



Evaluation of the Results of Mosaicplasty in the Treatment of Articular Knee Ulcers

*Systematic Review / Meta-Analysis for Partial
Fulfillment of Master Degree in Orthopedic
Surgery*

By

Akram Samy Iskandar AbdelSayed Mikael
MB BCh- Misr University for Science and Technology

Under supervision of

Dr. Ahmed Samy Kamel

*Assistant Professor of Orthopedic Surgery
Faculty of Medicine - Ain Shams University*

Dr. Waleed El-Sayed Abd Elalim Elshbrawi

*Lecturer of Orthopedic Surgery
Faculty of Medicine - Ain Shams University*

Dr. Waleed Arafat El Tohamey

*Lecturer of Orthopedic Surgery
Misr Univ. For Science and Technology*

*Faculty of Medicine
Ain Shams University*

2019

Acknowledgment

*First and before all, my deepest gratitude is to **GOD** whose help and mercy are undoubtful.*

*I would like to express my deepest gratitude and cardinal appreciation to **Dr. Ahmed Samy Kamel**, Assistant Professor of Orthopedic Surgery Faculty of Medicine - Ain Shams University, who kindly supervised and motivated the performance of this work, for his kind guidance and constant encouragement throughout this work.*

*I am greatly honored to express my sincere appreciation to **Dr. Waleed El-Sayed Abd Elafim Elshbrawi**, Lecturer of Orthopedic Surgery Faculty of Medicine - Ain Shams University, for his continuous support, help and generous advice throughout this work.*

*I'd like to express my respectful thanks and profound gratitude to **Dr. Waleed Arafat El Johamey**, Lecturer of Orthopedic Surgery Misr Univ. For Science and Technology for his keen guidance, kind supervision, valuable advice and continuous encouragement, which made possible the completion of this work.*

Akram Samy Iskandar AbdelSayed Mikael

List of Contents

Title	Page No.
List of Tables	i
List of Figures	ii
List of Abbreviations	iv
Introduction	1
Aim of the Work	4
Review of Literature	
Histology	5
Biomechanics	10
Etiology	15
Pathology	19
Clinical Picture	20
Treatment	27
Mosaicplasty	30
Methodology	38
Results	52
Discussion	67
Summary	69
Conclusion	71
References	72
Arabic Summary	—

List of Tables

Table No.	Title	Page No.
Table (1):	Population included in these studies.	44
Table (2):	The diversity of scoring systems utilized by different authors.	45
Table (3):	Level of evidence of each study.	46
Table (4):	Testing heterogeneity of studies included in meta-analysis of postoperative pain score as measured using the VAS scoring system.	52
Table (5):	Pre and post according to VAS of pain.	55
Table (6):	Testing heterogeneity of studies included in meta-analysis of the Lysholm knee scoring system.	56
Table (7):	Review pre and post-operative evaluation of the results by lysholm.	59
Table (8):	Testing heterogeneity of studies included in meta-analysis of the IKDC scoring system.	61
Table (9):	Review pre and post-operative evaluation of the results by IKDC.	63
Table (10):	Scores according to JOA.	64
Table (11):	KOOS scores for pre- and postoperative Kellgren–Lawrence grades and changes in Kellgren–Lawrence grade.	65

List of Figures

Fig. No.	Title	Page No.
Figure (1):	The arrangement of articular cartilage fibrils.	7
Figure (2):	Distribution of subchondral plate thickness represented in color steps of 100 lm, black 900 lm, blue 100 lm.	12
Figure (3):	8 Distribution of mineralization (by means of CT-OAM) in the tibial plateau (seen from above) of a healthy person (black and red are zones of highest density, green and blue of lowest density).	13
Figure (4):	Types of traumatic injuries to the articular cartilage.	15
Figure (5):	Lysholm score (left) and RHSSK (Right).	23
Figure (6):	45 degrees posteroanterior weight bearing view. 45-year-old man had pain in the left knee at the medial joint line.	24
Figure (7):	Harnessing T1 contrast to delineate articular cartilage.	25
Figure (8):	ICRS Arthroscopic Cartilage Assessment Scale.	26
Figure (9):	A full thickness chondral lesion (A) before debridement, and (B) after debridement.	32
Figure (10):	Notch site for graft harvest.	33
Figure (11):	OAT: Arthroscopy image demonstrating an OAT plug of the medial femoral condyle just prior to final seating.	35
Figure (12):	(A) An arthroscopic photograph shows a 10 mm by 10 mm grade IV defect of the medial femoral condyle (B) a 10 mm diameter osteochondral autograft is in place and effectively resurfacing the defect.	37

List of Figures Cont...

Fig. No.	Title	Page No.
Figure (13):	Flow chart.....	42
Figure (14):	A. Forest plot showing mean postoperative VAS score for pain.....	53
Figure (15):	B. Funnel plot depicting mean postoperative VAS score on the x-axis versus its standard error (SE) on the y-axis.....	54
Figure (16):	A. Forest plot showing mean postoperative Lysholm score.....	57
Figure (17):	B. Funnel plot depicting mean postoperative Lysholm score on the x-axis versus its standard error (SE) on the y-axis.....	58
Figure (18):	Forest plot showing mean postoperative IKDC score.....	62

List of Abbreviations

Abb.	Full term
ACI.....	Autologous chondrocyte implantation
ACL.....	Anterior cruciate ligament
AP	Antero-posterior
BMI.....	Body mass index
CL	Confidence limits
CT-OAM	CT osteo-absorpiometric
ECM.....	Extracellular matrix
FATSAT.....	Fat saturation
FUP.....	Follow up
HSS.....	Hospital for Special Surgery scoring system
I ²	I-square index
ICRS	International cartilage research society
IKDC.....	International Knee Documentation Committee
JOA.....	Japanese orthopedic association
K-L.....	Kellgren– Lawrence grades
KOOS.....	Knee Osteoarthritis and Outcome Survey
MFx.....	Microfracture
MRI.....	Magnetic resonance imaging
MSC	Meniscus
OA.....	Osteoarthritis
OAT.....	Osteo-articular transfer
OCD	Osteochondritis dissecans
OKS.....	Oxford knee score
PGs.....	Proteoglycans
Q.....	Cochran chi square
REM.....	Random-effects method

List of Abbreviations Cont...

Abb.	Full term
RHSSK.....	Revised Hospital for Special Surgery Knee Score
SD	Standard of deviation
SE.....	Standard error
SPIR.....	Single photon inversion recovery
STIR.....	Short tau inversion recovery
VAS.....	Visual analogue scale
WOMAC.....	Western Ontario and McMaster's

INTRODUCTION

The layer of cartilage covering the knee joint surfaces helps protect the joint and reduce friction during movement. Cartilage injuries of the knee in adults can result from trauma, such as during sport, or from a cartilage disease (osteocondritis dissecans). If left untreated, cartilage injuries do not mend by themselves and can lead to significant destruction of the joint (osteoarthritis). ⁽¹⁾

It is important and necessary to thoroughly document and grade chondral lesions when treating patients with articular cartilage defects. In 1961, Outerbridge ⁽²⁾ described the simplest scale by directly observing damaged patellae during arthrotomy. The Outerbridge grading system is widely accepted, although it has size, depth and lesion locale descriptive limitations. Many other classification systems have been established to indicate the severity and type of articular cartilage damage. The international cartilage research society (ICRS) grading system observes the importance of subchondral osseous involvement and is used to describe the defect (area, depth, location). ⁽³⁾

A number of treatment options are available for cartilage injuries but are often aimed at treating symptoms such as pain rather than providing a cure. Non-surgical methods, such as physical therapy, may relieve symptoms but cannot heal cartilage injuries. Microfracture, drilling, mosaicplasty, and

allograft transplantation are surgical treatments that attempt to preserve the joint.⁽¹⁾

Current cartilage repair algorithms ^(4,5,6,7) aim for the optimal treatment to reduce symptoms and restore function. These algorithms stress the importance of lesion-specific factors such as size and intra-articular location (patellofemoral or tibiofemoral). Patient knee demand level, as well as other knee-specific comorbidities (meniscal deficiency, mechanical malalignment, ligamentous laxity) also affect treatment choice. Patient-specific factors such as age and physical activity level are also common considerations.^(7,8,9,10,11) Several factors have been found to affect cartilage defect treatment outcomes, yet have not been included in most existing algorithms. For instance, the intra-articular location of the lesion, specifically the medial femoral condyle, has been shown to predict better outcomes of autologous chondrocyte implantation (ACI) and microfracture (MFx) than lateral defects.⁽¹²⁾ Higher patient body mass index (BMI) has also been associated with worse outcomes of MFx.⁽¹³⁾ Further, female sex has been linked to greater cartilage loss and defect progression.⁽¹⁴⁾

The treatment of full-thickness cartilage defects of the articular surfaces of weight-bearing joints is a frequent problem in orthopaedic practice. Previous experimental and clinical experience with autogenous osteochondral grafting has demonstrated that the transplanted hyaline cartilage has had a good rate of survival.^(15,16,17,18)

The use of small-sized multiple cylindrical grafts would permit more tissue to be transplanted while preserving the integrity of the donor site and that the implantation of grafts in a mosaic-like fashion would allow progressive contouring of the new surface.^(19, 20)

AIM OF THE WORK

The aim of this review is to give surgeons a smart idea and some logic expectations about mosaicplasty in the treatment of articular knee ulcers while making their own decision in treatment.

*Chapter 1***HISTOLOGY****1- Histology of articular cartilage:**

Articular cartilage forms a layer that varies in thickness between 1 and 7 mm which covers tightly the underlying bony surface. This layer mostly intensifies or alter the superficial geometry of the bone. The thinnest portion is usually in center of concave surface and vice versa on convex side. The general characteristics of a healthy young articular cartilage change by ageing. It passes from a smooth compressible white shinny cartilage to a brittle darker less cellular and conspicuously less functional cartilage. ⁽²¹⁾

The articular cartilage remains adherent to the subchondral bony surface throughout life and varies in chemistry and constitution from one site to another in the same joint and to higher extent from one joint to another. ⁽²²⁾ Studies also showed that the 2 to 3 mm in average layer of cartilage that covers most of our joints can withstand a compressive power of 150 and 600 pounds per inch square for an average of 2 million times a year due to its well-designed architectural collagenous deposition. ⁽²³⁾

In a shell nut, this cartilage is composed of chondrocytes (the main cellular portion) and extracellular matrix (ECM). 60 to 85 % of the ECM is water and dissolved electrolytes. The

backbone on which the ECM is built is formed of collagen fibers (10 to 30%), proteoglycans (3 to 10%), non-collagenous proteins and glycoproteins.⁽²⁴⁾

Arising from mesenchymal cells, the chondrocytes have a crucial role in the formation and maintenance of the ECM.⁽²⁵⁾ These cells form about 1% of the whole cartilage volume leaving the rest 99% for ECM complex.⁽²⁶⁾ Chondrocytes are present into cavities called lacunae. Their presence could be isolated on in aggregations. In both conditions, no direct contact between cells is present. Only cilia are propagating into the adjacent ECM.⁽²⁶⁾

Water distribution is variable due to difference in aggregation of macromolecules and to higher extent proteoglycans.^(27,28) Also, it has been proven that an unstopping movement of entry and exit of water is present at the articular cartilage in response to compression and lubrication needs.⁽²⁹⁾

Up to seven types of collagen has been identified in the articular cartilage which includes the following: type II, III, IV, IX, XI, XII and XIV.⁽³⁰⁾ 90 to 95% of the whole content of collagen is of type II. In conjunction with type IX and XI, type II collagen fibrils form a mesh which acts as a backbone for the ECM.⁽³¹⁾ The resting types of collagen are present in small amounts and of a lesser importance.^(32,33,34)

Proteoglycans, due to being highly negatively charged, play an important role in determining the watery content of cartilage.⁽³⁵⁾ 50 to 85 % of the whole PGs content is formed of versican and aggrecan. These PGs form the base on which unbranched glycosaminoglycans including chondroitin sulfate and keratan sulfate get attached.^(36,37) Zonal and genetic differences leads to alteration of the arrangement these PGs.⁽³⁸⁾

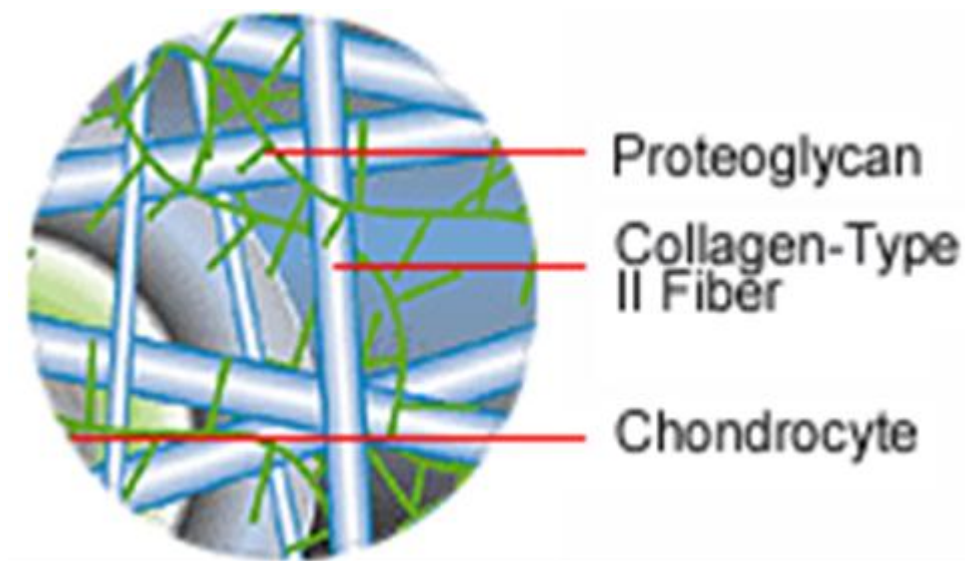


Figure (1): The arrangement of articular cartilage fibrils.⁽³⁹⁾

The articular cartilage is also divided according to depth into zones: -zone 1 superficial or tangential layer –zone 2 intermediate or transitional layer –zone 3 deep layer also called radiate layer –zone 4 calcified layer. Each zone has its characteristic cell volume and shape, watery content and collagenous deposition.⁽²²⁾ On the other hand, cartilage could be divided according to distance from chondrocytes into regions: