

Mosaicplasty Technique for Treatment of Osteochondral Defects of the Knee

Hossam Fathi, Hany Mokhtar El-Elesh, Omar Kelany, Mohammad El-Sadk, Mohammad Elattar

Orthopedic Surgery Department, Faculty of Medicine ,Zagazig University.

Abstract

Background: Articular cartilage lesions have limited capacity for repair. The avascular nature of articular cartilage and the limited stem cell population limit the healing response. In addition, the constant load of articular cartilage, particularly in the knee, creates a challenging mechanical environment for an appropriate healing response.

Aim of the work: The work aims evaluate the results of osteochondral autograft in treatment of chondral and osteochondral defects

Material and Methods: This prospective study was conducted on twenty patients in Zagazig University in Sharqia between 2011 and 2014. Osteochondral grafts were done for all of the patients either by open technique (13 patients), or by arthroscopic technique (7cases) all of them were proved to have chondral or osteochondral defects of one of the femoral condyles.

Results: The study results use Chondral defect scoring system as being simple. The results for subjective score have shown significant improvement of the pain, swelling, locking and full weight bearing and improvement of objective score also show significant improving of range of motion, effusion, knee bends and pain with varus and valgus stress. we use also use Lysholm score system : The results for the score have shown significant improvement of the Limp , using cane , locking sensation , giving way , swelling ,climbing stairs and squatting .

Conclusion: Mosaicplasty is a one-step operation, the morbidity is low , independent of laboratory use , and based upon follow up results , mosaicplasty seems to be an alternative in treatment of full thickness cartilage damage..

Key words: Mosaicplasty, Autograft, Osteochondral defect, Knee.

Introduction

Articular cartilage is a hypocellular, avascular, alymphatic tissue with dense collagen and proteoglycan matrix that provides a low-friction and highly durable wear-resistant surface . It provides smooth, pain-free gliding of the joints during skeletal motion and shock absorption . However, articular cartilage has minimal reparative potential, and degeneration of the articular cartilage surface leads to arthritis (**Ulrich-Vinther, 2003**).

Patients with chondral or osteochondral injuries typically report either a twisting, shearing-type injury combined with an axial load or significant blunt trauma causing an impaction injury. The patient presents with pain aggravate with weight bearing, In addition recurrent effusion catching and locking (**Williams and Brophy, 2007**).

The principal goals in the surgical management of symptomatic chondral defects are to reduce symptoms, improve

joint congruence, and prevent additional cartilage deterioration. . (**Treme and Miller, 2008**).

Standard diagnostic imaging should include a standard weight-bearing anteroposterior radiograph of both knees in full extension, lateral view, and an axial view of the patellofemoral joint. Magnetic resonance imaging can be helpful in delineating the extent of articular cartilage lesions (**Mckeon, 2009**).

Osteochondral autograft transfer (OAT), which involves the transfer of plugs of intact cartilage and subchondral bone from an area of low load bearing to a full-thickness lesion in another area of the knee, it can be performed either arthroscopically or via an arthrotomy as a single-stage procedure . Donor-site morbidity and the limited amount available for harvest are known complications (**Treme and Miller, 2008**).

Patients and Methods

This prospective study was conducted on twenty patients in Zagazig University in Sharqia between 2011 and 2014. Osteochondral grafts were done for all of the patients either by open technique (13 patients), or by arthroscopic technique (7 cases) all of them were proved to have chondral or osteochondral defects of one of the femoral condyles, no severe osteoarthritic patients were selected or severe lower limb deformity. All patients were grafted by autologous osteochondral grafts from the same knee. -Age limits in this study was between 17 and 39 years with a mean of 27.1 years (SD ± 7.2), weight range was 60 -103 Kg with mean of 79.6 Kg (SD ± 10.5) and height of the patients ranged between 162 to 197cm with a mean of 174.4 cm (SD ± 9.9). Chondral and osteochondral defects were found in all of the 20 patients, out of this total, 17 patients (85%) were injured in the M.F.C., while 3 patients (15%) were injured in the L.F.C. Chondral and osteochondral defects were found to be more common in males in this study: as 15 patients out of 20 were males (75%), while 5 patients only (25%) were females. Site of injury: Sixteen patients had their defects in their right knees (80%), while 4 Patients had their defects in their left knees (20%). Defects were found to occur in the dominant knee in 14 patients (70%) and in the non-dominant knee in 6 patients (30%). Presenting symptoms: all of patients presented with a complaint of knee pain and pain was annoying in all of the case and catching was annoying in 11 (55%) patients, swelling in 13 patients (65%). Plain X-ray and M.R.I. is two faces of the same coin in dealing with cases of chondral and osteochondral defects.

In this study we use double scoring system, the first is chondral defect scoring system. Chondral defect scoring system as being simple, specific for studying cartilage dilemma: chondral defect scoring system uses subjective assessment (60 points) by history (pain(20), Ability to perform sport /work (20),

Swelling(10), and locking(10) and objective assessment (40 points) by examination Range of motion (10), Effusion (10) Ability to perform Knee bends (10), and Pain with varus /valgus stress on ROM (10). The same items are used for preoperative and post-operative evaluation. (Rodrigo and Steadman, 1994).

The second one is The Lysholm score, which is Which is an 8-item (limp, support, locking, instability, pain, swelling, stair climbing and squatting) questionnaire. The total score is the sum of each response to the 8 items, of a possible score of 100 (100 = no symptoms or disability) The Lysholm score is validated for patients with cartilage injuries. (Tegner Y, Lysholm J, 1985).

Operative Technique

In this study the sets used: the OATS of Arthrex (Osteochondral Autograft Transfer system). Prophylactic antibiotic third generation cephalosporin were administrated intravenously before tourniquet application. Pneumatic tourniquet is used in all cases with average time 75-90 minutes. **Diagnostic Arthroscopy** is done first to Probe the defect by arthroscopic probe to determine the grade of the defect, condition of the cartilage, degree of osseous involvement whether it is only the cartilage is denuded or the subchondral bone is involved, probing the bed of the lesion for the depth, and estimate roughly the size of the lesion and number of the expected grafts using a measuring tamp introduced through the portal, to defect area. Finally asses the defect is accessible arthroscopically or opens technique (Robert, 2011).

Surgical Grafting Technique :

1-Arthroscopic procedure : Preparation of the first graft is started by introduction of the recipient harvesting tube through the access portal, which can be changed to provide perpendicular access to the defect and introduced by hammering on T handle while observing perpendicular access, and the length introduced by observing the caliber over the tube until length of 13 mm approximately. The T handle is rotated 90°

clock wise and anti-clock wise 3-4 times then rocking movement at right angles then the core is pulled out and release harvesting tube from T handle and apply graft harvesting tube which can be taken from one of the following sites

-Intercondylar notch at sites of notchplasty

-Lateral femoral condyle above the level of the sulcus terminalis. Needle is introduced to determine the incision from outside at the upper lateral border of lateral femoral condyle. small skin incision applied then tube delivered perpendicular to the cartilage under vision which is possible from inside the knee by scope until the length taken is a 15mm Tube rotated as previously mentioned 90° clock wise and anti-clock wise and rocking in two directions, then extracted while rotating gently. Cartilage cap and the T handle middle piece are removed, and the graft tube is placed at the prepared tunnel, and grafts hammered while securing its being perpendicular, and visualized through the slot in the tube. Ensure hammering the graft till the cartilage is flush with the surface of the condyle (Levy , 2001).

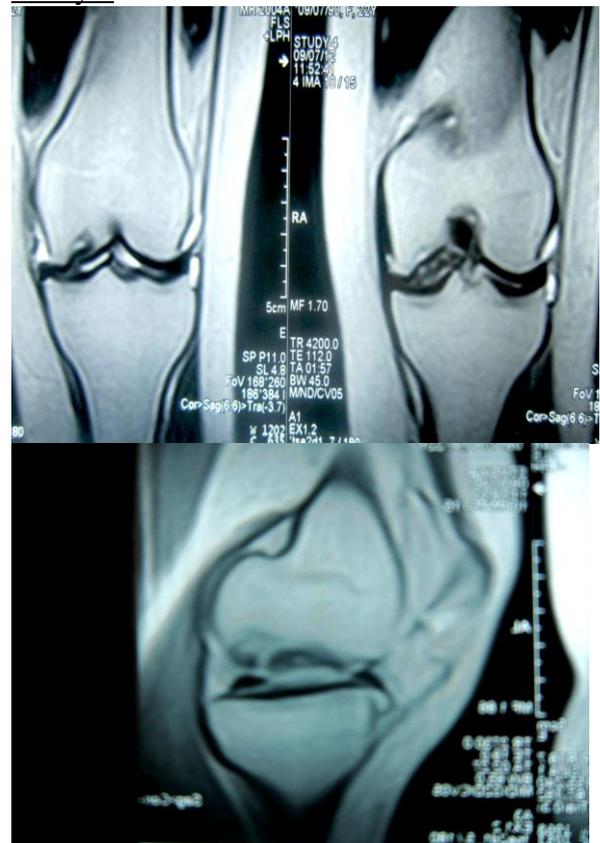
2-Open Technique: In case the defect is not accessible arthroscopically partially or totally so that devices are perpendicular to the lesion surface or the defect is large in size: the skin is opened surgically by anterior mid line incision of the knee and then the subcutaneous tissue is opened in the same incision, the knee is opened by medial parapatellar incision and everting the knee exposing both condyles and the under surface of the patella. The same technical steps are carried for grafting. The wound is closed in layers and drain is applied. Crepe bandage is applied. (Robert ,2011) .

Post-operative rehabilitation regimen:

Phase I : Non weight bearing for 4-6 weeks , but early range of motion and isometric quadriceps strengthening. **Phase II :** partial weight bearing using only one crutch for two weeks and full range of motion is allowed. **Phase III :** For 8-16 weeks full weight bearing and full R.O.M. are promoted (Hangody et al., 2008).

Cases :

Case (3) : A female patient 21 years ,house wife of 164 cm height , 60 Kilograms weight , has experienced falling on the ground while working , causing pain and limping for few days , mild swelling appeared next day. she took medical treatment in the form of medication , brace and physiotherapy for next 3 months , but the patient still complaining of swelling of the knee and pain on standing interrupting with her daily activity. Plain x-ray and M.R.I. are done and they revealed a medial femoral condyle



Figure(1) : M.R.I. showing osseous defect on T2 image on M.F.C. (coronal – sagittal view) .

A scope was done revealed about 24 mm defect of the medial femoral condyle , on the weight bearing area. Open mini-arthrotomy is done due to large size of the defect. Surgicalgrafting was done using two plugs



Figure (2): Medial parapatellar approach showing defect in medial femoral condyle



Figure (3) :Showing 2 plugs inserted to fill the defect

This is a follow up M.R.I. after one year shows filling of the defect and incorporation of the graft.



Figure(4) : M.R.I. showing Defect healing on T2 image on M.F.C. (sagittal – coronal view)

Post-operative Complications:

Superficial wound erythema occurred in one patient (5%) in an open procedure, Hemarthrosis, persistent effusion , presented in four cases (20%) of cases, Postoperative stiffness in an open procedure in two cases (10%) ,and Pain in the donor site in five cases (25%).

Statistical analysis:

The results were expressed as means \pm SD. The data obtained from the used double score system were analyzed statistically using paired T test. P values less than 0.05 were considered significant

Results

The intra- operative findings:

I- Synovitis

It was found in 9 cases (45%) had mild to moderate synovitis which needed shaving during scope, while 11 patients (55%) did not need shaving.

II- Menisectomy

It was done arthroscopically for 6 patients (30%) of the cases , 5 of them was for the medial meniscus and one for the lateral meniscus , none of them was repaired , while the rest 14 patients (70 %) had no meniscal injuries .

III- Loose bodies

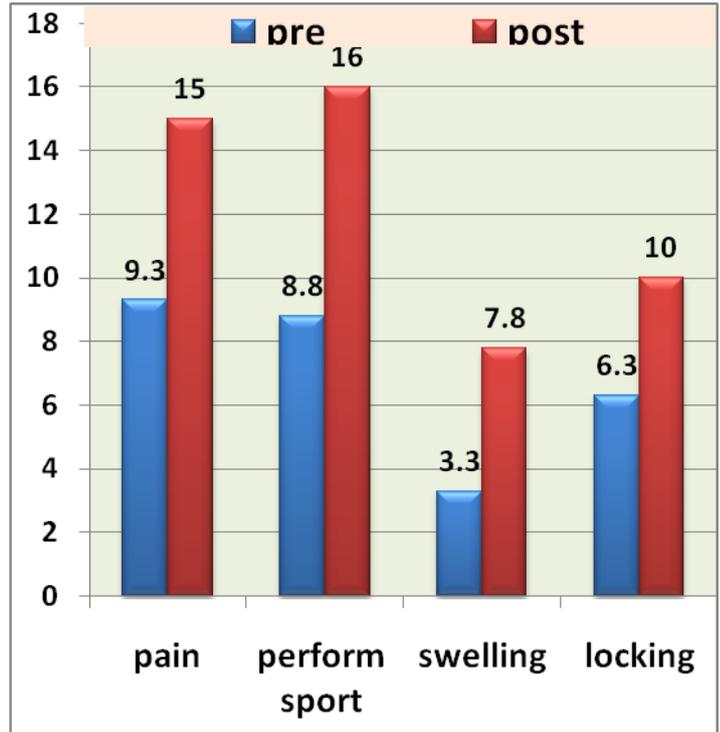
It was found in 7 patients resembling chondral and osteochondral parts in the knee which form (35%) and 13 patients no loose body was found (65%).

IV - size of the defect

The size of the defect was between 1cm-3.5cm in diameter on average with mean 2.1cm (SD ±0.8) and number of grafts used per defect between 1-4 grafts with mean 2.5grafts (SD±1.1),and according to grading of lesion from grade 1-4 with mean 2.9 (SD±1.1).

V- Surgical Grafting Technique

Arthroscopic procedure was used for 7 patients (35%) , while open procedure was used for 13 patients (65%) , as the lesion was not easily accessible through the usual arthroscopic portals in a perpendicular fashion and most of patient presented late with chondral lesion > 2 cm .



Assessment of the results of surgery

1)- Assessment using Chondral Defect Scoring System

Chondral defect scoring system as being simple, specific for studying cartilage dilemma: chondral defect scoring system uses subjective assessment (60 points) by history and objective assessment (40 points) by examination. The same items are used for preoperative and post-operative evaluation.

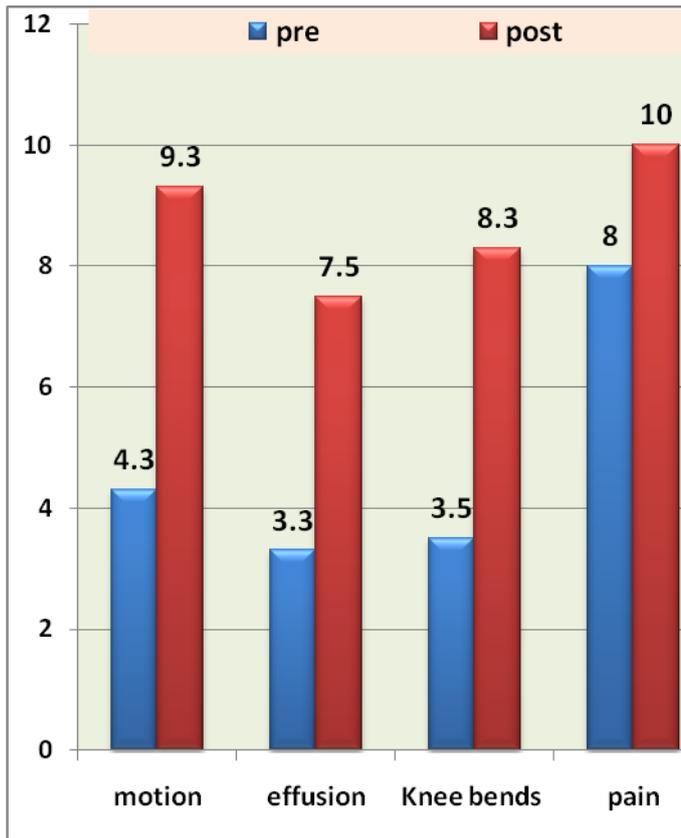
1- Subjective (60):

Figure (5):- pre and post operative results regarding different parameters of subjective Chondral defect scoring system.

2-Objective scoring (40):

Mean

Mean



squatting) questionnaire. The total score is the sum of each response to the 8 items, of a possible score of 100 (100 = no symptoms or disability).

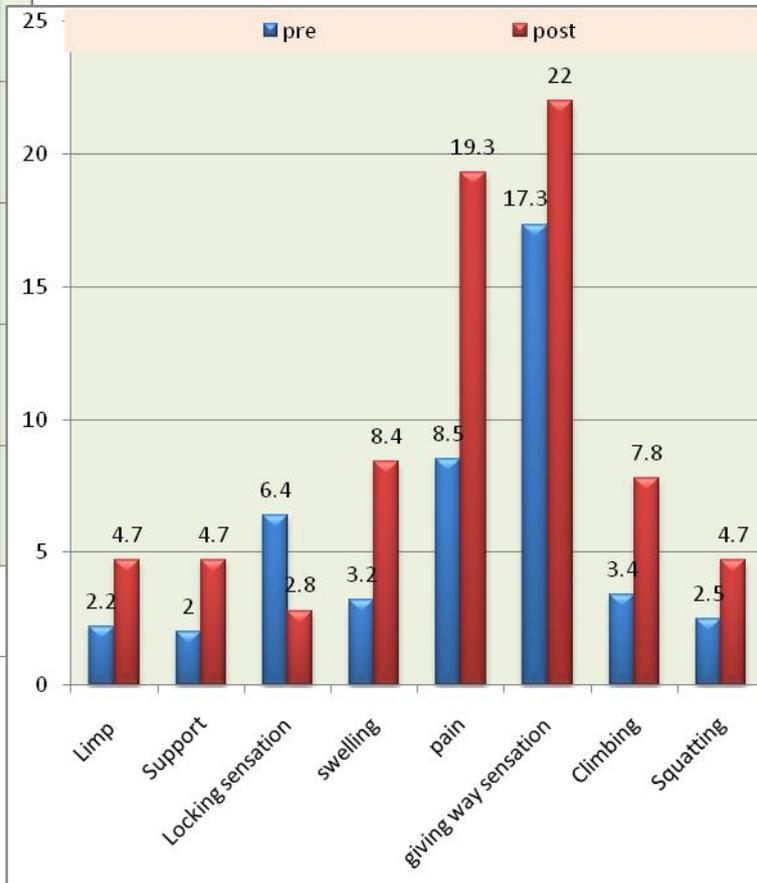


Figure (6):- pre and post operative results regarding different parameters of objective Chondral defect scoring system.

3-Relation between total objective & subjective score preoperative and postoperative:

Mean

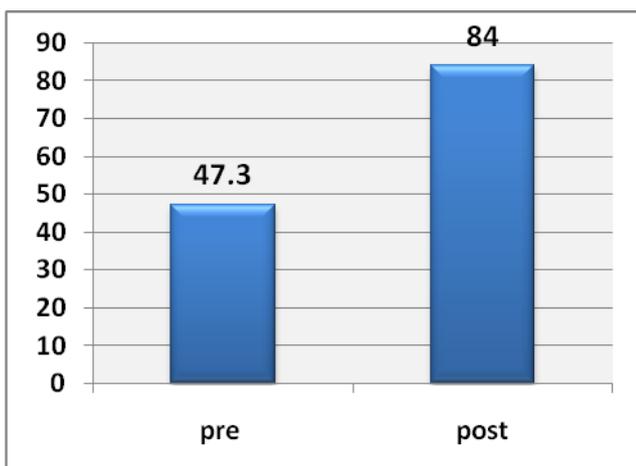


Figure (6): Pre and post scores as regard total subjective & objective scores.

2)-The Lysholm score:

Which is an 8-item (limp, support, locking, instability, pain, swelling, stair climbing and

Discussion:

The results of the present study using Chondral defect scoring system as being simple. The results for subjective score have shown significant improvement of the pain, preoperative mean for pain is **9.3 (SD±2.4)** and postoperative mean **15.3(SD±2)**, also improvement of swelling, preoperative mean for pain is **3.3 (SD±2.4)** and postoperative mean **7.8 (SD±2.6)**, also for Locking, preoperative mean for pain is **6.3 (SD±4.8)** and postoperative mean **10 (SD±0.002)** and all patients were full weight bearing at 3months and were able to return to normal activities for those patients

followed for more than one year from preoperative mean for pain with work is **8.8 (SD±3.9)** and postoperative mean **16 (SD±3.1)**. Relation between total subjective score preoperative and postoperative : It was found that mean for total subjective preoperative is **27.5 (SD±9.4)** and postoperative mean **48.8(SD±48.8)** . The results for objective score have shown improvement in the range of motion, Preoperative mean for **R.O.M.** is **4.3(SD±2.9)** and postoperative **9.3(SD±1.8)** , also improvement for effusion. is **3.3 (SD±2.4)** and postoperative **7.5 (SD±2.6)** ,and also improvement for ability to perform Knee bends and pain with varus /valgus stress. It was found that mean for total objective preoperative is **19.8 (SD±7.9)** and postoperative mean **35 (SD±5.8)** also improved . The total chondral score system , mean improved . It was found that mean for total objective & subjective preoperative is **47.3 (SD±16.3)** and postoperative mean **84 (SD±11.4)** .

In our study we use also use Lysholm score system : The results for the score have shown significant improvement of the **Limp** as it was found that the mean for preoperative was **2.2 (SD ±1)** show improvement postoperative mean **4.7(SD ±0.7)** ; also for **Using Cane Or Crutches (Support)** from preoperative mean **2 (SD ±1.6)** to postoperative mean **4.7 (SD ±0.9)** ; also for **Locking Sensation In The Knee** from preoperative mean **6.4 (SD ±4.4)** to postoperative mean **2.8 (SD ±2)** ; also for **swelling** from preoperative mean **3.2 (SD ±2)** to postoperative mean **8.4(SD ±2)** ; also for **Giving Way Sensation From The Knee (Instability)** from preoperative mean **17.3 (SD ±4.7)** to postoperative mean **22 (SD ±2.5)** ; also for **Climbing Stairs** from preoperative mean **3.4 (SD ±2)** to postoperative mean **7.8 (SD ±2)** ; also for **Squatting** from preoperative mean **2.5 (SD ±1)** to postoperative mean **4.7 (SD ±0.5)** ,and for comparison between **pre and post total scores for lysholm** show improvement from preoperative

45.5(SD±16.1) to postoperative **84.4(SD±10.4)** .

Ulstein, et al. 2014 has Fifteen patients age mean **32.7 (SD±7.8)** , lesion size between 2-4 cm ,11 case in medial femoral condyle and 4 patients in lateral femoral condyle . The OAT mosaicplasty was performed through a medial parapatellar arthrotomy or a mini-invasive arthrotomy, depending on the lesion size and localization. Mean Lysholm score for the patients preoperative **49.2** to postoperative **69.7**.at 2 year followup .

Solheim, et.al.2010 has Thirty-three patients 50 years or younger with symptomatic focal full-thickness chondral lesions verified by arthroscopic examination were included; with articular cartilage defects ranging in size from 1 to 5 cm² were included. Clinical outcome was evaluated by Lysholm score mean for preoperative score **48.1**improved postoperative to **82.3** in one year follow up.

Ma, et.al. 2004 has 18 patients with posttraumatic focal osteochondral defects of the knee were treated with osteochondral autograft transfer. There were 12 males and 6 females with an average age of 29 years (from 16 to 51 years). There were 12 articular defects over the medial femoral condyle, 6 over the lateral femoral condyle. By evaluation of the Lysholm scores, the average preoperative score was **47.5** (range **35—60**), and the average post-operative score was **92.4** (range **79—100**).

Marcacci, et al. 2005 has Thirty-seven active patients younger than 50 years , grade IV lesion of the medial or lateral femoral condyle less than 2.5 cm², confirmed by arthroscopic control, were selected for the study. They were treated using mosaicplasty technique .The results of this series, were satisfactory in 78% of cases at 2-year follow-up.

Following 30 patients for 2 to 5 years, **Chow et al,2004** showed good or excellent results in 83% of patients, with chondral defect score system improvement. MRI at the final follow-up showed 92% restoration of the chondral surface.

Gudas,et al.,2005 has 27 patients treated by OATs . The average score system preoperative 77.88 ± 6.23 , increased to 91.08 ± 4.15 with folowup 20-30 months

Summary and Conclusion

The treatment of articular cartilage lesions remains a difficult clinical problem. Cartilage has a poor intrinsic capacity for repair. Untreated lesions persist indefinitely and can predispose affected joints to pain and dysfunction. Osteochondral autograft transplantation is a well-established technique in the treatment of chondral and osteochondral defects. Also known as mosaicplasty, this method was first described by Yamashita and later popularized by **Hangody**. The procedure involves harvesting small, cylindrical, osteochondral plugs from the comparatively nonweight-bearing periphery of the patellofemoral joint or margin of the intercondylar notch and transplanting them into an area of cartilage damage. Through the utilization of numerous cylinders, it is possible to maintain the radius of curvature of the affected cartilage surface and potentially maintain overall articular congruency. Mosaicplasty can be carried by open or arthroscopic technique with no difference on the outcome except for the wound in open procedure .Donor site morbidity has no problems was encountered except some cases show transient pain not precisely relevant.

The osteochondral plugs will be inserted perpendicular to the joint surface to fill the defect area. The appropriate size chisel is advanced to the proper depth and removed while alignment is maintained at all times.

The postoperative rehabilitation is important for the success of the technique .An emphasis is placed on regaining range of

motion and reducing the postoperative effusion.

Mosaicplasty is a one-step operation , the morbidity is low , independent of laboratory use , and based upon follow up results , mosaicplasty seems to be an alternative in treatment of full thickness cartilage damage. Osteochondral autograft is the best solution for limited cartilage defect.

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الرقع العظمية الغضروفية لعلاج الفجوات العظمية الغضروفية بالركبة

حسام فتحي محمود ، هاني محمد مختار القلش ، عمر محمد عبد الوهاب الكيلاني ، محمد الصادق عطية
قسم جراحة العظام - كلية الطب البشرى - جامعة الزقازيق

إن التكوين الهستولوجي للغضروف المفصلي السطحي يمنحه قدره على تقليل الاحتكاك في المفصل أثناء الحركة وأيضا يتحمل الغضروف السطحي كمية هائلة من الضغوط القوية والمتكررة ولكنه يفقد قدره على الالتئام حتى بالنسبة للإصابات الطفيفة .

تنتج اصابه الغضروف المفصلي السطحي من التواء بالمفصل مع وجود حمل عمودي على المفصل في ذات الوقت مما يؤدي إلى اصابه المريض بالأم وارتشاح للمفصل .

واصبح التصوير بالرنين المغناطيسي يعطي صور دقيقة عن حالة الغضروف و التحديد المبكر لاصابات الغضاريف ويوفر المعلومات ذات الصلة عند التخطيط لإصلاح الغضروف. وايضا بإمكان التصوير بالرنين المغناطيسي تصور ليس فقط على سلامة الغضروف السطح، و قد يسهل رؤيتها بواسطة المنظار الجراحي، ولكن أيضا يوضح حالة العظام تحت الغضروف، والتي لن يسهل رؤيتها بواسطة المنظار الجراحي .

ونتيجة الاهتمام باصابه الغضروف المفصلي السطحي ادى الى استخدام هذه طرق لإصلاح وعلاج إصابات الغضروف المفصلي السطحي . و من بين هذه الطرق استخدام الرقع العظمية الغضروفية لعلاج الفجوات الغضروفية و العظمية الغضروفية بالركبة مما يؤدي الى استعادة سطح المفصل كما كان . ويشمل الاجراء حصد رقع عظمية غضروفية من اماكن فب الغضاريف اقل في تحمل الوزن .و يمكن اجرائها عن طريق تقنية مفتوحة أو بالمنظارو لا فرق في النتائج

الهدف من العمل

تقييم الترقيع العظمي الغضروفي كوسيلة لعلاج الفجوات الغضروفية في مفصل الركبة

طرق والمواد المستخدمة

: سيتم إجراء الدراسة علي عشرون حالة منطبقه عليهم الشروط الآتية

التهاب العظم الغضروفي السالخ حالات كسور العظمية الغضروفية 2- -1:مقاييس إدراج الحالات في عينة البحث

3- نخر لعظمه اللقمة الداخلية أسفل عظمه الفخذ

1-عوجاج شديد بالطرف السفلي 2- خشونة بالمفصل 3- العدوى :مقاييس استبعاد الحالات من عينة البحث-

الأشعة السينية - أشعة الرنين - إكلينيكيًا: - باستخدام الأشعة - سيتم تقييم المرضى قبل إجراء الجراحة كالاتي - المغناطيسي

سيتم تقييم المرضى إكلينيكيًا بعد إجراء الجراحة لمدة سنة و باستخدام الأشعة كل 3 أشهر

النتائج و المضاعفات

الألم هو المشكلة الأكثر لفتا للمريض قبل الجراحة وتخفيف الألم بعد العمل الجراحي هو الأكثر مرضية للخروج من جراحة

المضاعفات تمثلت في الاحمرار السطحي للجرح او الارتشاح الدموي للمفصل او تيبس بالمفصل ما بعد الجراحة

الملخص و الاستنتاج

ان استخدام الرقع العظمية الغضروفية لعلاج الفجوات الغضروفية و العظمية الغضروفية بالركبة هو الحل الأمثل حيث انه يتم بخطوة واحدة و الإجراء رخيص التكلفة .