Basko Healthcare

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Healthcare

Swing Phase Lock

Plan of treatment

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Plan of treatment for a dynamic orthosis with the Swing Phase Lock Joint

Swing Phase Lock

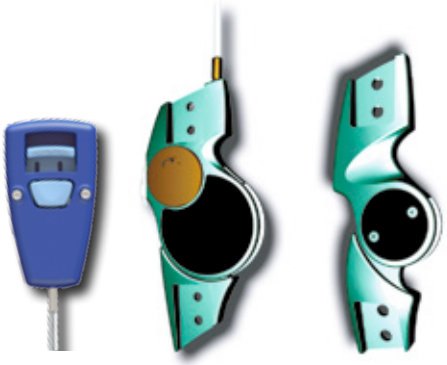
Neuro-Orthotics

COMPENSATING FUNCTIONAL RESTRICTIONS DUE TO NEUROLOGICAL CONDITIONS

The Swing Phase Lock Joint

Introduction

The Swing Phase Lock joint was developed for users with an insufficient function of the quadriceps muscle so they can develop a gait pattern that mimics the normal gait pattern. With insufficient force in the quadriceps muscle, problems will occur in the beginning of the stance phase, in-between heel strike and foot flat (shock absorption phase). In this phase the quadriceps muscle is active to control the flex moment on the knee joint (see chapter normal gait). In this phase however, the patient can also control this with his gluteal musculature. He will have to bring his knee joint in a hyperextension, which unfortunately in the long run will overload his hamstrings. Especially when, as in some syndromes, there exists an insufficient gluteal musculature and/or plantar flexors, one seeks refuge in an orthosis system that provides full knee blockage.



Satellite SPL SPC

Hereby the extra support of the gluteal musculature (to stabilize the knee joint) is not necessary, but one is confronted with the consequences of this in the swing phase. Mainly the beginning of the swing phase is complicated, but also the deficiency of knee flexion during the bringing upfront of the swing leg introduces problems which are compensated by circumduction and/or raising the pelvis high. All these measures cost the user extra energy and make the gait pattern asymmetric.

The SPL joint provides, without any overload, a blockage of the knee joint, directly at heel strike till after midstance and this without further overloading the hamstrings. After midstance an unlocking finds place. At the end of the stance phase, the user can evolve towards knee flexion to initiate the swing phase.

Gait cycle with SPL

SPL, how does it work?

The locking and unlocking of the SPL joint is accomplished by the changes of angle in the sagittal plane. During the swing phase a pendulum movement of the lower leg is generated, that results in a knee extension just prior to heel strike. This knee extension blocks the joint because a pawl is pinched within the mechanism. The joint is now completely blocked and prevents the knee joint to flex under the influence of the knee flex moment, which originates from the knee joint in the period after heel strike.

Locking Unlocking

The locking takes place in the lateral placed joint. The medial placed joint (SPC or Swing Phase Control) makes it possible to influence the swing phase and to slow down excessive knee flexion. A too high swing speed can induce a too big knee flexion, owing to missing eccentric control of the quadriceps muscle. The result is that the period until knee extension will last too long.

By adjusting the SPC joint correctly this problem can be prevented. The SPC joint is intended only for mounting on the medial side. After midstance an extension moment arises out of the knee joint that sees to it that the pawl falls out of the mechanism. The joint is now unlocked and the knee joint can be brought in flexion at the end of the stance phase.

Adjustments

Mode 1 Mode 2 Mode 3

The joint can be regulated in many ways by the user through a remote push/slide button switch, the so-called satellite. This satellite, which is mounted on the joint, has 3 possible adjustments, namely an automatic locking/unlocking, a manual single unlocking and a manual permanent locking.
The first mode is the most common adjustment to walk with an automatic locking in the beginning of the stance phase and unlocking just before the swing phase.
The second mode is a permanent unlocking mode which can be used i.e. for cycling or when driving a car
The third mode is a manual permanent locking mode that can be used to stand upright safely for a long time and to carry out standing activities. This safety mode is very suitable for usage in a domestic environment. By standing and ambulating in a small space frequent turning movements are made, steps aren't always finished or one makes small steps forwards, side wards and backwards. By using the safety mode the orthosis can be loaded without taking account of the position. Even in hectic and disorderly circumstances or in unknown environments this safety mode can be very useful for the user.

Possibilities (KO or KAFO)

The SPL can be built in a Knee Orthosis (KO) as well as in Knee Ankle Foot Orthosis (KAFO). The choice is determined by the somatic possibilities of the patient. The KO solution is preferred when the patient disposes of sufficient ankle function. The patient must be able to make an active plantar flexion.

In every other case, it's necessary to build in the joint in a KAFO to generate an extension moment on the joint. In the chapter 'Therapy' we will discuss the therapeutically approach for both solutions.

Benefits of the joint

Stability
By the locking of the joint, which is realized just before heel strike, stability is delivered from heel strike to midstance. Hereby the hamstrings are not overloaded, in other words, even towards hyperextension the knee joint is stabilized. Even in stance the knee joint stays blocked so there will not be an extension moment on the knee joint. When standing upright for a long time, there is also the possibility to bring the joint in a permanent locking by means of the satellite. Stability in stance can also be reached by positioning the inflicted leg with orthosis an inch before the other leg or past the centre line.

Mobility

A normal swing phase can be generated. Throughout this, benefits arise in different areas:

- The cosmetic of the gait approves extensively
- The gait will better mimic the normal gait
- The user will be able to bring the inflicted leg faster forwards which improves the symmetry.
- Less compensation is needed in lifting the pelvis and/or making circumduction to be capable to bring the inflicted leg forward. This has its results on the energy expenditure.

The speed of the gait also increases because the leg is brought faster upfront. The user is sure of his stability from heel strike on and dares to load the inflicted leg faster.
The reduction of the energy expenditure and the increase of the speed of the gait results ultimately also in an increase of the total gait distance. The user performed a test whereby the patient walk 10 meters (about 30 feet) in this treatment plan. This led to a 20% higher gait speed when walking with the SPL then by walking with a locked knee. A test (timed up and go) whereby the user arises from a seat, walks 3 meters (about 10 feet), turns around en sits back down, led to a 25% higher speed when walking with SPL then by walking with a locked knee.

Indications

The SPL joint is indicated for all the disorders accompanied by a full or partial deficiency of the knee extensors. We are thinking of MS and other progressive disorders, CVA (apoplexy), peripheral paresis/paralysis, myopathies, post-polio, partial spinal cord lesion or pareses in general. Also with orthopedic problems the SPL is also well indicated, especially when the knee joint needs extra stability, if there is insufficient force in the quadriceps muscle or if an unsafe feeling arises during the stance phase.

Contra indications

The user must be able to make a hip extension of 5°. This means that a flexion contraction of the hip makes it impossible to operate the joint safely. The user must be able to generate a full extension of the joint. Bend contractions greater than 10° or spasms around the knee joint are also contra indications.
A certain teaching program is needed to be able to operate the joint well and to learn to make the right choices at the right time. Sufficient learning and interpretation capacities must be present. The user must be able and willing to train with a physiotherapist.
The unlocking of the joint does not function when using a load bearing orthosis, by which a tuber support is used, because that way an extension moment can not be generated.

Minimal functions of the user

At the end of the stance phase the user must be able to flex the knee. This is possible by using the hip flexors, by activity of the plantar flexors or by pelvis tilting. In the beginning of the swing phase it has to be possible to bring the upper leg upfront fast so one can induce a knee flexion by means of the inertia. Afterwards the pendulum movement of the lower leg induces a knee flexion at the end of the swing phase. At heel strike the foot of the inflicted leg must be in front of the other foot or the centre line. This means that the force and speed, when bringing upfront the inflicted leg, must be big enough to accomplish this result. Therefore there must be enough force in the plantar flexors, hip flexors or in the abdomen musculature. After midstance the user must be capable to induce an extension moment on the knee joint. This happens when combining a hip extension and forefoot contact. One needs sufficient power in the hip extensors or sufficient force in the other leg. One can also accomplish this by using extra ambulatory aids.

Donning correctly
(considerations when donning the Swing Phase Lock orthosis)

The orthosis with SPL can be donned sitting or lying down. The joint must be at the same height as the anatomic axis of the knee, this means at the height of the femur condyls. There also has to be a good foot contact with the footplate with a KAFO. The orthosis must be mounted firmly, so the orthosis can not wrench or fall off.

Operating the satellite

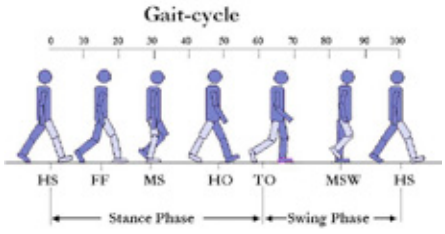
Modus 1

Modus 2

Modus 3

As mentioned, the SPL joint has 3 modes:
1 Automatic locking/unlocking during stance phase
2 A manual permanent unlocking
3 A manual permanent locking.
The first mode is the most common adjustment to walk with a locking in the beginning of the stance phase and unlocking just before the swing phase. The permanent locking can be used to stand upright safely for a long time and to ambulate safely in a limited space (see also chapter "adjustments"). The joint is secured and locks automatically in a situation where the satellite cable is broken.

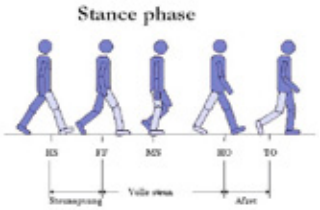
Biomechanics of gait



A gait cycle exists of a stance phase and a swing phase. The activity that finds place in-between heel contact and the thereon following heel contact of the same foot is called a stride. A step is limited by the subsequent of two heel contacts of the two different feet.

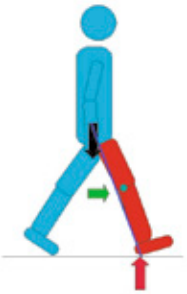
The stance phase

The stance phase begins at heel strike and ends when the foot loses contact with the substratum at toe off. The stance phase can be divided in three different phases: the shock-absorption, midstance and push-off. These three phases are separated from one another by 4 moments, namely heel strike, foot flat, heel-off and toe-off.



The shock-absorption phase

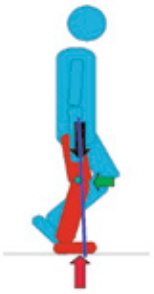
When the heel makes first contact with the substratum at heel strike, the stance phase begins. At this moment the ankle is in a neutral position, the knee is actively extended and the hip is bend 25°. The range of hip flexion is dependent of the step length. The bigger the step, the bigger the hip movement will be. According to how the weight is placed on the leg that is brought forward the ground reaction force will grow. Under the influence of this ground reaction force there will occur a plantar flexion moment at the ankle. This plantar flexion moment is controlled by an eccentric action of the dorsiflexion muscles until the whole foot has contact with the substratum at foot flat. At this moment the plantar flexion of the ankle is 10°. At heel strike there is also a flexion moment in the knee joint. This flexion moment is controlled by an eccentric contraction of the quadriceps muscle. At foot flat the knee joint will reach a flexion of approximately 10-15°. The extension of knee flexion is dependent of the step length and of the gait speed.

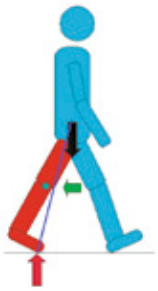


The occurring flexion moment in the hip joint is controlled by an isometric action of the gluteus maximus and the hamstrings by which the hip joint is stabilized in a flexion of 25°. In the frontal area the abductors start to help stabilize the pelvis on the femur. The tensor fascia lata works as an agonist of the abductors. The adductors have a stabilizing function.

Midstance

At foot flat of the support leg, the swing phase of the other leg begins. The trunk now begins a movement above the support leg. Consequently the hip joint moves towards extension. The knee bends on to a flexion of 20° and begins afterwards an extension movement. The plantar flexion in the ankle joint switches over to dorsal flexion. This results in the moment of midstance in a 5° dorsal flexion in the ankle joint and almost full knee extension and a hip flexion of 10°.
The hip abductors stay active to stabilize the pelvis on the femur. The calf musculature now becomes very active in a concentric contraction to control the flexion movement of the knee joint. After midstance an extension moment occurs from the ground reaction towards the hip joint and the knee joint. The hip reaches an extension of 10 - 15°, the knee joint moves towards full extension and the ankle joint reaches 15° dorsal flexion.





The push-off phase

Under the influence of a powerful concentric contraction of the plantar flexors the ankle joint switches over from dorsal flexion to a 20° plantar flexion. The knee joint is taken out of his extension moment and moves towards a 40° flexion when the swing phase begins.
The hip joint moves in the direction of flexion again. Mainly the adductors are active now. The rectus femoris controls eccentric the knee flexion. The iliopsoas begins to contract concentric just before the swing phase. The tensor fascia lata becomes active a moment earlier.

The swing phase

The swing phase begins when the stance phase ends. This is the period between toe-off and heel strike. The swing phase starts with an acceleration of the swing leg under the influence of the hip flexors. The hip begins to flex and the law of inertia sees to it that the lower leg stays behind. This results in an increase of the knee flexion until 65°. The rectus femoris contracts eccentric to limit the flexion angle until the mentioned 65° and the adductors stabilize the hip joint. The dorsal flexors begin to contract concentric to bring the foot to his neutral state. The joined actions of hip flexion, knee flexion and dorsal flexion see to an optimal shortening of the swing leg. This way the swing leg can be brought upfront from under the trunk, without extra lifting worth mentioning of the pelvis, which is therefore energy saving. In the second part of the swing phase, the deceleration, the rectus femoris evolves from eccentric contraction into concentric action to induce an extension of the lower leg. Hereafter the hamstrings tighten eccentric to slow down the movement forward of the lower leg in the direction of knee extension, to prohibit the knee joint to fall into a hyperextension and to prevent the ligaments of the knee to be overloaded.

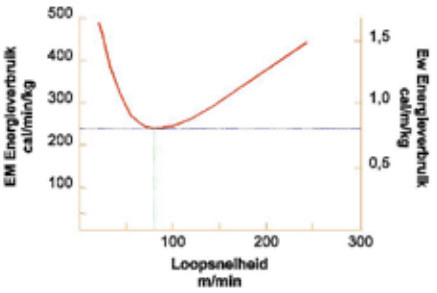
The double support

The double support is the phase in which both feet have contact with the floor. This phase occurs in-between heel-off and toe-off of the one foot and heel strike and foot flat of the other foot. In one stride a double support phase takes place twice. The time limit is related directly to the speed. When the speed increases, the period of double support decreases. Double support distinguishes itself from running as well. When running we notice a hovering phase, by which none of both feet make contact with the substratum, instead of double support.

Energy consumption during gait

Each person has an optimal gait speed by which he or she consumes the least energy. We call this the comfortable walking speed. When walking slower or faster than this comfortable walking speed the energy consumption increases. The average human walking speed amounts to 80 meters per minute. The lower the comfortable walking speed is, the more energy is needed to cover a certain distance. Research of energy consumption shows that the energy consumption rises when one or more joints are immobilized.

The immobilization of a knee joint in 0° delivers an increasing of the energy consumption with 13% and the immobilization of an ankle 6%. In general we can put that the more loss there is of normal gait functions, the more energy is needed per distance unit and the less efficient the walking itself becomes. A 10 meters gait test (about 30 feet), performed by the user in this treatment plan, led to a 20% higher gait speed when walking with the SPL then by walking with a locked knee. A test (timed up and go) whereby the user arises from seat, walks 3 meters (about 10 feet), turns around and sits back down, led to a 25% higher speed when walking with SPL then by walking with a locked knee.



Gait analysis

The gait analysis form underneath is a useful means to analyze the gait in a systematically manner and to collect usable information about gait functionality and treatable quantities (course gait analysis and gait training -Deckers and Beckers). It can also be used to compare 2 situations, for instance walking with and walking without the SPL joint.

Ganganalyse - formulier

	steun-opvang	mid stance	afzet	ver-snelling	ver-traging
Frontaal vlak					
rompverplaatsing :					
assym armzwaai :					
valgisering knie :					
varisering knie:					
bekkenlift:					
breed gangspoor:					
smal gangspoor:					
Sagittaal vlak					
overdreven lordose :					
heupextensie:					
te weinig knieflexie :					
te weinig knieextensie:					
te veel knieextensie:					
voorvoetcontact:					
contact met hele voet:					
te weinig plantairflexie:					
veel plantairflexie:					
weinig dorsaalflexie:					
verkorte standfase:					
verlengde standfase:					

Naam:
datum:
aangedane zijde:
stapfrequentie: stappen per minuut
orthese prothese:
loopafstand: meter
loophulp:
schoeisel:

Algemeen loopbeeld

- asymetrie
- rompverplaatsing op/neer
- rompverplaatsing links/rechts
- dynamisch loopbeeld
- statisch loopbeeld
- passief loopbeeld

Rotaties

- veel rotatie bovenste romp:
- weinig rotatie bovenste romp:
- veel rotatie onderste romp:
- weinig rotatie onderste romp:

Opmerkingen:

Ganganalyse en looptraining voor de paramedicus J. Deckers D. Beckers Bohn Stafleu Van Loghum ISBN 90-313-1692-X

Training

Objectives

The user must be capable to operate the functionality of the device. While using the SPL joint, it has to be possible to initiate a swing phase and a small extension moment has to find place to operate the unlocking of the system. Furthermore the user must be capable to attain a complete extension at the end of the swing phase to insure the locking of the joint.

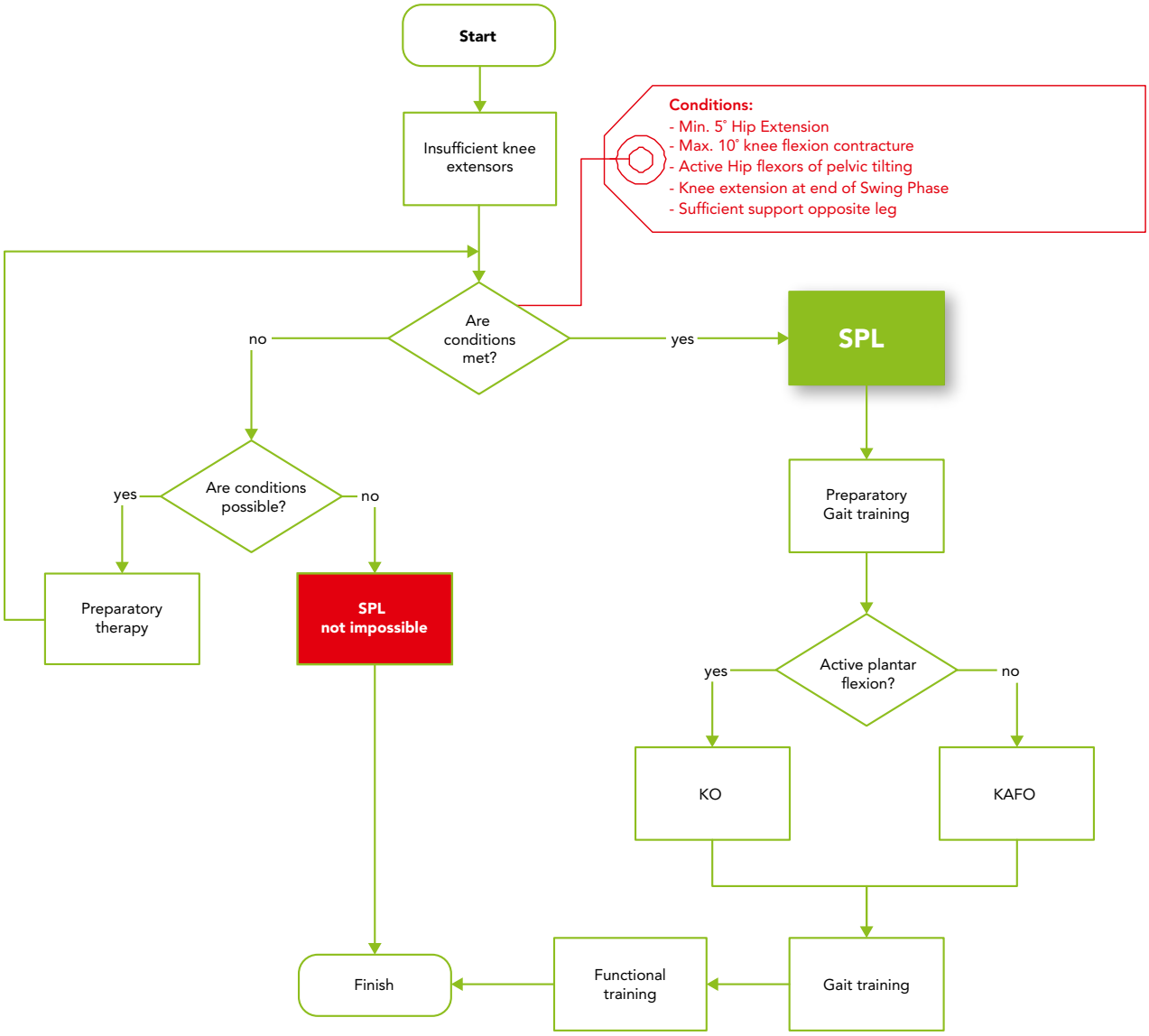
Conditions

One is capable to use the operating functions of the joint when following conditions are fulfilled:

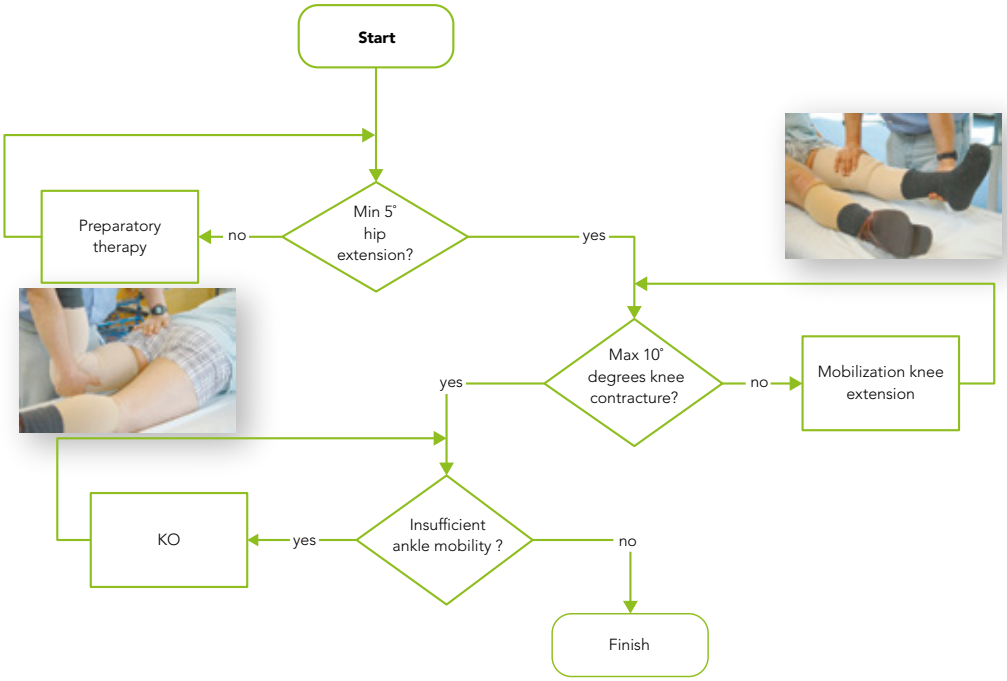
- Sufficient (passive) extension in the hip joint (minimal 5°)
- A flexion contraction of no more than 10° in the knee joint
- Capability to bring the inflicted leg forwards with sufficient power For this one needs an active hip flexion. This can be accomplished with the aid of the hip flexors or by tilting the pelvis with the abdomen musculature.
- Capability to attain knee extension at the end of the swing phase. When the onwards movement of the upper leg is powerful enough, this knee extension is attained from the pendulum movement of the lower leg.
- Capability to bring the axis of the joint behind the ground reaction line between midstance and heel-off.

For this, one needs hip extension and forefoot contact. Hip extension in this phase can find place passively out of the other leg or actively under the influence of the hip extensors. The forefoot contact finds place by making an active plantar flexion in the ankle joint or by a KAFO in shortage of a plantar flexion.

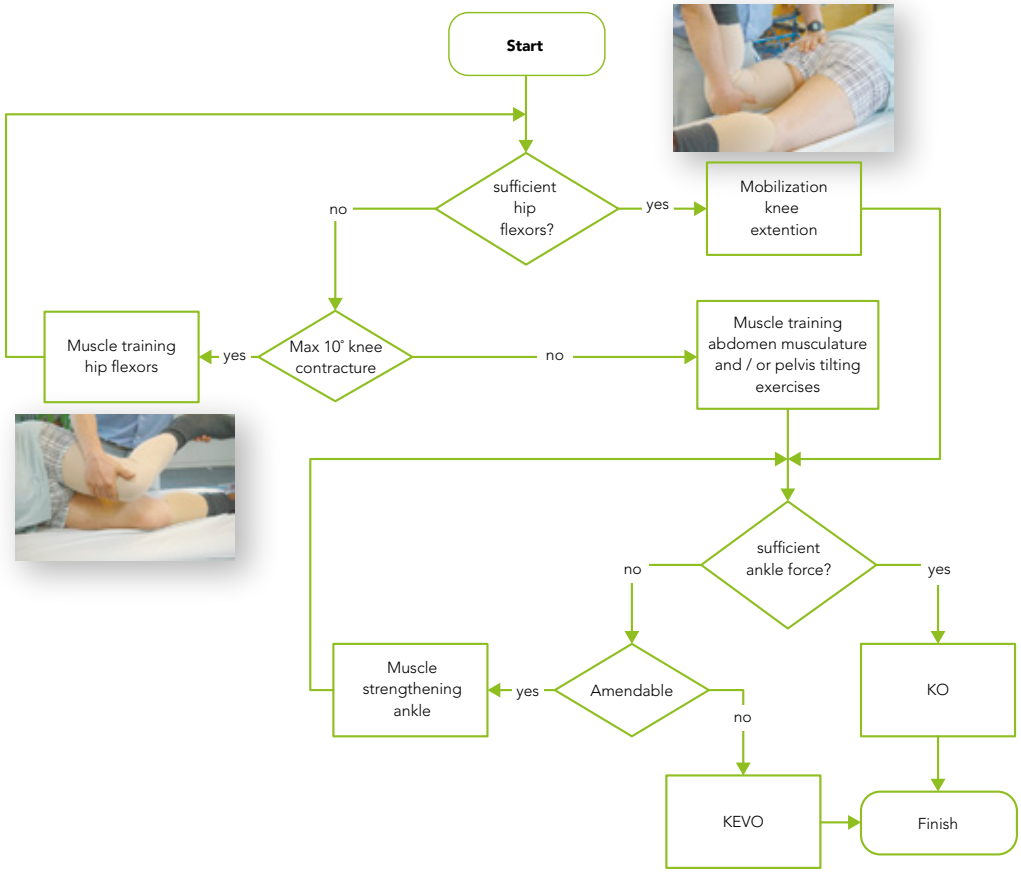
SPL choices in therapy



SPL mobilization



SPL muscle force



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SPL Start gait training

Start

Check fitting and adjustment

Practice to divide the bodyweight over both legs

Practice shifting center of gravity

Practice standing savely without support

Stand straight and move freely during stance

Finish

SPL gait training

Start

Practice swing phase and knee extension

Practice SP of affected leg and hip extension

Intensify gait training

Intensify gait training:
- Axial load after heel strike
- Straight trunk
- Forefoot contact
- Take big step with sound leg
- Intensify swing phase

Intensify functional training

Intensify functional training:
- Practice stairs walking
- Practice slope walking
- Practice standing up / sitting down

Automate generalize

Finish

Therapy

Mobilization

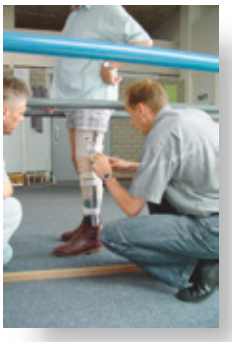
A hip extension of 5° and knee extension until minimal 10° are the goals to achieve here.

Muscle strengthening and pelvis tilting

Muscle strengthening of the hip flexors and/or of the abdomen musculature must find place so the leg can be brought forwards with a powerful swing and the pendulum movement of the lower leg can be set in motion.

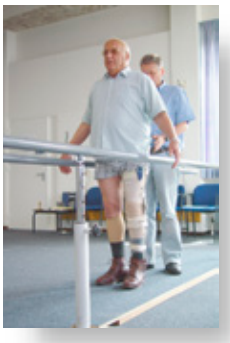
Exercises in stance

These exercises can be performed in the parallel bars. If this is not safe enough, one can choose a semi sitting position on an exercising bench, with the bench installed on the right height. Possible with facilitation at the pelvis the patient is asked to powerfully swing the upper leg forwards by means of the hip flexors or by means of a pelvis tilting. In this start position the plantar flexion, when present, can also be trained. Here, all sorts of training material can be used to stimulate the patient in the direction of plantar flexion.



Gait training with SPL

Before starting the gait training, the knee joint is tested on his functionality. It is recommended to do this in the presence of the orthotist. Controlling the fitting of the orthosis is the first thing to do. The patient has to load the orthosis with locked joint for some time. Locking as well as unlocking has to be tested in the parallel bars with sufficient support. The orthotist is present to adjust the joint on the capabilities of the user. It is best to adjust the joint as safe as possible. The safer the joint is adjusted, the bigger the step length has to be to unlock the joint. In a later phase an adjustment can be made on behalf of the dynamic capabilities of the user.



Exercises in stance

Considerations in stance are:

- Correct weight division on both legs.
  Very often the patient will feel insecure in the beginning. He will tend to load his inflicted leg insufficiently. With the aid of 2 scales the patient will get feedback on the division of the load on both legs. With the aid of a mirror he will also get a better impression of his total attitude. The therapist gives facilitations to the pelvis by means of navigation or light resistance to give the patient an impulse to move his pelvis above both legs.
- Shifting the centre of gravity left-right and forth-back.
  By means of facilitation on the pelvis the therapist lets the patient shift his pelvis left and right, so the weight alternates on both legs. The therapist directs the patient by means of facilitations on the pelvis forth and back, within safer boundaries. This way there is a first start towards forefoot contact.
- Hip extension.
  Even here facilitations are used to achieve a proper hip extension.
- Standing upright safe and secure.
  The next step in this part of the treatment plan is to teach the patient to stand upright safe without use of extra support of the upper extremity. In this phase we let the patient experience that his knee joint is blocked in the direction of flexion by letting him try to flex his knee joint during loading. Thus the patient can experience that his knee joint is stabilized safely in extension.
- Ambulating safe and secure.
  When the patient can stand upright safe and secure, he is stimulated to ambulate freely in stance. Ball exercises are very appropriate, but also all sorts of functional situations can be used here. Within the framework of motoric learning, we let the training resemble the daily activities of the patient as well as possible.

Gait training

- Exercising the swing phase and knee extension.
  The patient stands in the parallel bars in forwards spread position with the inflicted leg behind. The assignment is to flex the inflicted leg by means of hip flexion or pelvis tilting.

The inflicted leg now has to be swung under the trunk until the knee is completely stretched. The therapist first explains what he expects and then he demonstrates the movement. The bringing forwards of the leg can be facilitated on the pelvis. If the patient is not capable enough to perform this movement, he is facilitated on the hip and knee to help him perform the movement. We keep repeating this exercise until the leg can perform this movement faultless.

- Exercising the stance phase and the hip extension.
  The following exercises are essential to practice a good stance phase. This means that every exercise has to be repeated until it is performed faultless. The patient stands in the parallel bars in forwards spread position with the inflicted leg upfront. The patient will load axially the inflicted leg so he can learn to fixate the foot well on the floor. After this a plantar flexion finds place (with a KO). For the next exercise the patient is instructed to, connect to the last exercise, moves the trunk by hip extension over the support leg. Hereby the patient can use the hip extensors or he can push off on the other leg by knee extension and plantar flexion. After this the complete stance phase is practiced, combined with a swing phase of the other leg. Again we start in forwards spread position, the inflicted leg upfront. There is an axial load, hereafter plantar flexion finds place (with KO). The trunk is brought upfront until the hip joint is in front of the knee joint. At this time there needs to be forefoot contact. Hereafter the other leg is brought upfront in front of the inflicted leg.
- Further building-up the gait training.
  Now a combination is made of a stance and a swing phase and we will practice a complete gait cycle by letting the patient perform these two phases after one another. Afterwards we will move on to walking in the parallel bars. Considerations are and will stay:
- Axial load right after heel strike
- straight trunk
- bringing the trunk above the inflicted leg by hip extension
- forefoot contact (by plantar flexion or by hip extension)
- Big step forwards of the healthy leg before the inflicted leg (not level to the inflicted leg)
- Big swing forwards of the inflicted leg resulting in a knee extension at the end of the swing phase.

These gait exercises in the parallel bars are being repeated until this gait is an automatism and there is enough stability and load. Hereafter further building-up of the gait finds place outside of the parallel bars with further reduction of the use of ambulatory aids until the end situation is reached.

Functional situations

We do not wait to practice the next functional situations until the end of the gait training. On the contrary, within the framework of motoric learning, we start these exercises as soon as possible.

Sitting down and getting up

To be ensured of a correct locking and unlocking of the SPL joint we teach the patient to sit down and get up from a chair in this way:

- Getting up.
  The foot of the inflicted leg is a few inches before the other foot. The patient gets up according to his functional capabilities, with or without support of his hands. He brings his trunk upfront and pushes himself forwards diagonally. The hips are stretched while both legs are loaded. Because the inflicted leg is in front of the other leg, the patient is ensured of a good locking.
- Sitting down.
  Dependent on the somatical capabilities of the user, sitting down can happen in many ways: When the patient is capable to make an active hip flexion out of stance, we will let him walk to the chair and let him turn around until he feels the seat. The patient then places the healthy leg a few inches in front of the other, pushes his forefoot in the substratum to disconnect the joint and hereafter sits down with flexed knees. Seeing the quadriceps insufficiency the downward decelerating action will have to find place in the healthy leg. If this is not possible the patient will have to use the satellite. Until the sitting down part, the action is the same, but instead of unlocking by forefoot contact, the unlocking is accomplished by putting the satellite in mode 2.

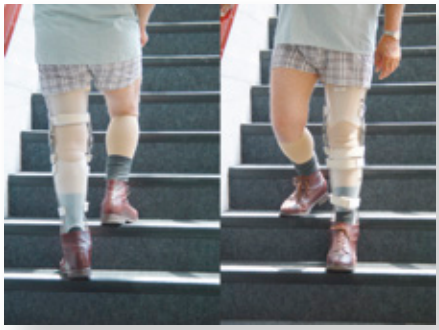
Walking backward, walking side wards

During these activities it is important to guard the joint from staying locked. That is why the patient is instructed to, while walking side wards, place the foot of the inflicted side a few inches in front of the other leg, so there can not be an extension moment on the joint. The user also has to learn to develop an automatism to place the inflicted leg forwards and completely stretch his leg, when unlocked or when uncertain about this. This way the locking is adjusted again. While walking backwards it is sensible to place the healthy leg backwards and then place the inflicted leg level to the healthy one. Thus the locking stays ensured.

Walking a slope

The most secure way to walk down a slope is by making a big step with the inflicted leg and a small step with the other leg. Walking up a slope can be done by making normal step lengths left and right. While placing the non-inflicted leg forwards, the joint off course will unbolt, but there is a big enough extension moment out of the ground reaction to stabilize the knee. Big slopes can also be walked side wards.

Walking stairs



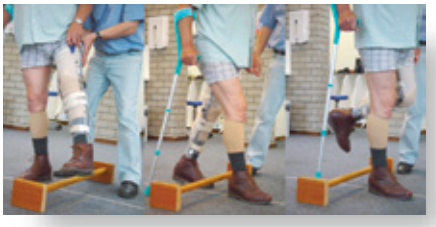
The non-inflicted leg will have to be powerful enough to bring the body above the leg. Therefore extension power in hip and leg will have to be sufficient.

When walking up the stairs, first the healthy leg is brought to the higher stair, the inflicted leg level.

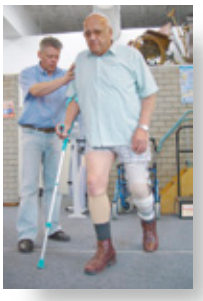
When walking down the stairs, first the inflicted leg is brought a stair lower, then follows with the healthy leg level. During both activities the joint stays locked.

Sidewalks
When stepping up a sidewalk, first the non-inflicted leg is placed on the sidewalk and the inflicted leg is placed level. When stepping off a sidewalk, first the inflicted leg steps off, then the healthy leg is placed level. It is sensible to start with the satellite in mode 3 (permanent locking) during practicing walking stairs

Stepping over an obstacle
Stepping over an obstacle, such as a threshold, can be performed the safest when first the inflicted leg is placed over the obstacle with a big movement forwards, the non-inflicted leg follows afterwards. When the obstacle is very high, one can also perform this side wards, whereby preferably first the inflicted leg is brought over the obstacle and hereafter the non-inflicted leg.



Kneeling down
The non-inflicted leg must have enough extension force in hip and knee. Place the non-inflicted leg a step length before the other. Push the forefoot in the ground to unlock the joint. Bend both knees and kneel down with the inflicted leg on the ground. The patient now finds himself in marksman position. Out of this position the hands are placed on the floor and the other leg also kneels down. Getting up happens in the reversed sequence.



Standing activities ADL situations
During standing activities it is possible that an extension moment occurs on the joint and an unlocking finds place. While performing standing activities it is sensible to adjust the joint in mode 3

Walking uneven grounds, walking in unknown surroundings
During these activities it is possible an extension moment will occur on the joint and an unlocking finds place at the wrong time. Walking in unknown surroundings can also cause insecurity. It is therefore recommended to adjust the joint in mode 3. This is not necessary while using the joint in a KO.

Automation and generalization
Walking is only truly functional when it can find place automated and is applicable in different circumstances. In the learning phase it is important to facilitate a lot and to demonstrate. Repetition must find place with as much variation in exercising material as possible. Double tasks must be integrated in the therapy as soon as possible and one has to practice with a lot of variation in surroundings and floor circumstances.

Inspection and maintenance
All orthoses have to be checked before use for damage and proper functioning of the hinging parts. Skin inspection deserves attention. Pressure points can occur. This needs to be reported to the orthotist so he can take measures to prevent this in the future. Within the framework of transpiration problems and skin problems under the influence of transpiration and pressure, it is recommended to wear a sock underneath the orthosis.

Advised is to use a SmartKnit interface sock. This sock is produced out of Coolmax„ with Lycra„ material. The transpiration damp is transported much better and the present Microsafe™ fibers inhibit the development of bacteria and fungus. The producer advises a check-up every 6 months of the complete system.

Problem solving

- Joint does not (always) lock.
  - Is the pendulum movement of the lower leg powerful enough to reach full extension of the joint?
  - Does the foot sufficiently enough come off the ground during swing phase?
  - Is the joint well adjusted?
  - Is the orthosis built up in a flexion angle of 5°? Is the step length big enough?
  - Is the orthosis well mounted?

- Unlocking does not (always) work during gait.
  - Does the patient make enough hip extension during the second part of the swing phase?
  - Is there still enough load during the second part of the stance phase, either by active plantar flexion or by forefoot contact?
  - Is the step of the non-inflicted leg big enough?
  - Is the joint well adjusted?
  - Is the joint built up in a 5° flexion?
  - Is the orthosis well mounted?

- Unlocking does not (always) work during sitting down
  - Can the patient disconnect the joint by forefoot contact or hip extension?
  - Is mode 3 adjusted to the satellite system?
  - Did the cable break?
  - Is the orthosis well attached?

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