Intraoperative Complications of Primary Anterior Cruciate Ligament Reconstruction Using Quadriple Hamstring Tendon Graft (Semitendinosus and Gracilis): Measures of Avoidance

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ABSTRACT:

BACKGROUND:

Anterior cruciate ligament reconstruction is widely done orthopedic procedure, during this procedure there is potential risk for development of complications, which need to be dealt with or better to be prevented by specific measures.

OBJECTIVE:

To avoid intra operative complications during anterior cruciate ligament reconstruction using hamstring muscles graft in order to reduce incidence of the graft failure due to technical error.

PATIENT AND METHOD:

prospective cohort study for patient who has undergone primary anterior cruciate ligament reconstruction surgery using hamstring graft by same surgical team during the period from 2016-2017. History, examination and investigations were done for all patients and surgery was done under general anesthesia or spinal anesthesia. Specific rehabilitation program was instructed to all patients. Intra operative complications might be encountered during anterior cruciate ligament reconstruction surgery which includes: cartilage injury, Bleeding, Screw breakage, Screw mal direction and graft harvest complications. Identification of the measures to avoid these complications was crucial in this study.

RESULTS:

Fifty four patients who underwent primary anterior cruciate ligament reconstruction with mean age 27.7. Fourteen patients (26%) developed complications. Seven patients had cartilage injury (13)% , (2/54) patients had bleeding (3.7)% , (2/54) patients had developed screw breakage (3.7)% , screw mal direction (1.9)% was encountered in (1/54) patient and (2/54) patients had sustained premature graft cutoff short (3.7)%.

CONCLUSION:

Complications of anterior cruciate ligament reconstruction may occure at any stage of operation, avoidness of these complications is important step in improving the functional outcome and the surgeon need to be aware about it and how to avoid them.

KEY WORDS: Anterior cruciate ligament reconstruction, graft harvest,cartilage injury and screw

INTRODUCTION:

ACL is very important intra-articular knee structure as stabilizer where it act as primary (85%) restraint to limit anterior translation of the tibia and it also serves as a secondary restraint to tibial external rotation in full extension[(1)]. This ligament is commonly injured structure [(2, 3)] in the knee joint, especially during sport activities with special attention to non-contact activities, although tear of the ligament can happen even with non-sport trauma as simple as twisting injuries or more severe trauma like knee dislocation. Because of the nature of ligament, there is no role for repairing, so the best choice of management is to reconstruct the injured structure to restore normal knee function and to overcome complications of ACL deficient knee such as cartilage damage and early osteoarthritic changes , meniscal problem in addition to instability[(4)]. The reconstruction of ACL is widely done orthopedic procedure that can be achieved by open technique or more commonly by arthroscopy assisted technique, which now considered the standard procedure for ACL reconstruction, the outcome of this procedure has been well documented in a variety of studies, with good-to-excellent results in approximately 85% to 95% of patients [(5)] .

Medical City Complex.

During ACL arthroscopic procedure which involve multiple steps there is potential risk for development of intra operative complications at any step of surgery even in the hand of experienced orthopedic and sport surgeon. Although the careful surgical technique with meticulous attention during the surgery lead to safe procedure. The surgeons doing ACL reconstruction as usual procedure may face these intra operative complications , so they need be aware about these problems and how to avoid them. The current study include analysis of the intra operative complications of ACL reconstruction using hamstring graft and how to deal with them and the preventive measures to reduce these complications.

AIM OF THE STUDY:

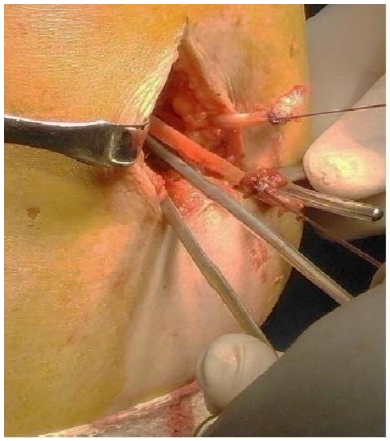
To avoid intra operative complications during ACL reconstruction using hamstring tendon graft in order to reduce the incidence of graft failure due to technical errors.

PATIENTS AND METHODS:

Prospective cohort study conducted from December 2016 to December 2017 at Baghdad medical city complex (Ghazi AL Hariri teaching hospital and Private Nursing Home hospital), for(54) young male (only) patients sustaining chronic ACL tear who underwent ACL reconstruction procedure. Patients with following criteria were included in the study:Young age "less than 40 years old" and Chronic ACL tear. Exclusion criteria include Pediatric, geriatric age group and Revision surgery. Pain in the injured knee is the most common symptom that may be associated with sense of instability and sometime weakness due to non-contact trauma like twisting knee injury or in rare time direct trauma. No patient has comorbidity like DM, hypertension and ischemic heart disease. Local knee examination like effusion, Joint tenderness, with neurological assessment and vascular examination, in addition to special test like Lachman, Pivot shift test, anterior drawer test,McMurray and Thessaly test, the last two test used to assess if there is associated meniscal injury. Routine preoperative investigations including complete blood picture and virology screen. Radiological evaluation,anteroposterior and lateralview of knee. MRI of knee to confirm the diagnosis of ACL tears. All patients were admitted to the orthopedic ward one day before, having all the pre-operative preparations done. Antibiotics was given one hour before surgery prophylactically. Under general or spinal anesthesia in supine position; examination was done for the patients using anterior drawer test,lachman test and pivot shift test. Pneumatic tourniquet applied, with foot of table flexed completely to allow the surgical knee to flex to at least 130° while Contralateral leg on extended table part. Usually starting with diagnostic arthroscopic examination of the knee joint unless the the diagnosis of ACL tear is clear. Then graft harvesting and preparation is performed from the same limb:Vertical incision of 3 to 4 cm length which is approximately 5-6 cm or 3 finger breadth distal to the joint line on the antero medial aspect of the tibia(Figure 1).

Figure 1: Intra operative picture shows a vertical skin incision.

Splitting the fascia along the inferior border of the gracilis tendon after palpating the tendon of gracilis. Any fascial slips need to be cut whether to the sartorius or from medial gastrocnemius. After gracilis tendon has become free, then the semitendinosus that was deep and inferior to the gracilis tendon. Tendon stripper used to strip the freed tendons with freeing tendons from their tibial attachment completely. Measurement of the diameter of the graft and keeping it in a moist environment (Figure 2,3).



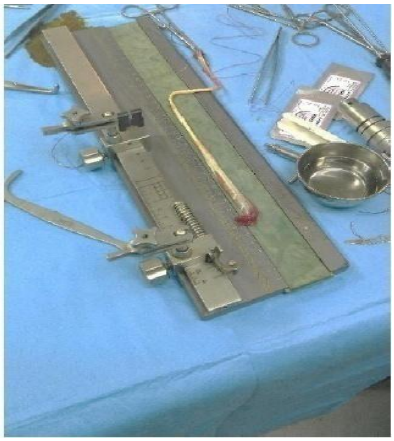
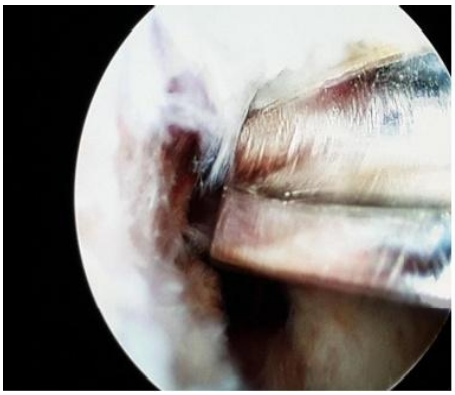


Figure 2, 3: Intra operative pictures shows harvesting of detached hamstring tibial insertion

Diagnostic Arthroscopywith 30' angle usually done with two portals—standard Anterolateral (AL; viewing) and anteromedial(AM working). Antero medial portal under arthroscopic vision to prevent cartilage damage, verify ACL injury with evaluation of tear pattern; in addition to assessment of both cartilage and meniscus. Insertion site preparation by using arthroscope in AL portal and working instruments in AM portal. Ideally is to start with femoral side, by using remnant of torn ligament as guide for graft placement , center of insertion site was marked with 30° awl. Then using the shaver to expose the wall of lateral femoral condyle. Femoral tunnel placement done via medial portal, independent of tibial tunnel. Native footprint at knee flexion of 90° is generally below the resident ridge and slightly distal to the bifurcate ridge , with maximum knee flexion (>120°) mallet the guide pin into the awl marking position through the medial portal in a postero lateral direction aiming toward 10 o'clock in right side or 1 o'clock in the opposite side (figure 4,5).



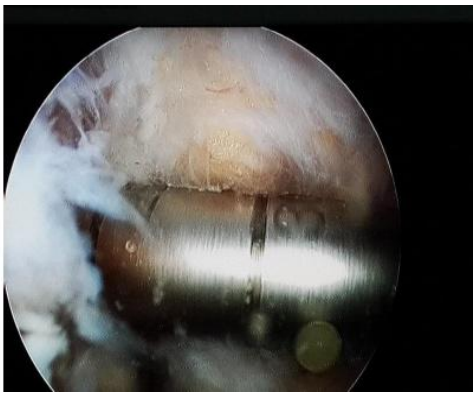


Figure 4,5: Intra operative pictures shows preparation of femoral tunnel.

Make a shallow provisional footprint by hand; using the cannulated reamer over the guide wire at 0.5 mm undersized reamer. At this stage evaluation of the tunnel placement with reference to the resident ridge, then starting the power ream to predetermined depth for the fixation technique of choice. Then dilatation of the tunnel to previously measured size of graft. Tibial tunnel placement started with using ACL tip-guide set at position of 55° angulation, the preferred site was at intersection between the free edge of the anterior horn of the lateral meniscus and the midline between the tibial spines. Insertion of guide wire approximately 1.5 cm medial to the tibial tubercle and 3 cm below the medial joint line. Slightly advance K-wire until the visible tip is appear under direct arthroscopic visualization. Assessment of K-wire placement through arthroscopy, excluding the impingement of guide pin on the notch with full knee extension Figure (6).

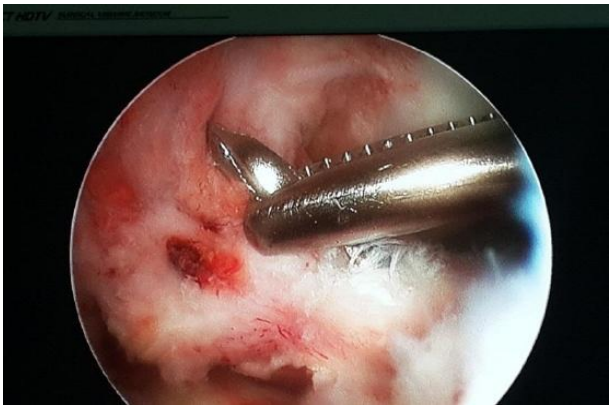


Figure 6: Intra operative picture shows preparation of tibial tunnel

Use cannulated compaction reamer (1 cm smaller than final graft size) to drill the tunnel. Then the tunnel is dilated in increments of 0.5 mm to a final size. Passing the pin with attached suture loop from tibial tunnel into joint and eventually into femoral tunnel and out the skin on the lateral aspect of the thigh.The last step is Graft Passage and Fixation (Figure 7,8,9,10).

Figure 7: Intra operative pictures shows insertion of graft through the tibialtunnel.

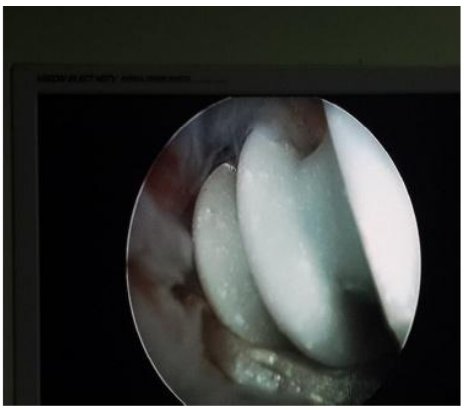


Figure 8, 9: Intra operative pictures shows insertion of interference screw through the femoral tunnel.

Figure 10: Intra operative pictures shows insertion of interference screw through the tibial tunnel.

Pulling the sutures from the femoral side of the graft out through the lateral aspect of the thigh. Advancing the graft up the tibial tunnel, and maintain the tendon in the posterior aspect of both tunnels.After fixation of the femoral and tibial tunnels by interference biodegradable screws of appropriate length and diameter. Pretensioning with cyclic loading (15 -20 times), closure of the wound, dressing and knee splint in extension. Full weight bearing postoperatively in hinged knee brace locked in extension for 7 days. Brace is removed for motion activities when start physical therapy 1 week postoperatively. Regaining full extension by 10 days, with 80° to 90° flexion of knee joint.After 2 to 6 weeks—Closed-chain exercises, hamstring curls, and stationary bike with flexion goal of 120° usually obtained. Eight to 10 weeks—Patients advanced to light jogging and outdoor biking. Return to play at 4 to 6 months postoperatively for professional players. During the ACL reconstruction many complications could be encountered Intraoperatively including: Cartilage damage, Bleeding , Metal breakage , Screw mal-direction and Graft harvest complications.

RESULTS:

Fifty four male patients had undergone ACL reconstruction during the study period that had the inclusion criteria and involved in this study. Their ages range from 19-38 years with mean was (27.7 ± 4.8) year. Fourteen of fifty four patients (26%) had developed intraoperative complications (Diagram 1).

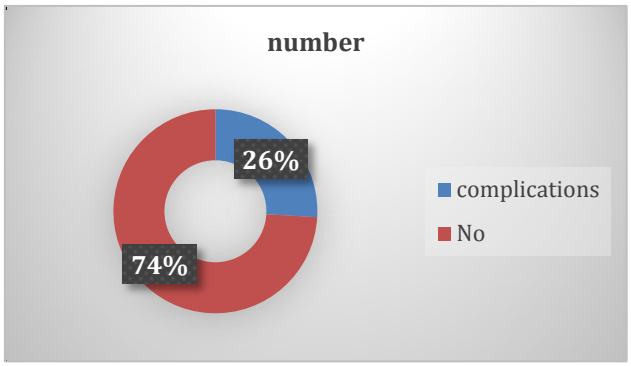


Diagram 1: Distribution of the patients regarding their intra operative complications.

In this study (7/54) patients had cartilage injury (13)% , (2/54) patients had bleeding (3.7)% , (2/54) patients had developed screw breakage (3.7)% , screw mal direction (1.9)% was encountered in (1/54) patient and (2/54) patients had sustained premature graft cutoff short (3.7)%. (Table 1) and (diagram 2).

Table 1: The frequency distribution of studied parameters.

		count	%
Cartilage injury(superficial)	Yes	7	13.0%
	No	47	87.0%
Bleeding	Yes	2	3.7%
	No	52	96.3%
Screw breakage	Yes	2	3.7%
	No	52	96.3%
Screw mal direction	Yes	1	1.9%
	No	52	98.1%
Premature graft cut off short	No	52	96.3%
	Cut Off Short	2	3.7%

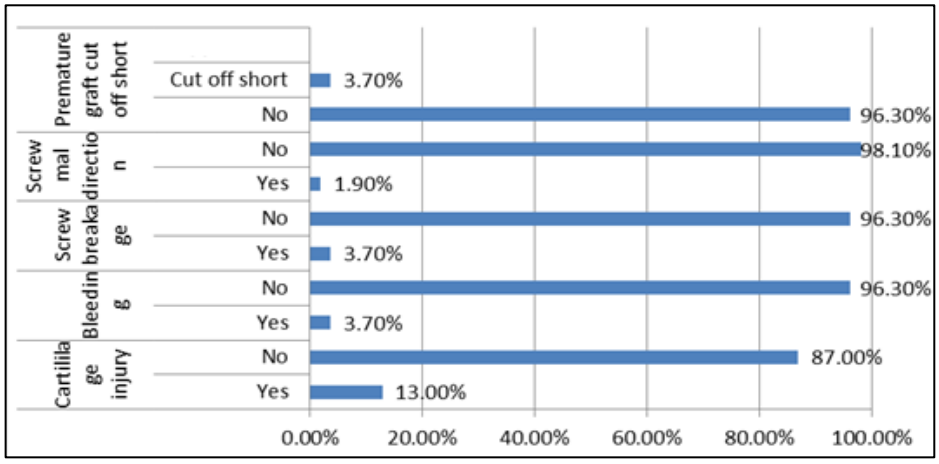


Diagram 2: The frequency of distribution of studied parameters.

Statistical analyses were performed using SPSS statistical package for Social Sciences (version 20.0 for windows, SPSS, Chicago, IL, USA). Data are presented as mean ± SD for quantitative variables(age) and as number and percentage for qualitative variables(cartilage injury). Quantitative variable differences between multiple groups were evaluated with Student's t-test; qualitative relations were evaluated using Chi-square test. P value of <0.05 was considered statistically significant.

DISCUSSION:

Reconstruction of ACL is one of the most common orthopedic intervention performed annually, like any procedure it could carry in their folds some complications that may leads to adverse outcomes and poor patient's satisfaction. These complications can happen at any step during the procedure like tourniquet application, graft harvesting and preparation, tunnel placement and fixation as intra operative problems or it may be occurred as a short term or as long-term issues postoperatively.Therefore, it is conspicuously very wise and important to know which encountered complications during surgery and how to avoid them in the future surgeries. All patients in this study were male which occurred due to chance factor and life style in our society which make male more vulnerable to injury and seeking surgery for management of such injuries because of their high demand work unlike majorityof female who more often live their life sedentarily. The intra operative complications rate in this study was 26 %, the majority was due to cartilage injury that occurred in 13% of the cases as mentioned previously in the results. Arturo et al [7] described 13.5% as intraoperative complication rate in patients with using hamstring graft; complications in this study mostly take place during the graft-harvesting phase. This difference in the rate of overall complication in this study is due to small sample size and some lack of theatre facilities like for example small size shaver (only large size shaver was available). Panisseta et al [8] found in his study ; the adverse events rate was 12% in short term events including intraoperative events with hematoma formation as result of bleeding was the most common problem which happened in 6% . Cartilage injuries was the common problems encountered in this study, this adverse event can be avoided during diagnostic arthroscopy steps by doing medial portal under direct visualization. Risk of cartilage injury to the medial femoral condyle with anteromedial portal femoral drilling is common error, this procedure is technically demanding and it needs a learning curve, while drilling the femoral tunnel, limited flexion might injure the subchondral bone plate or articular cartilage of the lateral femoral condyle or the posterolateral soft tissue [8,9]. During this maneuver it is better to perform the following sequences: anteromedial portal inferior and between the medial femoral condyle and patellar tendon [10] this is better to be done under arthroscopic control and 90° knee flexion , insertion of a long spinal needle at the intended place inferiorly. This needle is introduced to the joint to the proposed bone tunnel position centrally at ACL femoral origin. Assessment of the distance between medial femoral condyle articular cartilage and the spinal needle to confirm safe passing and drilling of reamer head during this steps , at the same portal care must be taken to avoid injury of anterior horn of the medial

meniscus by surgical blade.The insertion of guide pin with knee flexion of 130° ,then advancing the guide pin through the lateral femoral condyle to make femoral tunnel with a length of 32-40 mm approximately to avoid posterolateral damage of the soft tissue [8,9], after that the introduction of cannulated reamer over guide pin with safe distance from lateral femoral condyle. Articular cartilage of the tibia can be damaged \during tibial tunnel drilling especially with flat angle drilling less than 45° and from far medial tunnel insertion, in addition ; reamer with a large diameter could exceed the subchondral base plate and may damage and elevate the articular cartilage while traveling along the guide pin. In order to avoid this problem we use high drill angle more than 45° and we use set to 55° starting 1.5 - 2 cm medial to tibial tuberosity this distance ensure a safe area between the reamer and articular cartilage. Bleeding is the second common problem happened during the current study as 3.7% of the cases, Panissetaet al[8] described 6% of his study patient developed hematoma where surgical evacuation of hematoma indicated in one case (0.4%). To overcome this troublesome bleeding surgery is performed with a pneumatic tourniquet inflation or exsanguination. A pump of fluid could be controlling factor for bleeding by increasing the pressure.Finally, the use of local anesthetic prevents minor bleeding from the arthroscopic portal in a non– bloodless field. Screw breakage occurred in 3.7% of our patients. This might be due to poor technique, such as attempting to divergent screw insertion from the tunnel line or improper screw setting on the screwdriver. Screw breakage can happened in situation of using oversized screw for corresponding tunnel in patients with hard bone. To prevent this complication occurrence, first is to recognize the characteristics and design of Screw, because of some screws are made to be placed on the central position between tendons or it might be used in side of the graft, in addition to proper size and design with adequate setting in screw driver and correct insertion angle in the tunnel. If this complication occurs, a broken screw removal is attempted. If not possible to remove screw and well-fixed graft, this fixation was accepted and supplemented with a soft tissue staple. If the graft protruding from the aperture of tibia is insufficient, fixation may be supplemented by whipstitch sutures tying of the graft over a cortical screw and washer with protective brace for 6 weeks post-surgery. If poorly fixed graft with broken screw, then the graft and the broken screw is removed with relative ease. In special situation, broken bioabsorbable screw removal may need reaming, after that re-preparation of tunnel should be done with re-fixation of the graft [11]. This finding correlate with study of Jontan N and Mark R [18]. Screw mal direction occurred in 1.9% of the patients in this study that mainly occurred when the screw is placed with a greater than 15 ° divergence resulting in fixation loss. This problem need early recognition and changing the direction of screw angle , sometime it needs flexion of knee more than 20° of the tunnel angle. This can be avoided by using a screw guide wire in the tunnel. The last observed intraoperative complication in this study is related to graft harvesting as premature graft cut off short that occurred in 3.7% of the patients. Short graft can be happened due to laceration of the tendons with tendon harvester or scissors, often due to inadequate intertendinous bands release [12,14]. This mainly anticipated in patients with scarring of hamstring muscle due to previous surgery or trauma. To obtain better quality tendon lengths with minimum disruption of soft tissue by using of a closed blade harvester, as compared with a stripper of the tendon [13]. If the proximal end of a short tendon appears through the wound, we can use tendon forceps to retrieve the graft that can be harvested and whip stitched in situ. If inadequate graft length is encountered due to premature amputation of the tendons, other options should be attempted like harvest the hamstrings from the opposite knee , a harvest bone patella tendon bone from the same knee, use synthetic ligament or an allograft [15]. To prevent this adverse event, taking care about harvest technique and cutting gastrocnemius bands to advance stripper up the tendon with pulling of the tendon, during this maneuver observation of skin over the muscle for dimpling. Presence of this skin dimple indicate noncutting band which effectively prohibits advancing the stripper in this condition. Also, keeping the distal insertion of hamstrings graft to tibia until complete harvesting is very effective and ensuring measure to avoid this complication. These finding coincide with other study[19]. In cadaver specimens, some author [16,17] found that the age is limiting factor in biomechanical properties and fixation of the graft fixation that decrease with older age that explained by low bone mineral density.

CONCLUSION:

1.Complications can happened at any stage of surgery; tourniquet application, graft harvesting and preparation, tunnel placement and fixation.

2.Surgeon need to be astute about management of those complications.

3.Prevention of these complications is important step in obtaining good functional outcome.

Recommendations

1.Meticulous surgical technique and Carful evaluation of each step to avoid complications.

2.Technical errors during surgery are responsible for intra operative complications (included in this study), so prevention of these adverse events is important step in obtained good outcome, which can be achieved by obtaining accurate surgical techniques. Prevention of these adverse events need steep learning curve and awareness about these problems.

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