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RESEARCH ARTICLE

ARTHROSCOPIC RECONSTRUCTION OF THE ANTERIORCRUCIATE LIGAMENTTOTALLY NO HARDWARE (PRESS- FIT TECHNIQUE)

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ABSTRACT

Background: The goal of this study is to evaluate the clinical outcome of arthroscopic ACL reconstructions, subjectively and objectively using the ALL PRESS-FIT fixation technique . This study will evaluate the results of this technique, highlight its limitations and point out to its complications.

Subjects and methods: From July 2012 to October 2013, a prospective study was undertaken to assess the results of arthroscopic reconstruction of the ACL totally no hardware (press-fit technique) using hamstring tendons on 30patients with torn ACL .The follow up period ranges from 7 months to 1.5 yrs after surgery. All patients were discharged on the 2nd day after surgery and were followed up at 1st, 2nd, 6th week post operative, then at 3 months.

Results: Subjectively, all of the patients in our study group reported improvement in the functional ratings of their knees from pre to post operative. None of the patient has rated his knee to be the same or worsened after the operation. Almost 93.4 % of our patients rated their Knees from 0 to 4 preoperatively and their knees were categorized severely abnormal or they were unable to use their knees in the usual daily activities. On the other hand, 96.6 % postoperatively have rated their knees to be normal with excellent fimction or at least nearly normal.

Conclusion: All press fit technique can be used safely and successfully in ACL reconstruction surgeries and represent a good alternative among other options for ACL reconstruction.

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INTRODUCTION

The anterior cruciate ligament (ACL) is one of the most commonly injuried ligaments in the body, for which surgery is frequently performed (Petersen and Tillmann, 2002). The incidence of anterior cruciate ligament tears depends on the type of sport, and more injuries occur during a game than in training. These sports with a high risk to sustain an anterior cruciate ligament injury include sports, which require the athletes to make sudden decelerations, accelerations, and other unanticipated running and cutting maneuvers. The typical mechanism of injury is deceleration with twisting and change of direction (Zantop *et al.,* 2005; Zaffagnini *et al.,* 2004). In recent years, new reconstruction techniques have been developed (single versus double bundle) tendon graft. These aim to better restore the kinematics of the knee, and thus possibly protect the knee from recurrent injury, meniscal tears and osteoarthritis (Muneta *et al.,* 2011). Currently, commonly used auto grafts include bone- patellar tendon – bone (BPTB), quadrupled bundle hamstring tendons and quadriceps tendon with or without bone. Meanwhile the allograft used mainly are (Achilles tendon, BPTB) (Seon *et al.,* 2012). It has been advocated that the tendon to bone healing is slower than bone to bone healing, however, this seems to depend on the fixation material used, so that suspensory fixation leads to slower healing (Pavlik *et al.,* 2014). Secure graft fixation is an important factor, especially in the early postoperative period. There are many different fixation methods, such as metal and biodegradable interference screws, staples, buttons, sutures post screw and press – fit fixation (Ekdahl *et al.,* 2008).

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MATERIALS AND METHODS

During the period from July 2012 to October 2013 30 patients with ACL deficient knees underwent arthroscopic ACL reconstruction using an all press – fit technique. The patients included were 28 males and 2 females, (Table 1). The range of age was21-44 year.

Pre-injury level of activity

According to the IKDC evaluation form, the activity level is defined as follows

- Very strenuous; jumping pivoting; hard cutting, foot ball, soccer.
- STRENUOUS; heavy manual work, skiing, tennis.
- Moderate activity; light manual work, jogging, running.
- Sedentary work (ADL).

Table 1. Shows the age incidence of patients in our study group

Age in years	N	%
20-25	8	26.6
26-30	9	30
31-35	10	33.3
36-40	2	6.6
>40	1	3.3
Total	30	100

The level of activity of patients in our study group was as followed (Table2).

Table 2. Shows the patients categorized according to the pre-injury activity level

Activity level	N	%
I	4	13.3
II	12	40
III	8	26.7
IV	6	20
Total	30	100

Method of evaluation

Our patients have been evaluated; subjectively, objectively, instrumentally, functionally and radio logically (Fig.1-2). Our subjective assessment form was done using the IKDC subjective assessment form (Hefti *et al.,* 1993).

1-Subjective assessment: Three questions out of the IKDC subjective assessment from were used to cover this sectionalong with the Tenger –Lysholm knee scoring system;

A. FIRST (Symptomatic assessment): "what is the highest level of activity that you can perform without significant knee pain or significant swelling or giving way ?"
B. Second question (Functional) is :" how would you rate the function of your knee on a scale from 0 to 10".
C. Third set of questions is used to assess the level of daily activity that the patients can perform currently.
D. Tenger –Lyshom knee scoring was also made to assess the patient and compare his preoperative status.

Fig. 1. Plain X-ray of male patient 36 year old preoperative

2-Objective assessment: The first three groups of the objective IKDC assessment form were included in our patient' evaluation. The patient then were categorized into 4 groups; normal, nearly normal, abnormal & severely abnormal as regards effusion, range of motion, ligament examination (Table 3).

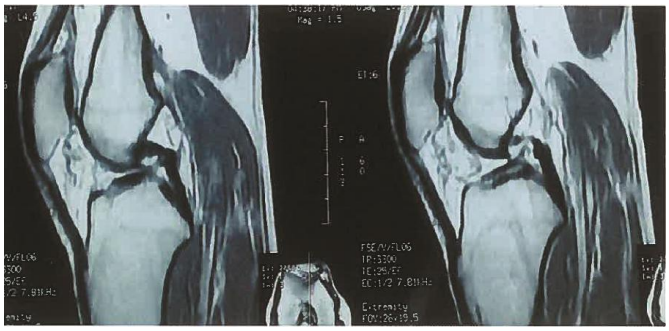

Fig. 2. MRI of the patient preoperative

Table 3. Showing the objective evaluation

Examination	A Normal	B Nearly normal	C Abnormal	D Severely abnormal
EFFUSION	None	Mild	Moderate	Severe
Lack of extention	$<3^0$	$3\text{-}5^0$	$6\text{-}10^0$	$>10^0$
Lack of flexion	$0\text{-}5^0$	$6\text{-}15^0$	$16\text{-}25^0$	$>25^0$
Ligament testing				
Lachman	-1-2mm	3-5mm	6-10mm	>10mm
End point	Firm	Firm	Soft	Soft
Anterior drawer	0-2mm	3-5mm	6-10mm	>10mm
Pivot shift	Equal	+glide	++(clunk)	+++(gross)

3- Instrumental testing: Instrumental measurement of the ligamentous instability was done to our patients comparing side to side differences this was done using a digital rollimeter device.

4- Radiological: Our hypothesis assumed faster healing of the graft than tendon to bone, due to bone to bone healing (contact between the bone plug window in the graft and tunnel) . The healing occurs within4-6 weeks postoperative, so we did plain x- ray and CT Scan for all patient at 6-8 weeks postoperative to make sure of this.

Surgical technique

Preoperative period; All patients were either admitted on the same day of surgery (12 patients) or the day before (18 patients).
Medication: All patients were given a pre –operative dose of prophylactic Iv antibiotics and continued throughout their hospital stay period.
Position: patients were laid supine with the affected kneeflexed at the side of the able.

Anaesthesia: All patients had spinal anesthesia.

The surgical steps of this study followed Felmet,s technique, summarized as follows

- Routine arthroscopy is performed and any concomitant pathology is addressed.

- Graft harvesting and sizing: The semi – tendinous tendon can be used solely or can be combined with the gracillus (depending on the length of the graft that allow quadriple bundle).
- Bone plugs production :The proximal tibia is drilled away from the tunnel site (1.5 cm below the medial tibial plateau) using the surgical diamond instruments to produce the bone cylinder 15 mm length 1mm greater than the tibial tunnel (Fig.3).
- Tunnel drilling: Preparation of the tibial tunnel according to the predetermined size of the graft then expansion of the distal half of the channel is done with taper milling to 14 mm depth. The femoral tunnel is 30 mm depth, done throught the medial portal at 120^0 of knee flexion.(Fig.4).
- Graft preparation: The graft is prepared and sutured in an appropriate way with inclusion of the bone plug at the tibial end of the graft.
- Graft pre tensioning: As routinely done in other ACL reconstruction procedures.
- Graft implantation: The BTT (bottom to top) (Fig.5).
- Graft fixation: Usually the transplant is fixed in the femoral tunnel with the femoral bone cylinder after impaction (press- fit) fixation at the tibial side.
- The extraction defect of the tibial tunnel is filled up with the remaining bone cylinder.
- Follow up (Felmet, 2006).

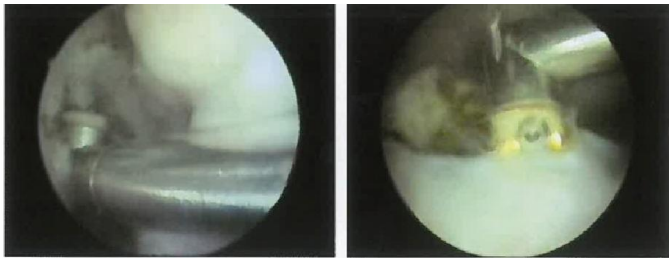

Fig. 3. Preparation of the notch and tibial side

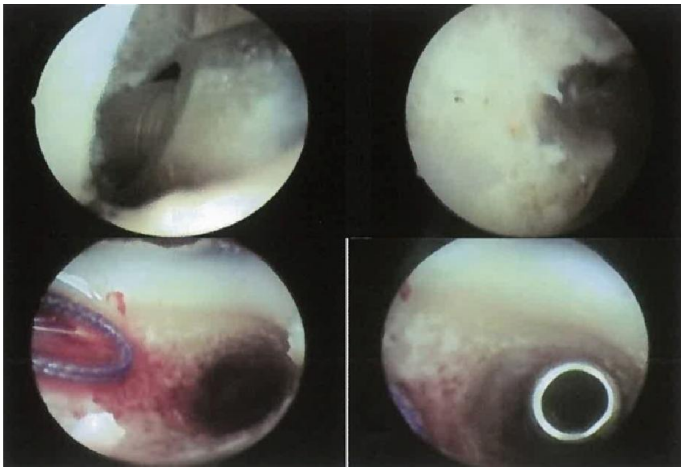

Fig. 4. Femoral guide inserted and femoral tunnel drilled (tunnel blow out)

Postoperative rehabilitation program

Howell and Hull 2013 stated that the chosen rehabilitation program should be based upon six basic principles:

- Healing tissue should never be overstressed.
- The deleterious effect of immobilization must be prevented.
- The patient must fulfill specific criteria to progress from one stage to the next.
- The rehab program must be based on current clinical and scientific grounds.
- The rehab program should be adapted to each patient‘s goals and characteristics (Howell and Hull, 2013).

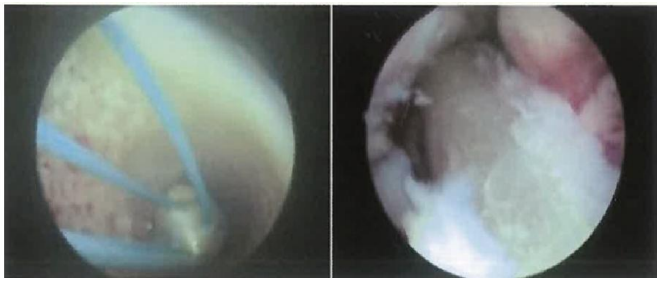

Fig. 5. Graft passage and fixed in the femur by screw and washer

RESULTS

None of the patients were able to perform strenuous activities like jumping or pivoting as in basketball or soccer or some heavy physical work pre operatively while 23 were able to do this post-operatively without pain, swelling or giving way.

17 of our 30 patients were unable to perform any of the sports activities or even moderate activities like moderate physical work, running or jogging due to knee pain, while 28 of our patients were able to do post operatively.

15 patients only were able to perform some of these light activities pre-operatively while all patients were able to do these light activities post-operatively (Table 4).

Table 4. Show the level of activity of our patients before and after surgery

Categories	Level of activity	Pre-operative number (%)	Post-operative number (%)
1	Strenuous activities; jumping pivoting or soccer	0(0%)	11(36.6%)
2	Strenuous activities like heavy physical work, skiing or tennis	0(0%)	12(40%)
3	Moderate activities like modrate physical work, running or jogging	13(43%)	5(17.6%)
4	Light activities like walking, house-work or yard work	15(50%)	2(6.6%)
5	Unable to perform any of the above activities due to knee pain	2(7%)	0(0%)

Functional subjective assessment

- The IKDC subjective assessment from (Table 5) was also used to evaluate patients through rating the function of their knee in daily activities on a scale from 0 to 10.

Table 5. The level of activity of our patients before and after surgery

Level of activity	Pre-operative	Post-operative
0(unable to perform the usual daily activities)	0	0
1-3 (severely abnormal)	13	0
4-6(abnormal)	17	1
7-9(nearly normal)	0	21
10(normal with excellent function)	0	8

Radiological assessment

- Compartmental findings:

No narrowing of joint line was detected in any case of our study.

- Position of tunnels:

- Tibial tunnel position:

The tibial tunnel position was good in 29 and posterior in 1 patient

- Femoral tunnel position:

Femoral tunnel position was good in all patients.

Postoperative CT scan and MRI

They were done to assess graft healing and the union of bone plug within 6 weeks (our hypothesis) (CT scan). In all cases the plug united within 6-8 weeks post operatively.

The insertion of the bone plug in the femur make the ligament acquire its simi lunar shape.

Complications

Premature graft amputation

This has been met with two patients and despite this a quadruple tendon graft was prepared.

Posterior wall blowout

This has been encountered only in one patient due to the use of free hand technique without using the femoral guide.

Poor quality bone plugs

This has been done two times and this graft is put back in its harvesting tibial site and another bone plug is taken more or less superior.

Bone plug breakage

This was encountered four times during pushing the femoral plug into the Tunnel. This was managed by removing the loose broken part of the plug out of the joint and then pushing back another piece into the tunnel

IKDC Subjective assessment form

SPORTS ACTIVITIES:

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

4❑Very strenuous activities like jumping or pivoting as in basketball or soccer
3❑Strenuous activities like heavy physical work, skiing or tennis
2❑Moderate activities like moderate physical work, running or jogging
1❑Light activities like walking, housework or yard work
0❑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	4❑	3❑	2❑	1❑	0❑
b.	Go down stairs	4❑	3❑	2❑	1❑	0❑
c.	Kneel on the front of your knee	4❑	3❑	2❑	1❑	0❑
d.	Squat	4❑	3❑	2❑	1❑	0❑
e.	Sit with your knee bent	4❑	3❑	2❑	1❑	0❑
f.	Rise from a chair	4❑	3❑	2❑	1❑	0❑
g.	Run straight ahead	4❑	3❑	2❑	1❑	0❑
h.	Jump and land on your involved leg	4❑	3❑	2❑	1❑	0❑
i.	Stop and start quickly	4❑	3❑	2❑	1❑	0❑

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:

Couldn't perform daily activities 0❑ 1❑ 2❑ 3❑ 4❑ 5❑ 6❑ 7❑ 8❑ 9❑ 10❑ No limitation in daily activities

CURRENT FUNCTION OF YOUR KNEE:

Cannot perform daily activities 0❑ 1❑ 2❑ 3❑ 4❑ 5❑ 6❑ 7❑ 8❑ 9❑ 10❑ No limitation in daily activities

Deep venous thrombosis_DVT

One patient suspected to have acute deep venous thrombosis in the 2nd‘week after surgery but after doing venous duplex he was diagnosed as just Musclehaematoma in the calf muscle. The condition resolved completely.

DISCUSSION

In 1996, Malek *et al*., described press-fit fixation with the middle-third patellar tendon auto graft and found that it was an interesting technique because no hardware is necessary to achieve fixation. In 2002, Gobbi *et al.* reported this technique as a simple, cost effective, and reliable alternative for patellar tendon fixation in ACL recons-truction. In 2005, Hertel *et al*. reported their 10-year clinical results of bone- patellar tendon-bone press-fit fixation and found the following advantages of press-fit fixation: direct bone to bone healing of the graft, decreased donor site morbidity, and cost-effectiveness. In 2003, Lee *et al*. noted that the initial fixation biomechanical properties of press-fit technique are found to have no significant differences when compared with titanium or bioabsorbable interference screws. Dargel *et al*., 2005 also published several papers to elucidate the properties of press-fit fixation. Later on, the use of the hamstrings as a graft was further encouraged and this led many authors to start utilizing a press-fit technique for ACL reconstruction using the quadruple hamstring tendon graft. Lui *et al.,* 2008, Passler *et al.,* 2003 & Felmet, 2006 published their results on Press-fit ACL reconstruction using the quadruple hamstrings tendon graft.

This study in ACL reconstruction technique is the least one 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 (Shelbourne and Nitz, 2014) Subjectively, all of the patients in our study group reported improvement in the functional ratings of their knees from pre to post-operative. None of the patient hasrated his knee to be the same or worsened after the operation. Almost 93.4 % of our patients rated their Knees from 0 to 4 preoperatively and their knees were categorized severely abnormal or they were unable to use their knees in the usual daily activities. On the other hand, 96.6 % postoperatively have rated their knees to be normal with excellent fimction or at least nearly normal. The results of our study group according to the IKDC evaluation system conform to the results of previous clinical studies for assessment of Press fit ACL reconstruction. While we have 96.6 % normal or nearly normal results according to the IKDC, Lui *et al.,* 2008 had 87% and Felmet2006had 98% normal or near normal subjective results.

The overall results of our technique in ACL reconstruction are good to excellent results in more than 96.6 % of cases. These results present this technique as a trust worthy technique among different alternatives in ACL reconstruction. This techniqueis further encouraged by being biological, cost effective and allows easier revisions. When compared to other "press-fit or implant free" trials of ACL reconstruction, it conforms to most of these results which further support this technique.

Conclusion

This concept of press fit has been utilized in ACL reconstruction with the use of PTB and quadriceps tendon. It has evoluted to be used with the hamstrings as well since 2003. We adopted one of these techniques in all press fit reconstruction using the hamstrings as a tendon graft. Through a prospective study, the outcome of an all press fit technique in ACL reconstruction. Our results were promising regarding the patients' satisfaction regarding their knee conditions. Our patients could do all of the day to day activities without problems. Most of them returned to sports and to their previous level of activity.

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