separate 2 bundles orientation.

- Closure, **Fig. (9 a, b):**

The excess of bone cylinders is impacted by a pusher at the tibial donor site at the proximal tibia to close this bony defect, and continue closure.

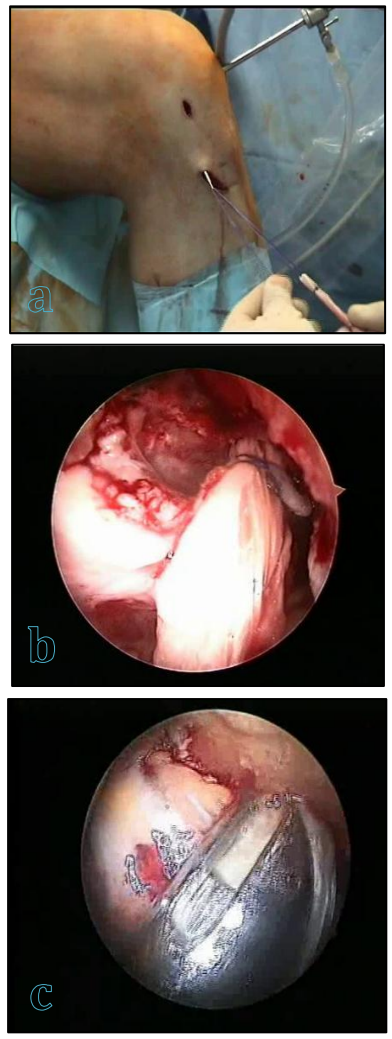

Figure (8): Grafts passage using press fit fixation.

Figure (9): Closure of tibial donor site.

- **Post-operative Rehabilitation Program:**

Rehabilitation for Patients Following ACL Reconstruction: A Knee Symmetry Model

This clinical commentary outlines a new clinical model for anterior cruciate ligament (ACL) rehabilitation, the Knee Symmetry Model. This model has been developed by clinical observation, patient interaction, and by analyzing outcome measures derived from prospective follow-up of patients. More specifically, the best outcome scores occurred in patients with symmetric range of motion and strength (160).

Statistical methods:

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 26 (IBM Corp., Armonk, NY, USA). Data was summarized using mean and standard deviation for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparisons between values measured pre and post were done using paired t test. For comparing categorical data, Chi square (χ^2) test was performed. Exact test was used instead when the expected frequency is less than 5. P-values less than 0.05 were considered as statistically significant.

Results

Subjective evaluation:

IKDC score questionnaire for all patients done and recorded pre-operatively for all patients and the mean of pre-operative IKDC for was 52.92 ranged from 34.50 to 71 (SD 8.67).

Subjective IKDC results are graded as very good, good, fair a bad results as follows: (A) Very good results > 90 %, (B)- Good results 76-89% (C) Fair results 50-75 and (D)- Bad results <50%.

There are significant statistical differences between the pre-operative IKDC and post-operative IKDC as the P-value in was < 0.001 which indicate high improvement after ACL reconstruction.

After using student's t- test and calculation of the P- value to compare the pre and post-operative IKDC it was <0.001 that mean highly significant results after the ACL reconstruction.

I. Lysholm results:

Lysholm score questionnaire for all patients done and recorded accordingly in every follow up visit and we take the last score reading at 6 months.

Subjective Lysholm results are distributed as very good, good, fair a bad results as follows: (A) Very good results > 90 %, (B)- Good results 76-89% (C) Fair results 50-75 and (D)- Bad results <50%. 82.5% of the results are very good to good results.

After using student's t- test and calculation of the P-value to compare the pre and post Lysholm score it was <0.001, that mean highly significant results after the ACL reconstruction.

Objective assessment:

I. Post-operative ROM deficit:

The ROM of the knee is measured using goniometer for extension and flexion graded as A, B, C and D, the difference between flexion and extension measured and also graded as (A, B, C and D). The ROM deficit is considered as the worst results of both flexion and extension. (if the patient score A in extension and B in flexion the ROM deficit considered as B (the worst).

We found 97.5% (39 patients) normal to nearly normal results, 2.5% (one patient) with abnormal results and no severely abnormal results

After using Chi-Square Test and calculation of the P-value to compare the pre and post operative, it was less than 0.001.

II. Post-operative effusion:

After clinical examination at 6 months post-operative the effusion is graded as A normal, B nearly normal, C abnormal and D severely abnormal, the results were as follows:

We found 97.5% normal to nearly normal and 2.5 % (one patient) with abnormal results.

After using Chi-Square Test and calculation of the P-value to compare the pre and post operative, it was less than 0.001. Post- operative clinical ACL specific testing were done using the main 3 clinical reliable tests:

- Lachman test
- Anterior drawer test (ADT)
- Pivot-shift test

And also graded as A (Normal), B (Nearly normal), C (Abnormal) and D (Highly abnormal).

III. Post-operative LACHMAN TEST:

Lachman test done at 6 months after surgery and graded as (A) 1-2 mm translation (Normal), (B) 3-5 m translation (Nearly normal), (C) 6-10 mm translation (Abnormal) and (D) more than 10mm

translation (Highly abnormal)., and the results were as follows:

We found 100% normal to nearly normal and 0% (no patient) with abnormal result.

After using Chi-Square Test and calculation of the P- value to compare the pre and post operative Lachman test, it was less than 0.001.

IV. Post-OP Anterior Drawer test (ADT):

Post-operative Anterior Drawer test (ADT) done at 6 months after surgery and graded as (A) 1-2 mm translation, (B) 3-5 m translation, (C) 6-10 mm translation and (D) more than 10mm translation, and the results were as follows.

- 80% normal
- 17.5%nearly normal.
- 2.5% (only one patient) with abnormal result.

After using Chi-Square Test and calculation of the P- value to compare the pre and post operative AD test, it was less than 0.001.

V. Post-OP Pivot shift test:

Post-operative Pivot shift test done at 6 months after surgery and graded as (A) equal, (B) glide, (C) clunk and (D) gross, and the results were as follows:

- 95% (38 patients) normal to nearly normal.
- 5% (only 2 patients) with abnormal result.

After using Chi-Square Test and calculation of the P- value to compare the pre and post operative pivot test, it was < 0.001.

- **Instrumental assessment;**

Multiple measurements and readings using KT 1000 were done in every post -operative visit starting from the 3rd month post-operative and the last one was at 6 months put in the master table in this study.

After using student's t- test and calculation of the P- value to compare the pre and post- operative measurement of (KT 1000), it was <0.001.

Complications:

- **Intra-operative complications:**

o *Failed spinal anesthesia*

o *Happened in one case which transformed to general anesthesia*

o *Premature graft amputation:*

o *No patients had such failure*

o *Posterior wall blow out:*

The most common complication of this technique. This has been encountered in 1 patient and another tunnel was drilled just anterior and superior to the first tunnel.

o *Poor quality bone plugs:*

Not happened.

o *Bone plug breakage;*

Not occurred

- **Early post-operative complications;**

o *Infection;*

One case with massive post- operative effusion 2 weeks after surgery, urgent arthroscopic drainage and lavage done and sample for culture and sensitivity taken, drain inserted and removed 24 hours later, and culture and antibiotic sensitivity done, and antibiotic prescribed according the culture and sensitivity, the patient improved and there is no need for any other procedures.

o *Effusion,*

There we no such complication

- **Late post-operative complications;**

No late complications such as graft failure, Stiffness and restricted range of motion and deep venous thrombosis (DVT) were reported.

Discussion

The purpose of this study was to assess the clinical results of the press-fit fixation in ACL reconstruction in a prospective, cohort study.

The main focus in this study was the analysis of the clinical results between the pre and post-operative, all objective clinical tests, subjective questionnaire (IKDC & Lysholm), and instrumental measurements were done by 2 independent examiners and data collected and statistics and results are done by another independent doctor.

Firstly, we will discuss our results in press fit techniques with results of others did similar techniques.

With other press fit studies:

Clinical evaluation of press-fit fixation technique in ACL reconstruction had been studied by many.

Gobbi et al. in 2002 [7], in this study 40 patient with press fit technique 85% of the patient are rated as normal to nearly normal in IKDC score and the mean Lysholm score was 90 and 92% are rated normal to nearly normal in Lachman test

Al-Husseiny and Batterjee [8] in (2004) reported 42 patients with 92% are rated as normal to nearly normal in IKDC score, 95% are rated normal to nearly normal in Lachman test.

Hertel et al. (2005) [9], reported that 95 patients in the study with mean Lysholm score 93.2 with 84% are rated as normal to nearly normal in IKC score and 90% rated normal to nearly normal in PIVOT test, Pavlik et al. [10], 285 patients with 85% are rated normal to nearly normal in IKDC score and the mean Lysholm score 93.2, 25 patients with 92 % are rated normal to nearly normal with mean Lysholm score 86 and 92 % rated as normal in Lachman test and 88% are rated normal in Pivot test

Felmet [11] 148 patients with 10 years follow up 87% are rated normal to nearly normal in IKDC score an 97% rated normal to nearly normal in Lachman and 97% rated normal to nearly normal in Pivot test

Widuchowski et al. [12] in 2012, 52 patients mean IKDC score was 80.2 and 75% rated as normal to nearly normal, the mean Lysholm score 86.4, 83 % are rated normal to nearly normal in Pivot test and 89% rated normal to nearly normal in Lachman test.

Farouk et al. [13] in (2015), 50 patients with mean IKDC score 83.35 with 95% rated s normal to nearly normal, and the mean Lysholm score 92.3.

We will compare the latest 2 studies with our study.

1) Widuchowski study [12]:

Femoral press fit fixation in ACL reconstruction using bone-patellar tendon-bone autograft: 15 years follow-up, 2012.

Now we will discuss the main findings in our study, the major findings of our study are:

A) In subjective evaluation:

There was significant differences between pre and post subjective evaluation as the mean pre IKDC was 52.92 while the post IKDC was 87.94, p-value was <0.001 and the mean of pre Lysholm score was improved from 66.53 preoperatively to be 93.50 post operatively, p-vale was <0.001 that means significant differences, and our results are matched with **Widuchowski et al. study [12]** that evaluate 52 patients with ACL reconstruction with press fit technique in which the subjective IKDC evaluation improved from 60.1 ± 9.2 to 80.2 ± 8.1 (p = 0.003) and the mean Lysholm improved from 59.7 ± 18.5 preoperatively to 86.4 ± 5.6 postoperatively (p = 0.004).

Regarding IKDC score distribution, in our study, 62.5% (25 patients) had a very good, 27.5% (11 patients) had good and 10% (4 patients) had fair grade.

While in **Pavlic et al. study** [10] that asses 285 patients with ACL reconstructed by press fit technique in which the post-operative IKDC score distribution, 16.14% (46 patients) had a very good, 68.42% (195 patients) had a good results, whereas 13.68% (39 patients) had fair and 1.75% (5 patients) had a bad overall results, the p-value was 0.98.

At the same study, the preoperative mean Lysholm score was 63.5 ± 12.7 points while the post-operative lyshlom mean was 93.5 ± 7.8 points (P <. 01).

Also, in **Jagodzinski et al. study** [14] confirm our results as the IKDC and lyshlom results were improved from the pre-operative and postoperative scores

B) In objective evaluation:

There are significant differences between the pre and post-operative in Lachman test.

Which matches with **Felmet et al.** [11] results that states that there is marked improvement in Lachman testing.

Also, **Akoto** [15] study showed that there significant improvement in Lachman test. Moreover, **Jagodzinski et al.** [14] study reported similar results with significant differences in instrumental testing.

In the other hand, there are significant statistical differences between the results of the pre and post-operative scores as follows:

Post-operative effusion:

As 98% of the patient are improved to be normal or nearly normal with P<0.001, this may be explained by presence of autogenic biological material as mentioned in **Pavlic et al. study** [10]. **Akoto et al.** [15] study, Seung-Ju Kim study and **Jagodzinski et al.** [14] didn't comment on effusion in their studies.

Post-operative ROM deficient:

About 98% of the patients rated as normal to nearly normal with P<0.001 which means significant difference, and this result is matched with the result of Seung-Ju Kim, as it shows also that there is no significant difference between the

pre and post-operative scores.

Our result may be explained by the reduction in post-operative effusion as mentioned by **Gotlin et al. [**16] (presence of post- operative knee effusion may increase the incidence of decreased range of motion).

Pivot shift test:

As 95% rated as normal to nearly normal with P<0.001, and this is different than the results of **Akoto et al.** [15] study, in which 90% are normal to nearly normal, and also different than **Seung-Ju Kim.**

C) In instrumental evaluation:

KT-1000.

There was significant differences between the pre and post-operative scores in instrumental testing (P<0.001) which match with **Felmet et al.** [11] results, **Hertel et al.** [9] also **Jagodzinski et al.** [14] study showed that there are significant differences in instrumental testing (P<0.001), and **Akoto et al.** [15] study that also concluded that there is significant differences in instrumental testing (P<0.005).

From presented formerly we can summaries the different comparative studies and our study in the following.

Also, we find in this study that there is no significant association between age and the clinical results when we compare the average post-operative IKDC in different age group, we didn't find a significant difference between them, and this result is matched with **Al-Husseiny and Batterjee** study [8].

But this point needs more studies to find out detailed results regarding to the relation between age and clinical results.

Also, we try to find correlation between the time intervals and post-operative IKDC score, we find that there no correlation between the time interval and the IKDC score, p value >0.1

Meniscal procedures and its implications in post-operative IKDC:

We try to find out the implications of this meniscal procedure on the IKDC (the average) results.

- In 25 partial meniscectomy, the average IKDC results was 86.4.
- In 15 patients with no meniscal injuries the average IKDC results 90.5.
- The average IKDC results 50 patients 87.9.

From the previous results we find that there is marked improvement in clinical subjective and instrumental assessment outcomes with press fit fixation method in ACL reconstruction, and the press fit has many advantages like:

1. Biological method of fixation without the use of any hardware or foreign implant inside the body.
2. Economic & cost-effective method of ACL reconstruction.
3. Aperture (near the joint surface) fixation of the graft is another advantage of press fit technique which goes on both sides either femoral or tibial. This anchorage near the articular surface closely mimic the native ACL insertions and abolish the negative consequences of cortical fixation techniques like the bungee cord effect and the wind shield effect that accompanies Endo buttons and rigid fix and washer lock fixation techniques in ACL reconstruction.
4. Press fit technique is the least technique with bone defects post reconstruction. All bones harvested during tunnel formation are reapplied into the tunnel. This in turn has many advantageous consequences; First, this facilitate better rehabilitation and faster recovery from the reported osteopenic changes that takes place in the proximal tibia and the distal femur post injury and post reconstruction. Second, in cases of re-rupture or revision, single-staged procedures are possible with decreased costs and faster functional recovery.
5. The use of cylindrical bone plugs offers larger surface for bone to bone healing which takes less time than tendon to bone healing. This allows better and faster graft integration within the tunnel and allows a more aggressive rehabilitation programs that results in better functional outcome.
6. The use of bone plugs instead of hardware allows post-operative MRI investigations which offers an advantage of this technique rather than implants with metals that impedes the use of MRI and loses us the chance of assessment of our procedures.
7. This technique avoids the tunnel dilatation post-operative unlike the use of hardware that causes tunnel dilatation due to toxic effects of the materials used in the synthesis of either the metal interference screws or bio-screws. Also, our technique avoids bone tunnel dilation that results from longitudinal movement of the graft within the tunnel (Bungee effect) as what happens with the Endo buttons.

All of these proposed advantages of the press-fit technique match the criteria for ideal method of graft fixation which should be anatomic, biocompatible, safe and reproducible allows undisturbed post-surgical MRI of the knee and does not complicate possible revision surgery as stated by **Fu** [17] in 1999 & **Martin** [18] in 2002.

Conclusion

Our study assessed the clinical results of the press fit subjectively, objectively and instrumental and we found that the press fit technique results are promising subjectively, and instrumentally.

1. Biological method of fixation without the use of any hardware or foreign implant inside the body.

2. Economic & cost-effective method of ACL reconstruction.

3. Press fit technique is the least technique with bone defects post reconstruction.

4. The use of cylindrical bone plugs offers larger surface for bone to bone healing which takes less time than tendon to bone healing.

5. No problem with post- operative MRI

6. This technique avoids the tunnel dilatation post -operative unlike the screws that causes tunnel dilatation.

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