Arthritic swelling and bone deformations alter the structure’s expected consistency and contours.

**Palpating Bony Prominences**

**Examples:** Medial epicondyle of the humerus, Lister tubercle, anterior superior iliac spine, tibial tuberosity, Gerdy tubercle, posterior superior iliac spine, external occipital protuberance, sacral spinous processes.

**Technique:** Circular palpation using the finger pads and a minimal amount of pressure.

**Expectations:** The bony prominence protrudes from the surrounding bone. The structure itself feels hard when direct pressure is applied to it.

**Commentary:** On the extremities, tubercles, tuberosities, etc. are clearly elevated in comparison to their surroundings and can be clearly differentiated from other tissues with this technique. In most cases, the pelvic spines can be differentiated from their surroundings by their distinctly protruding form. Boundaries cannot always be felt so easily. Their shape is palpated using flattened fingers (Fig. 1.4). Too much pressure makes it difficult to feel differences in shape and position, decreasing the chance of success. Direct pressure is only applied to the structure to confirm that bone is being palpated.

**Tip:** The shape of bony prominences can be visualized by looking at their morphology. However, variations are expected to be encountered quite often (see, e.g., external occipital prominence). This can be a distinct protrusion or very flat.

**Palpating Muscle Bellies**

**Examples:** Infraspinatus, deltoid, erector spinae, semispinalis capitis, gluteal muscles (Fig. 1.5).

**Technique:** Slow palpation. The finger pads (possibly using more than one to create a larger area of contact) are positioned perpendicular to the muscle fibers most of the time. Minimal pressure is applied.

**Expectations:** Soft consistency. Tissue yields slightly to pressure. Deeper structures can frequently be palpated.

**Commentary:** The muscles are palpated using one or several finger pads. Pressure should target the muscle directly. The tissue’s soft, elastic consistency can only be felt by proceeding slowly.
Tip: Tissue consistency is directly dependent on the strength or tension in the fascia enveloping the muscle or the section of the trunk or extremities.

Thickening of the Fasciae

Fasciae can be very soft on the anterior and lateral sides of the trunk, in the neck, along the throat, in the medial forearm, the calf, or the medial aspect of the thigh, for example. Muscles yield easily to the pressure of precise palpation here and have an especially soft, elastic consistency. In contrast, extremely hard fasciae feel significantly firmer during palpation, even when the active muscle tension is normal. Typical examples of this are the thoracolumbar fascia superficial to the lumbar erector spinae and the rectus sheath. Therapists may easily conclude that muscles are tense when increased resistance is felt in the tissues. Once they are aware of the qualities fasciae possess, however, they will have correct expectations regarding the consistency of muscle tissue.

Tension in the Fasciae

The consistency of muscle and skin is also influenced largely by the length of tissues. An approximated muscle (where the ends of the muscle are found close to each other) generally feels softer than the resting tension felt in a stretched muscle.

Approximation or lengthening occurs in the limbs due to the angular position of joints. It is very difficult to palpate local quadriceps induration when the knee is bent at 90°.

Positioning can influence muscle length in the trunk considerably. The changes to palpation become obvious when the lumbar and thoracic trunk extensors in the sitting SP are palpated and this is compared with palpation in the prone position. Even when resting the upper body on a treatment table and other supportive surfaces, muscles are stretched by the flexion/kyphosis of the lumbar spine in a sitting position and by the forward bend of the body. Tissue feels significantly firmer when pressure is applied. Therapists may interpret this as a pathological increase in muscle tension. The amount of tension in the back muscles is also altered when the therapist places padding underneath the abdomen in the prone position, lowers the head end of the treatment table, and elevates the arms. It is not always possible to avoid approximating or stretching muscles during the positioning or skillful examination of patients while keeping symptoms to a minimum. It is important that the therapist takes this into account when looking at the expected consistency of the muscles to be palpated and does not reach the wrong conclusion when interpreting results.

The following exercises should clarify how differences in fascial tension can affect the interpretation of palpatory results on the posterior aspect of the body:

- **Exercise 1:** The gluteal region is palpated, starting at the sacrum and moving systematically in a lateral direction. A hardened area is frequently palpated between the greater trochanter and the iliac crests. The iliotibial tract is located here (thickening of the fascia in the buttocks and the thigh), running from the iliac crest toward the greater trochanter and the lateral thigh. The therapist changes the hip joint’s SP by moving it into more abduction or adduction and attempts to feel how the tract changes under direct palpation (different consistencies due to the muscle being stretched or approximated).

- **Exercise 2:** Firm fascia already restricts direct pressure from being applied to the lumbar trunk extensors. The patient’s pelvis is moved toward or away from the therapist. This causes lumbar lateral flexion. The therapist palpates the trunk extensors and attempts to find out how their consistency changes (different consistencies due to the muscle being stretched or approximated). Lumbar tension is also increased when patients raise their arms over their heads.

**Palpating the Edge of Muscles**

**Examples:** Sartorius, adductor longus, semispinalis capitis, erector spinae, sternocleidomastoid.

**Technique:** A muscle edge is usually palpated with the muscle slightly tensed. The palpating fingers can be positioned using all possible variations (fingertips, finger pads, sides of the fingers) and should be placed against the edge of the muscle as best possible (Fig. 1.6). Once the edge of the muscle has been located, it is steadily followed so that the course and the length of the muscle can be perceived.

**Expectation:** When tensed, the edge of the muscle has a firm consistency and a uniform, smooth contour. Large and small gaps differentiate the edges of the muscle from neighboring muscles.

**Fig. 1.6** Palpating the edges of muscles, demonstrated here on the extensor carpi radialis brevis.
(glenoid cavity) and is the direction for manual therapeutic traction at the GH joint. Manual therapists should therefore first determine the direction of traction by palpating the spine of the scapula before applying traction to the joint. This is possible in any SP.

**Technique**

The inferior and superior edges of the spine of the scapula are palpated using the perpendicular technique with which we are already familiar. The supraspinatus and infraspinatus are often quite tense, which makes locating the spine of the scapula more difficult than on the medial border of the scapula.

The inferior edge is palpated from medial to lateral. The spine of the scapula has a rolling, undulating shape that has developed as a result of the pull of muscular attachments, for example, the ascending part of the trapezius.

To locate the inferior edge exactly, the therapist uses the finger pads to push against the elastic resistance of the skin and muscles and moves the palpating fingers in a superior direction until the finger pads encounter hard resistance (Fig. 2.12).

The muscle belly of the infraspinatus is found underneath the spine of the scapula.

**Acromial Angle**

**Technique**

When the arm is hanging down, the acromial angle is the prominent structure on the lateral end of the inferior edge of the spine of the scapula. The spine of the scapula becomes the acromion at this point (Fig. 2.13).

**Acromion**

The acromion is also an important reference point. The height of the acromion in the resting position can indicate the presence of an "elevated shoulder." During arm elevation, the acromion is also used for orientation to assess the range and speed of shoulder girdle elevation and, when observed from the side, retraction (Fig. 2.14).

**Tip:** The lateral edge of the acromion is generally aligned anteriorly, medially, and slightly superiorly. The shape and dimensions of the acromion vary greatly among individuals and must be palpated precisely. This will be described later in the text.
In the next stage of the palpation, the superior edge of the spine of the scapula is followed from medial to lateral until it meets up with the posterior edge of the clavicle. The therapist will discover that the spine of the scapula is significantly thicker than imagined. When the edges are projected and drawn onto the skin, they are almost parallel to each other, appear very broad, and are 2–3 cm apart.

**Technique**

This palpation uses the same technique described in the palpation of the inferior edge (Fig. 2.15).

The spine of the scapula can be followed from its base to the acromion. The palpation finishes laterally when the fingertips encounter another hard structure. This is the posterior edge of the clavicle. Both of these bony edges (superior edge of the spine of the scapula and the posterior border of the clavicle) taper in toward each other and connect, forming the “posterior V” (see p. 30).
The other carpal bones and their boundaries cannot be reliably differentiated from one another using palpation. Bony reference points or connecting lines are therefore used for their location (Fig. 4.48). These reference lines have been reproduced on anatomical specimens and demonstrate consistent reliability. Orientation begins on the capitate.

**Lunate**

The lunate, another component of the central column, is located by moving the palpating finger about 1 cm proximal and slightly ulnar. The lunate is found exactly halfway along the line connecting the capitate and the joint space of the DRUJ.

**Tip:** The correct localization is confirmed by moving the wrist into flexion and extension, as was the case for the capitate. The lunate disappears palmar during passive extension of the wrist and the edge of the radius becomes palpable.

**Boundary between the Lunate and Scaphoid**

The scaphoid can be found halfway along the line connecting the capitate and Lister tubercle. Another connecting line reveals the boundary between the lunate and scaphoid and involves connecting the Lister tubercle to the DRUJ space. The joint space between these two carpal bones is found halfway along this line.

**Tips for Assessment and Treatment**

In particular, the assessment of lunate mobility on the capitate and the radius provides therapists with information on the presence of lunate instability within the central column (Figs. 4.49 and 4.50). Mobility is often restricted in the articulation between lunate and scaphoid and can interfere with mobility in both the proximal row of the carpal bones and movements in the wrist as a whole (Figs. 4.51 and 4.52).

**Carpal Bones in the Ulnar Column**

The palpation begins proximal, on the forearm. The recommended position for the therapist is on the thumb side of the hand, allowing free access to the ulnar column (Fig. 4.53).
Technique

Triquetrum

The therapist starts palpating the head of the ulna. The triquetrum is the next bony structure distal to the head of the ulna. A depression can be felt at the junction between these two structures, indicating the presence of an articular disk.

It is easy for the thumb and the index finger to hold onto the dorsal triquetrum and palmar pisiform and to move these bones, with the articular disk, opposite the head of the ulna in a posterior–anterior direction (Fig. 4.54).

This movement is always extensive compared with the previously described movements within the carpus. The range of motion indicates the presence of hypermobility and therefore the ability of the TFC complex (see p. 74) to stabilize the ulnar column.

Tips: In principle, it is relatively easy to locate the triquetrum because it is the most prominent carpal bone distal to the head of the ulna. There are situations, however, that require additional reassurance. The localization is confirmed by assessing the way the triquetrum moves during movement of the wrist, as was done with the scaphoid in the radial column:

- The therapist palpates the dorsal aspect of the triquetrum and passively flexes and extends the wrist. The triquetrum protrudes dorsally during flexion and disappears in a palmar direction during extension.
- When conducting radial and ulnar deviation of the wrist, it becomes evident that the normal rolling and gliding movements are accompanied by rotation. The triquetrum becomes more prominent during radial deviation and disappears again in a palmar direction during ulnar deviation. This makes the large range of motion in the ulnar direction possible and permits the base of the fifth metacarpal to move closer to the ulna.
- The movement of the triquetrum can be felt beneath the tendons of the extensor carpi ulnaris, similar to the be-
When the therapist palpates laterally over the femoral and tibial condyles, the fingers are soon pushed superficially out of the joint space again.

**Proximal to the Knee Joint**

The entire width of the tract can be located when this collagenous structure is tensed by the strong contraction of muscles. The vastus lateralis and tensor fasciae latae contract here.

With the knee in slight flexion, the patient is instructed to isometrically contract the quadriceps. The hip is also flexed, abducted, and medially rotated.

Using a perpendicular palpation technique, the edges of the tract can be identified slightly proximal to the level of the base of the patella (Fig. 6.50).

**Note**

- The tract is found directly over the lateral epicondyle when the knee is in 30–40° flexion. Less flexion shifts the tract so that it is then anterior to the epicondyle, while more flexion moves it posteriorly. It now becomes apparent that the iliotibial tract must slide over the epicondyle during the gait cycle. This can occasionally cause symptoms.
- A significant number of tract fibers extend down to the lateral edge of the patella and insert slightly distal to the vastus lateralis tendon.

**Gerdy Tubercle**

The iliotibial tract’s main insertion has many names. It is generally referred to as the “Gerdy tubercle.” Other terms used in the literature include lateral condyle of the tibia and lateral tibial condyle.

**Technique**

It is usually easy to locate this area of roughness and its borders by again using several flattened fingers to stroke over the anterolateral side of the tibia slightly inferior to the joint space (Fig. 6.51). This elevation is palpated as a semicircular structure directly inferior to the edge of the tibial plateau.
**Lateral Epicondyle of the Femur**

This structure is significantly less prominent yet easier to find than its medial counterpart.

**Technique**

The same palpatory procedure is used here as for the medial side. This region is palpated by placing several finger pads flat over the region and applying gentle pressure. The most prominent elevation is the lateral epicondyle (Fig. 6.52).

**Tip:**
- This structure can be used as a point of orientation when searching for the lateral collateral ligament.
- The tendinous insertion of the popliteus can be felt from the epicondyle by palpating approximately 0.5 cm distal to the tip of the epicondyle and then 0.5 cm anterior. The tendon inserts between the collateral ligament and the capsule and can only rarely be differentiated from the neighboring structures. Localization is therefore confirmed by instructing the patient to rhythmically flex and extend the knee slightly. A contraction is felt underneath the palpating finger. However, this localization can be categorized as rather difficult.

**Head of the Fibula**

The next stage of the palpation of the lateral knee joint encompasses the entire dimensions of the head of the fibula.

**Technique**

The localization of the posterolateral tibial plateau can usually be palpated without problems by initially using the flattened finger pads. The anterior, proximal, and posterior contours of the head of the fibula are identified next. Again, a perpendicular palpation technique is used. Therapists will be surprised by how large the head of the fibula is when they locate it for the first time (Fig. 6.53).

It also becomes apparent that the head of the fibula has a tip that varies greatly between individuals and marks the lateral collateral ligament as well as the large portion of the biceps tendon.

**Tip:** If it is still difficult to locate this structure and palpate it in its entirety, the prominent tendon of the biceps femoris can be followed distally onto the tip of the head of the fibula (see the “Biceps Femoris” section below, p. 142).

**Lateral Collateral Ligament**

The therapist can mark the course and dimensions of the lateral collateral ligament by drawing a line between the lateral epicondyle and the head of the fibula (Fig. 6.54).
this muscle compared with the localization of the sternocleidomastoid. The muscle often has to be strongly contracted to make its position clear. Its muscle belly becomes distinct during extensive active movements of the cervical spine into extension, rotation, and lateral flexion toward the side being palpated.

The patient’s cervical spine is positioned in neutral and the therapist places the finger pads flat over the edge of the occiput in the space between the semispinalis capitis and sternocleidomastoid (Fig. 12.64a, phase 1). The therapist then positions the cervical spine in slight extension, rotation, and lateral flexion toward the side to be palpated (Fig. 12.64b, phase 2). The patient is now looking over the therapist’s shoulder. The patient pushes their head further in this direction, while the therapist’s hand opposes this movement. The splenius, in particular, provides the necessary strength and its muscle belly can be clearly felt as it pushes against the palpating fingers.

Suboccipital Nerves and Blood Vessels

As already discussed in the chapter on anatomy, two nerves and one artery pass over the edge of the occiput as they travel toward the head: the occipital artery and the greater and lesser occipital nerves. The position of these structures is very variable. The most accurate de-
A description of their course can be found in Lanz and Wachsmuth (1979). The course described in this book represents the accepted average. These structures can be identified very precisely using palpation once therapists have practiced a lot and gained experience. Two areas on the occiput exist that are covered by less firm muscles. These areas will be named the intermuscular gaps on the occiput in the following text; they aid therapists in locating the nerves and the artery. These intermuscular gaps can be clearly felt at two points when palpating from medial to lateral along the occiput. Each gap is located in the space between two neighboring muscles (Fig. 12.65):

- **Medial intermuscular gap:** lateral edge of the semispinalis capitis and medial edge of the splenius capitis. The occipital artery and the greater occipital nerve pass through the fascia at this point and travel subcutaneously onto the occiput. At this point, the posterior arch of the atlas can be indirectly reached when firm pressure is applied. This is of great importance for a variety of mobility and stability tests as well as for manual therapeutic treatment techniques targeting the C0/C1 segment.

- **The lateral intermuscular gap** is found between the lateral edge of the splenius and the posterior (medial) edge of the sternocleidomastoid. The lesser occipital nerve passes over the edge of the occipital bone here.

It juts out from behind the sternocleidomastoid around the level of C2 and travels in a straight line up onto the occiput.

To locate the **occipital artery**, a finger pad is gently placed flat over the edge of the occiput at the level of the medial intermuscular gap (Fig. 12.66a). It usually takes a while before the arterial pulse can be felt. If the pulse cannot