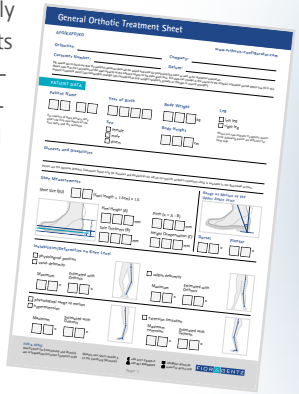
General Physical Examination Guide

for the Orthotic Treatment of the Lower Extremity

6th edition

The First Step towards a Custom-Made Orthosis


General Orthotic Treatment Sheet

An individual AFO, KAFO or KO is exclusively produced for a single user. Body measurements and muscle strength are examples for patient-related data determined during the examination. Number and accuracy of the gathered data have a great effect on the functionality of the orthosis. Therefore, all data collected during the physical examination should be recorded in the orthotic treatment sheet.

In this guide, each step of the physical examination is presented clearly and chronologically. The relevant movements are displayed descriptively. In order to facilitate an interdisciplinary communication, the muscle strength is determined according to Janda. The structure of this guide is based on the orthotic treatment sheet. For the indications stroke, cerebral palsy and multiple sclerosis, please see the respective guides and use the orthotic treatment sheets specially designed for these indications.

You can also find the physical examination among the online tutorials on our website **www.fior-gentz.com**.
All steps for providing orthotic treatment are listed clearly in the form of online tutorials.

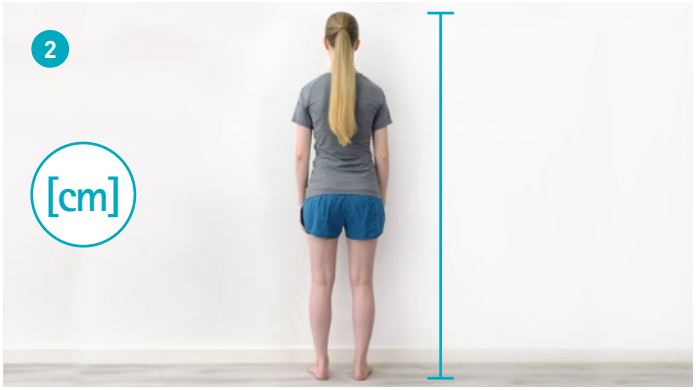
Use this guide as a code of practice, reference text, personal check list or as a basis for your physical examination procedure.

Your FIOR & GENTZ team

Content

Body Weight and Height

Determine the **body weight**. Foreseeable changes due to growth should be taken into account.



Determine the **body height**. Foreseeable changes due to growth should be taken into account.

Range of Motion in the Upper Ankle Joint

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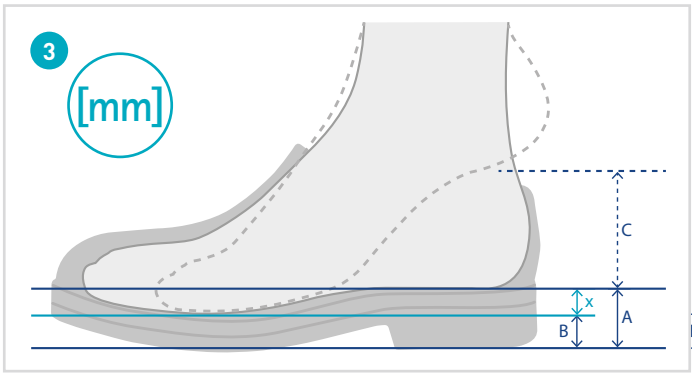

Determine **pitch** x of the shoe (difference between heel height A and sole thickness B in the ball area). Measure A and B and apply the formula x = A - B. Transfer the determined pitch to the h-Cast.

C represents a possible height compensation.

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x – 10mm	x – 10mm	x – 10mm	x – 10mm

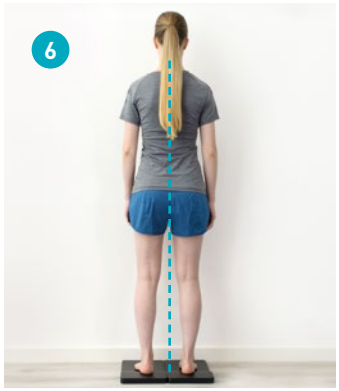
If the patient wishes to use different shoe models, take all measurements. If the shoes only differ in heel height A and sole thickness B, but have the same pitch x, note the maximum values of A and B and go to step 6. Otherwise continue at step 5.

If the shoe models have a different pitch x, there are two options:

1. The orthosis is equipped with a system joint that can be adjusted to different pitches. This is the case with the NEURO HiSWING system ankle joint.
2. The patient chooses a set pitch.

Option 1: Determine the maximum and minimum value of pitch x of the different shoe models. Calculate the mean value. This value is needed for making the negative cast. For all other work steps, use the maximum value of pitch x.

The patient is standing on the h-Cast. Check if the patient stands in a plumb line, e.g. by using a laser plumb bob. The plumb bob should fall from the 7th cervical vertebrae (C7) through the cleft between the buttocks and the middle of the supportive area of both feet. If this is not the case – e.g. due to a unilateral contracture – the patient requires a **height compensation**. Determine the height compensation (see C at step 3) and transfer it to the h-Cast. Check the result.

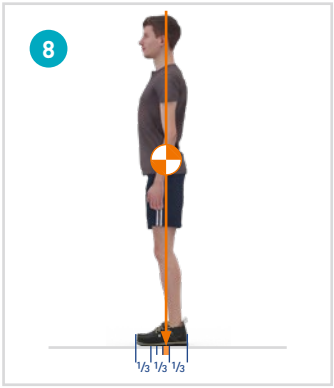


Note: if the patient is unable to stand (even with assistance), determine the height compensation e.g. while lying.

Determine the **shoe size** (S1) by measuring the foot length and applying the formula (foot length + 1.5cm) x 1.5. If the feet differ in length, write down the larger shoe size.

Check the **individual normal posture** in the sagittal plane with the help of a laser plumb bob. The plumb line should fall as follows:

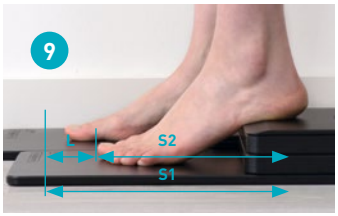
- from the body's centre of gravity,
- across the greater trochanter,
- centrally through the ap measurement at knee height,
- to the rear third of the front half of the supportive area.



With extension deficits, the knee joint does not serve as a reliable point of orientation. If this is the case, get as close to the above-mentioned fixed points as possible.

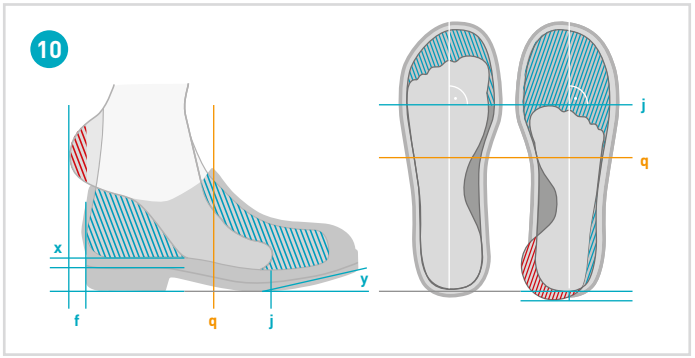
Note: take the length difference of the feet into account, if present.
Note: if the patient is unable to stand (even with assistance), mark the plumb bob reference area (orange) on a stencil and note the values.

Determine the **length difference** L. Measure S1 and S2 and apply the formula L = S1 - S2. Write down the length difference L in order to be able to compensate the difference during the following steps.



Note: if the patient is unable to stand (even with assistance), use a stencil for markings and note the values.

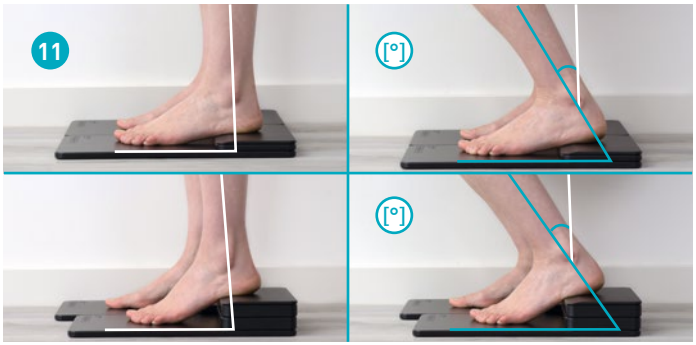
Important! For a symmetrical stride length, there should be equal leverage ratios on both sides. To achieve that, the rolling-off line's position and the heel lever must be adjusted in case of a functional shortening (e.g. due to a height compensation).



When producing a **height compensation**, it is essential to create a leverage ratio that is similar to the contralateral side. To do so, the following steps are necessary:

- compensate the volume under the heel and in the forefoot area (blue hatching)
- set the heel back (pink hatching)
- define the mechanical rolling-off line (j)
- consider the heel-to-toe drop (x)
- consider the toe spring (y)

Note: mark the plumb and rolling-off line of the healthy/unaffected foot on the shoe's insole (or a stencil) and use the values as a guidance for all further steps.



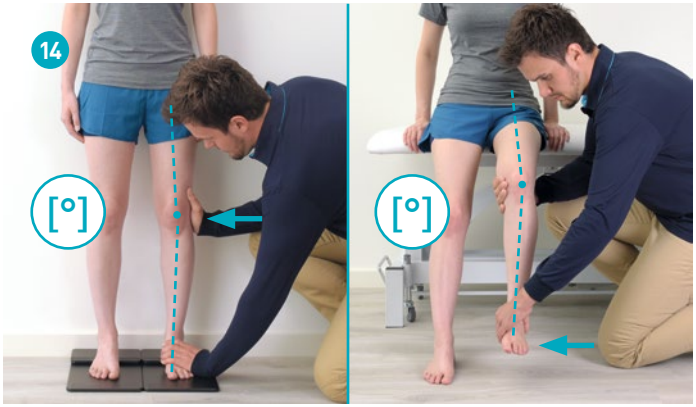
The **range of motion in the upper ankle joint in dorsiflexion** is measured based on the individual normal posture. Position the patient on the h-Cast, taking into account the leg length/height compensation and the shoe pitch. Measure the range of motion of the upper ankle joint in dorsiflexion based on the individual normal posture.

Note: if the patient is unable to stand (even with assistance), place them on a chair and push their feet back on the h-Cast until the heel lifts from the plate.

The **range of motion in the upper ankle joint in plantar flexion** is measured based on the individual normal posture. Position the patient on the h-Cast, taking into account the leg length/height compensation and the shoe pitch. Measure the range of motion of the upper ankle joint in plantar flexion based on the individual normal posture.

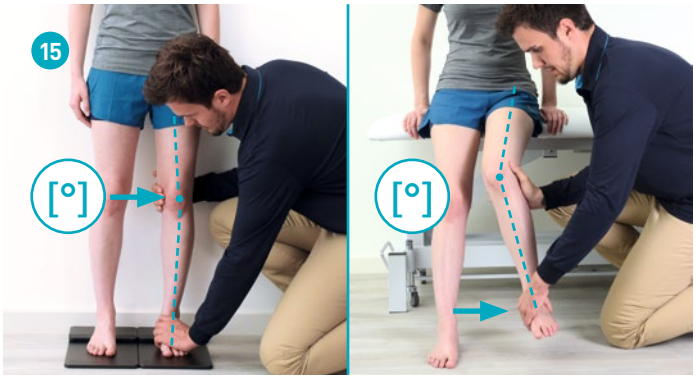
Note: if the patient is unable to stand (even with assistance), place them on a chair and push their feet forward on the h-Cast until the forefoot lifts from the plate.

The patient is standing on the h-Cast with their patellae facing forward. Check whether the leg axis deviates from the neutral position (**deformities**).



If there is a deviation in varus, correct it as much as possible and determine the **value estimated with orthosis** of the corrected **varus deformity**. If the deformity cannot be corrected, we recommend that you still use the box on the General Orthotic Treatment Sheet to document the estimated value. Then, determine the **maximum** varus deformity without load on the leg. If the values match, there is a deformity, but no instability.

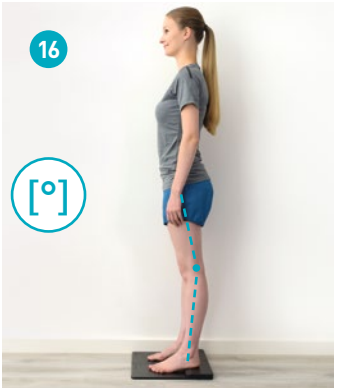
Note: if the patient is unable to stand (even with assistance), determine the approximate values in a sitting position.



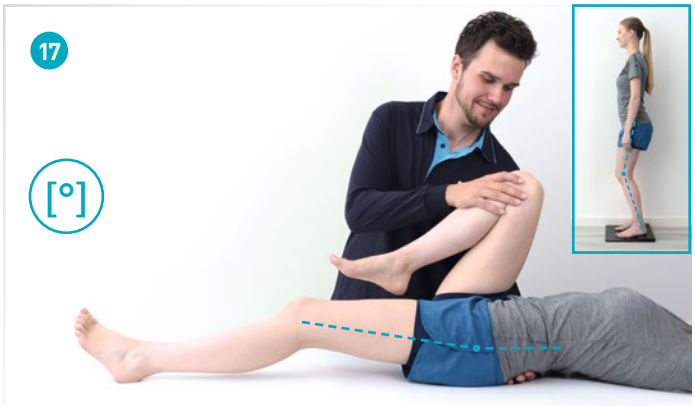
If there is a deviation in valgus, correct it as much as possible and determine the **value estimated with orthosis** of the corrected **valgus deformity**. If the deformity cannot be corrected, we recommend that you still use the box on the General Orthotic Treatment Sheet to document the estimated value. Then, determine the **maximum** valgus deformity without load on the leg. If the values match, there is a deformity, but no instability.

Note: if the patient is unable to stand (even with assistance), determine the approximate values in a sitting position.

Measure the maximum knee **hyperextension**. Correct it, if possible, to achieve a physiological knee angle. Due to patient-specific conditions, this may not be attainable in some cases. In any case, determine the hyperextension **estimated with orthosis** (e.g. 4°). All values, which exceed 0° flexion (e.g. 4° flexion), undo any hyperextension and are marked as 0°.



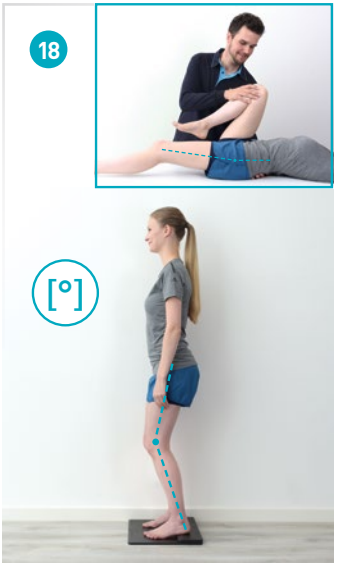
Note: if the patient is unable to stand (even with assistance), determine the approximate values in a sitting position. Keep in mind that the angles of the upper ankle joint and hip affect the knee angle.

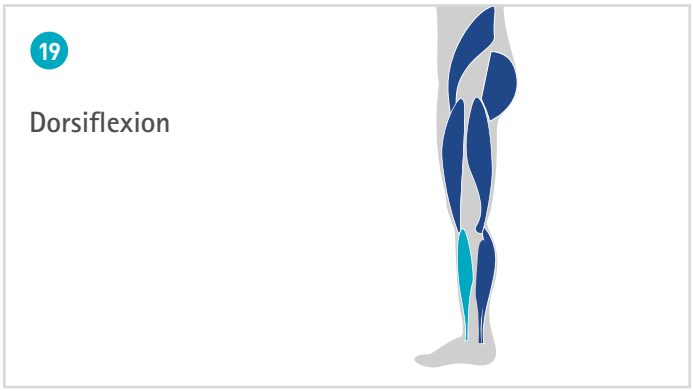


Apply the Thomas test to determine the **extension limitation of the hip**. The patient is lying on their back. Place one hand under the lumbar vertebrae to check the reduction in the curve of the lumbar spine. Bring the leg not to be tested into hip flexion with the knee bent. The hip flexion angle is measured on the side to be tested. Note that the extension limitation of the hip **estimated with orthosis** can affect the individual normal posture in the sagittal plane.

The patient is standing on the h-Cast. Adjust it so that all influencing factors, such as the extension limitation of the hip, are taken into account. Measure the knee angle. It deviates from the physiological angle if there is an **extension limitation of the knee** and/or hip. Pain can also lead to a deviation.

Note: if the patient is unable to stand (even with assistance), determine the approximate values in a sitting position. Keep in mind that the angles of the upper ankle joint and hip affect the range of motion at knee height.





Dorsiflexion – Muscle Strength 5 and 4

The patient is lying on their stomach. The foot of the leg to be tested is hanging over the edge of the examination table. Hold the lower leg in place with one hand without restricting the muscle function. Press against the back of the foot with the other hand. Have the patient bring the foot into dorsiflexion. At complete range of motion against gravity with full resistance, the **muscle strength** is **5**. At range of motion against gravity with some resistance, the **muscle strength** is **4**.

Dorsiflexion – Muscle Strength 3

The patient is seated. The lower legs are hanging over the edge of the examination table. Hold the lower leg in place with one hand without restricting the muscle function. Have the patient bring the foot into dorsiflexion. At range of motion against gravity, the **muscle strength** is 3.

Dorsiflexion – Muscle Strength 2

The patient is lying on the side of the leg to be tested. Place one hand under the foot so that it is no longer resting on the examination table. Have the patient bring the foot into dorsiflexion. At range of motion with gravity eliminated, the **muscle strength** is 2.

Dorsiflexion – Muscle Strength 1 and 0

The patient is lying on the side of the leg to be tested. Place one hand under the foot so that it is no longer resting on the examination table. Have the patient bring the foot into dorsiflexion. Palpate if there is any muscle activity. At slight contraction with no joint motion, the **muscle strength** is **1**. At no evidence of contraction, there is a total paralysis and the **muscle strength** is **0**.

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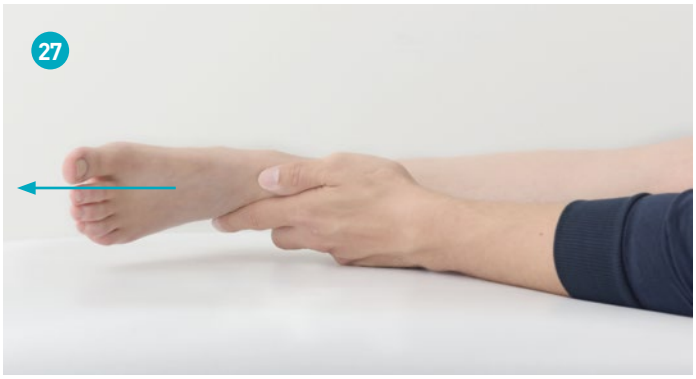
Plantar Flexion

Plantar Flexion – Muscle Strength 5 and 4

The patient is lying on their stomach. The foot of the leg to be tested is hanging over the edge of the examination table. Hold the lower leg in place with one hand without restricting the muscle function. Press against the forefoot from below with the other hand. Have the patient bring the foot into plantar flexion. At complete range of motion against gravity with full resistance, the **muscle strength** is **5**. At range of motion against gravity with some resistance, the **muscle strength** is **4**.

Plantar Flexion – Muscle Strength 3

The patient is lying on their stomach. The leg to be tested is flexed. Have the patient bring the foot into plantar flexion. At range of motion against gravity, the **muscle strength** is **3**.



Plantar Flexion – Muscle Strength 2

The patient is lying on the side of the leg to be tested. Place one hand under the foot so that it is no longer resting on the examination table. Have the patient bring the foot into plantar flexion. At range of motion with gravity eliminated, the **muscle strength** is **2**.

Plantar Flexion – Muscle Strength 1 and 0

The patient is lying on the side of the leg to be tested. Place one hand under the foot so that it is no longer resting on the examination table. Have the patient bring the foot into plantar flexion. Palpate if there is any muscle activity. At slight contraction with no joint motion, the **muscle strength** is **1**. At no evidence of contraction, there is a total paralysis and the **muscle strength** is **0**.

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Knee Extension

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Knee Extension – Muscle Strength 5 and 4

The patient is seated. The lower legs are hanging over the edge of the examination table. Hold the thigh in place with one hand without restricting the muscle function. Press against the lower leg above the foot with the other hand. Have the patient bring the knee into extension. At complete range of motion against gravity with full resistance, the **muscle strength** is **5**. At range of motion against gravity with some resistance, the **muscle strength** is **4**.

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Knee Extension – Muscle Strength 3

The patient is seated. The lower legs are hanging over the edge of the examination table. Hold the thigh in place with one hand without restricting the muscle function. Have the patient bring the knee into extension. At range of motion against gravity, the **muscle strength** is **3**.

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Knee Extension – Muscle Strength 2

The patient is lying on the side of the leg not to be tested. Support and lift the upper leg with one hand. Hold the pelvis in place with the other hand without restricting the muscle function. The leg to be tested is slightly flexed. Have the patient bring the knee into extension. At range of motion with gravity eliminated, the **muscle strength** is **2**.

Knee Extension – Muscle Strength 1 and 0

The patient is lying on their back. The leg to be tested is slightly flexed in hip and knee. The other leg is extended. Have the patient bring the knee into extension. Palpate if there is any muscle activity. At slight contraction with no joint motion, the **muscle strength** is **1**. At no evidence of contraction, there is a total paralysis and the **muscle strength** is **0**.

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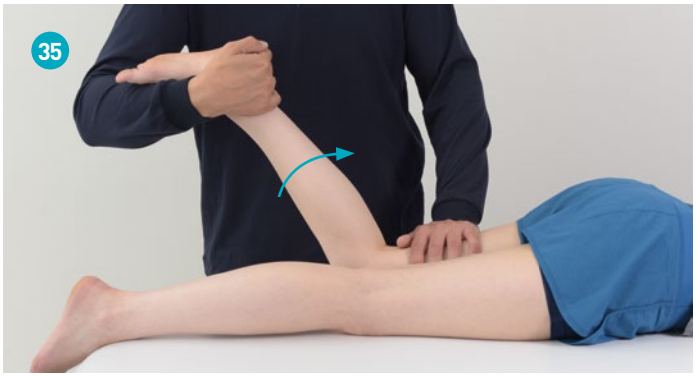
Knee Flexion



Knee Flexion – Muscle Strength 5 and 4

The patient is lying on their stomach. The foot of the leg not to be tested is hanging over the edge of the examination table and the leg to be tested is flexed. Hold the thigh in place with one hand without restricting the muscle function. Press against the lower leg close to the foot with the other hand. Have the patient bring the knee into flexion. At complete range of motion against gravity with full resistance, the **muscle strength** is **5**. At range of motion against gravity with some resistance, the **muscle strength** is **4**.

Knee Flexion – Muscle Strength 3

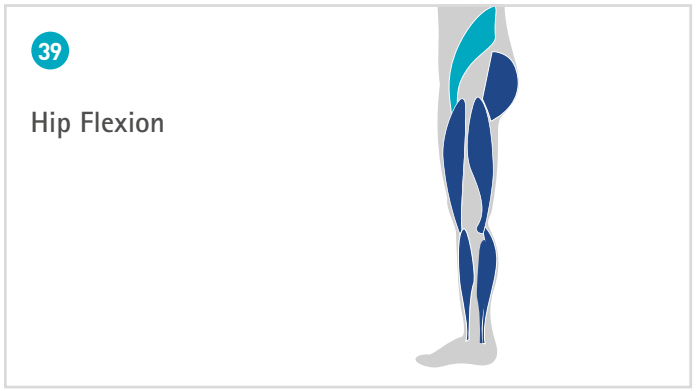
The patient is lying on their stomach. The foot of the leg not to be tested is hanging over the edge of the examination table and the leg to be tested is flexed. Hold the thigh in place with one hand without restricting the muscle function. Have the patient bring the knee into flexion. At range of motion against gravity, the **muscle strength** is **3**.

Knee Flexion – Muscle Strength 2

The patient is lying on the side of the leg not to be tested. The upper leg is slightly flexed. Support and lift the upper leg with one hand. Hold the pelvis in place with the other hand without restricting the muscle function. Have the patient bring the knee into flexion. At range of motion with gravity eliminated, the **muscle strength** is **2**.

Knee Flexion – Muscle Strength 1 and 0

The patient is lying on their stomach. The foot of the leg not to be tested is hanging over the edge of the examination table and the leg to be tested is slightly flexed. Support the flexed leg with one hand. Have the patient bring the knee into flexion. With the other hand, palpate if there is any muscle activity. At slight contraction with no joint motion, the **muscle strength** is **1**. At no evidence of contraction, there is a total paralysis and the **muscle strength** is **0**.



Hip Flexion – Muscle Strength 5 and 4

The patient is lying on their back. The lower legs are hanging over the edge of the examination table. Hold the pelvis in place with one hand without restricting the muscle function. Press against the thigh close to the knee with the other hand. Have the patient bring the hip into flexion. At complete range of motion against gravity with full resistance, the **muscle strength** is **5**. At range of motion against gravity with some resistance, the **muscle strength** is **4**.

Hip Flexion – Muscle Strength 3

The patient is lying on their back. The lower legs are hanging over the edge of the examination table. Hold the pelvis in place with one hand without restricting the muscle function. Have the patient bring the hip into flexion. At range of motion against gravity, the **muscle strength** is 3.

Hip Flexion – Muscle Strength 2

The patient is lying on the side of the leg not to be tested. The upper leg is slightly flexed in hip and knee. Support and lift the upper leg with one hand. Hold the pelvis in place with the other hand without restricting the muscle function. Have the patient bring the hip into flexion. At range of motion with gravity eliminated, the **muscle strength** is 2.

Hip Flexion – Muscle Strength 1 and 0

The patient is lying on their back. Hip and knee of the leg to be tested are slightly flexed. Support the flexed knee with one hand. Have the patient bring the hip into flexion. With the other hand, palpate if there is any muscle activity. At slight contraction with no joint motion, the **muscle strength** is 1. At no evidence of contraction, there is a total paralysis and the **muscle strength** is 0.

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Hip Extension

Hip Extension – Muscle Strength 5 and 4

The patient is lying on their stomach. The feet are hanging over the edge of the examination table. Press against the thigh close to the knee with one hand. Have the patient bring the hip into extension. Make sure that the pelvis stays on the examination table. At complete range of motion against gravity with full resistance, the **muscle strength** is **5**. At range of motion against gravity with some resistance, the **muscle strength** is **4**.

Hip Extension – Muscle Strength 3

The patient is lying on their stomach. The feet are hanging over the edge of the examination table. Have the patient bring the hip into extension. Make sure that the pelvis stays on the examination table. At range of motion against gravity, the **muscle strength** is **3**.

Hip Extension – Muscle Strength 2

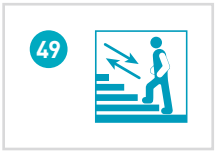
The patient is lying on the side of the leg not to be tested. The upper leg is slightly flexed. Support and lift the upper leg with one hand. Hold the pelvis in place with the other hand without restricting the muscle function. Have the patient bring the hip into extension. At range of motion with gravity eliminated, the **muscle strength** is **2**.

Hip Extension – Muscle Strength 1 and 0

The patient is lying on their stomach. Have the patient bring the hip into extension. Palpate if there is any muscle activity. At slight contraction with no joint motion, the **muscle strength** is **1**. At no evidence of contraction, there is a total paralysis and the **muscle strength** is **0**.

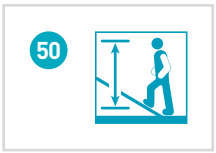
Assess the everyday requirements together with your patient while taking into consideration foreseeable changes.

Stair Steps to Walk per Day



I: The patient walks none (0) to 10 stair steps max. per day.
II: The patient walks 11 to 50 stair steps max. per day.
III: The patient walks more than 50 stair steps per day.

Altitude Meters to Walk per Day

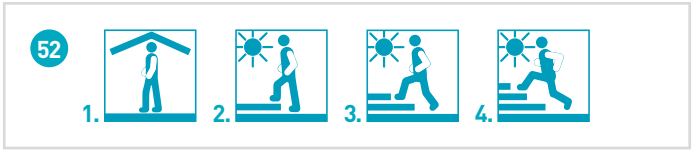


I: The patient walks none (0) to 10 altitude meters max. per day.
II: The patient walks 11 to 50 altitude meters max. per day.
III: The patient walks more than 50 altitude meters per day.

Reaching the System Joints

Determine the patient's ability to safely reach a system ankle joint with one hand.

Assess the **activity level** together with your patient while taking into consideration foreseeable changes.



1. Indoor Walker

The patient has the ability or the potential to make transfers and to move with an orthosis on even surfaces at low walking speed. Ambulation is only possible for a very short distance and duration due to the physical condition of the patient.

2. Restricted Outdoor Walker

The patient has the ability or the potential to move with an orthosis at low walking speed and is able to overcome small environmental obstacles such as curbs, single steps or uneven surfaces.

3. Unrestricted Outdoor Walker

The patient has the ability or the potential to move at medium to high and also varying speed and to overcome most environmental obstacles. Additionally, the patient can walk on open terrain and perform professional, therapeutic and other activities, which do not apply an above average mechanical load on the orthosis.

4. Unrestricted Outdoor Walker with Especially High Demands

The patient has the ability or the potential to move with an orthosis like the unrestricted outdoor walker. Additionally, the increased functional demands can generate high impact loads, tension or deformation on the orthosis. These patients are mainly athletes and children.

Determine the **ap measurement** by using a calliper. Measure at the slightly flexed, relaxed knee. Measure at a right angle from the knee fold to the longitudinal axis of the lower leg and parallel to the movement direction.

Note: in order to avoid measuring errors, do not use the patella as a basis for determining the ap measurement, as the patella's position can vary (e.g. in case of luxations, TEPs and patella alta).

AFO
short for ankle-foot orthosis; an orthosis encompassing both the ankle joint and the foot

ap Measurement
(abbrev anterior-posterior measurement, from Latin *anterior* = forward, before; *posterior* = coming after): lateral measurement at knee joint space height which describes the extent of the knee from the patella to the back of the knee

Contraction
(from Latin *contractio* = drawing together): active shortening of e.g. a muscle

Contracture
(from Latin *contrahere* = to tighten): permanent tissue shortening or shrinking, e.g. of certain muscles or tendons. This leads to a reversible or irreversible mobility restriction or fixed deformity of the adjoining joints. There are elastic and rigid contractures.

Distal
(from Latin *distare* = to be distant): denoting a position away from the centre of the body. The opposite of distal is ↑proximal.

Dorsal
(from Latin *dorsum* = back): belonging to the back, located at the back. Positioning on the foot: on the dorsal foot side.

Dorsiflexion
Lifting of the foot. The countermovement of ↑plantar flexion. Referred to as a dorsiflexion because it reduces the angle between the lower leg and foot (↑flexion). Functionally, however, it is a stretching movement in the sense of an ↑extension. Muscles which perform this movement are called dorsiflexors.

Extension
(from Latin *extendere* = to extend): active or passive straightening of a joint. Straightening is the countermovement of bending (↑flexion) and characteristically increases the joint angle. Muscles which perform this movement are called extensors.

Flexion
(from Latin *flectere* = to bend): active or passive bending of a joint. Bending is the countermovement of straightening (↑extension) and characteristically reduces the joint angle. Muscles which perform this movement are called flexors.

Height Compensation
Orthopaedic appliance in the form of a shoe modification, an insert, a loose wedge or a construction underneath the foot piece of an orthosis. Independently from the ↑leg length compensation, a height compensation aims to achieve an additional compensation (for example in bilateral contractures).

Individual Normal Posture
Standing position in which the conditions of the shoe pitch and the ankle, knee and hip angles are optimal for the patient. Possible constraints (e.g. contractures) determine these angles partially or completely. By taking into consideration the individual normal posture, the alignment and biomechanical properties of the orthosis are in accordance with the individual needs of the patient: The individual normal posture ranges from standing with weight either on both legs or one leg, depending on whether the orthosis is designed for a low or high dynamic use. After the individual normal posture of the patient has been determined, the negative cast is produced in that exact position.

KAFO
short for knee-ankle-foot orthosis; an orthosis encompassing the knee, the ankle joint and the foot

KO
short for knee orthosis; an orthosis encompassing the knee

Laser Plumb Bob
Tool used to determine a vertical or horizontal reference line using a laser beam. The exact alignment of the desired reference lines can be adjusted.

Leg Length Compensation
Orthopaedic appliance in the form of a shoe modification, an insert, a loose wedge or a construction underneath the foot piece of an orthosis. A leg length compensation aims to balance out an existing ↑leg length discrepancy.

Leg Length Discrepancy
measurable length discrepancy between both legs from hip to foot

Leg Length Shortening
functional or structural shortening of a leg, which leads to a ↑leg length discrepancy if the contralateral leg is not or not as much affected

Muscle Strength
Muscle strength is a parameter used to assess the force generated by a muscle group (e.g. knee flexors). This force is determined by the muscle function test [Jan], which tests each muscle group to assess the extent to which each respective movement can be performed. The muscle strength is classified on a six-level scale depending on whether or not the subject is able to overcome manually applied resistance or gravity:

0 (zero)	total paralysis, no evidence of contraction
1 (trace)	slight contraction, but no joint motion
2 (poor)	complete range of motion with gravity eliminated
3 (fair)	complete range of motion against gravity
4 (good)	complete range of motion against gravity with some resistance
5 (normal)	complete range of motion against gravity with full resistance

Neutral Position
Refers to the body position that a person assumes as a normal, upright, approximately hip-width stance. The joint's range of motion is determined in neutral position.

Palpate
(from Latin *palpare* = to touch, feel): examining the body's structures or functions by touching and feeling with the hand

Physiological
(from Greek *physis* = nature; *logos* = doctrine): concerning the natural life processes

Pitch
Effective difference between the heel's centre and the ball area. In shoes, this difference is calculated from the heel height and the sole thickness in the ball area.

Plantar
(from Latin *planta* = sole of the foot): concerning the sole of the foot, towards the sole of the foot

Plantar Flexion
Lowering of the foot. Countermovement of ↑dorsiflexion. Muscles which perform this movement are called plantar flexors.

Proximal
(from Latin *proximus* = the nearest): positioned towards the centre of the body. The opposite of proximal is ↑distal.

Rolling-Off Line
Line which passes the ball area of the foot and in which a flexion occurs in the metatarsophalangeal joints during the end of stance phase. Analogue to this anatomical rolling-off line, there is a mechanical rolling-off line in the foot piece of the orthosis.

Thomas Test
Named after the British surgeon Hugh Owen Thomas (1834-1891). This orthopaedic examination method is used to evaluate the ability to extend the leg in the hip joint.

Upper Ankle Joint
(from Latin *articulatio talocruralis*): the upper ankle joint and the lower ankle joint are the two joints between the lower leg and the tarsus. It is a hinge joint composed of the tibia and fibula at the lower leg and the ankle bone of the tarsus. It is stabilised by a joint capsule and several ligaments. The upper ankle joint is mainly responsible for the ↑plantar flexion and the ↑dorsiflexion of the foot.

Valgus Deformity
(from Latin *valgus* = twisted): bone and joint deformity in which the ↑distal end of the joint differs from the normal axis towards the body's centre. The valgus deformity in the knee is called genu valgum. This axis deviation is also commonly called knock knees.

Glossary

Varus Deformity
(from Latin *varus* = bow legged): bone and joint deformity in which the ↑distal end of the joint differs outwards from the normal axis. The varus deformity in the knee is called genu varum. This axis deviation is also commonly called bandy legs.

Ventral
(from Latin venter = belly, body): abdominal, facing forward

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Orthosis Configurator

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