

SENSORIMOTOR FUNCTION



- Theoretical basis
- Scientific knowledge
- Practical application



CHILD



PAIN



SPORT

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Proprioceptive insole treatment in paediatric orthopaedics

Proprioceptive insoles are a modern, efficient and cost-effective therapeutic agent in the elimination of malpositions of the foot and functional pain syndromes in children.

In recent years a modern insole treatment in the form of proprioceptive insoles has proved successful in paediatric orthopaedics. As a result of this flexible malpositions of the foot as well as functional pain syndromes, particularly of the lower extremities, have been treated effectively, quickly and cost-effectively, provided that they are pathogenic and accompanied by malpositions of the foot.

The limit of this treatment is reached with contracted malpositions. Here proprioceptive insoles are not promising of success. The treatment is based on the principle that by setting proprioceptive information in the foot area, changes are caused in the muscle tension of the short musculature of the foot and lower leg, which on the one hand and in the context of a chain syndrome make possible reactions towards the proximal region and also induce a learning effect at spinal cord level. In this way malpositions can also be corrected and eliminated long-term and permanently.

Before each insole treatment and in the course of progress a regular follow-up check on clinical progress, generally every 3 months, is indispensable. This follow-up check includes examination of the child. In particular, the feet and legs are tested in sitting position for capacity for correction of visible malpositions of the foot so that, if appropriate, instances of muscular shortening can be determined and neurological underlying diseases, such as spastic paralysis, can be ruled out.

The second step is the examination of the child standing up. Here, in addition to the position of the foot with the child standing being assessed from the front, the side and from behind, the leg axis is to be assessed as well.

Genu recurvatum or genu valgum/genu varum can be diagnosed here. A check on the leg length is also necessary.

Particular attention is to be placed on the position of the heel in relation to the lower leg. The examination of the knee with the patient walking is carried out according to this. Observation of the dynamics is the most important part of the examination as greater weight-bearing on the foot and the lower extremity basically takes place on walking.

The rotation of the leg, the position of the knee in the course of weight-bearing as well the position and behaviour of the heel and the longitudinal arch of the foot are assessed. These are to be described clinically. In addition, in specific situations pedobarographic, dynamic measurement examinations can be necessary.

With which symptoms are proprioceptive insoles used?

Severe talipes planovalgus/pes valgus flat foot

Talipes planovalgus is a foot deformity, which is accompanied by a valgus position of the heel or a flattening of the longitudinal arch. At times excessive pronation of the forefoot in relation to the calcaneal part of the foot is evident. In the examination attention is to be placed on the dynamics, in particular on the extent of the flattening of the longitudinal arch and the excessive pronation. With the patient walking on tiptoes it is observed whether the heel, starting in a valgus position moves into a varus leading position, i.e. straightens itself. If this is not the case or if there is considerable excessive pronation, there are indications for dynamic insole treatment, which in particular must give rise to a





strengthening of the tibialis posterior/tibialis anterior muscle.

Congenital pes valgus flat foot, a so-called vertical talus, which is the result of a highly contracted congenital deformity of the calcaneal part of the foot with complex scarring and is accompanied by a shortening of the Achilles tendon, is always to be ruled out. A shortening of the Achilles tendon can also be present in the event of extensive talipes planovalgus and pes valgus flat feet. This shortening is to be ruled out by correcting the valgus position of the heel with the patient sitting. If this is present, physiotherapeutic exercise treatment is also important for extension of the shortening of the Achilles tendon.

Pes cavus

With pes cavus we understand a markedly excessively high longitudinal arch. This is in part accompanied by a varus position of the heel. There are indications for proprioceptive insole treatment with pes cavus if it is not contracted and there is a varus position of the heel on walking. Flattened pes cavus is an exception; here there is a straight to varus position of the heel with marked longitudinal arch insufficiency. Here there are definitely indications for proprioceptive insole treatment. The change in tone takes place via the lateral chain of the peroneal musculature, the medial chain of the tibial group as well as via the short musculature of the foot.

As pes cavus is an osseous deformity, correction of the pes cavus is not the aim of the treatment. It is rather the support of muscular stability in order to straighten the heel.

Talipes varus

With talipes varus there is a deformity of the foot with an adduction malposition in the tarsal bones or in Lisfranc's joint. The talipes varus malposition is in part already present from birth. Here, if there is pronounced talipes varus, treatment must be started in infancy. I consider proprioceptive insole treatment to be indicated from a medical perspective in infancy and childhood if the talipes varus is mobile, i.e. it can be corrected passively with slight pressure. The proprioceptive insole is far superior to the 3-jaw insole because during the stepping movement the rotation centre of the jaw shifts to the height of the metatarsophalangeal joint of the toe and thus pressure is exerted by the insole only in parts of the stepping movement.

Functional pes equinus gait pattern

We understand pes equinus to mean a gait pattern that does not cause any structural changes to subsequently occur to the gastrocnemius, the Achilles tendon or other tendon parts.

The limits to minimal brain dysfunction as the expression of minimal infantile cerebral palsy are in part fluent because abnormal strain of all muscles towards the proximal region occurs due to a tiptoe gait pattern. There are indications for treatment here as well. Ideally this is to be solved by proprioceptive insoles because as a result of pretension of the short musculature of the foot, a reduction in tone of the calf musculature occurs due to toe strap and retrocapital support.

In this way normalisation of gait pattern can be achieved very easily with proprioceptive insoles in shoes. As with all proprioceptive insoles, it is particularly important that there is adequate children's footwear with sufficient support in the heel region.

Internal and external rotation gait patterns

Basically these are torsion variants in the hip joint region or in the lower leg region. By proprioceptive insole treatment a cosmetic improvement of the gait pattern can be achieved.

A significant change of function and detorsion of the joint axes is not

possible with insole treatment. Furthermore, it is doubtful whether a compulsory correction, especially of the internal rotation gait pattern in the event of coxa antetorta does not even hinder the natural straightening of the longitudinal arch, therefore in my opinion torsion malposition alone does not represent any indication for proprioceptive insoles.

Functional pain syndrome of the lower extremity

Chondropathia patellae, chronic Achilles tendon symptoms and pains in the lateral region of the hip in particular are to be borne with adolescents. In my experience a considerable dysfunction of the foot is always present here, which can be corrected actively and thus alleviates the symptoms. The majority of patients become asymptomatic as a result. At some point it is also possible to dispense with insoles as a result of the proprioceptive learning effect. In the course of each insole treatment continuous clinical follow-up examinations are necessary in order to adapt the insoles to the changing malpositions of the foot and the dynamic conditions. It has proved successful to carry this out every three months.

In summary, it can be said that proprioceptive insole treatment is a good and appropriate method for the treatment of correctable malpositions of the foot and pain syndromes of the lower extremity.

As a result of the learning effect and adaptation insole-free follow-up treatment is possible at some point.

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Sensorimotor foot bedding – care for children via network

Ideally sensorimotor insoles are made for the patients in close co-operation between physician and orthopaedic shoemaker. This type of co-operation is described below and results from four years of treatment in a surgery are presented.

For more than four years in our surgery in joint special consultation clinics with the master craftsman orthopaedic shoemaker children's feet have been examined, pathological patterns diagnosed and in the event of appropriate findings, the children have been treated with sensorimotor foot beddings. Regular follow-up checks are subsequently carried out. Thus a total of 628 children could be involved in a programme of observation of progress.

The follow-up check on the findings was carried out after 3 months, 6 months and 12 months at the latest. The improvement in gait pattern, posture and status of the foot in standing position and dynamics was assessed.

In addition, the children were questioned about the comfort of wear and the parents about the change in the gait pattern and symptom pattern.

After one year in a total of 560 children examined a marked improvement in the results could be achieved and verified by footprint, video analysis and inquiry directed at the parents.

After 12 months with 48 children there was no improvement or only slight improvement in the movement pattern documented at the beginning of the treatment and in the pathologically changed structures.

Those primarily involved were children whose previous treatment often seemed inadequate or with patients where there had previously been an insufficient acceptance of daily usage.

Special foot consultation clinic

The physiological conditions should have absolute priority in the treatment of children because of their

wide range of learning and development processes. This assumes that general physique, posture and co-ordination are also always to be taken into account in the assessment of foot and leg statics.

Therefore in our so-called special foot consultation clinics set up in our surgery precisely these influence factors are to be taken into consideration and clearly to be verified in consultation between physician and master craftsman orthopaedic shoemaker. It is only from this that the definitive treatment of the pathological postural and movement patterns results.

Close contact between physician and master craftsman orthopaedic shoemaker is therefore not only important and desirable in the context of initial treatment. Co-operative exchange during the follow-up examinations also proves very positive in the sense of a qualified patient care.

The follow-up examinations are carried out in our surgery on a standardised basis, if appropriate beyond the regular appointments, provided that these are necessary due to problems experienced by the patient on wearing the sensorimotor insoles, changes in gait pattern or in the status of the foot as well as wear and tear of the material of the orthopaedic device.



1 In the special consultation clinic the patients are mutually assessed by Dr Udo Herberger (left) and Stefan Woltring (right)

Main focus of the treatment

The 628 children treated/supported showed pathological foot and leg position and posture in addition to neurological symptoms (hemiparesis/diparesis and tetraparesis).

The main focus of the indications and treatment were:

- pathological talipes planovalgus malposition
- internal and external rotation gait pattern, often accompanied by supination and pronation malposition, not age-appropriate
- initial and complex talipes equinus gait pattern
- pes adductus
- pes varus / valgus et adductus
- muscular dysbalance with pathological influence on the body statics and dynamics of the child
- disturbance of co-ordination/perception and symmetry of the children
- 'so-called signs' of chondroпатия patellae, better: retropatellar pain syndrome, patellar apex syndrome
- hypotonic or hypertonic postural defect of the child (often treated in connection with physiotherapeutic exercise treatment, physiotherapy and occupational therapy).

Overall the children treated were differentiated in age groups:

- Age 2 – 4 = 84 treatments
- Age 5 – 10 = 323 treatments;
- Age 11 – 15 = 175 treatments;
- Age 16 – 18 = 46 treatments.

Production and Fitting

For the production of sensorimotor foot bedding CAD-milled EVA materials on a carrier layer are used as a rule.

Production takes place in an orthopaedic workshop specialising in the treatment of children in accordance with individual specifications according to the diagnosis and the subjectivity of the patients.

Within the special foot consultation clinics the sensorimotor foot beddings are fitted and handed over to the patient and as far as possible, the way they take effect is explained to the patients and the parents.

Regular follow-up examinations, modifications and follow-up corrections according to the symptom pattern as well as possible modifications due to wear and tear of the lining or the surface structure of the sensorimotor foot beddings are recorded and carried out in accord-

ance with the regulations of qualified treatment. In this the outline patient history sheet proves particularly helpful, here all information can be pooled quickly and clearly.

This sheet is standardised or submitted to the health insurance companies on request and it is regarded as a template by physician and master craftsman orthopaedic shoemaker in the context of the co-ordination of the special consultation clinic.

Result

Now after four years of treatment of children's feet on an interdisciplinary basis, a close co-operation between physician and master craftsman orthopaedic shoemaker resulted due to the specificity of the sensorimotor foot beddings and their detailed history, examination, assessment of findings as well as the initiation of treatment and follow-up examination.

Very good acceptance of the treatment could be established with the majority of the patients. The progress of the abnormal statics of the foot could be made significantly more favourable and at times the duration of treatment could be shortened considerably. Within the first year the so-called malrotation gait patterns could be improved or completely corrected by up to 84%.

Pes adductus, without antivarus shoes and/or 3-jaw-insoles with medial jaw was improved or corrected completely.

In the early stage of adequate treatment the functional talipes equinus gait patterns could be improved with approximately 90 percent of the patients and with



2 Kids feet require special therapy particular attention



3 The wide range of learning and development processes requires physiological and child-oriented treatment.



4 Autologous compensations – help to self-help – are steered and guided

approximately 50% of the patients they could be corrected completely within the first year after treatment had been carried out.

In the context of the treatment with sensorimotor foot bedding postural insufficiencies, sensorimotor dysfunction and postural weaknesses could be improved in the same way as co-ordination and perceptual disorders.

The assessments of the parents, teachers and therapists were also repeatedly included in this.

By wearing the sensorimotor foot bedding patients with preoperative/postoperative pes varus/valgus et adductus improved their foot statics as well.

Conclusion

It is therefore to be concluded that wearing sensorimotor foot beddings, accompanied by the special foot consultation clinic in co-operation between physician and master craftsman orthopaedic shoemaker, brings about a considerable improvement in the pathological structures within a significantly shorter period of time. Not least the results identified in the specialist orthopaedic consultation clinics were able to confirm the descriptions of the physiological orthopaedic principles of afference-stimulating insole treatment (see amongst others Pfaff, Natrup/Fischer, Bernius, Hafkemeyr and Woltring). In the context of the paediatric treatment carried out by us it is therefore hard to imagine this treatment without the use of sensorimotor foot beddings

Udo Herberger, Stefan Woltring:

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(Orthopaedic Footwear Technology)
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5 Feeling the correction capacity and sensitivity lies at beginning of each treatment with sensorimotor foot bedding.

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PROPRIO® A1-0



A1-0 in connection with talipes planovalgus in

- ✓ patients with neurological disease
- ✓ poor perception
- ✓ severe deformities of the foot in children also without neurological disease

SOME INDICATIONS

- ✓ hypotonic/hypertonic
- ✓ talipes planovalgus in children
- ✓ flat foot
- ✓ neutral gait pattern/gait pattern with slight internal rotation

PROPRIO® A1-1



A1-1 in connection with talipes planovalgus/
talipes equinus in

- ✓ patients with neurological disease
- ✓ poor perception

SOME INDICATIONS

- ✓ hypertonic talipes equinus
- ✓ habitual talipes equinus gait
- ✓ infantile cerebral palsy

PROPRIO® A2-0



A2-0 in connection with flexed pes cavus in

- ✓ patients with neurological disease
- ✓ poor perception
- ✓ severe deformities of the foot in children also without neurological disease

SOME INDICATIONS

- ✓ hypotonic/hypertonic
- ✓ flexed pes cavus in children
- ✓ flat foot
- ✓ neutral gait pattern/gait pattern with slight internal rotation

PROPRIO® A3-0



A3-0 in connection with talipes planovalgus and
severe valgus deformity of the heel in

- ✓ patients with neurological disease
- ✓ poor perception
- ✓ gait pattern with internal rotation
- ✓ severe deformities of the foot in children also without neurological disease

SOME INDICATIONS

- ✓ hypotonic/ hypertonic
- ✓ talipes planovalgus in children
- ✓ flat foot
- ✓ gait pattern with internal rotation

PROPRIO® A3-1



A3-1 in connection with talipes planovalgus and severe
valgus deformity of the heel or flexed pes cavus in

- ✓ patients with neurological disease
- ✓ poor perception
- ✓ gait pattern with external rotation
- ✓ severe deformities of the foot in children also without neurological disease

SOME INDICATIONS

- ✓ hypotonic flat valgus foot in children
- ✓ snapped off contracted foot
- ✓ flat foot
- ✓ neutral gait pattern/gait pattern with external rotation
- ✓ rotating

PROPRIO® A3-2



A3-2 in connection with clubfeet which have been
operated on in

- ✓ forefoot adduction
- ✓ gait pattern with internal rotation
- ✓ valgus/varus deformity of the heel

SOME INDICATIONS

- ✓ rebellious clubfoot
- ✓ talipes varus

PROPRIO® A4-0



A4-0 in connection with clubfeet in

- ✓ patients with neurological disease
- ✓ poor perception
- ✓ gait pattern with internal rotation

SOME INDICATIONS

- ✓ clubfoot
- ✓ pes cavus
- ✓ pes cavus/talipes varus

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| | | |
|----------------------|--|---|
| <p>PROPRIO® B1-0</p> | <p>B1-0 in connection with normal feet with ✓ gait pattern with internal rotation</p> | <p>SOME INDICATIONS ✓ coxa valga et antetorta</p> |
| <p>PROPRIO® B2-0</p> | <p>B2-0 in connection with talipes planovalgus with ✓ gait pattern with severe internal rotation</p> | <p>SOME INDICATIONS ✓ talipes varus ✓ sunken pes cavus ✓ coxa valga et antetorta</p> |
| <p>PROPRIO® B3-0</p> | <p>B3-0 in connection with talipes planovalgus in ✓ gait pattern with slight internal rotation</p> | <p>SOME INDICATIONS ✓ talipes planovalgus ✓ flat foot</p> |
| <p>PROPRIO® B3-1</p> | <p>B3-1 in connection with talipes planovalgus in ✓ gait pattern with severe external rotation</p> | <p>SOME INDICATIONS ✓ talipes planovalgus ✓ flat foot</p> |
| <p>PROPRIO® B4-0</p> | <p>B4-0 in connection with talipes planovalgus in ✓ neutral gait pattern</p> | <p>SOME INDICATIONS ✓ talipes planovalgus ✓ flat foot</p> |

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➤ ANALYSING AND ADVISING

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- ✓ pedography

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- ✓ own models readable

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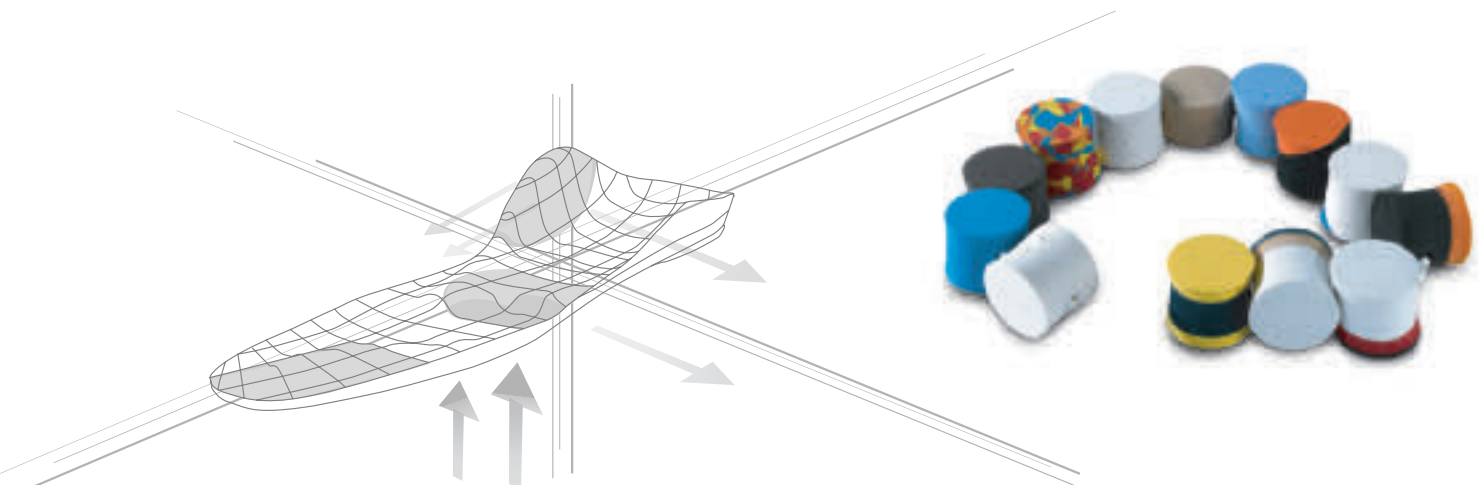
- ✓ simple construction in 4 minutes
- ✓ set the longitudinal arch height
- ✓ vary module in position and design, such as lowering, pad, retrocapital pad, level or toe strip
- ✓ wide range of material

➤ HAVE INSOLES MADE TO DO THE WORK

DELIVERY

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- ✓ very fine milling quality

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Sensorimotor foot beddings in the treatment of children

The characteristic function of a living structure is more than all passively correcting influences. This basic principle runs like a golden thread through many of our operations since we began to produce sensorimotor foot beddings in 1999. The nature of the shoes, although in particular the nature of the insoles, influence the development of the foot shape and gait pattern in children and are therefore of particular importance.

In the meantime many patients have been treated with sensorimotor foot beddings in co-operation with physicians and therapists. At the beginning of a treatment the indication-dependent criteria should be established.

These include:

- age of the patient
- status of the foot, standing and in dynamics
- overall status/posture, standing and in dynamics
- gait pattern barefoot and with shoes
- overall tone
- pains
- if appropriate underlying diseases
- previous treatments and therapies
- concomitant treatment and therapies

A patient history sheet can be used for recording this. Videos and photographs are useful for establishing the actual condition and for checking and assessing the progress of the treatment. Manual examination of the foot, palpation, is carried out. The foot is palpated for capacity for correction and sensitivity of the muscle reactions. On the basis of the findings gained, a treatment objective and indication-related focal points of the treatment should be defined.

This applies in particular with patients with a neurological underlying disease or with multiple abnormal weight-bearing or functional disorders. A neurological underlying disease is not a compelling condition for treatment with foot beddings with sensorimotor effect. The sensorimotor system also does not end with completion of the 18th year of life.

The necessary measurements are now taken using the known media - blue print, step foam or pedography. Production of the sensorimotor foot beddings starts on the PC. The acquired data and documents are entered or scanned. After that the sensorimotor foot bedding is constructed and produced by means of a CAD milling machine. Because these milling systems are still very cost-intensive, there is the option of sending the measurement data and description of the pathological findings to central offices and have the milling carried out there after previous training. An important task is to adjust the foot bedding, which was created according to objective criteria, to the subjectivity of the patient and the given conditions.

An orthopaedic device is only as good as it is accepted by the patient. Sensorimotor insoles have to be adjusted to the shoes, to the expected daily strain and to the patient's sensitivity. At the first follow-up check the strains on the foot beddings, which have been worn, can be identified exactly and if appropriate can subsequently be corrected after the patient has become used to the initially strange padding under the foot. Regular follow-up checks, if appropriate by the physician or therapist providing treatment, ensure optimum progress of the treatment as well as the opportunity to react in good time to changes in the symptoms, foot growth or wear and tear of the foot beddings. With treatment of children consultations with the parents with regard to their impressions and findings are often highly informative.

Case study: Tom

The way sensorimotor foot bedding takes effect and its effectiveness are illustrated in two case studies below.

Tom - 7 years old - talipes plano-valgus on both sides:

- incomplete straightening of the longitudinal arch when standing on tiptoes
- slight internal rotation gait pattern
- valgus malposition of the calcaneal part of the foot on the left/right
- overall hypotonic

For 3 years Tom has been treated with plastic shell insoles as well as concomitant physiotherapy.

The objective of the treatment was a lasting correction of the abnormal statics of the foot and an improvement in overall tone. In producing the sensorimotor foot bedding it was necessary to develop appropriately the individual elements of the indication.

-> A medial pad in the calcaneal part of the foot is placed in such a way that it mechanically forms a support of the sustentaculum tali and simultaneously exerts pressure on the tendon of the tibialis posterior muscle. The thus generated relaxation of the muscle and the altered latency period have as a result a higher level of muscle activity and stimulate an active straightening of the longitudinal arch of the foot. The tarsal joints as well as the short musculature of the foot do not receive any complete underpinning and can continue to function freely.

-> A lateral pad in the calcaneal part of the foot forms a mechanical counter bearing to the medial information and thus it secures the positioning of the heel on the foot bedding. By pressure on the tendon of the peroneus longus muscle and the peroneus brevis muscle the anta-

gonist to the tibial musculature is activated and thus helps to stabilise the calcaneal part of the foot. At the same time a stronger activation of the peroneal musculature stimulates external rotation of the foot.

As in many cases the internal rotation gait of the child results from the position of the angle of the head of the femur to the femur (antetorsion angle) and the CCD angle changes with growth, an internal rotation gait pattern is in no way always pathological and therefore absolutely requires specialist orthopaedic assessment.

-> A retrocapital pad has to be attached exactly behind the second to fifth metatarsal bones. By a slight elevation in the course to the fifth metatarsal bone it brings about countertorsion to the forefoot and thus counteracts adduction and internal rotation. At the same time it improves plantar contact without unnecessarily restricting the foot in its mobility.

-> A toe strip with a flattening course to the apex of the foot brings about slight extension of the toes and improved contact of the tips of the toes. The tips of the toes comprise a vast number of nerve cells and are an essential element of the subconscious co-ordination of gait.

Tom wore ready-made children's shoes with good guiding of the calcaneal part of the foot and sufficient forefoot flexibility.



1 a+b Footprints of Tom at the beginning of the treatment

2 a+b Today Tom no longer needs any insoles and physiotherapy

The result of the treatment was a spontaneous improvement in gait pattern, an orthograde step development as well as good acceptance. This was also confirmed at subsequent follow-up examinations. At the appointment for measurement for subsequent treatment due to growth of the feet, it was to be established that the status of the foot had improved considerably, step development was also orthograde in walking barefoot and overall posture had corrected visibly according to the parents. Today Tom no longer wears insoles and no longer needs physiotherapy either.

Case study: Alina

Alina - 3 1/2 years old

- functional, non-contracted pes equinus

- muscular dysbalance
- in plantigrade position childhood age-appropriate talipes planovalgus both sides

The objective of the treatment was a reduction of the muscle tension to allow physiological plantigrade step development. Here - as in example 1 - it was also necessary to develop the indication-related elements of sensorimotor foot bedding.

-> The pads in the calcaneal part of the foot are used reduced as the tension of the stapedius musculature, the tibial muscle and peroneal muscle should not be increased. Nevertheless, holding and guiding as tight as possible is necessary.

-> Strengthening of the retrocapital second to fifth metatarsal bones as well as the toe strip generate pre-tension over the plantar aponeurosis



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3 a+b On palpation the sensation and capacity for correction are palpated on the foot and the intended padding is simulated.

and flexor digitorum muscle, which simulates a tension situation to the gastrocnemius muscle via the muscle chain, before the actual weight-bearing takes place. The muscle spindles, which register the longitudinal tension of the muscle, conduct the signal for relaxation, so that the tone is already reduced at the time of the real weight-bearing which follows.

Alina wore ready-made shoes with good guiding of the calcaneal part of the foot. With talipes equinus gait care is to be taken that the ready-made heel to toe movement of the shoe soles is not too pronounced as

otherwise the pretension generated by the sensorimotor shoe beddings can at times be eliminated. With this child a spontaneous improvement of gait pattern was not identifiable by wearing the foot beddings. In a telephone discussion after approximately three weeks Alina's mother informed us that Alina was once again always lowering her heels on walking, which until then she had not done, despite physiotherapy.

At a further follow-up examination 10 weeks later, it was shown that when walking barefoot Alina lowered her forefoot in a splashing manner, although the heel received ground contact with every step. The gait pattern with shoes and sensorimotor foot bedding could be described as orthograde, even though slightly abducted. With this child it was also to be predicted that in the foreseeable future she would no longer require any foot bedding and she would also no longer require any physiotherapy. Treatment with botulinum toxin, which had already been considered, was not carried out.

It was also noted in passing here that the relevant health insurance company rejected the application for acceptance of costs, which had been submitted, on the grounds that with the existing indications, shell insoles in conventional form were sufficient. We are just learning to understand that subconscious perception and with it subconscious orientation in space as well is stimulated by the mechanoreceptors of the skin. However, just how insoles with shells for the calcaneal part of the foot can become effective, has not been explained to date despite enquiry.

With sensorimotor foot bedding former natural events are simulated. The foot is again understood as a grasping organ. Via the receptors of the skin (exteroception = superficial sensation; mechanoreception, nociception, thermoception) as well as receptors of deep sensation (proprioception, Golgi tendon organs, joint capsules, muscle spindles) the foot is not only a part of the body, with which we walk and stand or score a goal whilst playing football if we are lucky. The foot is an essential organ of our subconscious perception and co-ordination. Learning to understand this must be a very important focus of our attention, particularly in the treatment of children's feet.

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4 After 10 weeks of wearing sensorimotor insoles Alina's talipes equinus gait pattern had improved considerably.



5 a+b Production of sensorimotor food bedding which fits exactly in accordance with the indications and the patient's senses are essential requirements for successful treatment.



Sensorimotor insoles, a concept from head to toe?

Deviations from the normal, physiological position of the foot are an important factor in the development of malpositions. Problems with the cervical spine and the mandibular joint can also have their cause in the foot. The joints of the foot, knee, hip, vertebra and jaw are functionally connected. It follows from this that treatment of malpositions of the foot should not only play an important role in rehabilitation in order to avoid further ascending symptom. On the basis of the description of the functional connections in the body it can be shown that sensorimotor insoles exert a positive influence on body statics and therefore they can also be suitable for treatment of symptoms in the jaw and cervical vertebra.

Can an orthopaedic craftsman help a patient with symptoms in the jaw and cervical vertebra?

Recently there have been increasingly more frequent reports on networks, functional chains and functional connections and in medicine there has been more and more talk of integrated treatment. Yet, what is the significance of this for the orthopaedic craftsman?

In order to answer this question anatomical and physiological connections must first be discussed.

The body's centre of gravity

The centre of gravity of the body in vertical position is approximately 1 – 2 cm in front of the navicular bone between both feet. The centre of gravity of the body varies by 4 mm around this point. Through the visual, vestibular and proprioceptive system position changes are recorded and regulated from the centre (see box 1).

Muscle activities are necessary to restore balance. Thus, with medial/lateral displacements first reactions occur in the hip area (abductors and adductors), in the foot area the peroneal muscles (in particular the peroneus brevis muscle) are active.

A dorsal displacement is balanced by the activity of the tibialis anterior muscle, with ventral displacement the activity in the gastrocnemius, soleus and abductor hallucis muscles increases (Hochschild 2002).

Aetiology of pains with postural problems

In order to stabilise the trunk against unsteady forces if there are long-sustained malpositions of the body, adaptations in the muscles are constantly required.

If there is fatigue of the musculature, mechanical strain of pain-sensitive structures occurs (e.g. by permanent extension of the ligaments, joint capsules, or compression of the blood vessels), therefore sensitive nerve endings become irritated and pain develops. If the mechanical strain exceeds the capacity for strain of the tissue, overexertion syndromes occur (inflammatory reactions, pain, functional limitation) without an appropriate injury being identifiable (Kisner, Colby 1997). With malpositions over a long period the strain can become too great for the articular surfaces, therefore damage of the articular cartilage occurs. The surface of the cartilage becomes irregular, axially correct movement sequences are no longer ensured. The cartilage becomes limp and loses its mechanical resistance.

Normal pressures already give rise to pain as the subchondral bone sections are no longer protected by sufficient cartilage padding. The abrasion can lead to inflammations in the synovial tissue (secondary synovitis). As a result of the altered

pressure and tensile strain in the joint, disturbances in proprioceptive input develop, which lead to new, abnormal muscle tensions, the vicious circle is complete (Frisch 2003).

In order to break through or prevent this vicious circle it is important to strive for an integrated recording of findings and treatment tailored to this in the treatment/care of the patient.

Potential functional connections with malpositions of the foot

Deviations of the normal position of the foot are an important contributory factor in the development of malpositions. Consequently, on the basis of (bilateral) pes planus for example, the potential effects of malpositions of the foot on overall body statics should be made clear:

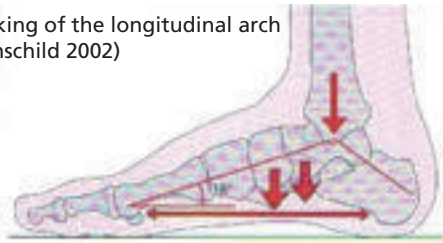
Primarily pes planus is to be attributed to a muscular insufficiency of the tibialis posterior muscle, or even more commonly of the peroneus longus muscle. The transverse arch of the foot, which is normally supported by the tendon of the peroneus longus muscle, flattens and the medial arch descends (see figure 1) (Kapandji 1992)*

Due to reduced inclination angle of the metatarsal bone (medial < 20°), the talus shifts towards the plantar and medial regions so that the leg

Sensorimotor function is the neurological forms the basis for the regulation of posture and movement of our patients. Muscle tone regulation succeeds by integration of sensorimotor regulatory systems. Slight irritations of the regulatory circuits of the nervous system trigger musculoskeletal reactions, adaptations and compensations in the locomotor system.

(Schömer 2006)

1 Sinking of the longitudinal arch (Hochschild 2002)



perpendicular strikes the ground medially instead of in the centre of the calcaneum. This internal rotation position of the malleolar mortise continues upwards, which leads to a genu valgum tendency in the knee joint (Hochschild 2002).

Due to the increased internal rotation of the femur, the acetabulum of the pelvis is lowered and thus causes the malpositions to affect the spine. The lumbar spine compensates the tilting of the pelvis with hyperlordosis, which is responded to with increased kyphosis in the thoracic spine. If there is hyperkyphosis of the thoracic spine, the cervical spine has to adopt hyperlordosis in order to be able to face forwards.

Many patients with back pain show these types of malposition of the vertebral column. The pain problems are intensified by, amongst others, the muscular dysbalances which develop due to the malpositions (see figure 2).

On the one hand stabilising muscles cannot function fully because they are closely positioned, other muscle groups are overextended and therefore do not offer any necessary stability (see box 2) (Kendall 2001).

The question asked at the beginning as to whether an orthopaedic craftsman can help a patient with symptoms in the jaw and cervical spine will be discussed in greater detail below.

The hyperlordosis of the cervical spine and the ventrally directed head position can bring about a change of the position of the mandible. Here the mandible is pulled towards the dorsal region by the traction of the ventral musculature and as a result of this the position of the jaw can be affected (see figure 3) (Rocabado 1985). In practice it is often to be seen that this malposition is a contributory factor in craniomandibular dysfunction (malpositions or diseases of the mandibular joints and the masticatory muscles).

In a study Valentino et. al. made clear the functional relationship between occlusal plane (occlusion = clenching of the teeth) and foot arch position by using measurement technology to record occlusion before and after the change of the foot arch position (pes planus, pes cavus). The

results showed significant changes in the occlusal plane with the changed foot arch positions in each case (Valentino et al. 1991). Furthermore, a tone change of the masticatory muscles due to changed foot arch positions could be established by using EMG measurements (Valentino et al. 2002).

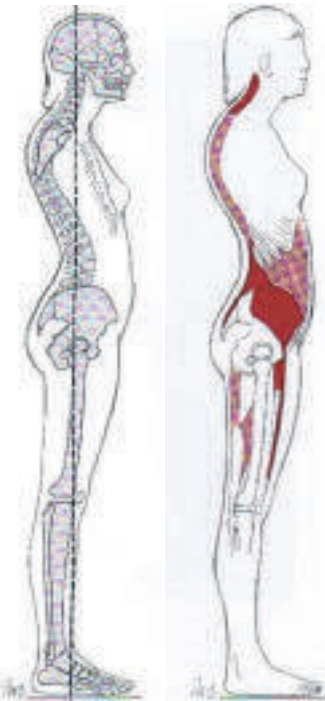
However, it must be emphasised that these studies are only restricted to a short period of time. To date the longer-term effects of the malpositions of the foot on the cervical spine and the mandibular joint region have not been subjected to sufficient scientific examination in order to be able to make definite statements.

The question arises as to whether sensorimotor impulses (e.g. sensorimotor insoles) on the sole of the foot can exert a positive influence even as far as into the region of the cervical spine and the mandibular joint region.

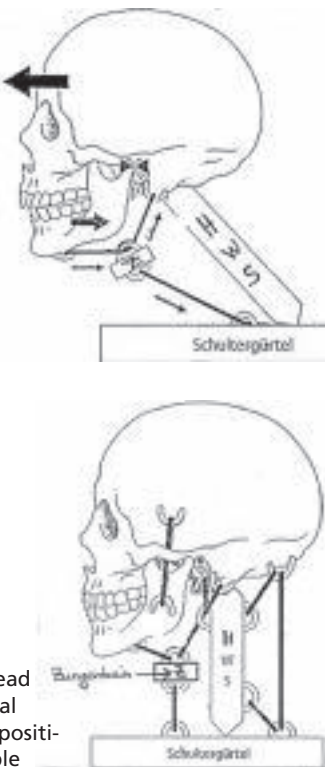
Ciuffolo et al. (2006) analysed the direct effect of plantar stimulation on the masticatory musculature as well as the shoulder and neck musculature. The test subjects of the test group wore insoles which were supposed to stimulate the plantar fascia, whilst the test subjects of the control group wore placebo shoes. Measured by EMG the tone changes in the named muscle groups were significant in the test group, which answers in the affirmative the question asked above.

The change in the muscular activities of the lower extremities brought about by proprioceptive insoles were tested on six test subjects in the context of individual case analyses. Using EMG measurements the

2 Hollow round back (Kendall 2001)



3 Changes in the position of the head and their potential influence on the position of the mandible



Short and strong muscle groups in hollow round back:

- cervical extensors
- hip flexors
- extensors of the lumbar region

Extended and weak muscle groups in hollow round back:

- cervical flexors
- upper section of the erector spinae muscle
- oblique abdominal musculature
- hamstring muscles

Muscular changes in hollow round back

tone changes in each case were determined on the tibialis anterior muscle, peroneus longus muscle, the lateral head of the gastrocnemius muscle and the medial head of the gastrocnemius muscle. A positive influence in terms of the planned muscle activation could be measured with all test subjects (Ludwig et al. 2004). The number of test subjects is too low to be of high diagnostic value; however, this study indicates increased activity of the desired muscles and could serve as a pilot study for a more extensive study.

Incel et al, (2002) analysed the connection between hallux valgus deformities and biomechanical changes in the lumbar region and foot region. A significant connection between hallux valgus and pes planus deformities could be established, as well as a tendency towards increased inclination to lordosis in the lumbar spine region.

The interconnection of the malpositions cited above can be demonstrated in the following case study:

Ms S. (24 years old) works as a hairdresser in an occupation which primarily involves standing. Her leisure time is spent as a conductor.

The main symptoms comprised tension headaches up to migraine, shoulder and neck tension and recurrent spinal blocks. The headaches were already present on waking up in the morning.

In particular, the symptoms increased in periods of stress, at times up to complete limitation of her fitness for work.

With regard to the treatment to date, it can be said that Ms S. had received physiotherapy for years, although without success. The constantly recurring symptoms in the form of blocks and enormous muscle tension disorders could be improved temporarily with Dorn-Breuß therapy. Long-term success with this therapy was not possible.

In addition Ms S. has craniomandibular dysfunctions which, due to grinding of the teeth at night, perpetuated or increased the symptoms (headache, shoulder/neck tension etc.). For relief of the mandibular joints Ms S. wears a bite guard at night. In this connection it is not without significance to point out that in childhood Ms S. had undergone orthodontic treatment, which was supposed to improve the position of her teeth.

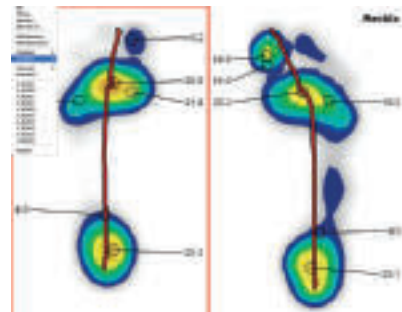
However, the position of the teeth changed again in the course of the years.

Treatment with shoe insoles had not been carried out up to this point.

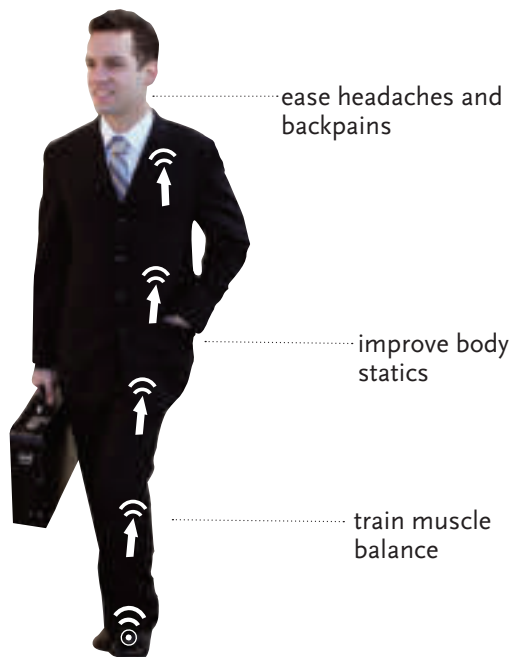
On inspection (see figure 3) it is noticeable in sagittal plane that Ms S. has a severe hollow round back, the head is displaced ventrally, there is internal rotation of the shoulders. In the knee region bilateral genu recurvatum, which forces the ankle joints



4 Internal rotation position of the legs with genu recurvatum and genu valgum tendency, internal rotation of the shoulders and ventrally directed head position can be seen.



5 Baropodography, asymmetrical step development, pes cavus, pes valgus, pes transversus on the left/right, deviating gait line left/right



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improve body statics

train muscle balance

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6 – 9 Examination and compensation of functional leg length difference by changing sensorimotor input of the craniomandibular region.

into a slight plantar flexion position in order to maintain balance.

The frontal view shows a tendency towards genu valgum (more on the right than on the left) and malpositions of the foot in the form of pes planus. There is slight internal rotation of the knee caps, which explains the tendency of the lower extremities towards internal rotation. The right gluteal fold is slightly lower, in the shoulder girdle region it is noticeable that the right shoulder "hangs".

The malposition of the vertebral column is to be recognised (amongst others) by the asymmetry of the waist triangles and the different position of the scapulae.

On closer examination a functional leg length difference emerged, which could be compensated by changing the sensorimotor input of the craniomandibular region.

It is not evident with which malpositions the static changes began in Ms S.

Several factors, such as for example unilateral exertion (work, hobby), insufficient muscular stability, incorrect footwear, orthodontic treatment and stress can influence the development of malpositions.

Ms S. was treated with sensorimotor insoles, which spontaneously had a positive effect on her posture. As Ms S. mainly stands in her work and in her leisure time, provision of insoles is an important treatment, which should be used parallel to treatment comprising physiotherapy and manual therapy. Whether the treatment with insoles alone can reduce Ms S.'s problem, cannot be foreseen at this time.

Summary and conclusion

The studies cited illustrate the functional connections between the joints of the foot, knee, hip, vertebra and jaw.

Therefore treatment of malpositions of the foot should not only play an important role in rehabilitation, but in prevention as well in order to avoid further ascending symptoms.

Whether a malposition of the foot is initially present, which then, in an ascending order, influences the joints lying cranially due to the malposition or whether a malposition in joints lying cranially, in a descending order, helps malformations of the foot to develop, has not been sufficiently researched to date.

On the basis of the descriptions of the functional connections in the body and the scientific findings we can conclude that sensorimotor insoles exert a positive influence on body statics and therefore it makes absolute sense for a patient with symptoms in the jaw and cervical spine to go and see an orthopaedic craftsman.

Monika Knust

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The afference-stimulating insole –

Effective corrective factor in the event of sensorimotor performance deficits and dysbalances as well as pains in the musculoskeletal system

Today afference-stimulating insoles are an important part of treatment, if, for example, co-ordination of all muscle groups within the link chain is impaired by dysfunction of one muscle group and muscle dysbalances, muscle tensions, malpositions and further co-ordination and proprioceptive disorders resulting from it, also develop. In addition, in the event of damage of the nervous system, if the complex neuromotor interconnection is restricted and disorders (e.g. spasticity) in the movement sequence of the link chain result, afference-stimulating insoles can influence sensorimotor function by stimulating the proprioceptors and exteroceptors with appropriate stimuli with the objective of correcting afferent input. The work with sensorimotor insoles still represents a science based on experience. However, the practical experiences are so sound that it is possible to create the insole according to the individual deficit found in the patient, so that the muscle to be corrected is boosted in the right intensity, at the right time and in the right duration of activity.

The sensorimotor system is a complex set of rules. On the one hand it comprises the peripheral and central nervous system, on the other hand the related functions of the musculature whereby the individual musculature and muscle groups are connected to one another via the link chain.

Via the nerve tracts the sensorimotor system transmits to the central nervous system all forces from the environment which, consciously as well as subconsciously, influence our organism. It also registers all environmental processes to which we have a relationship. The nervous system also perceives things to which we, however, do not have to or so not wish to react.

In many cases reactions to forces/information from our environment or from our body are also automatically responded to or suppressed by the nervous system.

The impressions from the environment or from our body affecting our nervous system are called stimuli.

Our nervous system has special stimulus perception structures for each type of stimulus. These are called receptors (Latin recipere = to assimilate, feel).

Figure 1 shows a list of a series of receptors, which our nervous system holds in order to be able register meaningfully the stimuli from the

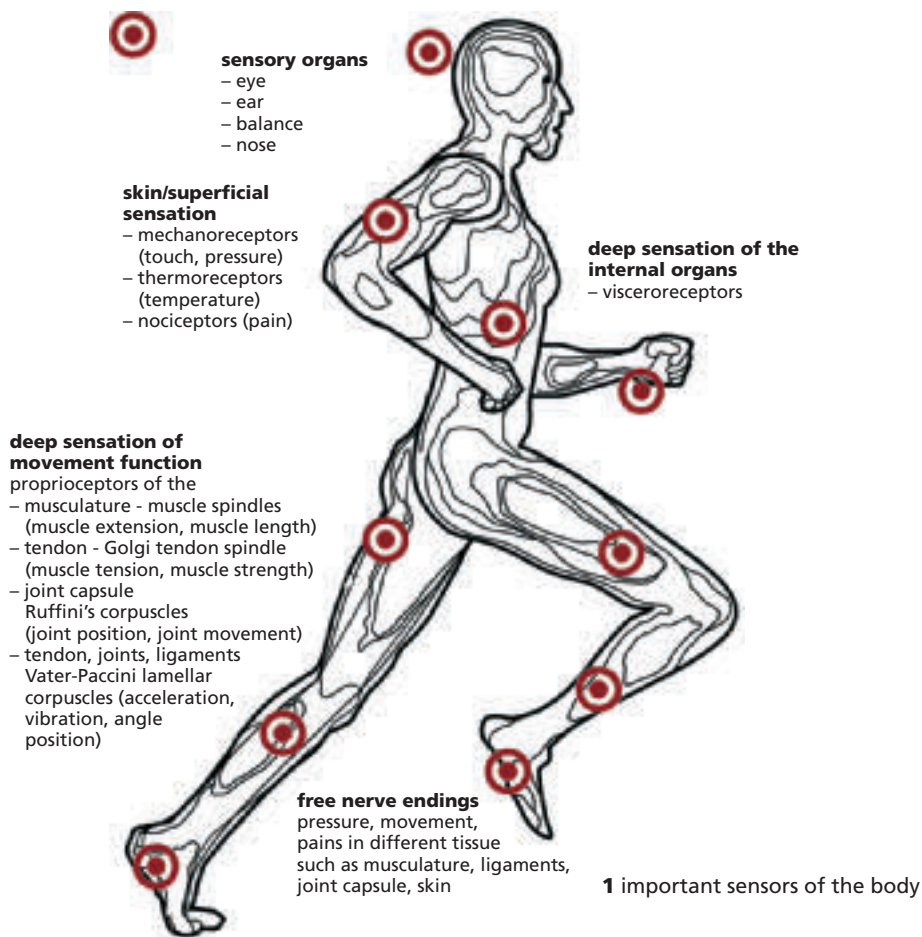
environment and our organism which have an effect us.

Physiology of sensorimotor function

Stimuli are received by our peripheral nervous system, conducted to the spinal cord, processed further there and

simultaneously transmitted to the different control centres of our brain.

The 'Messages' of the receptors from the periphery to the central nervous system, which begin in the spinal cord and whose highest switch point is the cerebral cortex, are called afferent stimuli.

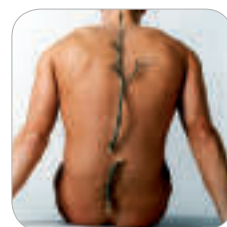










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| <p>PROPRIO® S1-1</p>  | <p>S1-1 in connection with clearly lowered foot type</p> <ul style="list-style-type: none"> ✓ flat foot ✓ splay foot ✓ slight pes cavus | <p>SOME INDICATIONS</p> <ul style="list-style-type: none"> ✓ knee pain ✓ back pain |
| <p>PROPRIO® S1-2</p>  | <p>S1-2 in connection with clearly lowered foot type and valgus deformity of the heel</p> <ul style="list-style-type: none"> ✓ piede valgo con arco abbassato ✓ piede cavo di grado lieve ✓ piede traverso | <p>SOME INDICATIONS</p> <ul style="list-style-type: none"> ✓ knee pain ✓ back pain |
| <p>PROPRIO® S3-0</p>  | <p>S3-0 in connection with foot type with clearly high avulsion</p> <ul style="list-style-type: none"> ✓ moderate to severe pes cavus | <p>SOME INDICATIONS</p> <ul style="list-style-type: none"> ✓ knee pain ✓ back pain |
| <p>PROPRIO® S2-0</p>  | <p>S2-0 in connection with forefoot overexertion pain without padding</p> <ul style="list-style-type: none"> ✓ splay foot ✓ talipes planovalgus ✓ slight pes cavus | <p>SOME INDICATIONS</p> <ul style="list-style-type: none"> ✓ forefoot overexertion pain ✓ knee pain ✓ back pain |
| <p>PROPRIO® S3-1</p>  | <p>S3-1 in connection with forefoot overexertion pain without padding</p> <ul style="list-style-type: none"> ✓ splay foot ✓ moderate to severe pes cavus | <p>SOME INDICATIONS</p> <ul style="list-style-type: none"> ✓ forefoot overexertion pain ✓ knee pain ✓ back pain |
| <p>PROPRIO® S4-0</p>  | <p>S4-0 in connection with hallux rigidus</p> <ul style="list-style-type: none"> ✓ splay foot ✓ flat valgus foot ✓ slightly contracted foot | <p>SOME INDICATIONS</p> <ul style="list-style-type: none"> ✓ hallux rigidus ✓ knee pain ✓ back pain |
| <p>PROPRIO® S3-6</p>  | <p>S3-6 in connection with hallux rigidus</p> <ul style="list-style-type: none"> ✓ splay foot ✓ moderate to severe pes cavus | <p>SOME INDICATIONS</p> <ul style="list-style-type: none"> ✓ hallux rigidus ✓ knee pain ✓ back pain |

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S5-0 in connection with tension pain

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- ✓ talipes planovalgus
- ✓ normal foot
- ✓ slight pes cavus

SOME INDICATIONS

- ✓ knee pain
- ✓ migraine
- ✓ calftension
- ✓ back pain
- ✓ tinnitus
- ✓ Achilles tendon

PROPRIO® S5-1



S5-1 in connection with tension pain

- ✓ splay foot
- ✓ moderate to severe pes cavus

SOME INDICATIONS

- ✓ knee pain
- ✓ migraine
- ✓ calftension
- ✓ back pain
- ✓ tinnitus
- ✓ Achilles tendon

PROPRIO® S6-0



S6-0 in connection with medial arthrosis of the knee joint (varus stability)

- ✓ splay foot
- ✓ talipes planovalgus
- ✓ pes cavus
- ✓ normal foot

SOME INDICATIONS

- ✓ medial arthrosis of the knee joint
- ✓ knee pain
- ✓ back pain

PROPRIO® S6-1



S6-1 in connection with lateral arthrosis of the knee joint (valgus stability)

- ✓ splay foot
- ✓ talipes planovalgus
- ✓ contracted foot
- ✓ normal foot

SOME INDICATIONS

- ✓ lateral arthrosis of the knee joint
- ✓ knee pain
- ✓ back pain

PROPRIO® S7-2



S7-2 in connection with plantar fasciitis

- ✓ splay foot
- ✓ talipes planovalgus
- ✓ slight pes cavus
- ✓ normal foot

SOME INDICATIONS

- ✓ plantar fasciitis
- ✓ knee pain
- ✓ back pain

PROPRIO® S7-3



S7-3 in connection with plantar fasciitis

- ✓ splay foot
- ✓ moderate to severe pes cavus

SOME INDICATIONS

- ✓ plantar fasciitis
- ✓ knee pain
- ✓ back pain

PROPRIO® S8-0

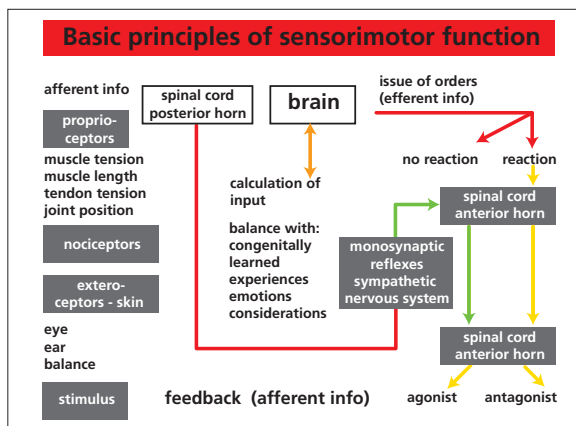


S8-0 in connection with peroneal paresis

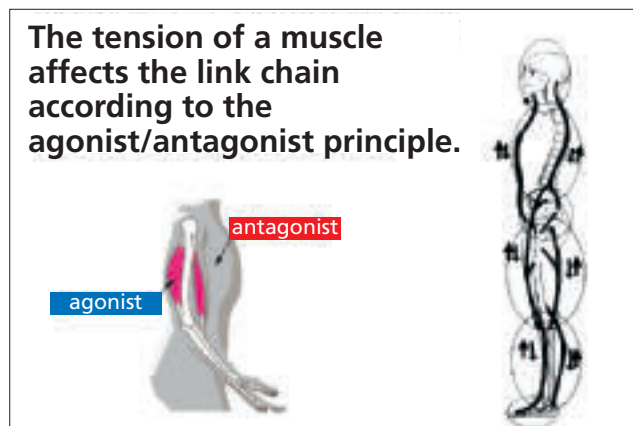
- ✓ slight clubfoot
- ✓ rebellious clubfoot
- ✓ pes cavus

SOME INDICATIONS

- ✓ condition following stroke
- ✓ condition following head injury



2 The sensorimotor system



3 The musculature works according to the principle of agonist/antagonist

In the brain stimuli are registered and integrated, balanced with experiences, sensations and reflections and subsequently the stimulus response is conceived and sent as an efferent stimulus to the effector organs (e.g. musculature) located in the periphery (figure 2).

Many stimulus responses also occur unconsciously via automatisms. On the one hand these automatisms are transmitted to us genetically.

On the other hand they are modified by conscious or unconscious learning processes (e.g. training) or by conscious or unconscious imitating of models. Walking, standing, posture and with posture, in particu-

lar work posture or movement sequence at work or during sporting activities, constitute automatisms of this type, which in different phases of our life we sometimes have to learn with difficulty initially.

Once learned we do not have to think about it any more if, for example, we wish to walk, sit, cycle or sprint, throw the javelin, hammer or write.

As our nervous system is affected by about 1 billion stimuli per second we also need a stimulus attenuation system because it is impossible for us to be able to react meaningfully and practically to such a large number of stimuli. This attenuation system, just like the stimulus perception system, is multi-stage. It begins with the notion that a stimulus must have a certain force to be accepted by the receptor (all-or-none law). In the course of further progress there are other "switching stages" in the attenuation system of the spinal cord and the brain, which is not to be examined in further detail here.

Finally, the nervous system also needs feedback as to whether the efferent reactions initiated by it have also been performed as "arranged" or whether any deviations/disturbances occurred. This is necessary in order to react effectively and consistently again in accordance with the new position/posture of the body when the next stimulus occurs.

The sensorimotor system therefore creates a mutually interlocking system of stimulus uptake, processing and output (figure 2). The nervous system receives and evaluates all sensory impressions which affect our

body or which our body itself generates (sensory function).

The nervous system controls the muscular reaction (motor function) in response to the sensory impressions (sensory stimuli).

The effects of sensorimotor function on the link chain

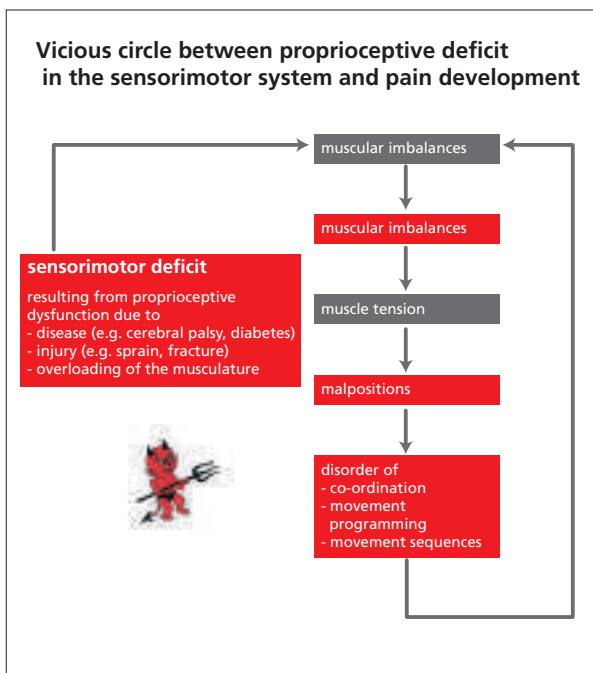
The motor reaction of a muscle group takes place according to the principle of agonist/antagonist (figure 3). If a muscle group becomes tense (e.g. the elbow flexors - in this case agonist), the antagonist muscle group must relax to the same extent and at the same speed (in this case elbow flexors - antagonist), so that the intended movement can also run fluently and smoothly.

The influence of the nervous system on all muscle groups occurs simultaneously within the related link chain (figure 3), so that our muscle groups can position and stabilise our body in space as planned.

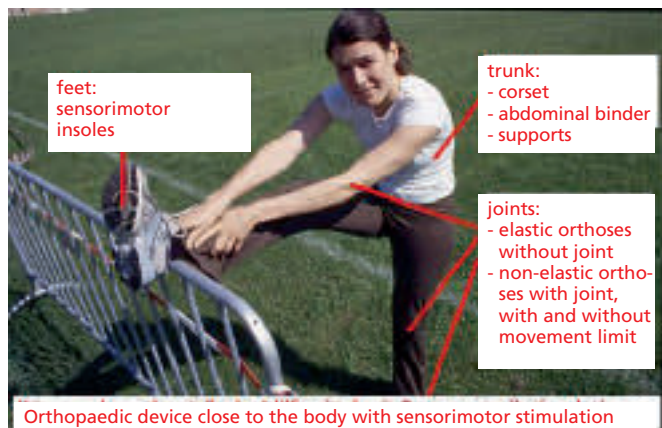
In addition, the muscular link chain is integrated in a complex manner into several hierarchical stages of control/order via the sensorimotor system.

All reactions to an efferent stimulus, which induces muscle movement for example, are reported back to the nervous system as a feedback. By definition the feedback constitutes a new afferent stimulus. In response to the feedback the nervous reacts again or it refrains from reacting if it is not necessary and "notes" only the registration of feedback.

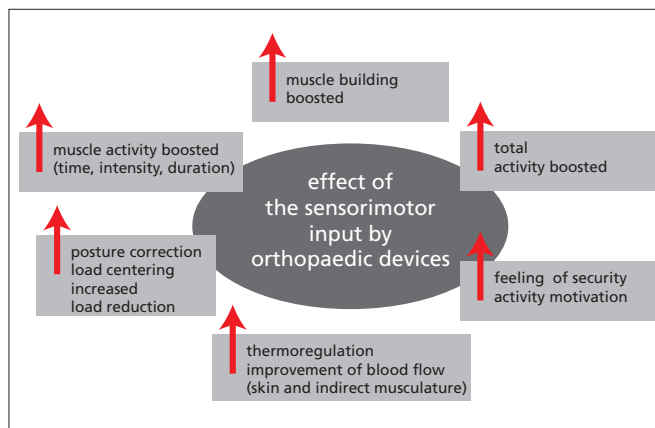
Thus the manner of function of the sensorimotor system in each case



4 Vicious circle of pain development



5 Sensorimotor simulation with orthopaedic devices



6 Manner of effect of afference stimulation by sensorimotor insoles

permits a meaningful and practical reaction to

- a) events in our environment without direct connection to our body
- b) influences on our body from outside and
- c) changes in our body itself (e.g. movement sequences).

Via the sensorimotor system our body's functions and skills can be controlled and utilised specifically and consciously through intended and planned reactions or through automatisms so that we can assert ourselves in our environment.

In order to be able to carry out our body's action or reaction to a stimulus as accurately and specifically as possible the sensorimotor system needs as much information as possible, which it receives via differentiated receptors for example. If the information is too vague or sparse, for example due to diseases or other disorders in the sensorimotor system, the efferent reaction to the incomplete (vague) afferent stimulus range (not enough information) can only take place incompletely (vaguely) or even incorrectly.

Example 1

If the performance of the brain (central nervous system) is impaired due to cerebral palsy in childhood, depending on the type of damage, stimulus perception, stimulus attenuation and stimulus output can be disturbed, so that from this, for example, the different stages of spastic paralysis as a result of the damaged brain will develop. The damage of the nervous system obstructs complex neuromotor intercon-

nection, from which result the disorders (e.g. spasticity) in the movement sequence of the link chain.

Example 2

If the functionality of individual muscles is for example impaired by a ligament strain on the foot, a malleolar fracture or overexertion of the Achilles tendon etc., due to the dysfunction of one muscle group, impairment of co-ordination of all muscle groups within the link chain occurs. As a result of the proprioceptive deficits, muscle dysbalances, muscle tensions, malpositions and further co-ordination and proprioceptive disorders, which are also caused by this, develop (figure 3).

Muscle dysbalances, muscle tensions and malpositions generate pain in the musculoskeletal system, which can spread beyond this via the interconnection of the link chain. In this way pains can occur in the musculoskeletal system, which are apparently inexplicable initially because, due to the sensorimotor interconnection and the intervention of the link chain, the pain region can lie a long way away from the region of the muscular overexertion, the sprain or other musculoskeletal dysfunction.

The connections between proprioceptive deficit, effects on the link chain and the development of pain just outlined constitute a vicious circle (figure 4), which is virtually self-perpetuating and even becomes worse without meaningful therapeutic intervention.

Through the interconnection of the muscle groups via the link chain proprioceptive deficits and painful

muscle dysbalances as well as malpositions also spread from the distal region to the proximal region, i.e. from the foot towards the head for example, although also in reverse direction (figure 3).

In order to break through the vicious circle outlined above there is a practical measure to influence and correct sensorimotor afferent input.

The sensorimotor insole and its influence on the link chain

Sensorimotor function can be influenced or stimulated by stimulating the proprioceptors and exteroceptors with appropriate stimuli with the objective of correcting the afferent input.

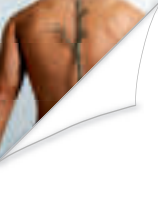
This effect can be achieved by orthopaedic devices which are worn on specific regions of the body (figure 5).

This sensorimotor stimulation triggered by the orthopaedic devices influences the muscle receptors, the tendon receptors and the exteroceptors of the skin.

In addition, the orthopaedic devices psychodynamically bring about a positive effect by an appealing design and ease of use and convey the impression of safety/protection to the patient being treated with the device. This effect motivates the patient to activity and simultaneously increases acceptance of the device.

The parameters cited in figure 6 can be influenced by the orthopaedic device which provides sensorimotor stimulation.

Whilst with an orthosis worn on the trunk, on the knee or on the elbow for example, sensorimotor



function can indeed be influenced in a positive way, albeit oriented in a relatively untargeted manner, afferent sensorimotor stimulation on the foot can be initiated in a targeted manner.

With sensorimotor insoles sensory afference can be influenced very precisely and with great sophistication depending on the requirements of the muscular performance deficits to be corrected.

The sensorimotor insole as a useful building block in the treatment concept of diseases (e.g. cerebral palsy) and other muscular dysbalances

The work with sensorimotor insoles still largely constitutes a science based on experiences. The evidence-based test results demanded nowadays are already hard to obtain from an ethical point of view. Because of a succession of competent experts, through whose practical experiences, experiences with regard to the correction of specific deficit complexes (clinical characteristics of disease) have reached such a level of maturity today that it is possible to create the insole according to the individual deficit found in the patient so that through the insole treatment the muscle to be corrected is boosted in the right intensity, at the right time and in the right duration of activity. This knowledge is so well founded that it can be shared in appropriate courses/training programmes and subsequently applied consistently by the course participants.

On this basis treatment with sensorimotor insoles becomes a useful and effective building block in the complex treatment of sensorimotor deficits caused by disease, injury and overexertion. Following appropriate functional investigations the musculoskeletal pain generated by the deficits can also be treated in a targeted manner with afference-stimulating insoles. If function is boosted, the pains also ease.

The role of sensorimotor function in the complex of modern pain therapy

There is no doubt that in the event of diseases, injuries, overexertion of the musculoskeletal system, active phy-

siotherapeutic/sports therapy treatment working with modern methods in a targeted manner, as has been carried out to date, is indicated for influencing functional disorders. In the event of pains, knowledge of modern pain therapy is also to be applied.

It is to be deduced from this that if there are dysfunctions in the musculoskeletal system, the modern treatment approaches demand a complex of treatment methods. In this complex the afference-stimulating insole constitutes the orthopaedic device with which to carry out a correction of the diagnosed performance deficit by specific change of the afference input in the event of a disorder in sensorimotor movement programming.

Therefore, in the context of the functional and activity-boosting treatment just outlined, in adulthood the purely bedding insoles and in growth age the conventional growth-guiding insoles, are not in a position to correct the afferent input in a targeted manner and with short-term effect.

The advantage of sensorimotor insoles compared with purely bedding insoles

The purely bedding insoles do not meet the requirements of a functional, afference-stimulating orthopaedic device. On the other hand the afference-stimulating sensorimotor insole brings about a very efficient treatment effect in the treatment of functional and painful sensorimotor function disorders in the musculoskeletal system. Whilst it is true that with the afference-stimulating insoles, even without further treatment methods, it is only by the correction of the afferent input that an initial benefit, which also occurs short-term, can be achieved in the region of the disorder to be treated. The treatment success is nevertheless significantly more effective if the afference-stimulating insole in combination with activating and functionally correcting physiotherapeutic/sports therapeutic treatment methods is integrated in a complex treatment programme.

The effect of the activating and correcting elements of movement

therapy is significantly boosted by the simultaneous correction of afferent input by the sensorimotor insole. The treatment objective is achieved more rapidly. The sensorimotor insole thus also exerts a positive effect on economy of treatment and economy of time.

In addition, long-term usage of the insole prevents correction deficits.

In this sense the sensorimotor insole constitutes a very effective and ultimately also economical treatment approach in the therapy complex for the treatment of an impaired sensorimotor system.

Professor Dr. med. Holger Hähnel

Original article for this special edition

Anatomical and functional leg length differences

The distinction between anatomical and functional leg length differences is not always entirely straightforward. Nevertheless there is hardly any other orthopaedic problem area where interdisciplinary co-operation is so worthwhile than in the differential investigations and treatment of malpositions of the pelvis. Only if the cause of pelvic tilting is found, can targeted and differentiated treatment be initiated. This includes orthopaedic insoles and treatment methods involving manual therapy and physiotherapy as well as orthodontic interventions.

Introduction

There is hardly any other everyday orthopaedic examination where so many incorrect diagnoses are made than in the assessment of pelvic tilting. The conclusion from pelvic tilting that there is an anatomical leg length difference, which can be balanced with insoles, often is drawn (too) quickly. The complex structure of the pelvis and the complex range of movement of its components (osseous, ligamentary and muscular) are often readily ignored. However, the distinction between anatomical and functional leg length difference, which both can lead to pelvic tilting, is not rocket science.

1. Functional differences of leg length

The effect of functional deficits on leg length and pelvis position will be shown on the basis of the following case study. The young adult complains of persistent symptoms in the right lower lumbar spine and in the region of the left sacroiliac joint. A deeper examination shows severe pain in the region of the small musculature of the right buttock. Here typical trigger points of the gluteus medius, gluteus minimus and piriform muscles respond with a feeling sharp pain. In the region of the lower sacrum and the coccyx tenderness to pressure also occurs. A postural analysis shows a clear low position of the right posterior superior iliac spine (PSIS).

The lumbar spine compensates the low base with slight scoliotic deviation towards the right. Figure 1 shows the dorsal view with pain zones marked in and the overlapping malposition of the pelvis.

Classical treatment, as had already been previously carried out this patient, consists of the balancing of suspected leg length difference. The instruction to straighten the pelvis again – or more precisely the iliac crest and the PSIS, because the usual examination is mainly concerned with this - only led to treatment with insoles with elevation by 6 mm on the left side. However, an alleviation of symptoms was not achieved by this during a period of several weeks of wearing the insoles.

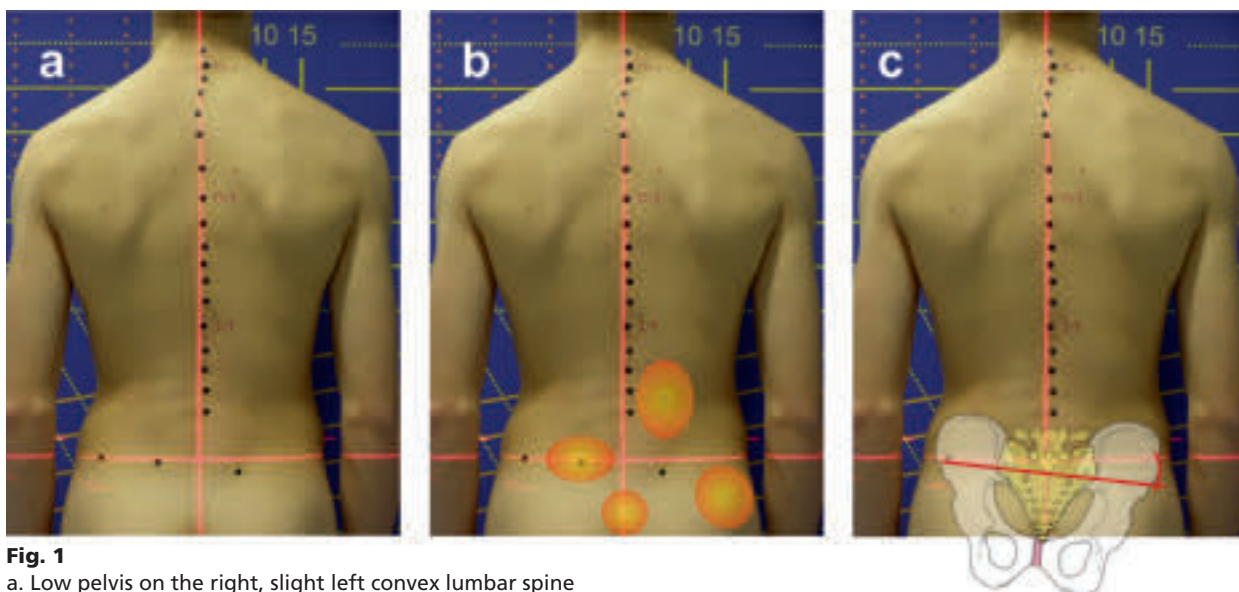


Fig. 1

- a. Low pelvis on the right, slight left convex lumbar spine
- b. Patient's pain zones
- c. Suspected position of the pelvis, beginning from the anatomical marker points

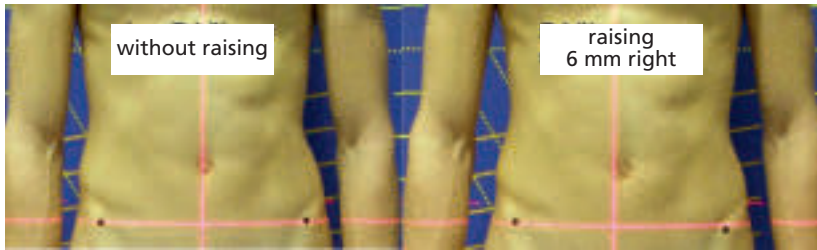


Fig. 2 Left: without elevation perpendicular position of both anterior superior iliac spines (ASIS). Right: With elevation on the right by 6 mm raised position of the right ASIS. Laser perpendicular through pubic symphysis no longer hits the centre of the body (navel).

If we examine the patient's posture more closely, we see that the low position of the right PSIS also does not simultaneously correspond with a low position of the right anterior superior spine (ASIS) on the frontal side. Figure 2 shows an upright position of the ASIS without insole elevation. In this case the perpendicular line also runs through the navel and apex of the sternum. However, with the insole elevation, which straightens the posterior pelvic region, the right SIAS tilts upwards.

With asymmetrical response of the posterior and anterior spines to a unilateral elevation, a functional leg length difference is always suspected. In this case the hip bone has carried out a rotation movement (torsion). On the right side the patient's hip bone is in retroversion (backward tilting). If we view from the side the patient, who is looking towards the of the clock face, the right pelvic ring (marked in fi-

gure 3) has turned slightly anticlockwise. The posterior superior spine thus lowers (figure 3 on the right) and simulates a low position of the pelvis. If in addition to this twisting, a slight lowering of the right pelvic section occurs, the anterior superior spine lowers to its original level again. The iliac crest is then lower on the right, as is the posterior superior spine, whilst the anterior superior spine is on a neutral level (figure 4). However, as in most orthopaedic examinations only the iliac crest (pelvis scale!) or PSIS are tested, no differentiation between genuine anatomical leg shortening and pelvic torsion is possible.

The consequences of pelvic torsion are manifold. The sacrum is connected in a springy manner with the ilia via the two sacroiliac joints (shaded in figure 3 on the right). The slight rocking movement is called nutation (Latin nutare - to nod). The articular surfaces of both sacroiliac

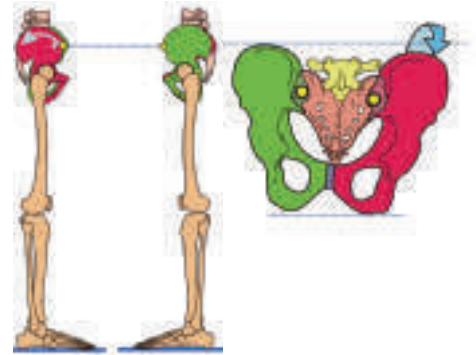


Fig. 3 Left: Retroversion (backward tilting) of the right hip bone (red). With simultaneous lowering the right and left ASIS are on the same level. Right: Pelvis situation from dorsal approach. Sacroiliac joints are shaded, yellow the position of the surface skin markers on the PSIS. In the event of unilateral torsion of the right hip bone (red) blocking in the right sacroiliac joint, occurs. The tilting of the sacral bone and of the coccyx is clearly visible. The pubic symphysis (violet) is exposed to torsion.

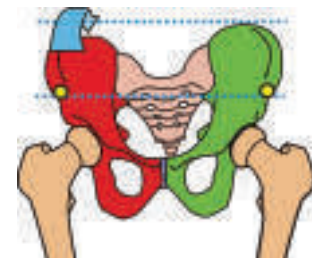


Fig. 4 Pelvis situation, frontal view. If the right hip bone (red) lowers during its retroversion by muscle contraction of the hip abductors, the two ASIS (yellow points) are at the same level. The asymmetry in the region of the pubic bone and sacral bone is visible.

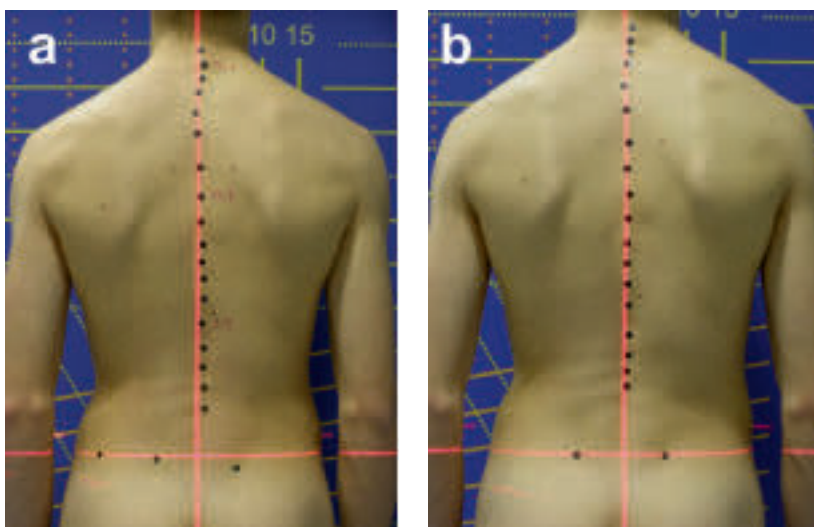


Fig. 5
a. Pelvis status at the time of the first assessment of findings
b. Pelvis status following treatment of the muscle tone and the sacroiliac joint, without elevation.

joints are complexly formed three-dimensionally, therefore no smooth surfaces. As a result the range of movement of a joint can already be impaired with regard to sensation due to slight "tilting". In the event of pelvic torsion, this type of joint blocking of one or both joints is not unusual.

In addition to the blocking of the left sacroiliac joint, a more detailed examination of the patient yielded another finding to be expected:

the musculature of the right hip abductors, in particular the gluteus medius muscle, were painful contracted. Thus this muscle group pulls the superior edge of the ilium slightly downwards in the direction of the head of the hip joint and the femur in a slight long-term abduction. With the leg rising up the right superior

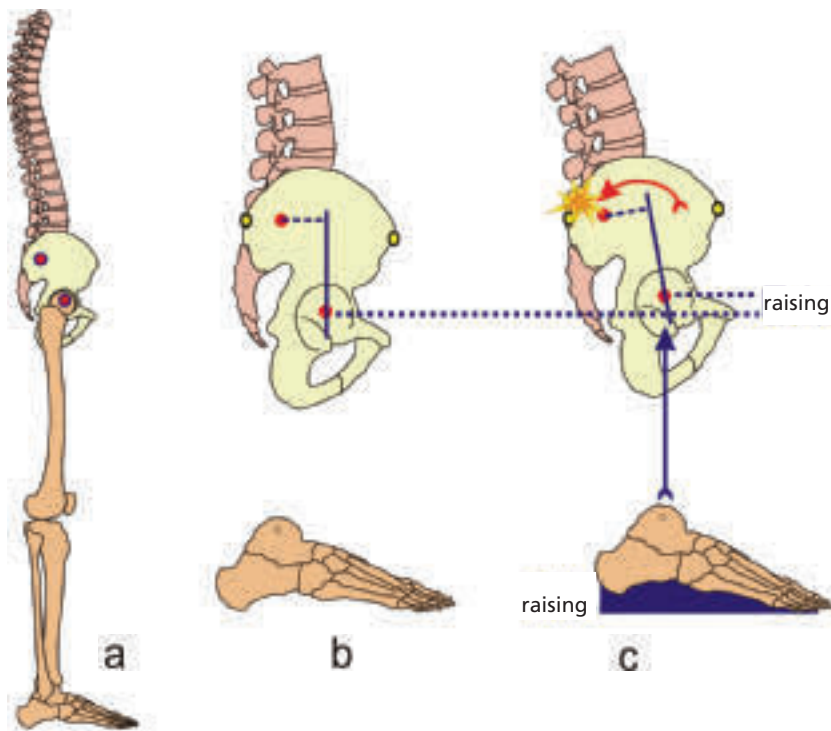


Fig. 6
 a. Position of the virtual rotation axes of hip joint and sacroiliac joint
 b. As both axes do not lie on top of one another, a leg lengthening via insole elevation brings about a rotation moment.
 c. An elevation because of an incorrect diagnosis brings the hip bone into additional retroversion and can cause blocking symptoms at the sacroiliac joint and can lock blockades

edge of the pelvis (here the muscle begins) is thus pulled down towards the posterior region biomechanically and brings about the observed pelvic retroversion on the right side. The lower lumbar vertebrae follow the sacrum tilted towards the right, which leads to the observed scoliosis. The result is increased tone of the lower spinal column stabilising musculature (erector spinae muscle), which explains the symptoms in the lower back region. With the pubic symphysis the pelvic ring has a cartilaginous supple connection, in which, torsion also occurs if there is unilateral pelvic torsion. With the sportsman this articular connection was also highly tender to pressure and blocked.

In the context of a differentiated treatment the existing elevation was removed. Every two days the muscles of the abductor group and of the lower lumbar spine were detoned (massage, TENS, passive extension). Both sacroiliac joints were regularly mobilised. After eight days the symptoms had subsided and a further posture analysis was carried out. Figure 5 (on the right) shows the changed

posture: the pelvis is entirely straight, both at the level of the PSIS and ASIS, without a leg having had to be mechanically elevated. Scoliosis is only still present in the region of the cervical spine.

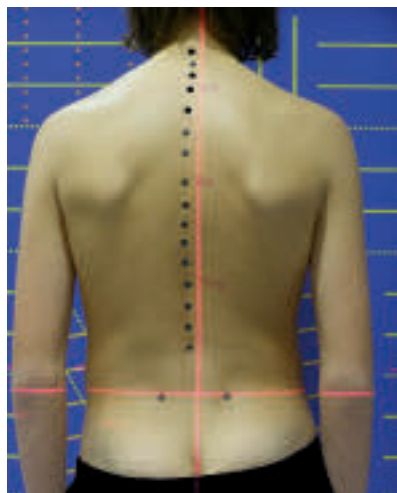


Fig. 7
 Patient with genuine anatomical leg shortening on the left. Low position of the pelvis on the left, compensatory left convex scoliosis of the lumbar spine and thoracic spine.

Conclusion:

The example shows very clearly how a malposition in the pelvis should have been subjected to a differentiated examination prior to further therapy and treatment being carried out. In this case the incorrect elevation had set the retroversion of the pelvis (figure 6) because it takes effect precisely in the same direction and thus worsens the symptoms.

For practical application, before establishing treatment, the following sequence is advisable:

1. Test for low position of the PSIS
2. If yes: Test for low position of the ASIS on the same side
3. Are PSIS and ASIS low to an equal extent on the same side?
4. If yes: pelvic tilting, repeat tests with unilateral elevation (OST, OT)
5. If no: pelvic torsion, tests for blockade of the sacroiliac joint and muscle contractures (PT, physician)

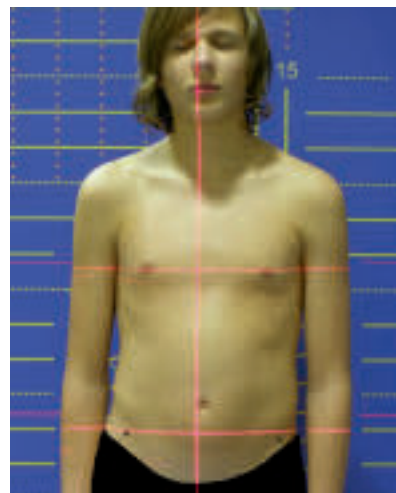


Fig. 8
 Patient from frontal approach. Low position of the pelvis on the left. Laser perpendicular goes through the pubic symphysis, although no longer hits the navel, centre of the sternum, centre of the neck and nose.

2. Anatomical differences of leg length

However, genuine anatomical leg shortenings are often also connected with functional disorders. Then a shortening balance is an important treatment of choice, which must be supplemented by other forms of treatment.

The second case study illustrates this: the 15-year-boy also has symptoms in the lower back as well as in the right inguinal region. A nervous temporary twitch in the form of a rapid rotation of the head upwards towards the right is occasionally noticeable.

A posture analysis clearly shows from the dorsal region clearly low PSIS on the left side (figure 7). Compensatory twisting of the vertebral column towards the left has occurred. The image is confirmed from the front: due to the pelvis tilted towards the left, the entire symmetry of the trunk is simultaneously disturbed. The frontal vertical perpendicular line should begin at the pubic symphysis and run through the navel, the sternum and the tip of the nose. Due to the left-tilted pelvis, the entire upper body is displaced towards the left (figure 8). The head is again slightly inclined towards the right side – here the central nervous system unconsciously balances malpositions of the lumbar spine and thoracic spine at the level of the cervical spine.

However, in the concrete case the boy's body overcompensates. Whilst the pelvis is tilted towards the left by approximately 3°, the bipupillar plane is tilted towards the right by 5°, the mandibular joint plane by 3° and the occlusal plane (bite plane) likewise by 3° (figure 9). To put it simply, the body has adjusted the head more obliquely than would be necessary because of the pelvic tilting.

The muscle groups (sternocleidomastoid muscle, scalene muscles) responsible for the inclination of the head indirectly influence the position from maxilla to mandible and, due to long-term unilateral toning, have the effect of encouraging the development of craniomandibular dysfunction (CMD).

With the young patient, at the same time as conventional insole elevation of 5 mm, a brace was made as an orthodontist had diagnosed disturbances in tooth position and in occlusal overlay. Perpendicular straightening of the trunk could already be achieved with the elevation (figure 10); however, the head was still oblique by approximately 3°. Due to the dental brace, the oblique posture disappeared within 8 weeks (figure 9 on the right).

It was only with both treatments simultaneously that it was possible to successfully normalise pelvis and vertebral column as well as the position of the head and jaw. The nervous

head twitches, which were connected with the unilateral muscle tone of the head rotators, likewise largely disappeared.

Conclusion:

The example shows that in addition to a genuine anatomical difference, further functional disturbances can also occur, which only permit a harmonious postural pattern when they were exposed and eliminated. Whilst pelvis position and vertebral column do balance themselves by unilateral elevation, if, however, there are asymmetries in the region of the shoulder or head, then a consultative examination of the status of the joints of the head and jaw as well as the eyes by a specialist is advisable.

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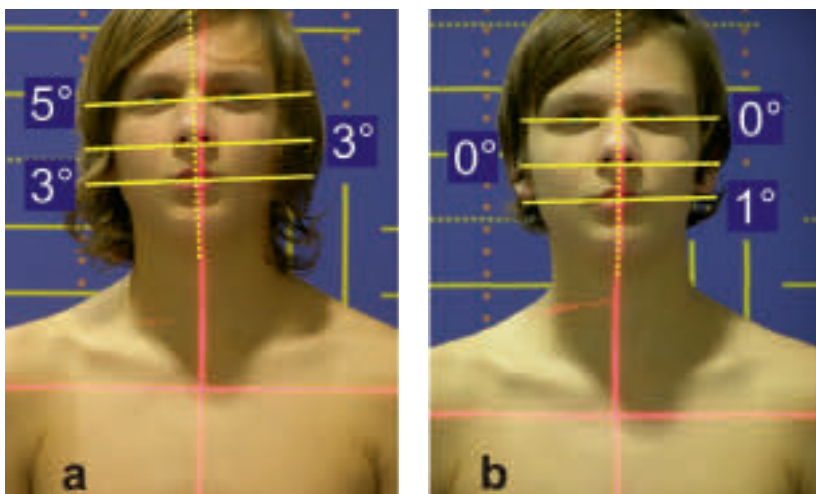


Fig. 9 Evaluation of head posture and face symmetry (corpus concepts measuring system). Asymmetrical position of the planes pupil and mandibular joint as well as bite plane in degrees to the horizontal line.
a. Patient prior to treatment
b. Patient after treatment: elevation on the left 6 mm, brace

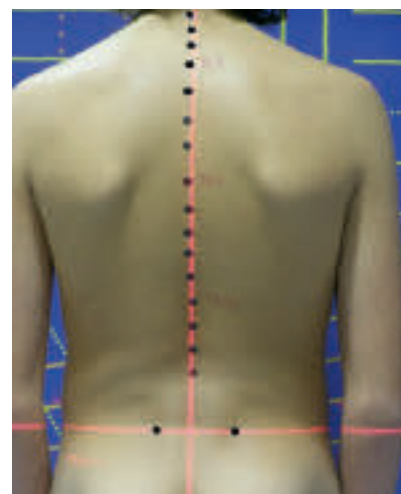


Fig. 10 Pelvis status and vertebral column after treatment, no non-physiological deviations any longer

Sensorimotor foot beddings in sport

Because of its technical specification, its capacity for interpretation of strains and abnormal strains as well as its craftsmanship in the subsequent conversion into efficient orthopaedic device, orthopaedic shoe technology is an important element in the care and treatment of sportsmen and sportswomen. These properties are also particularly in demand in the treatment of athletes with sensorimotor foot beddings.

For many years we have used sensorimotor foot beddings to treat sportsmen and sportswomen with their typical symptoms. Here the objective is to deal more appropriately with the dynamic strains which occur in sports. Sports-associated symptoms often have a functional origin. Causal connections are therefore to be sought in the entire movement chain.

Body statics and body dynamics begin with the foot. In many cases it is possible to work via the foot on symptoms, which are located in adjoining or remote areas of the link, joint and muscle chains.

Sensorimotor foot beddings in sport are intended to optimise the static and dynamic movement processes and to influence the latency of the muscles in the form of a strain-oriented muscle balance. Thus symbiosis develops between sports-appropriate bedding and support of the feet with retention of maximum independent dynamics.

Sensorimotor stimulus or tone inhibition supports autologous compensations in the form of the desired effect. The spectrum of the indications to be treated with orthopaedic shoe technology has changed significantly as a result of this.

As a result of experiences in previous years some symptom patterns

in sports have crystallized as particularly predestined for treatment with sensorimotor foot beddings. In addition to classic foot overexertion syndromes, we treat amongst others:

- Chronic whiplash injuries with relative ligament insufficiencies
- Pathological excessive pronation and supination strains
- Tibial edge syndrome
- Tibialis anterior/posterior syndrome
- Plantar fasciitis
- Insertion tendinosis (and tendinosis of the plantar aponeurosis, Achilles tendon, peroneus brevis muscle, tibialis anterior muscle, iliotibial tract....)
- Achillodynia
- Patellar apex syndrome
- Femoropatellar pain syndrome
- Meniscopathy
- Chronic sacroiliac joint blocks.

Efficient treatment should be preceded by an examination with simulation of sporting movement. Treadmill, video analysis, foot scanning and dynamic foot pressure stress measurement (pedography) rank amongst the indispensable prerequisites for us. In addition to the important analysis findings, the visualisation also helps the athlete in his own understanding of his movement and symptom pattern.



1 + 2 The scan of the feet is normal. Only the pressure distribution measurement in the dynamics showed the medial increased strain in the heel.



I would like to illustrate the possibilities for use of sensorimotor foot beddings in sport with an example.

PROPRIO®.Foot beddings

For athletes of all sport types

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PROPRIO® D1-0



D1-0 in connection with talipes planovalgus and slight overpronation

- ✓ for injury prophylaxis
- ✓ treatment of sports-associated diseases
- ✓ performance optimisation

SOME INDICATIONS

- ✓ slight talipes planovalgus
- ✓ slight pes cavus
- ✓ slight splay foot
- ✓ normal foot

PROPRIO® D1-1



D1-1 in connection with talipes planovalgus and severe overpronation

- ✓ for injury prophylaxis
- ✓ treatment of sports-associated diseases
- ✓ performance optimisation

SOME INDICATIONS

- ✓ talipes planovalgus
- ✓ flexed pes cavus
- ✓ splay foot
- ✓ tibial edge syndrome

PROPRIO® D1-6



D1-6 in connection with talipes planovalgus and Achilles tendon symptoms

- ✓ for injury prophylaxis
- ✓ treatment of sports-associated diseases
- ✓ performance optimisation

SOME INDICATIONS

- ✓ talipes planovalgus
- ✓ flexed pes cavus
- ✓ splay foot
- ✓ achillodynia
- ✓ induration of calf musculature

PROPRIO® D1-7



D1-7 in connection with talipes planovalgus, plantar fasciitis and calcaneal spur

- ✓ for injury prophylaxis
- ✓ treatment of sports-associated diseases
- ✓ performance optimisation

SOME INDICATIONS

- ✓ talipes planovalgus
- ✓ flexed pes cavus
- ✓ splay foot
- ✓ plantar fasciitis
- ✓ calcaneal spur

PROPRIO® D2-1



D2-1 in connection with supination of step and overpronation

- ✓ for injury prophylaxis
- ✓ treatment of sports-associated diseases
- ✓ performance optimisation

SOME INDICATIONS

- ✓ pes cavus
- ✓ talipes planovalgus
- ✓ splay foot
- ✓ tibial edge syndrome
- ✓ patellar apex syndrome
- ✓ tendency to sprains

PROPRIO® D2-2



D2-2 in connection with pes cavus, varus deformity of the heel and gait pattern with severe supination

- ✓ for injury prophylaxis
- ✓ treatment of sports-associated diseases
- ✓ performance optimisation

PRINCIPALI INDICAZIONI

- ✓ pes cavus
- ✓ splay foot

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D2-3 in connection with pes cavus, plantar fasciitis, calcaneal spur

- ✓ for injury prophylaxis
- ✓ treatment of sports-associated diseases
- ✓ performance optimisation

SOME INDICATIONS

- ✓ pes cavus
- ✓ splay foot
- ✓ plantar fasciitis
- ✓ calcaneal spur

PROPRIO® D2-4



D2-4 in connection with pes cavus and Achilles tendon symptoms

- ✓ for injury prophylaxis
- ✓ treatment of sports-associated diseases
- ✓ performance optimisation

SOME INDICATIONS

- ✓ pes cavus
- ✓ splay foot
- ✓ achillodynia

The light shell for the calcaneal part of the foot prevents shear forces and gives the athlete a secure feeling in step development.

Activates and boosts the tibial group and stabilises the medial edge of the foot.

The sports-appropriate, distinctly light toe strip improves toe tip contact and gives the athlete a secure feeling.

Boosts the activity of the stapes musculature, strengthens the calcaneal part of the foot and prevents sprains.

The sports-appropriate retrocapital notch relaxes the calf musculature and reduces the traction onto the Achilles tendon.



Case study: football

A few weeks ago a professional footballer, accompanied by the team's physiotherapist, presented in our company. The diagnosis described was: Morton's neuralgia of the right foot as well as persistent Achilles tendon pain on the right.

In football-mad Germany you could now simply say the player is a member of the wrong club. The fewest football players are satisfied with that!

The foot scanning showed no abnormalities with the exception of slight splay foot. The subsequent video analysis also showed no significant change, which could be concluded from the symptoms reported.

Only the dynamic foot pressure stress measurement (pedography) showed medial increased strain of the heel in the „initial contact” on the right as well as increasingly greater plantar pressure strain of the 2nd and 3rd metatarsal bones in the „terminal stance phase” on the right. In addition, a significantly intensified lowering of the longitudinal arch of the foot on exertion by walking became identifiable on the right.

The relative instability of the foot due to insufficient muscular compensation led to increased tensile strain of the Achilles tendon as the possible cause of the achillodynia.

An abnormal splay foot strain with metatarsalgia and Morton's neuralgia on the right followed the arch-static changes.

In this case the objective of treatment with sensorimotor foot beddings was to boost the balance of the stapedius musculature. Here the tibial muscle group in particular should be stimulated.

In order to reduce further the tensile strain in the Achilles tendon, the tone in the triceps surae muscle on the right should be reduced via pre-tension.

It was necessary to straighten the anterior transverse arch of the foot via retrocapital support and to relieve the head of the metatarsal by plantar soft bedding.

As material EVA was used in sandwich structure, which has proved successful in many sports treatments.

For stimulation of the tibial musculature the medial pad in the calcaneal part of the foot was placed in such a way that it forms gentle support of the sustentaculum tali.

The pressure point on the course of the tibialis posterior muscle towards the tendon enthesis led to a change in latency and an increase in tone intensity in the tibial muscle group. (See also Dr. Oliver Ludwig

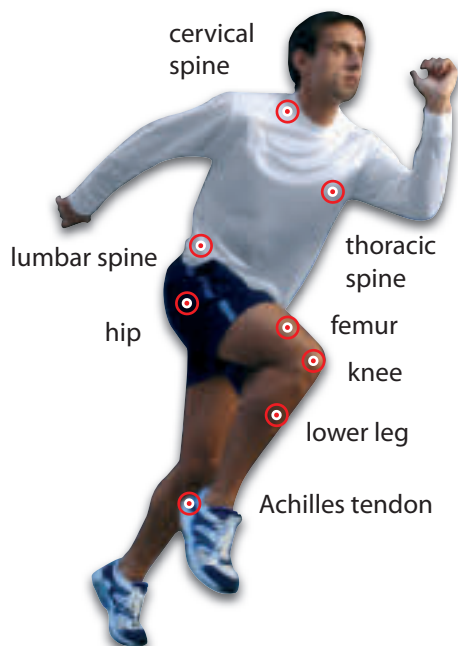
„Untersuchung zur Änderung der muskulären Aktivität durch das Tragen propriozeptiv wirkender Einlagen” [„Examination on the change in muscular activity by wearing insoles with proprioceptive effect”], OST 12/2004).

The lateral pad in the calcaneal part of the foot was only slightly developed.

The improved balance of the stapes muscles not only led to a stabilization of the longitudinal arch of the foot, it also supported the raising of the heel in the secondary function. The gastrocnemius muscle and soleus muscle received active support, which leads to the relief of the Achilles tendon.

A retrocapital support and a toe strip flattening towards the dorsal region were used for pre-tension. The tension maximum in the triceps surae muscle provoked early led to a tone reduction at the time of exertion. The traction force of the Achilles tendon was reduced.

The retrocapital support was developed with an elevation in the region of the 2nd and 3rd metatarsal bones and thus became a classical element of straightening of the transverse arch of the foot as well as a sensorimotor element of muscle tone regulation.



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For filtration of the impact forces with minimal elevation of the heel for tendon relief in the acute phase, a shock absorber glued to three quarters was used.

It was especially important to adjust the overall design and outline of the insole to the reduced space conditions of a football shoe. The paddings affecting sensorimotor functions had to take into account the considerable increased strain of the sporting dynamics and in their courses had to be used on a more reduced scale than in the treatment of children and adolescents.

The left foot, in identical foot bed construction, was provided with clearly reduced padding compared with the right foot.

Within a few days a significant reduction in the Achilles tendon symptoms and the forefoot strain pains could be achieved. In consultation with the physiotherapist, at an appointment for a follow-up examination the extent to which the individual components of the sensorimotor insoles are to be adjusted to the changing symptoms should be checked.

Stefan Woltring

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3+4 The sensorimotor foot bedding specifically takes effect on muscle groups in order to support the longitudinal arch, straighten the heel and relieve the Achilles tendon.



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improve pressure distribution under the foot

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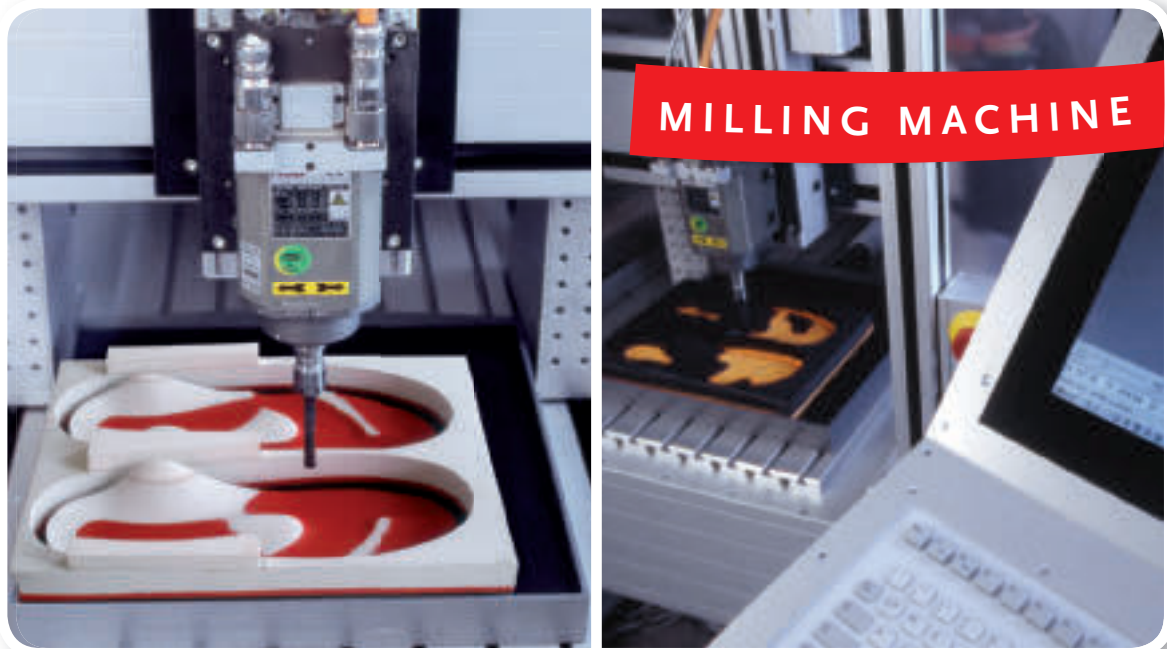
- ✓ Leading systems supplier
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- ✓ Online Support
- ✓ Easy to use



- ✓ Scanning in two seconds
- ✓ Analysis of foot type
- ✓ Display and print 1:1



- ✓ 4 mm thin
- ✓ Detailed analysis
- ✓ Structured documentation



- ✓ Controlled via an integrated PC
- ✓ Equipped with a robust three-phase motor
- ✓ Built-in vacuum table, no additional bonding material

PROGRAMME BEGINNERS – LEVEL 1

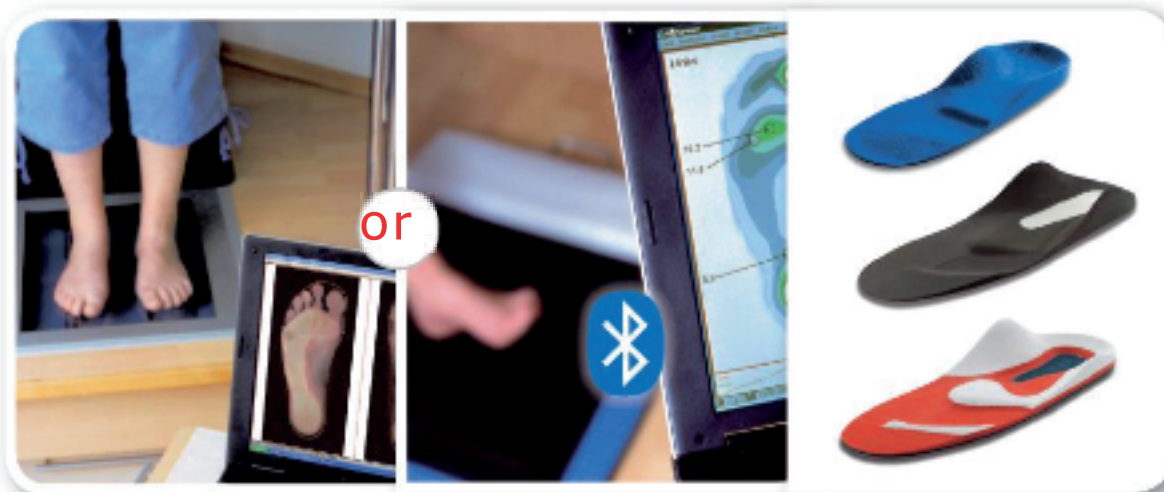


Use your measuring technique and choose the appropriate PROPRIO® insole from our proprio standard models. Flexible sale packages from 18 pair/size at a special introductory price!

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- ✓ Production + dispatch within 2 weeks

PROGRAMME ADVANCED – LEVEL 2

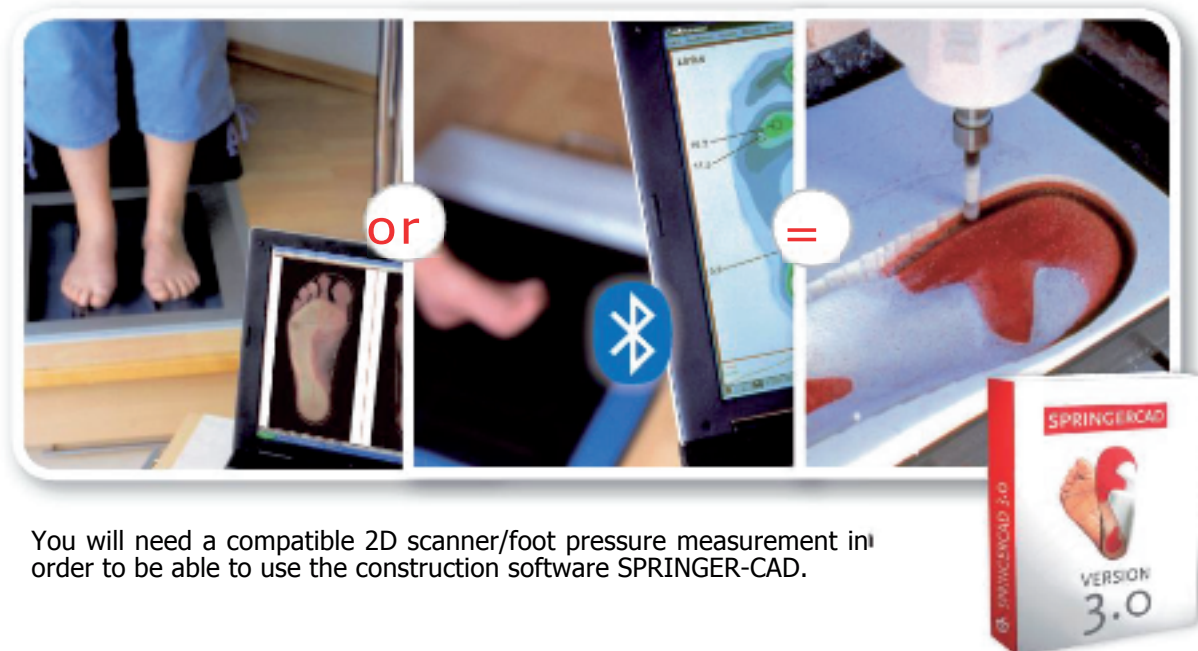


You can also use your measuring technique here and, with the PROPRIO® - patient history sheet (www.springer-berlin.de) in the areas of child, sports and pain, you can find the correct PROPRIO® insole. Recommendation: providing sensory motor function treatment also means analysing dynamically!

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- ✓ Easy + quick handling
- ✓ Production + dispatch within one week

PROGRAMME PROFESSIONAL – LEVEL 3



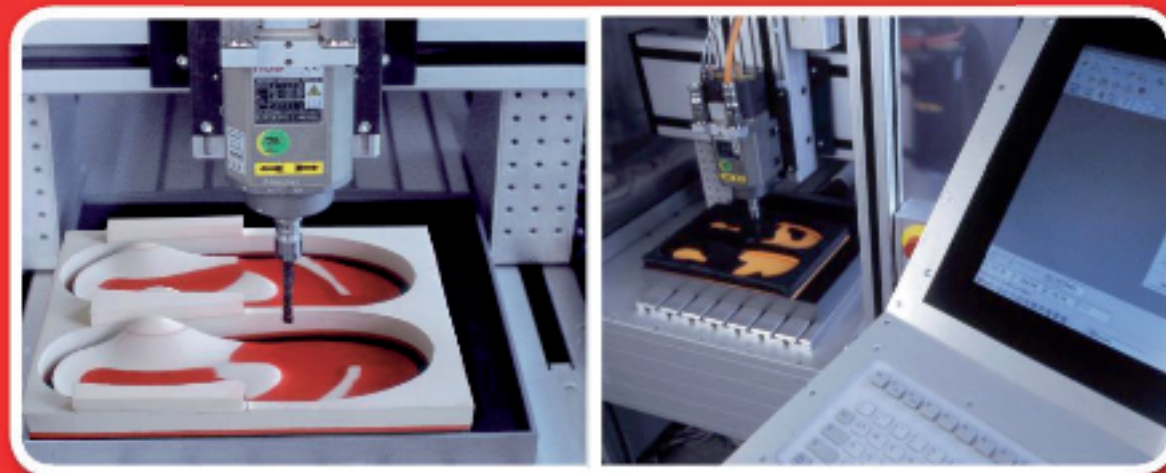
You will need a compatible 2D scanner/foot pressure measurement in order to be able to use the construction software SPRINGER-CAD.

AS THE MARKET LEADER WE GUARANTEE:

- ✓ 100% individuality, reproducibility and quality standard
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FURTHER QUESTIONS ?

Please write to us at info@sensomotorik-zentrum.de

Change in muscular activity by insoles with proprioceptive effect

In this study the change in muscular activity of test subjects participating in sporting activities will be examined within the framework of individual case analyses. In this way evidence of the effectiveness of the sensorimotor insole concept should be provided. The insoles were produced by OSM Stefan Woltring using blanks manufactured by Springer, Berlin, and corrected following kinematic analysis.

A change of movement assumes changed muscular activity. Therefore should the kinematics of the heel-to-toe movement be changed, then initially precise observation of the function of the muscle groups beginning at the foot is necessary.

Principles of muscular activity in the joints of the foot

Talocrural joint

The tibialis anterior, extensor digitorum longus and extensor hallucis longus muscles are responsible for dorsal flexion.

The dorsal flexors begin their activity in the pre-swing phase in order to increase the foot/ground distance (the so-called „clearance”) by flexion of the foot. In this the course of muscular activity shows a phasic pattern with a slight reduction in activity in the middle swing phase and a further increase in the terminal swing phase. Here the foot is positioned and by eccentric activity in the initial support phase a „break through movement” of the foot is prevented („heel rocker”).

In the middle support phase the activity of the dorsal flexors ends

with the transfer of body weight onto the supporting foot.

Plantar flexion of the foot is brought about by a total of seven muscles, whereby the gastrocnemius and soleus muscles generate the principal share of the torque. The soleus muscle already begins its activity in the phase of exertion response („loading response») followed by the gastrocnemius muscle. Both reach the most powerful activity in the terminal support phase („terminal stance»), whereby they generate a part of the forward thrust, which is responsible for the acceleration of pace.

Talocalcaneonavicular joint (subtalar joint)

Because of an oblique axis, the joint permits a tilting movement of the foot towards the medial region (eversion) and the lateral region (inversion). In particular the tibialis posterior, tibialis anterior, flexor digitorum longus, flexor hallucis longus and soleus muscles act as invertors (supinators). The activity of the tibialis posterior muscle as the strongest invertor begins directly in the phase of the exertion response and runs in a biphasic manner with an activity peak at the end of the phase of the exertion response and in the middle of the terminal support phase.

The gastrocnemius, extensor digitorum longus, peroneus brevis and peroneus longus muscles take over the function of the evertors (pronators). The latter begin their activity with the exertion of the forefoot and end this in the pre-swing-phase.

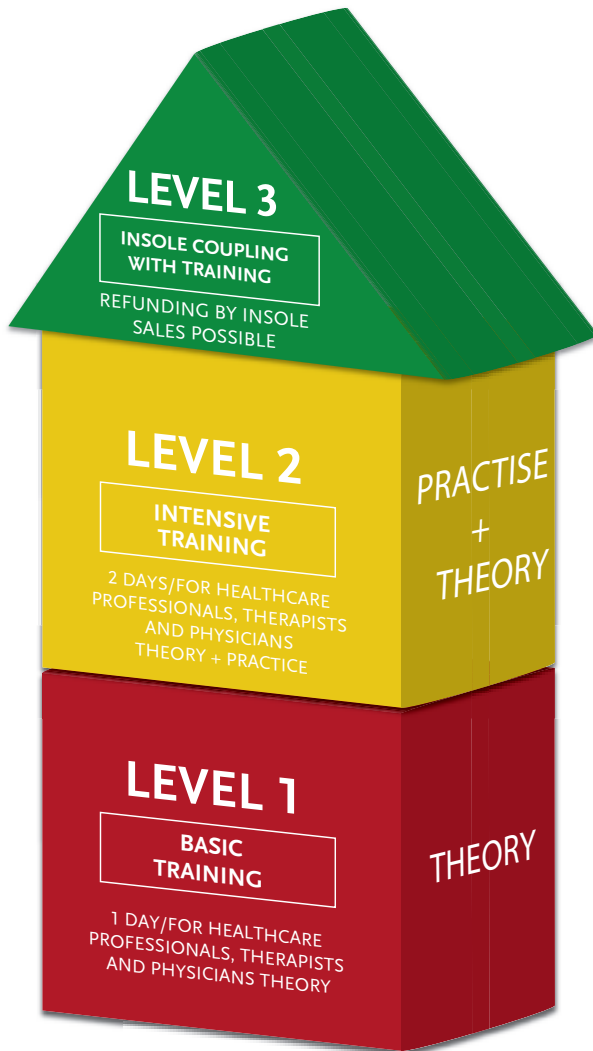


1. Dr. Oliver Ludwig fitting the sensors for the EMG measurement.



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2, 3, 4 Foot bedding examples used in the study

Movement stabilisation by muscle activity

The invertors are particularly important in the phase of initial ground contact and in the load uptake, when the pronation movement in the talocalcaneonavicular joint has to be slowed down by eccentric muscle activity. This is primarily the task of the tibialis posterior muscle, although it is also the task of the tibialis anterior muscle and the soleus muscle. The dual function of the soleus muscle in inversion and in plantar flexion makes clear that isolated contemplation of individual muscle groups is hardly ever meaningful.

In this study attention was focused on the „muscular stapes” (tibial group + peroneal group).

Influencing of muscular activity by sensory information

The „sensorimotor” insoles used are based on blanks manufactured by Springer, Berlin. They consist of a three-layered sandwich construction:

- uppermost material layer, 35 shore for guiding, bedding and support;
- middle material layer, 25 shore for cushioning and shock absorption;
- lowest material layer, 50 shore for processing of the insole shape and as support material;
- including one shock absorber in the heel area (Supersorb, 4 mm, partly glued).

Initially a biomechanical effect can be attributed to the insoles on the basis of the applied elements:

- medial support of the calcaneal part of the foot on the calcaneum at the sustentaculum tali;
- lateral support of the calcaneal part of the foot as a mechanical counter-support to secure the calcaneum;
- heel hollow for embedding of the calcaneum;
- retrocapital support of the 2nd to 5th metatarsal bones.
- toe strip with distal flattening course for extension of the toes.

In addition, in accordance with the postulated effect concept of sensorimotor influencing, the following proprioceptive/sensory influences are expected, the effect of which will be examined in this study:

- afference-boosting and stimulation of the tibial muscle group by medial support of the calcaneal part of the foot;
- afference-boosting and stimulation of the peroneal muscle group and the oblique head of the adductor hallucis muscle by lateral support of the calcaneal part of the foot.

Examination method

Four leg muscles were recorded by electromyography (tibialis anterior muscle, peroneus longus muscle, lateral head of the gastrocnemius mus-

cle, medial head of the gastrocnemius muscle).

Initially the muscle belly of the muscle to be recorded was palpated; in this the test subject was asked to tense the muscle. The recording points were set according to DELAGI ET AL. (1989) and ZIPP (1982.) The two electrodes necessary in bipolar recordings (pregelled Ag/AgCl electrodes, manufactured by Nessler medical engineering, Innsbruck) were always placed in the centre on the muscle belly. The distance between the electrodes was approximately 3 cm (two finger-breadths); the electrodes were directed towards the course of the muscle fibre. An additional electrode was attached to the patella. The power cables were guided to the dorsal region of the hip and fixed on the skin with Leukosilk plaster. In the region of the hip and knee joint relief loops were formed to prevent tension of the cables and therefore tactile influencing of the test subject.

In the hip region the cable bundle was guided to the 12-lead EMG (manufactured by Mörz, Saarbrücken), which was held by the test controller behind the test person walking on the treadmill.

Data acquisition was carried out with a scanning rate of 1000 Hz. The data was saved on a flash media card in an electromyography device and transferred to a PC after the end of the test. The electromyographic measurement was oriented towards the standardised guidelines of DE LUCA (1997a, 1997b).

The six test subjects were provided with their own running shoes, whose suitability (movement correction in the region of the talocalca-

| Speed | Movement correction | |
|--------------------|---------------------|---------------------------|
| | without insoles | with sensorimotor insoles |
| Walking (3,0 km/h) | without insoles | with sensorimotor insoles |
| Running (6,5 km/h) | without insoles | with sensorimotor insoles |

Table 1: test structure for the 6 test subjects. As a rule six partial tests were carried out on each test subject.

neonaviclar joint, stability of the calcaneal part of the foot, correct flexion in the forefoot, cushioning adapted to body weight) was checked beforehand. Before the beginning of the test the test subjects could become accustomed to walking on the treadmill for five minutes (Woodway medical). As a rule six subtests were carried out on each test subject (table 1).

Furthermore, in addition to the „sensorimotor” insoles, four of the six test subjects were provide with „classical” sports insoles in sandwich design, which had already been worn.

Between the subtests changes were made between the foot beddings belonging to the shoe, the sports insoles and the „sensorimotor” insoles. The adhesive electrodes were not removed between the single subtests in order to avoid measurement artefacts due to changes in skin resistance or different placing of electrodes.

Mathematical calculation of the data

The raw data registered was treated in accordance with the following schedule:

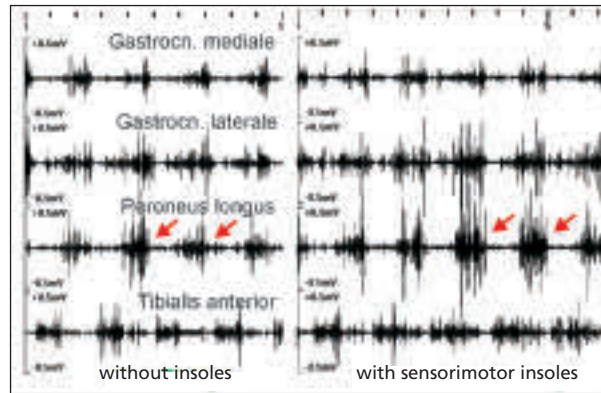
- filtering of the raw data with a high pass filter (base frequency 55 Hz, filter length 31 measurements);
- data rectification;
- calculation of segment averages following equalisation with the root-mean-square method (segment length 50 ms);
- calculation of the segment average value over the duration of the supporting phase, averaged over 10 individual steps.

Results

Table 2 shows an overview of the correction results with the individual test subjects. A tendency to positive influencing of the muscular activity in the sense of planned muscle activation could be found at least in all cases. In individual cases the change of the motor programme was very clearly pronounced and already occurred after a few paces.

Movement correction by lateral pressure point

In cases, in which an increased inversion position of the calcaneal part



5 Raw EMG of four superficially recorded leg muscles of one test subject. Left: with sports shoes, without insoles, right: with the same sports shoes and sensorimotor insoles with lateral pressure point. The amplitude of the peroneus longus muscle changes visibly (arrows), increases are also to be observed in the activity of the lateral head of the gastrocnemius.

| Test subject | Pathology | Therapeutic approach | Proprioceptive acting element | Measured muscle activity | | |
|--------------|--|-------------------------------|--|--|-------------------|------------------------------------|
| | | | | peroneus longus | tibialis anterior | gastrocnemius |
| 1 | calcaneal part of the foot in increased inversion in initial contact + loading response, pes cavus, frequent spraining | peroneus ▲ gastrocnemius ▼ | lateral info calcaneal part of the foot reinforced toe strip | ▲ ▲ | = | ▼ ▼ |
| 2 | genu varum, calcaneal part of the foot in increased pronation position in terminal swing/pre-contact | tibialis ▲ peroneus = ▼ | medial info calcaneal part of the foot | ▼ | ▲ | caput lat: ▼ caput med: = |
| 3 | shin bone pain, increased abduction + pronation in the terminal swing phase | peroneus ▼ tibialis ▲ | medial info calcaneal part of the foot | ▼ ▼ harmonisation/decrease 2 nd peak | = | = |
| 4 | pes cavus | peroneus ▲ tibialis ▼ | lateral info calcaneal part of the foot reinforced toe strip | ▲ | = | = |
| 5 | severe pes valgus severe flat foot | tibialis ▲ | medial info calcaneal part of the foot reinforced toe strip | = | ▲ | = |
| 6 | oversupination | peroneus ▲ tibialis ▼ | lateral info calcaneal part of the foot reinforced toe strip | ▲ | = | ▼ |

Key:
 ▲ significantly increased muscle activity (p < 0.05)
 ▲ ▲ highly significantly increased muscle activity (p < 0.01)
 = not significantly changed muscle activity
 ▼ significantly reduced muscle activity (p < 0.05)
 ▼ ▼ highly significantly reduced muscle activity (p < 0.01)

Table 2: Corrective actions with the individual test subjects, therapeutic approach in insole support and measurable change in muscle activities.

Key:

5 significantly increased muscle activity (p < 0.05)

55 muscle activity highly significantly increased (p < 0.01)

= not significantly changed muscle activity

6 significantly reduced muscle activity (p < 0.05)

66 highly significantly reduced muscle activity (p < 0.01)

of the foot in the phase of the initial contact was observed (often in combination with pes cavus symptoms, Achilles tendon angle < 6°), an increased activation of the peroneal group should be effected on the part of the OST. This was attempted by intensified lateral development of the insole „lateral information”).

There were only a few minutes between the two EMG recordings. The effect was reproducible when the insoles were changed again.

In one individual case the activity of the peroneus longus muscle was changed remarkably with wearing of the sensorimotor insoles. The test subject complains of symptoms in

| Test subject | without insole | with sports insole | with sens. insole |
|--------------|----------------|--------------------|-------------------|
| 4 | 0.025 (100%) | 0.025 (100%) = | 0.027 (108%) ▲ |
| 6 | 0.048 (100%) | -- | 0.055 (115%) ▲ |
| 1 | 0.040 (100%) | 0,083 (206%) ▲▲ | 0,102 (252%) ▲▲ |

Table 3: Change in the muscular activity of the peroneus longus muscle following attachment of a lateral support for the calcaneal part of the foot («lateral information») in the individual case (muscle potentials after filtering rectification and RMS information, relativised

| | | | |
|---|--------------|-----------------|-----------------|
| 5 | 0.101 (100%) | 0.140 (139%) ▲▲ | 0.146 (144%) ▲▲ |
| 2 | 0.069 (100%) | -- | 0.076 (110%) ▲ |
| 3 | 0.088 (100%) | 0.088 (100%) = | 0.095 (108%) ▲ |

Table 4: Change in the muscular activity of the tibialis anterior muscle after following attachment of a medial support («medial information») in the individual case (muscle potentials after filtering' rectification and RMS information,' relativised values in brackets).

the region of the shin bone; the EMG indicates atypical biphasic activity of the peroneus longus muscle, which generated additional everting leverage in the swing phase, which resulted in increased abduction and pronation of the (fore)foot shortly before ground contact. This activation pattern was also maintained on wearing sports insoles. With sensorimotor insoles the second activation peak almost completely disappeared (figure 6).

In one case the effect of the increased peroneal activation was also found with the sport insole worn (cf. table 2), although more weakly pronounced than with the proprioceptive insoles.

Movement correction by medial pressure point

In the cases, in which excessively

strong pronation (eversion position) of the calcaneal part of the foot was to be observed (Achilles tendon angle > 14°), an increased medial pressure point ("medial information") was inserted into the sole. Table 4 shows the change in muscular activity of the tibialis anterior muscle as inverter. An increase in activity due to the sensorimotor insoles could be observed. In one case this effect was also found with wearing of the classical sports insole, although slightly more weakly pronounced.

Adaption indications of muscular activity in the course of time

The measurable effects of the change in muscular activation pattern could already be observed after a few minutes of wearing the sensorimotor insoles.

Figure 7 shows the raw EMG application of a test subject directly after inserting the sensorimotor insoles (t=0 s) and after 5 minutes of walking in the sole (t=5 min). In the concrete case the peroneal muscle should be intensified in its activity by lateral stimulation of the calcaneal part of the foot and the antagonist (tibialis anterior) should be lowered slightly.

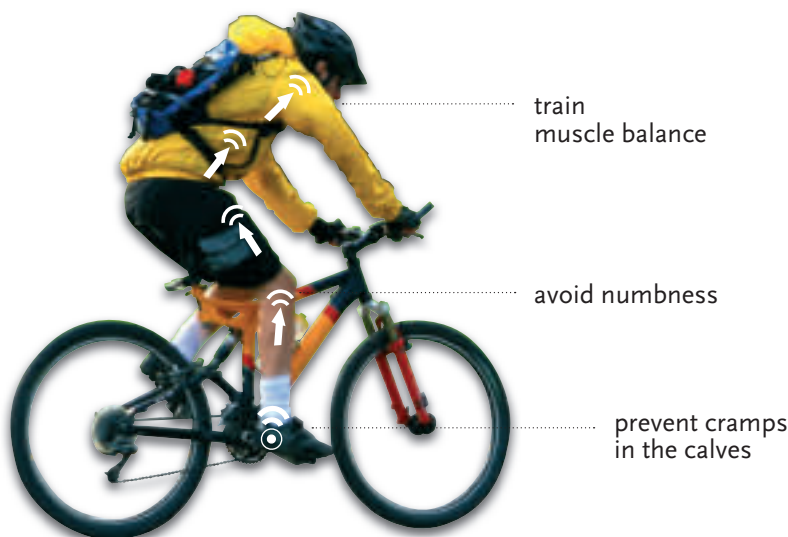
This effect was to be observed after a settling-in period of 5 minutes.

Discussion

Methodology

This study examined relatively few individual treatments, therefore a statistical analysis was only possible in an intraindividual comparison. Because a kinematic analysis of movement patterns and step development was carried out parallel to the measurements, an exact conception of the desired changes could be carried out prior to the insole treatment. Due to the constant feedback of the movement pattern changed by the insole and the muscular activity, the structure of the sensorimotor insoles could be corrected again in individual cases.

There is no doubt that this illustrates a particularly fortunate case of insole adaption, which does not occur in this way in craftsmanship in everyday work. However, the desired influencing of muscle activity could



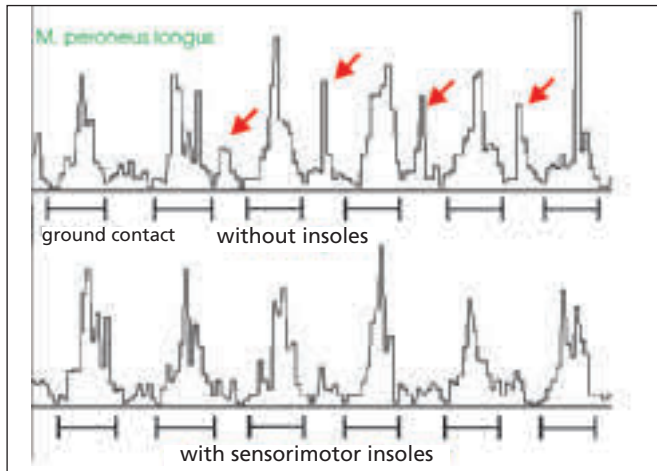
Legal doping for your feet!



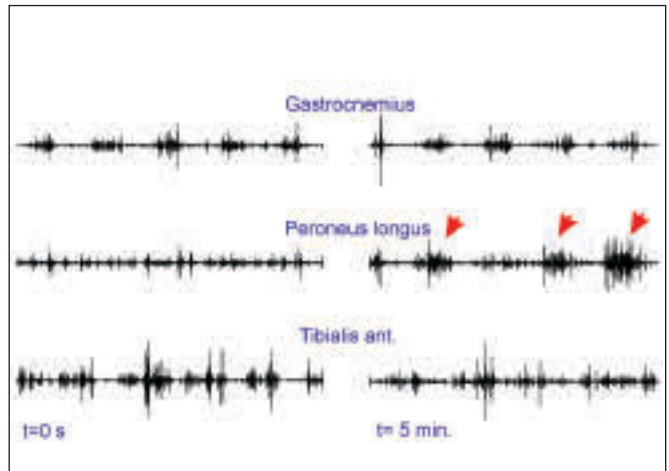
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6 Averaged and rectified activation pattern of the peroneus longus muscle on walking (7.0 km/h) of a test subject with shin pain. Above: sports shoe without insoles. An atypical second activation peak in the middle and terminal swing phase (arrows) is noticeable. Below: EMG under the same conditions, although with sensorimotor insoles. The horizontal bars mark the support phase.



7. Adaptation of muscular activity after inserting a sensorimotor insole with increased lateral stimulation. Left: partial graph: muscle activity (raw EMG) immediately after inserting the insole. Right: partial graph: muscle activity after 5 minutes of walking. Changes are visible in particular in the activation of the peroneus longus muscle (central line).

we worked out all the more precisely. Nevertheless the craftsman can obtain valuable information for the optimisation of his orthopaedic device via kinematic analysis ("treadmill analysis").

The advantage of a study analysing individual cases is that individual change can be documented very precisely.

Individual effects, which are calculated out in statistical averaging of many test subjects, remain preserved.

The experiences have shown that in the case of treatment with insoles

with proprioceptive effect, the individual effects have to be examined very precisely because adaptation of a plastic motor programme is can not always be predictable in the individual case.

Adaption indications of the motor programme

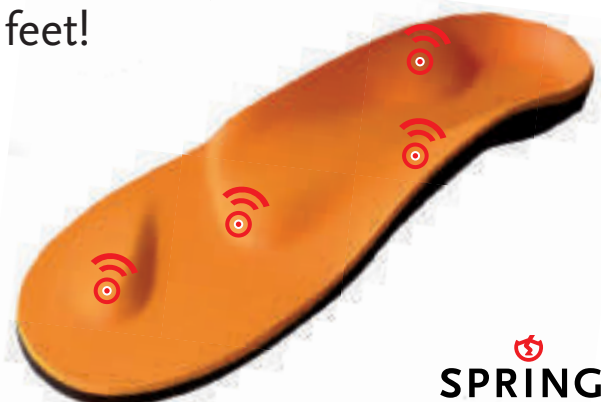
Steering of the musculature by the central nervous system occurs in the context of a neuromuscular programme. By this we understand the temporal activation of the involved muscles with a defined intensity. This

movement programme is learned from childhood onwards and is variable and plastic. In this connection variable means the muscular programme's ability to adapt to actual circumstances. Thus, for example, the muscular interaction of the leg musculature changes when carrying heavy loads or avoiding obstacles. With this we therefore understand the short-term change of the motor programme for adaptation to environmental conditions which last briefly and occur suddenly.



WALKING

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On the other hand, plasticity is the prerequisite for every learning process. Related to the process of walking this means a longer-term adaptation process, which adapts the motor program to changed conditions. This includes, for example, "protective positions", i.e. changed movements, which are supposed to lead to the relief of certain joints or muscle groups.

Sensorimotor information from the musculature, the tendons and joints is necessary for the adaptation of the individual task-specific movement pattern to current demands and for the maintenance of learning ability.

Only with the help of this proprioceptive information flow can the

central nervous system compare the planned movement pattern (target condition) with the actual movement (actual condition) and introduce corrections.

The ability to adapt to insoles, which produce changed proprioceptive input signals, has to be ascribed to the first case. The changes observed in the EMG tests occurred within minutes and also disappeared in this period of time when the insoles had been changed. This change of the motor programme can be interpreted on the basis of changed afferent information. In the concrete case this includes not only proprioceptive inputs from the musculature, the tendons and joints, it also includes in

particular changed pressure information from the corresponding sensory cells in the sole of the foot.

Quality of the correction

With the test subjects examined the change in the symptom pattern was checked in the context of a medical and therapeutic follow-up examination after eight weeks. In all cases an improvement in the symptoms and therefore a treatment success could be established.

Conclusion

In summary it can be recorded that the tested "sensorimotor" insoles induced a change in motor activation pattern. This change was differentia-

The authors

Prof. Dr. Holger Hähnel



(died in 2010) was a specialist in orthopaedics and trauma surgery with the additional designations of special orthopaedic surgery, special pain therapy, physical therapy, rehabilitation, social medicine.

He began his medical career by training in visceral and trauma surgery. Following his specialist training to be an orthopaedist and great experience in orthopaedic surgery he built up the spinal surgery department in the orthopaedic hospital Charité in Berlin and, as its director for many years, led it to international renown. This department was able to reach the spine via all operative access routes between the head and sacrum, from the front and rear, and, by using these access routes, successfully treat operatively degenerative changes, scoliosis, kyphosis, congenital and acquired malformations, fractures, tumours and inflammations.

He completed his knowledge and skill during several periods of study with Dr. Zielke in Bad Wildungen and with Prof. Dr. Harms in Karlsbad-Langensteinbach. Also with Prof. Dr.

Ch. Hopf, today at Lübeck, at that time at Mainz, he also learned their instrumentation technique. Periods of study in the USA, Australia, Austria and Sweden relating to spinal questions also extended his knowledge. In Debrecen/Hungary with Prof. Dr. Krompecher, he studied cartilage and bone metabolism. At that time he researched the bisphosphonates used for osteoporosis treatment today. In recent years his research papers, which number over 200, primarily dealt with the results of spinal surgery. Prof. Hähnel also delivered more than 300 lectures on this subject.

The spinal cord running in the vertebral column and the nerve roots emerging from it are closely connected with spinal surgery. Via this connection the physiological and pathophysiological (disturbed) function of the nervous system became another of Prof. Hähnel's research subjects, especially because his specific interest in pain therapy of course also deals with the functional structures of the nervous system.

His turning towards sensorimotor function and his work related to it were the result of this connection. Prof. Hähnel died in January 2010. We are deeply saddened by his early death. In him we have lost a friend,

who was extremely modest about his own achievements.

Dr. med. Andreas Heine,



Born in 1967, specialist in orthopaedics and trauma surgery with the specialisms rheumatology and paediatric. He received training in orthopaedics/rheumatology at the Northwest German Rheumatology Centre in Sendenhorst. Further specialist areas include paediatric orthopaedics, sports medicine, manual medicine and acupuncture.

Monika Knust



Born in 1979, physiotherapist and manual therapist, Bsc. She completed her studies for Bachelor of Science in physiotherapy in the health and rehabilitation centre Medicos in Osnabrück.

In 2006 she won first place in the Institute for Communication's Science Award in Bochum. Since 2006 she has worked at the health centre »Centrumed« in Osnabrück, special-

ted and reversible and met the predicted effects of the pressure point shown on the insole. This is an important point because each insole, regardless of construction type, naturally always induces sensorimotor stimuli. Amongst Others this can be seen from the fact that in individual cases the conventional insoles also changed muscular activity – although not predictably. However, only if muscular activation changes in such a way, which is desired by the craftsman, can a treatment concept be derived from it.

In the tested cases the active principle of the ‘sensorimotor’ insoles could be confirmed.

Oliver Ludwig, Norbert Fuhr

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12/2004
pp. 13 – 18

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lising in the field of treatment of craniomandibular and craniofacial dysfunctions.

Publications:

Knust M. Pilotstudie: Manuelle Therapie versus Physiotherapie bei der CMD-Behandlung. *Physiotherapie*. 2006; 5:25-28

Knust M. Mögliche Dysfunktionen des Kiefergelenks – Darstellung funktioneller Zusammenhänge und Vernetzungen. *Physiotherapie*. 2007; 3:15-22

Knust M. et al. Wirkung von Manueller Therapie im Vergleich zu einem multimodalen Physiotherapieprogramm bei Patientinnen mit kraniomandibulärer Dysfunktion. *physioscience*. 2007; 3:1-8

Dr. rer. nat. Oliver Ludwig



Born in 1967, human biologist, completed his doctorate in the field of postural and movement analysis within an interdisciplinary research project of the German Research Foundation. He is a lecturer in postural and movement disorders at the University of Saarland and has lead several scientific studies in this field. Dr. Ludwig serves as scientific director

of the Kid-Check postural analyses for children and adolescents.

He is a co-founder of a research and training academy. In addition to his university functions, he works as a scientific adviser for a medical company in the field of movement analysis and obtained special permission. His specialist areas of work are paediatric and adolescent, athlete and spastic medical supplies. Co-developer of the fisch sport concept. Speaker and chairman of many lectures and seminars on the subject of sensorimotor function in orthopaedic craftsmanship for doctors, physiotherapists and health insurance funds.

Stefan Woltring:



Born in 1962, master orthopaedic shoemaker, since 1992 has managed the traditional family business in Ibbenbüren and Osnabrück.

Of course an orthopaedic shoe technician can not and should not check the effect of the orthopaedic device he supplies by electromyography - this is unrealistic. On the other hand, a subtle change in muscle activation cannot always be established

with a kinematic treadmill analysis. Here the measurable angle changes are too slight and the measuring method is too fraught with error. However, as in this study the effect of sensorimotor insoles in individual cases could be proven, viewed with common sense, an effect can be generalised if an individual insole is produced according to this concept.



Portrait of Springer – MADE IN GERMANY

108 years of innovation

28 bones, 31 joints, 107 ligaments and 19 muscles - the healthy foot is our company's starting point and our product design's orientation point. Hermann Springer had an idea when he founded a production for medical foot supports in 1902. However, his feet never left the ground on which he stood. It was only in this way that imagination and reliability could complement one other.

Following these virtues the name SPRINGER stands for the latest medical insole concepts today. Our products combine the most up-to-date scientific knowledge, innovative design and intelligent technique with our own fascination for consummate manufacturing.

In this our standpoint is primarily a viewpoint as well. SPRINGER stands for »Made in Germany« in every respect.

Philosophy

All insoles, which have born the name SPRINGER for 108 years, have an active effect. They support metatarsal bones as well as sustentaculum tali in a scientifically recognised manner and provide the muscle belly with room to move. Meanwhile they can even influence in particular muscle reactions according to specific proprioceptive principle. We are the market leader in sensorimotor function and wish to extend this position.

In addition, its landmark design is developed continuously. For only those who change survive. That always did apply and still does apply to SPRINGER as a company and applies just as well to SPRINGER products.

Integrated quality awareness and the will to carry out quality work condition our trading on a daily basis.

As a family business in the fifth generation we combine the highest

powers of innovation with simultaneously upholding traditional values. Thus our clients not only remain outstandingly successful, they also remain satisfied partners over decades.

Concepts

If the basics are right, the idea makes the fine distinction. In order that orthopaedic craftsmanship gains more independence, can appeal to interesting target groups and increase its sales, SPRINGER not only supplies products, it supplies entire training and sales concepts for the four future segments of individual foot treatment - child, athlete, pain sufferer and diabetic.

In addition, our company develops and manufactures a large number of customised models according to clients' specifications. Functional insoles are manufactured to the highest quality for each treatment



Hermann Springer
1902 - 1946



1944 - 1968
Paul Springer



Frank Springer
1968 - 1988



Hans-Joachim Hepper
since 1982

Frank Hepper
since 2010

since 2001
Martin Hepper

philosophy – from correcting to sensorimotor function.

Craftsmanship has no future without high tech. Modern recording, analysis and production systems provide craftsmanship with marketing, quality assurance and efficiency. SPRINGER's exclusive partnership with go-tec underpins the integrated approach.

Manufacture

With our insoles we always also document passion for detail and fascination with consummate manufacturing.

From the craftsmanship tradition a demand results, which is still valid today: form, function and manufacture at the highest level as the basic foundation of each product design.

Craftsmanship skills combined with modern methods of manufacturing – such as CNC milling, for example as well as a high level of close customer relations – all this has made SPRINGER a concept in the industrial sector and have made our products frequently copied models.

However, only the originals possess the quality and the benefit which sustained success brings.

GEBIOM / GO-TEC

The company GeBioM Gesellschaft für Biomechanik Münster mbH was founded in 1994 as a spin-off company from the Institute of Motion Sciences – Department of Applied Biomechanics.

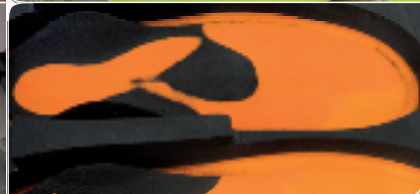
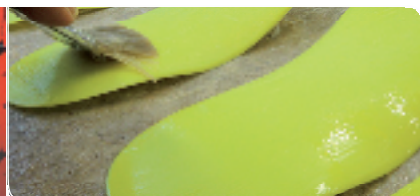
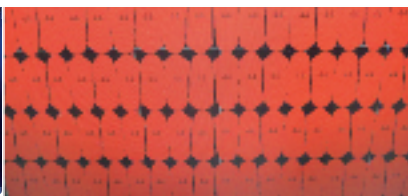
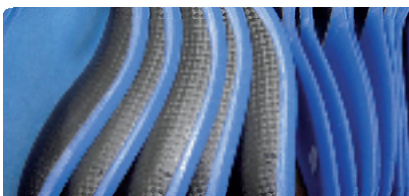
In the course of time the business sectors could be developed extensively. If at the beginning of the enterprise only a few biomechanical measuring systems for mattresses and car seats were developed and marketed, i.e. clients from the industrial sector, with entry into the health care market an expansion of the range of products and services began: to this was added the development and production of further systems for recording pressure distribution on different extremities and with most varied applications, optical measuring systems for recording the feet and back, user-friendly CAD software programs for the construction of shoe lasts and orthopae-

dic/sensorimotor insoles as well as OEM production of CNC machines for the production of the aforementioned insoles. Together with its own subsidiary company go-tec GmbH and its partner company Springer Aktiv AG the products are marketed worldwide.

The number of employees could be increased from 5 at the beginning of 1994 to on average 28 today.

Publishing information:

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Entered under the number HRB 132603 in the commercial register of Charlottenburg district court
Chairman of the Supervisory Board: Prof. Dr. H.C. Bernhard Motzkus
Chairman of the Executive Board: Hans-Joachim Hepper
Executive Board: Martin Hepper
Frank Hepper



OUR PROGRAMME LEVELS

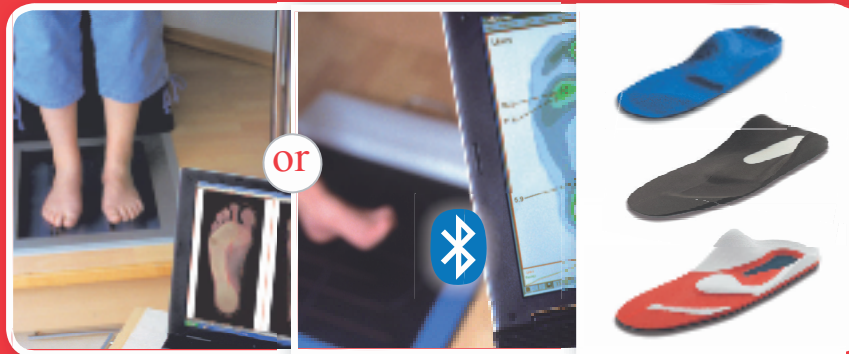
LEVEL
1

BEGINNER



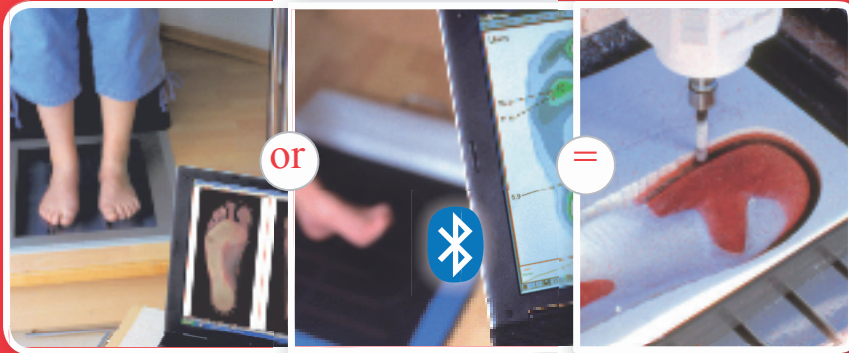
LEVEL
2

ADVANCED



LEVEL
3

PROF-
ESSIONAL



LEVEL
4

EXPERT

