

**Partial menisectomy Vs repair in combined
traumatic ACL and medial meniscus injuries.
A systematic review of long-term outcomes.**

Systematic review
*Submitted For Partial Fulfillment of Master Degree in
Orthopedic Surgery*

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2018

Acknowledgment

*First and foremost, I feel always indebted to **ALLAH**,
the Most Kind and Most Merciful.*

*I was honored to work under the supervision
of **Prof. Dr. Tarek Mohamed Samy**, Professor of
Orthopedic Surgery, Faculty of Medicine, Ain
Shams University, for his vital assistance and
unlimited co-operation. He had generously offered
me much of his time, precious advice and variable
guidance throughout this work.*

*I wish to express my deepest thanks and
gratitude to **Dr. Ahmad Hany Khater**, Lecturer of
Orthopedic Surgery, Faculty of Medicine, Ain
Shams University, for his close supervision
,generous efforts and constant encouragement .He
had sacrificed a lot of his busy time to teach me and
revise over step of this systematic review.*

*To my family, all my colleagues and all those
who helped me in this work, I am so thankful for
their support and co-operation.*

Poula Gad Shenouda

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List of Abbreviations

Abb.	Full term
ACL	Anterior cruciate ligament
Ap	Anteroposterior
BMI	Body mass index
BTB	Bone patellar tendon bone
HT	Hamstring
IKDC	International Knee Documentation Committee
ISAKOS.....	The international Society of Arthroscopy, Knee surgery and Orthopedic Sports Medicine
IT	Iliotibial band
Koos.....	Knee injury and Osteoarthritis Outcome Score
MCL	Medial collateral ligament
MM	Medial meniscus
MTC	Medial tibial condyle
NR	Not reported
OA	osteoarthritis
PCP	Perimeniscal capillary plexus
RCT	Randomized controlled trials
ROM.....	Range of motion
RR	Red red zone
RW.....	Red white zone
WW.....	White white zone

INTRODUCTION

The long-term risk of developing osteoarthritis (OA) after anterior cruciate ligament (ACL) reconstruction is of great interest because most patients undergoing ACL reconstruction are young at the time of surgery, with the mean age in outcome studies ranging from 20 to 30 years.⁽¹⁻⁷⁾ Many patients, however, are teenagers at the time of surgery. Being young age at the time of surgery, patients who develop osteoarthritis may be facing difficulty with both athletic and everyday functional activities 20 to 30 years later when they are 40 to 50 years old. Being able to counsel patients as to both the modifiable and non-modifiable risk factors related to the development of OA in the long-term after ACL reconstruction would be of great benefit. One of these modifiable risk factors is the medial meniscus tears.

The medial meniscus, most particularly the posterior segment, was identified as playing a role in anterior laxity control⁽⁸⁾. It therefore seems vital to preserve the meniscus status by repairing these lesions whenever possible to reduce the progression of cartilage lesions⁽⁹⁾.

A deficient medial meniscus results in knee instability and could lead to higher stress forces on the ACL reconstruction, in addition to function as chondroprotection⁽¹⁰⁾.

Anatomy of the menisci

The medial meniscus has a semilunar shape of fibrocartilage localized between the medial femoral and medial tibial condyle⁽¹¹⁾. The medial meniscus covers up to 60 % of the articular surface of medial tibial condyle⁽¹²⁾ and helps with the loading distribution in medial compartment. In 2015, Śmigielski et al.⁽¹³⁾ proposed a new, anatomical division of medial meniscus into five, uneven anatomical zones (Fig. 1). Within each zone, there is similar anatomy and identical ligaments attaching the meniscus to surrounding structures. Therefore, not only anatomy but also technique of suturing may need to differ between zones⁽¹³⁾.

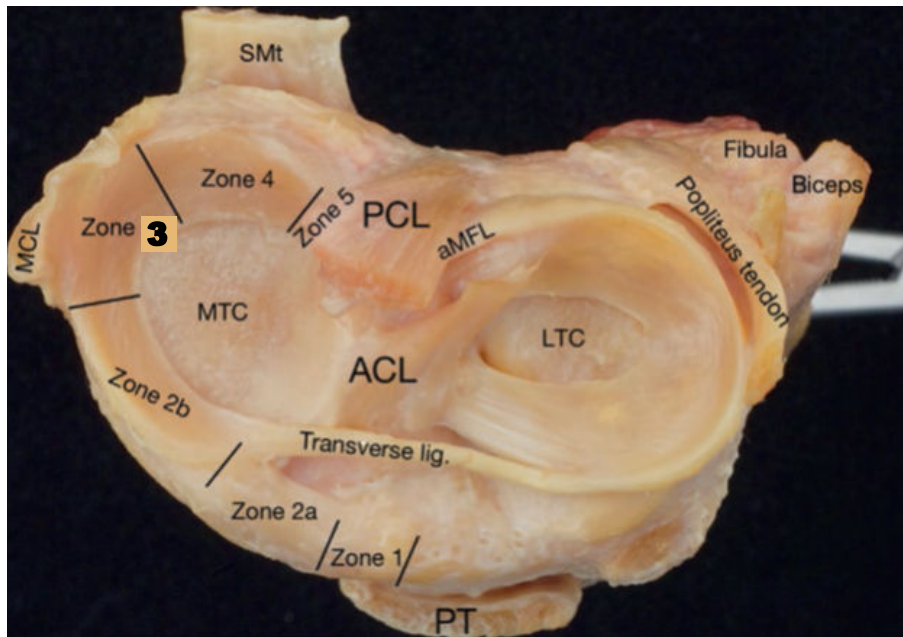


Figure (1): Cadaveric specimen of left knee joint. Femur removed. Division into five anatomical zones of medial meniscus is shown. *PT* patellar tendon, *ACL* anterior cruciate ligament, *PCL* posterior cruciate ligament, *MTC* medial tibial condyle, *LTC* lateral tibial condyle, *MCL* medial collateral ligament, *aMFL* anterior menisiofemoral ligament, *SMt* semimembranosus tendon⁽¹³⁾

Zone 1: Anterior Root

Zone 2: Anteromedial Zone

The meniscus in this zone attaches to the tibia by the meniscotibial ligament, also called the coronary ligament⁽¹³⁾.

Zone 3: At the Level of the Medial Collateral Ligament

This is the only zone where the entire outer part of the medial meniscus fully attaches to the joint capsule⁽¹⁴⁾.

Zone 4: Posterior Horn

It is the most frequently injured and sutured area. Within this zone, the medial meniscus has only its attachment to the tibia, via the coronary ligament, which attaches to the tibia about 7-10mm below its articular surface. The meniscal superior edge and outer part do not attach to anything (Fig. 2). Behind the outer part of the medial meniscus in this zone, there is a large posterior femoral recess⁽¹⁵⁾. Closing this recess by non-absorbable sutures fixing the medial meniscus to joint capsule clearly might impair meniscal biomechanics and therefore might be responsible for failure of the meniscal repair⁽¹³⁾.

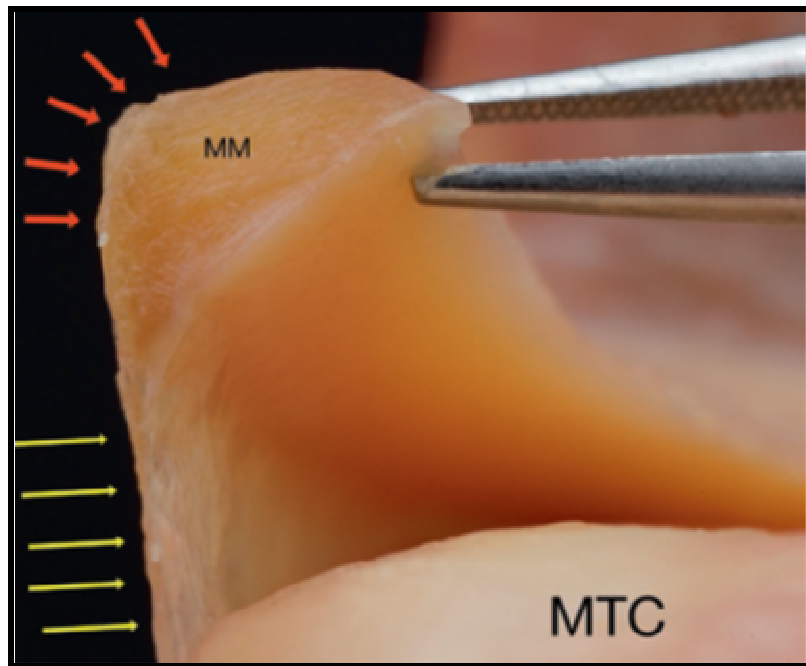


Figure (2): Cadaveric specimen of the left knee joint. Medial meniscus (MM) in the zone 4. *MTC* medial tibial condyle. Meniscotibial (coronary) ligament is marked with *yellow arrows*. Notice superior edge and outer part have no attachments to surrounding tissues (marked with *red arrows*). This type of meniscal ligaments with this zone should be taken into the consideration while planning meniscus suturing and/or reconstruction⁽¹³⁾.

Zone 5: Posterior Root

Vascular Anatomy of the menisci

The meniscus is a relatively avascular structure with a limited peripheral blood supply. Branches of the popliteal artery (medial and lateral inferior and middle geniculate arteries) are the major blood vessels that nourish each meniscus. Radial branches from a perimeniscal plexus enter the meniscus at intervals, with a richer supply to the anterior and posterior horns⁽¹⁶⁾. Vascularization is limited to the peripheral 10–25% for the lateral meniscus and 10–30% for the medial meniscus, which has important implications for healing^(17,18,19). Endoligamentous vessels from the anterior and posterior horns travel a short distance into the substance of the menisci to form terminal loops, providing a direct route for nourishment⁽¹⁸⁾. The remainder of the meniscus receives nourishment via synovial diffusion or mechanical motion⁽²⁰⁾.

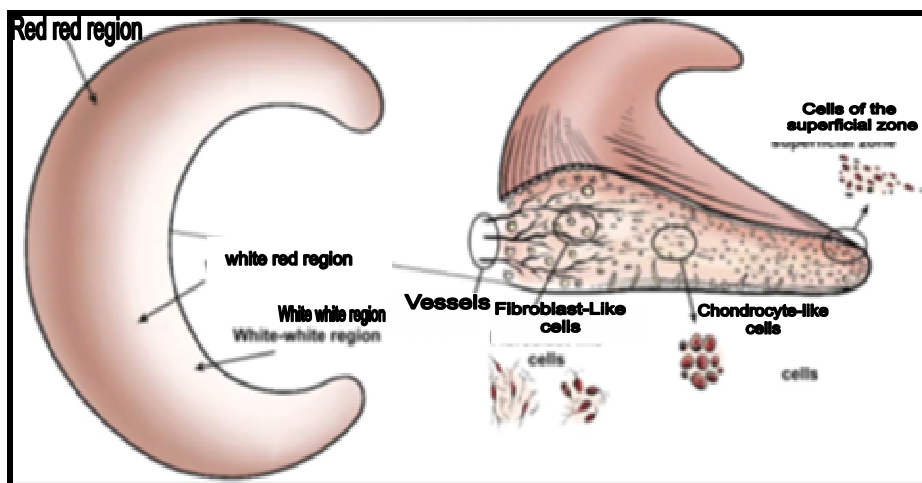


Figure (3): Anatomical variation in vascularization and cell population of the meniscus.⁽²¹⁾

Consequently, there is significant discrepancy in the vascularity of the menisci, with the peripheral tissue ('red-red' and 'red-white' zones) more vascular than the central zones ('white-white' zone). The vascularity of the menisci has also been shown to diminish and become more peripheral with age. Therefore, the healing potential of the meniscus depends largely on the location of the lesion and the age of the patient.^(17,22, 23) Because of its high vascularity, peripheral meniscal tears (red-red and the peripheral part of the red-white zone) have the greatest potential for healing.⁽²²⁾

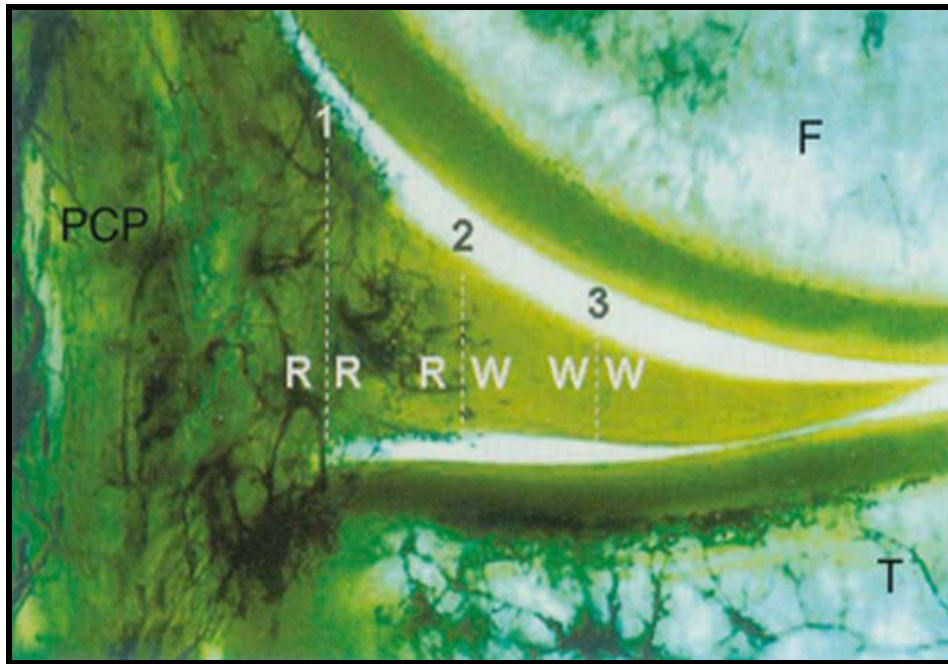


Figure (4): Frontal section of medial compartment. Branching radial vessels from the perimeniscal capillary plexus (PCP) can be observed penetrating the peripheral border of the medial meniscus. Three zones are seen: (1) RR, red-red area is fully vascularized; (2) RW, is at the border of the vascular area; and (3) WW, white-white is within the avascular area of the meniscus. F, femur; T, tibia; PCP, perimeniscal capillary plexus. R, red.⁽¹⁷⁾

Microscopic Composition of Menisci and How It Relates to Function

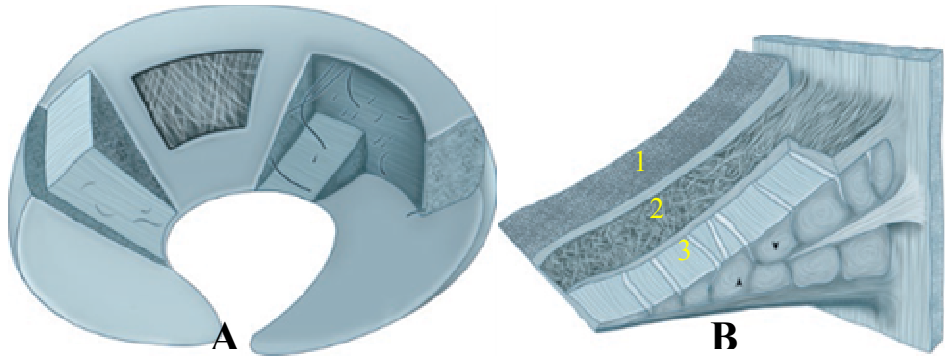


Figure (5): Images taken from Bullough et al. (A)^[24], Petersen and Tillman (B)^[25]. (A) The different fibre directions of the menisci, showing randomly oriented fibres of the superficial layer, vertical fibres of the lamellar layer, and the radial and circumferential fibres of the deep layer. (B) The three distinct layers of the menisci. 1.The superficial layer having disorganized fibres,2. the lamellar layer having peripherally oriented radial fibres with an internal interconnecting meshwork, and 3.the deep layer having large circumferential oriented bundles intermingling with radial tie fibres

Classification of the meniscal tears

Several classifications of meniscal injuries have been proposed over time. Each system of classification approaches a particular aspect of the meniscal structure according to its morphology, proximity to the blood supply, anatomical site, and injury pattern^(26,27).

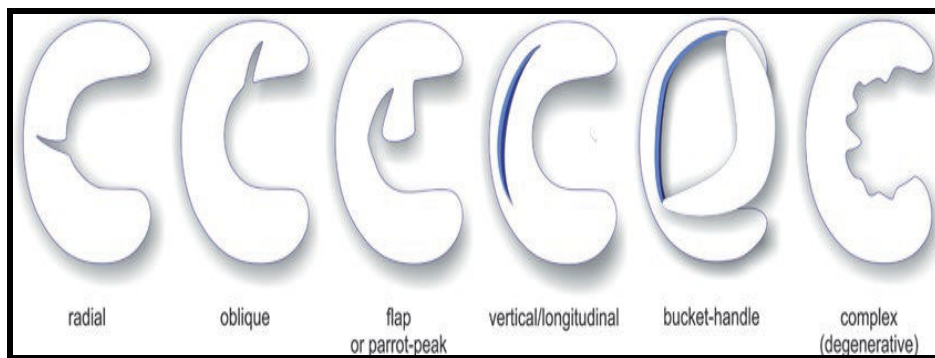


Figure (6): Different patterns of the meniscal tears⁽²⁸⁾.

1. Trillat's Classification

Trillat's classification⁽²⁷⁾ approaches the evolution of the different stages of the traumatic meniscal tear.⁽²⁸⁾

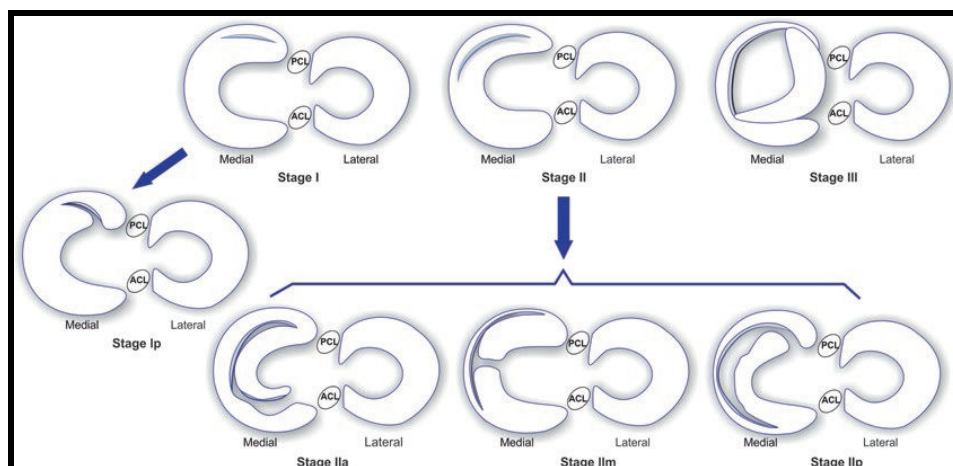


Figure (7): Trillat's classification of traumatic meniscal injury⁽²⁷⁾.

2. MRI Classification of Meniscal Tears

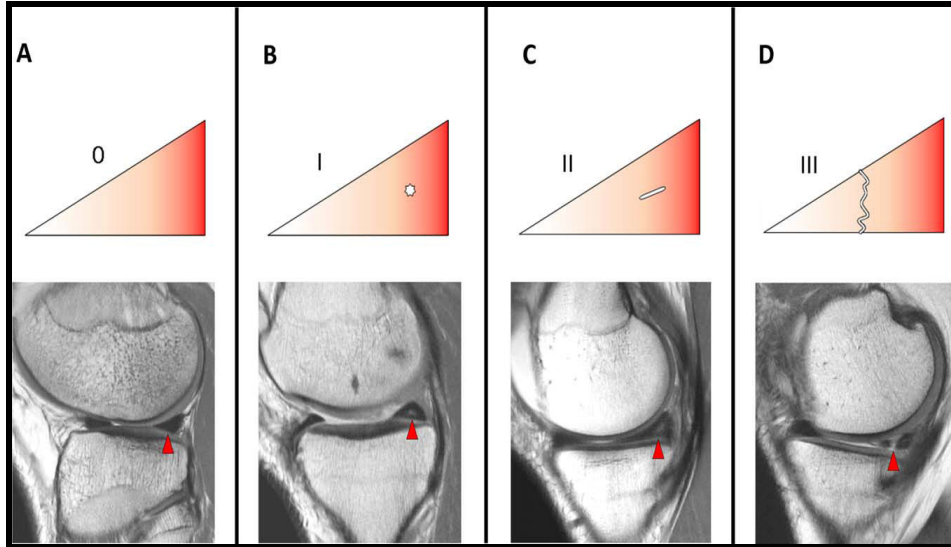


Figure (8): Grade 0, normal intact meniscus; Grade I, intrasubstance globular-appearing signal not extending to the articular surface; Grade II, linear increased signal patterns not extending to the articular surface; Grade III, abnormal signal intersects the superior and/or inferior articular surface of the meniscus, an arthroscopically confirmable tear. Red arrows indicate tear location⁽²⁹⁾.

3. ISAKOS Classification

The ISAKOS classification of meniscal tears⁽³⁰⁾ offers satisfactory results for classifying depth, location, tear pattern, length, tissue quality, and the percentage of the meniscus excised.⁽²⁸⁾