Osteopathic Medicine

The Knee

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1. Introduction

The knee joint is the articulation between the femur and the tibia.

It is the largest joint in the human body.

Because of its position between hip and foot in weight bearing situations, the knee must be able to withstand great forces in different planes. Therefore the knee is vulnerable to injury, not only in sports but also in daily activities.

Osteopaths often deal with patients who present with knee complaints. Beside the anatomy, the osteopath must understand the complex biomechanics of the knee to understand the different provocation tests and to differentiate the complex and great variety of injuries and strains to this joint.

This e-book will cover in detail the biomechanics, differential diagnosis, testing and techniques that are relevant to the assessment and treatment of knee conditions.

For those who are unfamiliar with osteopathic terminology, please refer to chapter 9.
2. Biomechanics


2.1. General
The knee is a hinge type synovial joint.

It comprises four functional compartments:

- The patellofemoral joint (planar joint).
- The lateral femorotibial joint (modified hinge joint).
- The medial femorotibial joint (modified hinge joint).
- The superior tibiofibular joint (syndesmosis joint).

2.2. Joint Specifications

2.2.1. The Patellofemoral Joint
The patella is a triangular bone that rests between the femoral condyle to form the patellofemoral joint.

The medial and lateral facets of the femoral condyles articulate with the patella.

![Figure 1 - medial and lateral facets](image)

The patella glides between the femoral trochlear groove.

The patella increases the angle of pull on the patellar tendon.

The patella improves the mechanical advantage of the knee extensors by as much as 50%.

The greatest compressive forces between patella and femur occur when the knee is in 60-90° of flexion.
The patellar position is maintained by:

- Lateral retinaculum.
- Medial retinaculum.
- Medial patellofemoral ligament.
- Lateral patellofemoral ligament.

![Figure 2 - Stabilizing forces of the patella](image)

The lateral stabilizing structures of the patellofemoral joint are stronger than the medial structures so any imbalance in forces will tend to cause the patella to become positioned more laterally. For example tightness of the lateral structures and weakness of the medial structures, particularly the vastus medialis muscle will cause the patella to move more laterally in this way.

Increased valgus angle at the knee will also tend to cause the patella to migrate more laterally.

### 2.2.2. The Medial and Lateral Femorotibial Joints

The upper end of the tibia has two flat, oval-shaped articular surfaces, the medial and lateral tibial condyles. The femoral and tibial condyles articulate with each other, forming the medial and lateral femorotibial joints. These joints enable the motions of flexion and extension of the knee. Because the articular surfaces are somewhat asymmetrical, the knee also rotates slightly during flexion and extension.

**Medially:** Tibiofemoral joint: modified hinge joint – between the medial condyle of the femur, medial meniscus and medial condyle of the tibia.
**Laterally:** tibiofemoral joint: modified hinge joint – between the lateral condyle of the femur, lateral meniscus and lateral condyle of the tibia.

![Diagram of the knee joint showing lateral condyles](image)

*Figure 3 - Femoral condyles*

![Diagram of the knee joint showing tibial condyles](image)

*Figure 4 - Tibial condyles*
3. Knee Pain

3.1. Sensory Innervation

(Horner & Dellon 1994)

3.1.1. Knee Capsule

Innervation of the knee includes contributions from several nerves:

- The femoral nerve (more medial and anterior side of the knee + patella).
- The lateral femoral cutaneous nerve (lateral side of the knee).
- The sciatic nerve (more posterior side).
- The obturator nerve (anteromedial capsule).

The innervation of the human knee joint is rather constant.

The common peroneal nerve innervates the proximal tibiofibular joint.
3.1.2. Area Nervina
Area nervina are the skin areas innervated by the sensory branches of the peripheral nerves.

Figure 43 - The area nervina - ventral
Figure 44 - The area nervina - dorsal
4. Lesions - Dysfunctions

(Peeters & Lason 2005)

Lesion means that there is a loss of mobility.

Dysfunction of the knee joints can cause symptoms such as pain or limited motion. Dysfunctions can also be due to hypermobility or hypomobility.

4.1. Case History

In the case history, the osteopath tries to identify the nature of the knee pain:

- Aching pain can be ligamentous in origin, especially when occurring in the morning with morning stiffness. Also when it occurs after a longer period of immobilization (sitting or standing). Ligament damage is also often associated with osteoarthrosis. Transient morning pain that subsides after the patient has taken a few steps, but which reappears with exercise such as walking longer distances or climbing stairs (exercise pain), is typical of degenerative knee disorders.
- Sharp pain on specific movements can be caused by muscle strain or inflammation, tendinitis or bursitis.
- Fatigue can be caused by bad posture and poor muscular balance. It can also be associated with arteriosclerosis, rheumatoid arthritis or cancer.
- Irradiating pain indicates a neurogenic factor, this can be radicular or pseudo radicular. (Hoppenfeld 1980)
- Numbness or muscle weakness indicates compression or damage of a nerve.
- Vague, sometimes irradiating pain in the legs during exercise can indicate an ischemic neuralgia. The differential diagnosis should consider neurogenic claudication (in the presence of stenosis of the spinal canal) and vascular claudication (in the presence of peripheral vascular disease). With neurogenic claudication, the patient feels no pain when beginning exercise, and bending forward in a sitting position lessens the pain. Generally, the pain radiates symmetrically into both the front and back of the thigh. With vascular claudication, the patient reports more rapid onset with exercise, and distal rather than proximal pain. This will be accompanied by alterations in perfusion, and occasionally by murmurs detectable by auscultation over the femoral and popliteal arteries.
- Bilateral pain in the knees can be associated with lumbar canal stenosis or rheumatic disease.
- Instability during walking can be associated with osteoarthrosis but also with central neurological problems such as cervical myelopathy.
- Nocturnal pain may indicate cancer, inflammation/infection or rheumatic disease.
The type of patient (child, adult, elderly, pregnant, peri-menopausal woman) can give information to the osteopath about the possible source of pain, and assist the diagnosis.

The onset of knee pain is important. Was there a trauma? Was the onset sudden or have the symptoms progressively worsened?

Where are any recent infections?

Is there symptom magnification and psychological distress? (superficial or non-anatomical pain distribution, non-anatomic sensory or motor disturbance, inconsistent neurological signs, inappropriate or excessive verbalization of the pain).

4.2. Observation
4.2.1. General
The general observation tries to identify:

• Muscular contour (asymmetry).
• Muscular atrophy.
• Swelling and/or erythema.
• Other deformities.
• Observational comparison bilaterally.
• Where are the somatic dysfunctions in the spine (more details in the e-book ‘Integration and Applied Principles in Osteopathy’ by the same authors).
• Observation of other joints such as the feet and hips (position and eventual deformations).

4.2.2. Observation of the shortened Structures
The osteopath observes the position of the knee in space with the patient standing. Important is that he observes the location of the shortened structures.

For example:

• When the osteopath observes a knee position standing in flexion, the shortened structures are on the posterior side of the joint, the relatively overstretched structures on the anterior side.
• When the osteopath observes a knee position standing in valgus, the shortened structures are on the lateral side of the joint, the overstretched structures on the medial side.
• When the osteopath observes a knee position standing in varus, the shortened structures are on the medial side, the overstretched structures on the lateral side.
• In the case of a varus knee, there is more compression in the medial knee compartment.
• In the case of a valgus knee, there is more compression in the lateral compartment of the knee.
• In the case of a valgus knee the patella has moved laterally.

The aim of this observation (of the shortened structures) is to see where local treatment can potentially be useful. Local treatment should be directed to the side of the shortened tissues (mobilization of manipulation).

The patient's pain may be experienced on either the shortened or the overstretched side.

![Diagram showing normal and false axis]

**Figure 75 - Shortened structures or false joint axis**

It is important to understand that the osteopath aims to balance the structure as well as improve the available range of motion of the joint.

In this example (*Figure 75*) the rotation between the two structures remains possible. However, independent of any changes to the range of motion the biomechanics are incorrect and require correction.

The retracted peri-articular structures will create the 3-dimensional false axis.

This concept is one of the significant differences between osteopathy and other manual therapies where the range of motion is considered to be the dominant evaluation for joint mobility.
4.2.3. Observation of the Body Load
This observation is done with the patient standing and in the sagittal plane.

![Diagram](Image)

**Figure 76 - Observation in the sagittal plane**

Important in this observation is to see whether the central gravity line falls in the middle of the knee.

4.2.4. Observation of the Dominant Plane of the Failing Posture
The dominant plane of the failing posture can be:

- The horizontal plane: the patient stands in rotation.
- The frontal plane: the patient stands in lateral shift.
- The sagittal plane: the patient stands in a posterior or anterior type of posture (*Figure 76*).

When the patient stands in rotation, especially horizontal orientated structure (hip rotators) must be considered for treatment. Mostly in relation with lumbar lesions in rotation and oblique abdominal muscles asymmetric tone.

When the patient stands in lateral shift, especially the ad- and abductors must be considered. Mostly in relation with lumbar lesions in sidebending or shift and asymmetric tone of the quadratus lumborum muscles.
When the patient stands in a posterior or anterior type, the flexors and extensors must be considered, as well from the hips and from the lumbar spine. More details can be found in the e-book ‘Integration and Applied Principles of Osteopathy’ by the same authors.

4.2.5. Observation of an antalgic Position
Is the patient standing in an antalgic position to avoid body load on one knee? In that case an intra articular problem such as arthritis must be suspected. Walking on that leg will then also be very difficult.

4.2.6. Observation of a Capsular Pattern
When the patient stands with the knee in a capsular pattern (knee in flexion), osteoarthrosis must be suspected.

Capsular pattern = limitation of extension, more limitation of flexion.

4.2.7. Observation of Gait
After observing the patient standing, the gait has to be observed.

Antalgic gait: the patient attempts to reduce stress on the painful knee with an antalgic gait.

4.3. Provocation Tests

Palpation is the most important way to provoke the complaint structure on pain (especially the peri-articular structures).

Beside that there are specific provocation tests.

4.3.1. Bone Provocation
Although the problem lies in the bone, the pain comes from the periost.

Bone provocation is done through compression on the bone.

Fractures or ‘tumors’, processes that become larger in time and space are possible causes of ‘bone’ pain.

Progression in the complaint pattern indicates a more severe condition.
4.3.2. Intra articular Inflammation
Beside the external observation (swelling, colour) the pain can be provoked by falling on the heels. This compression in the knee joints will cause local pain that remain for seconds.

The articular compression test can also be done through axial compression on the heel with the leg straight. The test is not absolute, meaning that also with intra-articular problems the test can be negative.

Video 1 - Articular compression test

4.3.3. Provocation of the Patellofemoral Joint
The patient lies with the knee on a small support so the knee isn’t completely extended.

The osteopath resists the patella and the patient contracts the quadriceps muscle.

Pain in the patellofemoral joint is an indication for chondromalaxia patellae. Only an indication, no certainty.

Video 2 - Provocation of the patellofemoral joint
5. Techniques

5.1. Mobilizations

5.1.1. General

The aim of a mobilization is:

- Correction of the false axis in the joint by stretching retractions in the capsule and surrounding ligaments. This is done with enough specificity so that it is appropriate even in a joint that is hypermobile in other directions. In this way the biomechanical quality of the joint can be repaired and the overstretched soft tissues can be relaxed.

- Via rhythmical mobilizations and use of long lever techniques a drainage (improved circulation) of all soft tissues around the joint will occur. Local to the false axis (shortened structures) a congestion of all tissue will still occur.

- The mobilization is done in a pain free and rhythmical manner. The aim is to normalize any hyperactivity of the sympathetic system in the surrounding tissues. Pain will increase this sympathetic activity further.

- Via rhythmical compression/traction the synovial production is stimulated which is a desirable reaction when treating arthrotic joints. This is also the reason why mobilizations (in amplitude) of an arthritic joint are not suggested.

- Range of motion increase is not necessarily the primary aim of mobilization. It can even be relatively contra-indicated so as not to cause instability (especially of concern in arthrotic joints).

The mobilization must be pain free so as to avoid increasing sympathetic activity further, which is contradictory to the aim.

The mobilization must occur on the end of range so that a light tension is maintained in the tissues being treated.

The mobilization is rhythmical and with circumduction where possible.
If the aim is to stimulate synovial production, a light push/pull (compression/traction) technique is indicated.

The mobilization is always done in the direction of the false axis (shortened structures) and according to the normal biomechanics of the joint. The hypermobile directions are avoided.
Contra indications

- Inflammation or infection.
- A joint with intra-articular swelling. Mobilization will only increase and worsen the swelling.
- Painful end of range.
- In the direction of a structurally damaged capsule.
- Directly following recent trauma.

5.1.2. Mobilization of the Patella in laterolateral Direction

This is a stretch of the retinaculum patella.

The patient is supine, the knee straight and a small support under the knee.

The osteopath mobilizes the patella medially with the thumbs and pulls back laterally with the fingers.

This movement mobilizes the retinaculum patellae. This is often retracted on the lateral side.

Video 42 - Mobilization of the patella in laterolateral direction
5.1.3. **Correction of an external Subluxation**
The osteopath stands in front of the patient.

He or she crosses the thumbs and contacts the apex patellae with both thumbs. While extending the knee the osteopath pushes the patella cranial and medial, over the border of the lateral condyle.

![Video 43 - Correction of an external patella subluxation](image)

5.1.4. **Lesion of the Patella towards Cranial**
Osteopaths correct this when there is limitation of flexion. The patient is supine, a small support under the knee to avoid complete extension.

With one hand (thenar and hypothenar) he or she takes the apex of the patellae while the other hand supports this grip. The patella is mobilized in a caudal direction.

![Video 44 - Lesion of the patella towards cranial](image)
7. About the Authors

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Both authors are holders of university degrees, namely the Master of Science in Osteopathy (MSc.Ost. – University of Applied Sciences), and are very active with the promotion and academic structuring of osteopathy in Europe. In 1987 they began The International Academy of Osteopathy (IAO) and are, to this day, the joint-principals of this academy. The IAO is since several years the largest teaching institute for osteopathy in Europe. Both osteopaths are members of diverse professional organizations, including the American Academy of Osteopathy (AAO), the International Osteopathic Alliance (IOA) and the World Osteopathic Health Organization (WOHO), as part of their mission to improve osteopathic development.

This osteopathic encyclopaedia aims to demonstrate the concept that a proper osteopathic examination and treatment is based upon the integration of three systems: the musculoskeletal, visceral and craniosacral systems.
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