Journal of Cardiovascular Disease Research
ISSN:0975-3583,0976-2833 VOL12, ISSUE07,2021

Osteochondral Auto Grafting Utility in Management of Treatment of Osteochondral Defects of the knee

Riad Mansour Megahed, Mohamed ElsayedRefaie, Hossam FathiMahmmoud, Mohammed Attia Abdelmoeti
Department of Orthopedic Surgery, Zagazig University Hospital, Egypt.
Corresponding Author: Mohamed ElsayedRefaie
Email:mohamadalrefay63@gmail.com

Abstract

Osteochondral defect is a known as localized defect of the subchondral bone and articular cartilage. Articular cartilage defects of the knee are an extremely common injuries, A recent review of more than 30.000 arthroscopic procedures of the knee by Curl et al revealed that 60% of patient had clue of full or partial thickness lesions. Osteochondral autograft transfer (OAT), that composed of the shift of plugs of intact cartilage and subchondral bone from an area of low load bearing to a full-thickness lesion to another site in the knee, it can be carried out, either arthroscopically or through an arthrotomy as a single-stage step. Donor-site morbidity and the restricted amount available for harvest are known complications.

Keywords: Osteochondral autograft transfer

Introduction

Articular cartilage trauma can result in multiple patterns of damage depending on the type and direction of injury force, position of the knee, age of the patient, and associated injury and pathology, moreover the rate of loading of the articular surface plays an important role, as the lack of these compensatory mechanisms caused by a rapid loading rate causes a greater than usual amount of force to be transmitted to the macromolecular framework that might result in microscopic damage as rupture of the collagen fibrils or damage to the chondrocytes. If these microscopic changes are severed enough gross damage to the cartilage may be apparent as chondral fractures, fissures or cracks. **(1,2)**

ISSN:0975-3583,0976-2833 VOL12, ISSUE07,2021

The goals of surgical treatment of articular cartilage defects specifically biological resurfacing include finding a method that restores zoned hyaline cartilage as well as the subchondral bone plate, ultimately to achieve a congruent, biomechanically efficient and durable resurfacing. **(3)**

The decision on the surgical management will have to take patient- specific and lesion-specific variables into account, without losing sight of the patient's physical ambitions, concerns and goals. Patient-specific variables focus on age, physical fitness, body mass index (BMI), co- morbidities, leg alignment, and associated injuries **(4)**.

Lesion specific variables include level of acuteness, size and location, containment, and history of previous surgical interventions. The mechanical environment of the knee often holds the key for success or failure in cartilage repair. Mechanical overload through malalignment, excessive joint laxity, patellar mal-tracking and meniscal deficiency will affect the equilibrium of forces within the joint, creating an environment un-favorable for successful cartilage repair **(5,6).**

Osteochondral Auto Grafting

Autologous osteochondral transplantation has been advocated as a treatment for focal cartilage defects, as this surgical technique can restore hyaline cartilage architecture and, to some degree, the structural support of underlying subchondral bone **(7)**.

Osteochondral auto graft transplantation (known as mosaicplasty) is a well-established technique in the treatment of chondral and osteochondral defects. This method was first described by **Yamashita et al. (8).** And popularized by **Hangody et al. (9).** The method is based on the transfer of one or more cylindrical osteochondral plugs into the cartilage defect, providing instantaneous repair through structural reconstitution. Although the procedure is generally performed through a mini arthrotomy, smaller lesions may be amenable to be treated entirely arthroscopically. A sizing guide is used to determine the number and size of grafts that are needed. Both the creation of the recipient socket and

the harvesting of donor graft plug require the tubular cutting instruments to be placed perpendicular to the surface to avoid graft obliquity. **(10).**

Grafts are harvested from the non-weight bearing periphery of the trochlea or inter-condylar notch and usually measure between 2.5 to 10 mm in diameter. A graft-harvester is introduced to a depth of about 12 to 15 mm and then twisted to disengage the base of the plug. it is recommended to undersize the depth of the recipient socket by 2 mm. The donor plug, which has remained in the harvester, is then placed over the recipient site and advanced by approximately 2 mm. The plug is then engaged with the opening. Once in-line with the socket it can be gently driven down until it is well seated but minimally proud. Using a sizing guide or tamp that overlaps the plug by 1-2 mm will avoid rim damage and allow the plug to be advanced further until it is flush with the surrounding articular surface. The technique is limited by the amount of donor tissue available and hence best suited for lesions of less than 4 cm2. Although fibro- cartilage will grow into the donor defect within 6 to 8 weeks, donor site morbidity such as anterior knee pain has been associated with this technique **(7)**.

Because it is an autologous transplant, the procedure carries no risk of disease transmission or graft-host incompatibility. When used in carefully selected patients, the results of osteochondral autograft transplantation are favorable in comparison to other surgical techniques **(7)**.

Indications

The indications for mosaicplasty in the knee are:

1. Focal unipolar cartilage defects measuring 1-5cm². Lesions less than 1 cm2 tend to be asymptomatic. With larger lesions, greater than 5 cm2, autologous osteochondral grafting is limited because of the amount of donor tissue available for harvesting.
2. The technique is limited to lesions with bone loss of depths less than 10 mm.
3. Grafts must be placed perpendicular into recipient site, which makes application virtually impossible for posterior condylar, and tibial lesions, while patella is not recommended because of cartilage thickness mismatch (5-10 mm

for patella and 2-3 mm for graft). So, the preferred lesion is on the femoral condyle in the anterior or middle third **(11).**

Precaution

1. Young patient (<50 years): where the donor site cartilage is thin and the cartilage surrounding the defect is of poor quality.
2. Normal axial tibio/femoral alignment and stable joints: restoration of joint mechanics needs to be addressed separately or at the time of mosaicplasty.
3. No severe degenerative arthritis (joint space narrowing (<4 mm) on standard antero-posterior X-ray films.
4. No infection **(12).**

Advantages of Osteochondral grafts

1. A normal viable hyaline cartilage with tidemark and subchondral bone architecture are transferred and maintained at the transfer site.
2. Transfer of physiologic hyaline cartilage functions at the transfer site. 3- Remove abnormal sclerotic bone from the area of injury.
3. Risk of infection is low and there is no risk of rejection **(12).**

Disadvantages:

1. Lesions greater than 5cm² (2.5 cm in diameter) cannot be completely resurfaced due to the limits of donor site area.
2. High morbidity for donor site.
3. Potential for donor /recipient surface geometry mismatch.
4. Harvesting of several grafts may result in postoperative pain **(12).**

Technique of articular cartilage autografting:

Patients receive preoperative intravenous (IV) antibiotics12hour before operation and the procedure is done with patients under general or spinal anesthesia and tourniquet control, and the table set up should allow for knee flexion to 120°. Once the lesion has been identified by arthroscopy it is measured for size. The decision is then made to proceed

arthroscopically or by open technique. This decision is based on the size and location of the lesion and the experience of the surgeon.

Any lesion should be treated by the open technique if it is more than 1.5 cm in diameter or if more than half of it is posterior to the center of the weight- bearing surface, because it is technically demanding. Smaller lesions can be treated by the arthroscopic technique **(9).**

The osteochondral autograft transfer system of instrumentation (OATS) (Arthrex®). was used in all cases. The osteochondral cylinders harvested by the OATS technique are usually large and more uniform in size as usually one set of disposable harvester tube is utilized per case. The Arthrex OATS system disposable harvesters are available in paired sets (Recipient harvester tube/Donor harvester tube; 4.75, 6, 8, or 10 mm) with the donor tube one millimeter larger than the recipient tube, to produce an osteochondral plug cylinder that exactly fits the diameter of the prepared recipient socket to ensure press fit stability of the graft. and the set size is named after the size of the recipient tube diameter. The completely disposable, size-specific system includes a recipient harvester, donor harvester, alignment rod, tamp, graft delivery tube, Core Extruder for controlled push-in core insertion, and optional graft driver. **(13).**

Figure (1): Single use OATS instrumentation from the Arthrex

A- Tamp B- Recipient OAT C- Donor OAT

1. Open technique:

The patient is in the supine position. Flexion of up to 120 should be possible. A tourniquet is placed and can be inflated if necessary. A small parapatellar (mini-arthrotomy) is made to explorer articular cartilage lesions for defects of the femoral condyles, the incision should be long enough distally to view the lesion with the knee flexed and should extend proximally to view the superior aspect of the trochlea (where donor grafts can be obtained) with the knee extended **(14).**

Step (I)-Preparation of Chondral Lesion: Chondral lesion is identified, using a curette or knife blade to bring back the edges of the cartilage defect to good stable healthy hyaline cartilage at right angles, The base of the lesion is then abraded using a curette to obtain viable subchondral bone which encourages the production of fibrocartilage between the grafts. Recipient site sizing is initially performed with probes to determine overall size. The metal graft impactors are then used to delineate plug size and array of the graft that will fill the lesion **(11).**

Believe that multiple smaller diameter (2.7 mm, 3.5 mm, 4.5 mm) grafts should be used. Others believe that larger but fewer grafts (>5mm diameter) should be used harvest fewer, larger diameter grafts to improve stability, coverage and simplify the procedure **(11).**

Step (II): Selection of Donor Site: Although there is no true completely non-weight-bearing articular cartilage of the knee, contact studies have revealed 2 sites with significantly less contact pressure. These include (superior trochlear ridge) the outer edge of the lateral and medial femoral condyle above the sulcus terminalis and the intercondylar notch (medial and superior aspect). Additionally, notchplasty studies have revealed that up to 8 mm of lateral notch can be removed without significant alteration in patellofemoral contact forces **(11).**

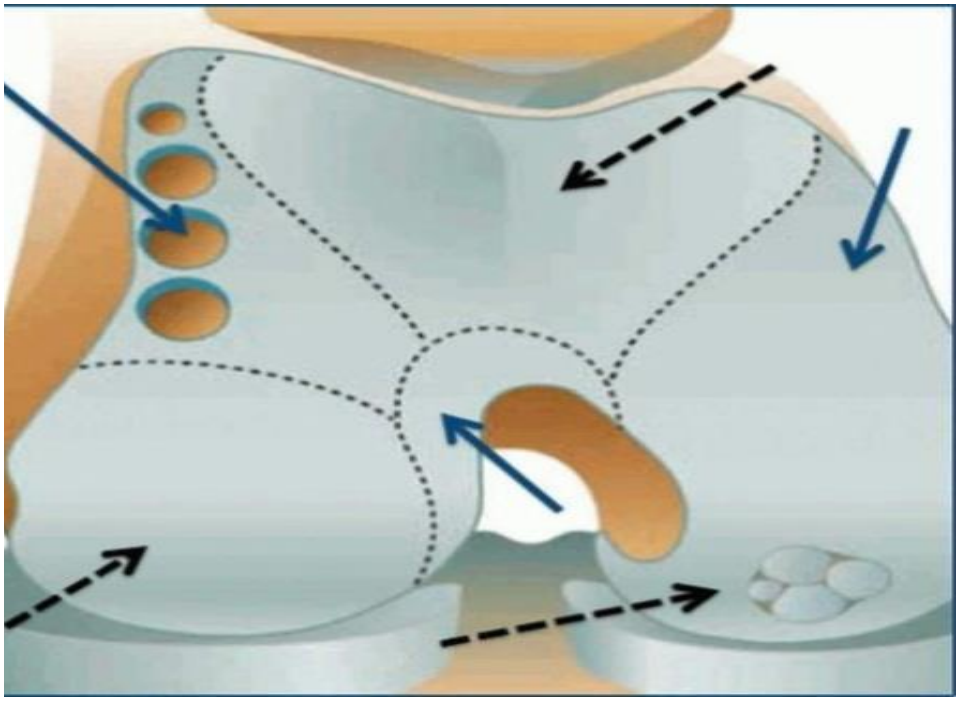

Figure (2): Donor sites(blue arrows) recipient sites (black arrows)**(11).**

Step (III): Graft Harvest: The appropriate size cutter is placed on the harvester and introduced into the knee. The devices used are specially designed tubular chisels, which allow a core of hyaline cartilage, subchondral bone, and cancellous bone to be harvested. Care must be taken to obtain appropriate length grafts for the defects being addressed. For chondral lesions, grafts generally are 15 mm in length, while for osteochondral defects, slightly longer grafts (20mm) are needed. Grafts that are too short compromise the surface area of the press fit and are not stable enough and also longer grafts (>20mm) generally are unnecessary. The cutter assembly is placed over the desired hyaline cartilage donor site. Care is required to assure that alignment is as perpendicular as possible. This should be checked by visualization around the entire harvesting device. The cutter/harvester is impacted to the 15 mm depth by using a mallet. The harvester is then rotated 360 ° so that the cutting tooth scores and cuts the graft 15 mm below the surface and do not spin the extractor to remove the harvester prior to breaking the base or the graft may become loose in the device, making removal difficult. The device is then withdrawn and taken to the back table with the graft held in the cutter. Donor sites may

be left open or may be filled with either cancellous bone or a graft substitute. If left open, they are filled with cancellous bone and are covered with a layer of fibrocartilage **(7)**.

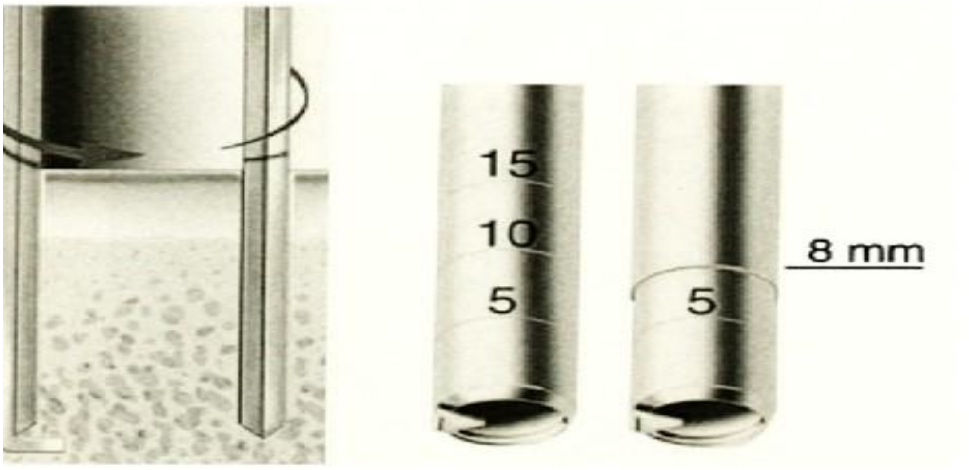

Figure (3): Impaction of graft cutter and harvest via tooth rotation **(11).**

Step (IV): Creation of Recipient Socket: The periphery is the best place to start, and attention is directed to the surrounding surfaces, radius of curvature, and donor graft that has been obtained, an appropriate recipient hole is created, so that when filled with the donor graft, it will recreate the surface intended. These holes are cored to depth for 15mm in chondral lesions, and 20mm for osteochondral lesions. The chisel used should be 1mm smaller than the donor harvester to obtain a press-fit effect **(14).**

Step (V): Delivery of Graft: The sleeve holding the graft is placed into the recipient hole. The sleeve is rotated to align any obliquity with the curvature of the stable surrounding cartilage. The graft is gently malleted into position by using a plunger. The graft is delivered so that all bone is below the surrounding cartilage. The sleeve is removed, and final impaction is performed to bring the graft cartilage parallel with the surrounding cartilage. Grafting is started at the periphery of the lesion, closet to a major part of the weight bearing area. The goal is to cover as much substance loss as possible with cartilage, at least 80%, starting withlarger of the grafts followed by smaller grafts that fill in any gaps left by the larger grafts. The graft should not lie directly side by side, as stability will be compromised, so spacing by 0.5-1mm of bone left between each other. This ensures a solid wall for the press fit **(11).**

ISSN:0975-3583,0976-2833 VOL12, ISSUE07,2021

The surface is examined to ensure that the grafts are at proper depth. At first, it may be prudent to leave the grafts too proud (1mm) rather than too deep. The knee is taken through a final range of motion; flexion- extension movements are made to make sure that the implant is perfectly stable. Routine closure is done in layers. Use of drain is optional **(14).**

II- Arthroscopic technique

The arthroscopic approach is technically challenging, perpend-icular access and portal placement is critical. Generally, portals are slightly more central than usual, as the approach to the main weight bearing areas points more centrally than expected. Following debridement and Subchondral abrasion, the lesion is measured for size. If the working portal being used does not appear to be perpendicular, knee flexion can be altered, or a spinal needle can be used to reassess proper portal placement and perpendicular position. Multiple viewing angles are used to be sure that the measuring device is flush on the lesion to accurately gauge its size, to determine the number and size of graft needed and to assess the direction that is perpendicular to the surface **(11).**

Donor grafts are obtained from either the supracondylar ridge or intercondylar notch. The medial trochlea is easier to approach when utilizing the scope. As knee inflates with fluid the patella naturally moves laterally away from the medial ridge. The lateral side is used for the intercondylar notch. This site is useful when only a few grafts are needed. The supracondylar ridge can be approached using the arthroscopic donorinstrumentation via a portal or small open incision. As in the open procedure (harvesting is usually performed by mini-parapatellar arthrotomy, 3 cm high, rather than by arthroscopy), care must be taken to ensure that harvesting device is perpendicular to the articular surface. Cylindrical chisel creates a recipient hole performed with a 1mm diameter tubular chisel (recipient harvester) that is 1mm smaller than the donor harvester to obtain a press-fit effect. The recipient harvester is positioned on the defect at the limit of debridement, in a perfectly perpendicular position. Impaction obtained with a mallet by arthroscopic control until a depth is reached that is the same as the harvested donor graft. The recipient chisel

harvester can then be turned 180◦ several times and removed from the knee. The length of the recipient sockets is confirmed with a flexible calibrated depth probe **(14).**

The graft removed from the recipient socket will be inserted into the donor site at the end of the procedure. The ‘‘donor’’ graft is placed opposite the condylar socket and gradually advanced by turning the graft delivery screw. When insertion is nearly complete, the instrument is removed, and the graft is impacted with a flexible tamper. Ideally that should be positioned so that it is barely touching the healthy femoral condyle. Osteochondral grafts tend to swell in saline. This can cause a size mismatch between the harvested graft and the recipient tunnel. In addition, turning off the inflow during insertion also prevents the graft from accidentally being expelled from the insertion tool because of fluid pressure **(7)**.

References.

1. **Ewers BJ, Jayaraman VM, Banglmaier RF, Haut RC (2002).** Rate of blunt impact loading affects changes in retropatellar cartilage and underlying bone in the rabbit patella. J Biomech.; 35(6):747- 755.

2. **Chu CR (2001**). Chondral and osteochondral injuries: Mechanisms of injury and repair responses. Oper Tech Orthop.; 11(2):70-75.

3. **Brittberg M, Winalski CS (2003).** Evaluation of cartilage injuries and repair J Bone Joint Surg Am.; 85-A Suppl:58-69.

4. **Krishnan SP, Skinner JA, Bartlett W, et al (2006).** Who is the ideal candidate for autologous chondrocyte implantation? J Bone Joint Surg Br.; 88(1):61-64.

5. **Coventry MB (1990).** The effect of axial alignment of the lower extremity on articular cartilage of the knee. ArticulCartil Knee JtFunct Basic Sci Arthrosc.: 311-317.

6. **Sterett WI, Steadman JR (2004).** Chondral resurfacing and high tibial osteotomy in the varus knee. Am J Sports Med.; 32(5):1243- 1249.

7. **Williams, R.J. (2006):** Articular Cartilage Repair: Clinical Approach and Decision Making. Operative Techniques in Orthopaedics. pp.118-225. Elsevier.

8. **Yamashita, F.; Sakakida, K.; Suzu, F. and Takai, S. (1985):** The transplantation of an autogenic Osteochondral fragement for Osteochondritis dissecans of t knee. Clinical orthopeadic and related research; 210: 43-50.

9. **Hangody, L.; Kish, G.; Karpati, Z. and Eberhart, R. (1997):** Osteochondral plugs: autogenous osteochondral mosaicplasty for the treatment of focal chondral and osteochondral articular defects. Operative Techniques in Orthopaedics; 7(4): 312-322.

10. **Jacob, R.; Franz, T.; Gautier, E. and Mainil, P. (2002):** Autologous Osteochondral grafting in the knee: indications results and reflections. Clinical orthopaedic; 401: 170-184.

11. **Levy, A.S. (2001):** Osteochondral autograft for the treatment of focal cartilage lesions. Operative Techniques in Orthopaedics; 11 (2): 108-114.

12. **Craig, D. and Morgan, D. (1998):** Chondral autograft transfer. Chondral resurfacing: Arthroscopy association of North America.

13. **Hangody, L.; Vasarhelyi, G.; Hangody, L.R.; Sukosd, Z. and et al. (2008):** Autologus Osteochondral grafting –technique and long-term results. Injury, International J. Care Injured; 3951: 532-539.

14. **Robert, H. (2011):** Chondral repair of the knee joint using mosaicplasty. Orthopaedics and traumatology surgery and research; 97 (4): 418-429.