Meniscectomy is one of the most popular orthopaedic procedures, but long-term results are not entirely satisfactory and the concept of meniscal preservation has therefore progressed over the years. However, the meniscectomy rate remains too high even though robust scientific publications indicate the value of meniscal repair or non-removal in traumatic tears and non-operative treatment rather than meniscectomy in degenerative meniscal lesions.

In traumatic tears, the first-line choice is repair or non-removal. Longitudinal vertical tears are a proper indication for repair, especially in the red-white or red-red zones. Success rate is high and cartilage preservation has been proven. Non-removal can be discussed for stable asymptomatic lateral meniscal tears in conjunction with anterior cruciate ligament (ACL) reconstruction. Extended indications are now recommended for some specific conditions: horizontal cleavage tears in young athletes, hidden posterior capsulomeniscal tears in ACL injuries, radial tears and root tears.

Degenerative meniscal lesions are very common findings which can be considered as an early stage of osteoarthritis in middle-aged patients. Recent randomised studies found that arthroscopic partial meniscectomy (APM) has no superiority over non-operative treatment. Thus, non-operative treatment should be the first-line choice and APM should be considered in case of failure: three months has been accepted as a threshold in the ESSKA Meniscus Consensus Project presented in 2016. Earlier indications may be proposed in cases with considerable mechanical symptoms.

The main message remains: save the meniscus!

Keywords: knee; meniscus; meniscus repair; meniscectomy; degenerative meniscal lesions; consensus; guidelines

Introduction

If it is torn, take it out! Take it all out! Even if you just think it’s torn, take it out. Those were the slogan words by Smilie in 1967 referring to meniscal injuries.1

Fortunately, things have changed dramatically and the management of the torn meniscus is now plurally based on basic science knowledge, new diagnostic tools, technical improvements and better long-term outcome assessment:

1. Basic science demonstrated for a long time the crucial role of the menisci in the knee homeostasis. It also demonstrated the repairability of the meniscus thanks to the peripheral vascularity which allows a healing process.2

2. New diagnostic tools, first MRI and then arthroscopy, gave us a better understanding of the meniscal lesions. Saying the meniscus is torn is not sufficient. These tools show the precise tear pattern, the exact location, the extent, the associated injuries such as anterior cruciate ligament (ACL) or articular cartilage. There is not one but several meniscal tears and we have to distinguish them: traumatic tears, which can be classified as a fracture, and degenerative lesions, classified as a disease. Their management is completely different.

3. Technical improvements have accompanied medical advances. Arthroscopy itself was a revolution and not just a tool. It allowed better assessment and partial meniscectomy with fast recovery and low morbidity. Meniscus repair techniques improved progressively. Biological enhancers have also been proposed. But as with all revolutionary tools, arthroscopy had some adverse effects, sometimes resulting in overuse.
4. Assessment of the outcome remains the main important issue, rendering the indication appropriate.

A high volume of meniscectomies are carried out globally.\(^3,4\) It is one of the most popular orthopaedic procedures. But long-term results, even with arthroscopic partial meniscectomy (APM), are not so good and the concept of meniscal preservation has therefore progressed over the years:\(^5,6\). Save the meniscus! However, the meniscectomy rate remains too high even though robust scientific publications indicate the advantages of meniscal repair or non-removal in traumatic tears and non-removal rather than meniscectomy in degenerative meniscal lesions (DMLs). It is interesting to note the considerable gap between these publications and daily practice.

The reasons are numerous:

1. The myth: I always did this operation so it works.\(^7\)
2. The learning curve: meniscal repair is said to be more demanding than meniscectomy. Is it true?
3. Patient pressure: ‘MRI shows a meniscal tear, please take it out’ or ‘Rehabilitation after repair is too long. I want to return to sport’.
4. The medico-economic constraints depend on healthcare systems.

The objective of this review is to describe the current management of meniscus pathology based on current literature and on the ESSKA Meniscus Consensus Project,\(^8\) which was presented in 2016. We will distinguish between traumatic tears and DMLs. Congenital tears are excluded.

**Traumatic tears**

A traumatic meniscus tear is defined by the history of a sudden onset of joint-line pain generally associated with an adequate knee injury. Primarily, vertical tears such as longitudinal, radial tears, flap tears and most posterolateral root tears belong to this group. A traumatic tear can be defined as ‘stable’ or ‘unstable’ according to its mobility. It is essential to locate the tear exactly: the meniscus should be separated into circumferential zones and radial zones\(^9\) (Fig. 1). The radial zone is divided according to the vascularity into red-red, red-white or white-white zones.

In stable knees (intact ACL), about 6% of acutely injured knees sustain a meniscus tear.\(^10\) In chronic ACL-ruptured knees, the rate of meniscal tears is very high,\(^11\) and increases with time with the medial meniscus while it remains the same with the lateral meniscus (around 20%).

In traumatic tears, meniscus preservation is the first-line choice. The reason for preserving the meniscus is, of course, the risk of secondary osteoarthritis after APM.

In stable knees, subjective results are good at more than ten-year follow-up; 85% of patients consider their knee as normal or nearly normal.\(^12\) Outcomes are usually better on the medial side. On the lateral side, the results deteriorate more rapidly with time and there is a higher rate of sports-level change.\(^12\) Iterative re-arthroscopy rate is 14% after lateral meniscectomy compared with 6% after medial meniscectomy.\(^12\) Degenerative changes are very frequent: in Société Française d’Arthroscopie’s (SFA) multi-centre trial, the prevalence of joint-line narrowing was 22% on the medial side and 38% on the lateral side at more than ten-years follow-up.\(^12\) Hulet and Seil\(^13\) observed at 20-year follow-up a 56% osteoarthritis rate in a specific population of lateral meniscectomies (Fig. 2). Other predictive factors are: amount of resection; age at surgery; and extent of articular cartilage damage. These two last factors explain why Osti et al\(^14\) reported 100% of excellent or good functional results after meniscectomy for longitudinal tears versus 79% for complex tears and why Matsusue and Thomson\(^15\) obtained 74% for excellent results after treatment for traumatic tears and 64% for degenerative tears.

In the ACL-deficient knee, isolated meniscectomy is very detrimental with a near 100% osteoarthritis rate at more than 30 years.\(^16\)

Meniscectomy in conjunction with ACL reconstruction is also a factor in causation of secondary osteoarthritis.\(^17\) In their multi-centre study reporting long-term outcomes of 675 ACL reconstructions, Hulet and Graveleau\(^18\) demonstrated an osteoarthritis rate of 29% in the medial meniscectomy group compared with 10% in the intact meniscus group.

**Longitudinal tears**

Meniscus repair outcomes (with or without ACL tear) are now well-established. For vertical peripheral longitudinal tears, the rate of failure is acceptable (6% to 28%).\(^19\)
Repaired tears in the red-red or red-white zones lead to excellent and good clinical mid-term results (Fig. 3).

The anterior-to-posterior location does not play a role in surgical outcome but the literature is unclear as to whether the length of a longitudinal meniscus tear influences the success of repair. Thus, length of meniscus tear should not be a reason against repair. Take the risk of failure and if it fails, the amount of secondary resection will not be higher than the primary virtual meniscectomy.

In the same way, timing influences outcomes: a repair as early as possible is better. In general, acutely repaired meniscus tears achieve superior results compared with chronically repaired tears. However, repaired chronic meniscus tears also achieve good to excellent results and thus should be repaired—when indicated—instead of resected.

The patient’s age does not play a role in the failure rate, provided tears are really traumatic.

Long-term comparative studies and meta-analyses with APM have demonstrated the superiority of meniscus repair in terms of function, return to sports and cartilage protection.

Meniscus preservation is particularly important in ACL-injured knees. Meniscus preservation (repair or non-removal) in combination with ACL reconstruction protects the articular cartilage, and the ACL graft, reducing the residual laxity. ACL reconstruction also protects the meniscus repair.

A Bucket-handle tear with ACL injury is a particular situation. A chronic ACL tear, associated with an acute locked knee, should be treated by prompt repair of the meniscus and simultaneous ACL reconstruction. In an acute or subacute ACL tear with locked knee, the best choice is a two-stage procedure, starting with a meniscus repair and then reconstructing the ACL in the chronic phase. A one-stage procedure can be reasonably proposed in a very acute phase (less than 60 hrs).

Non-removal of meniscus tears at the time of ACL reconstruction has been proposed. Lateral meniscus tears have a better prognosis in terms of secondary meniscectomy compared with medial meniscus tears left in situ. In their systematic review, Pujol and Beaufils included 15 studies with 843 lateral tears and 642 medial tears out of 1485 untreated meniscal tears with concomitant ACL reconstruction. The failure rate was 0 to 1.5% for lateral tears.
small (< 1 cm) tears (Fig. 4), 0% to 7% for larger lateral meniscus tears and up to 15% for medial meniscus tears. However, the exact definition of instability of a lesion has not been clearly defined and the problem of finding correct criteria (e.g. size of lesion and measurable abnormal mobility of the meniscus) remains unsolved. Regarding the risk of secondary meniscectomy, indications for surgical repair can be widened for the medial meniscus and non-removal proposed for the lateral meniscus.\(^{30}\)

Is there still a place for meniscectomy in traumatic longitudinal tears? For sure, yes, but in very selected cases and only when preservation techniques are not suitable. We can cite as examples:

1. Symptomatic complex tears with damaged meniscal tissue.
2. Rare symptomatic non-reparable meniscal tears in middle-aged patients with non-symptomatic ACL injury, justifying an isolated meniscectomy.

Proposing a meniscectomy in a young active patient, with the sole pretext that recovery will be more rapid compared with repair, is not acceptable despite the patient and societal pressure and the medico-economic constraints.

**Extended indications**

Good results after repair in longitudinal tears and the proven capacity to protect the cartilage has led to an extension of the indications to other types of traumatic tears apparently less suitable for preservation. To improve the outcomes which are related to the healing process, some biological enhancers have been proposed.

Meniscus needling and opening the medullary cavity should be avoided. Fibrin glue or fibrin clot can only be weakly recommended, due to a lack of validated studies. Platelet-rich plasma (PRP) use is controversial: one study did not show any improvement compared with isolated meniscus repairs.\(^{31}\) Pujol et al\(^{32}\) did demonstrate improvement with the specific indication of horizontal cleavages in athletes. Local application of cells has not been studied with a robustly designed trial yet.

**Horizontal cleavage in young athletes**

Horizontal cleavage in young athletes is a rare specific condition which can be regarded as an overuse microtraumatic lesion in stable knees, even if histological samples demonstrate some mucoid degenerative tissue. When functional treatment fails, meniscus repair can be considered. Pujol et al\(^{33}\) proposed an open approach. Meniscus repair is performed with vertical sutures (Fig. 5). Injection of PRP could enhance the healing process.
Preliminary results are encouraging demonstrating better results in terms of functional scores and rate of failure (secondary meniscectomy). Again, this treatment has to be compared with a meniscectomy which is subtotal and which would provoke early advanced osteoarthritis, especially on the lateral side. ‘Take the risk of failure!’

**Radial tears**

A radial meniscus tear causes complete loss of meniscus function, if it extends to the peripheral zone. Thus, radial tears of the red and red-white zones should be repaired in order to restore integrity of the rim. This is true for patients with or without concomitant ACL reconstruction. Only in cases when the tear is technically not repairable or there is re-tear of a failed repair should meniscectomy be considered. In contrast, radial tears in the white-white zone can be treated by partial meniscectomy, preserving the peripheral wall.

**Posterior menisco-capsular tears in conjunction with ACL injuries**

Posterior menisco-capsular or even intracapsular lesions have been described in conjunction with ACL tears, especially on the medial side. The natural history is not well-known, but the risk of extension of the tear and the low morbidity of meniscus repair are strong arguments for a repair during ACL reconstruction. It needs an arthroscopic assessment of the posterior compartment to recognise the tear and repair it using a hook.

**Degenerative meniscal lesions**

This section is largely based on the conclusions of the 2016 ESSKA Meniscus Consensus Project whose necessity was indicated after the publication of several randomised control trials (RCTs) followed by extensive discussions.

A DML can be defined as a slowly developing lesion, typically involving a horizontal cleavage of the meniscus in a middle-aged or older person. The most common location is the posterior horn of the medial meniscus. Such meniscus lesions are frequent in the general population with or without symptoms. The prevalence increases with age, ranging from 16% in the knees of women aged 50 to 59 years to over 50% in the knees of men aged 70 to 90 years. These epidemiological data are important from two aspects: first, they demonstrate the remarkably high prevalence of meniscus lesions in the general population which may be considered part of normal ageing. Second, most of these meniscus lesions do not directly cause knee symptoms as over 60% of tears were completely pain-free. MRI of these lesions will identify a linear intra-meniscal signal, often communicating with the articular surface. Such hypersignal indicates ongoing mucoid degenerative changes. The only longitudinal (natural history) study with repeat MRI capturing the development of meniscus degenerative lesions.
lesions in middle-aged persons reported that only 1 of 43 ‘incident’ meniscus tears was associated with acute knee trauma. Instead, it is a slowly developing process (over several years). Loss of meniscus function may negatively affect the knee in the long term. Therefore, in many people a DML is a feature indicative of a knee joint with (or at increased risk of) developing osteoarthritis.

**Diagnosis**

There is a strong need for accurate diagnosis based on clinical examination and eventually radiographs and MRI. This should answer the following questions:

- What is the cause of pain or mechanical symptoms?
- Is there any sign of advanced osteoarthritis?
- Is the DML related to the pain?

The clinical diagnosis of osteoarthritis and/or DML can be made typically on the basis of the duration and character of the knee-joint symptoms, patient history and findings from clinical examination.

Does an unstable DML cause knee symptoms? While there is limited support in the literature that DMLs are considered to be unstable, e.g. flap tears are truly causing knee symptoms, it is still possible that, in some patients, torn meniscus fragments from the DML (by its displacement) may cause knee-joint symptoms (Fig. 8) and particularly mechanical symptoms such as clicking or briefly locking knees.

What is the place of standard radiographs? In the orthopaedic setting, weight-bearing semi-flexed knee radiographs should be included in the work-up of the middle-aged or older patient with knee pain. Joint-line narrowing means advanced osteoarthritis. A skyline patellar view is also important for the detection of radiographic evidence of patella-femoral osteoarthritis.

Knee MRI is typically not indicated in the first-line work-up of the middle-aged or older patients with knee-joint symptoms. MRI captures an incredible amount of tissue change, but today there is very limited knowledge of how to differentiate normal ageing processes from pathological ones and where does, for example, the osteoarthritic processes fit in?

However, knee MRI may be indicated in selected patients with refractory symptoms or in the presence of symptoms indicating a rarer disease that needs to be ruled out, e.g. osteonecrosis. Hence, if a surgical indication is considered, based on history, symptoms, clinical examination and knee radiography, knee MRI may be useful to identify structural knee pathologies that may (or may not) be relevant for the symptoms.

**Management**

APM is a very frequent procedure in the DML field and its incidence is even growing in some countries. The success rate is, of course, high, even in DML in terms of symptomatic relief and return to daily activities and sports.

Pooled results of Salata’s systematic review demonstrated that total meniscectomy or removal of the peripheral meniscal rim, lateral meniscectomy, degenerative meniscal tears, presence of chondral damage, presence of hand osteoarthritis suggestive of a genetic predisposition and increased body mass index were all independent risk factors for poor clinical and radiological outcomes after arthroscopic meniscectomy.

Complications are rare (0.27% to 2.8%): Salzler et al found a 2.8% complication rate after APM and concluded that knee arthroscopy is not a benign procedure: deep vein thrombosis, complex regional syndrome, infection, rapid chondrolysis especially on the lateral side, may follow.

Last, but not least, patients treated with APM present a higher risk for symptomatic knee osteoarthritis compared with normal healthy knees.

Considering these results since 2002, several RCTs attempted to compare APM with non-operative treatment (mainly physiotherapy) or sham surgery. Moseley and Kirkley’s studies were based on osteoarthritic knees, the other ones on knees without advanced osteoarthritis. Apart from Gauffin et al, they all found APM had no benefit over non-operative treatment at a short- or mid-term follow-up, whatever the status of the cartilage. Thorlund et al., in their meta-analysis, confirmed these results.

Publication of these studies introduced a large controversy in the orthopaedic world. We must be aware
that these RCTs, as good as they are, have their biases and weaknesses, and conclusions must be read and interpreted with a critical scientific mind. But these RCTs exist and deliver three important messages:

- APM has no superiority over non-operative treatment.
- The rate of conversion from non-operative treatment to arthroscopic surgery varies from 0% to 35%. This cross-over rate has to be compared with the rate of APM failure.
- Presence of mechanical symptoms does not seem to modify these outcomes, but mechanical symptoms are not well-defined and further investigations are needed.

Starting from these findings, the ESSKA Meniscus Consensus Project proposed an algorithm (Fig. 9) in which ESSKA stated as the main messages:

1. APM should not be considered as the first-line treatment choice.
2. APM should only be proposed after a proper standardised imaging protocol.
3. APM can be proposed after three months of persistent pain/mechanical symptoms or earlier in case of considerable mechanical symptoms.
4. No APM should be proposed with advanced osteoarthritis on Schuss view.

It is definitely time to change the paradigm in meniscus management. Meniscectomy should never be the first-line choice. Meniscus repair in traumatic tears and non-operative treatment in DMLs are the first answers. However, changing the paradigm not only depends on robust scientific evidence but also on continuous education, informing general practitioners, radiologists, the patients and last, but not least, on altering the medico-economic environment.

**Fig. 9** Degenerative meniscus lesion. Algorithm proposed by the ESSKA Meniscus Consensus Project. AP, anteroposterior; LAT, lateral; OA, osteoarthritis.
REFERENCES


