hemiparesis, sciatic neuralgia,
neurology diseases, recovery monitoring

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THE NEUROLOGICAL DISEASE RECOVERY MONITORING BY WALK DISTURBANCES LEVEL ANALYSIS

This study was based on 27 patients' motor gait disturbances analysis using their pedobarographic records, affected by neurological diseases - hemiparesis or sciatic neuralgia. The evidence comparison concerns the data records collected before and after the rehabilitation processes. The essential conclusions explain a walk characteristics analysis explaining the neurological status of the patient and how to implement the PSW [2, 3] options in clinical practice. This approach can also be used for medical jurisdiction processes as a unique tool for the disease evidence making.

1. INTRODUCTION

The Parotec System for Windows (PSW) has already been presented in many studies [2,3,5,6] as measuring equipment allowing collect data of walk characteristics. The static part of the data record shows pressure values in points where sensors are installed. One of the most important factors of the walk characteristics description presents the patient's gravity centre movement. The dynamics part of the record shows also the data flow in a walk cycle. There are trajectories of patient's body gravity centre movement that illustrate the walk stability. An energy distribution within the sensors area and time diagrams of the walk cycle can also be used for the walk stability analysis.

For the experiments 27 subjects (in age from 31 to 76) were found. In this group 10 patients suffered from hemiparesis, caused by cerebral stroke or multiple sclerosis. In our clinical experiments only 5 patients with sciatic neuralgia were found.

Patients with bones or joints affections of lower limbs, with feet deformations (as: flat-foot or diabetics foot), disorders of equilibrium, considerable degree disorders of sight or with several dementia were not included to the investigated data records. For the control group 12 volunteers have been selected, from medical staff and patients with normal neurological status.

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2. THE HEMIPARESIS CLASSIFICATION

The clinical experiments were carried out on patients chosen by classical methods. The experimental group of patients was assigned by Barthel's points in range of 55 – 100. The selected cases were free from orthopaedic disease features, able to walk without any help. For these experiments 8 patients with left-sided and 2 with right-sided hemiparesis were found. The rehabilitation process of patients that suffer from hemiparesis was under control observing differences, before and after this treatment (Fig. 1 – 6).).

In a previous reports [10,12] several regularities were described. They concerned a body weight and a body gravity centre displacement to the affected limb-side. These regularities were adequate to the paresis severity. The body weight moved to a heel region of an affected leg and the not affected leg was used for walk assistance only [4].

The rehabilitation processes recovered muscles strength, reducing a burden on paresis limb and the body centre returned to almost proper position. Although the gravity centre moved into the metatarsal zone an overload within the heel was still visible (Fig.1). Before the medical treatment 69% of the body weight was on an affected limb. After the rehabilitation this position changed remarkable with 45% of the weight on the affected side only. Anyhow the overload on the heel was still high (reduced from 76% to 72% only).

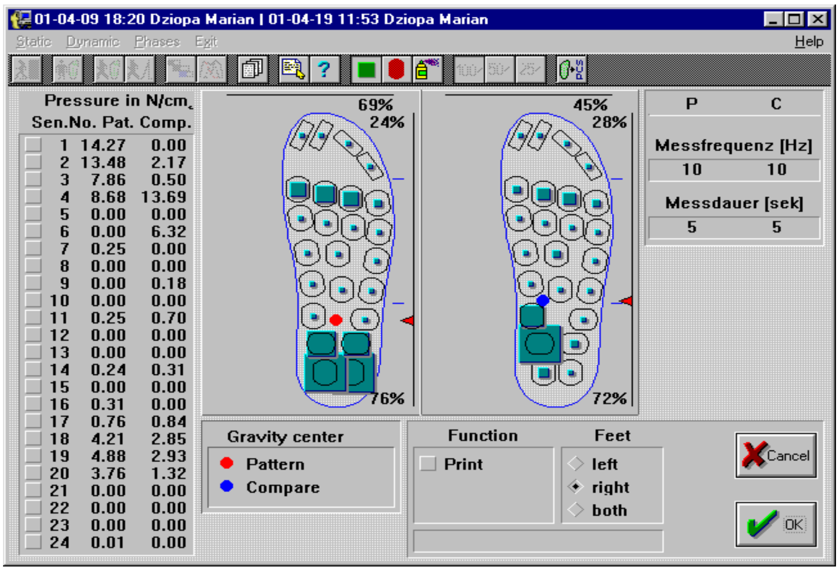

Fig.1. The visual comparison of a body weight and a gravity centre movement for right-sided hemiparesis

The gravity centre trajectory elongation on an affected limb was also observed. The example illustrating this case has been presented in Fig.2; as the result of the rehabilitation process. In addition the rehabilitation procedures cause several refining within centres of the body weight localisation (not illustrated here).

After the rehabilitation cycle the characteristic impulse and floor contact time values diminishing were noticed (Fig.3).

Very remarkable study illustrates the medium value for all steps phases for not affected limb (Fig. 4) – before and after the rehabilitation. There are small but visible differences for start and support phases (burden of heel and metatarsus). Also a considerable shortening of push off phase is noticed. The rehabilitation processes controlled these values into normal ranges, with visible improvement of the patient walk stability.

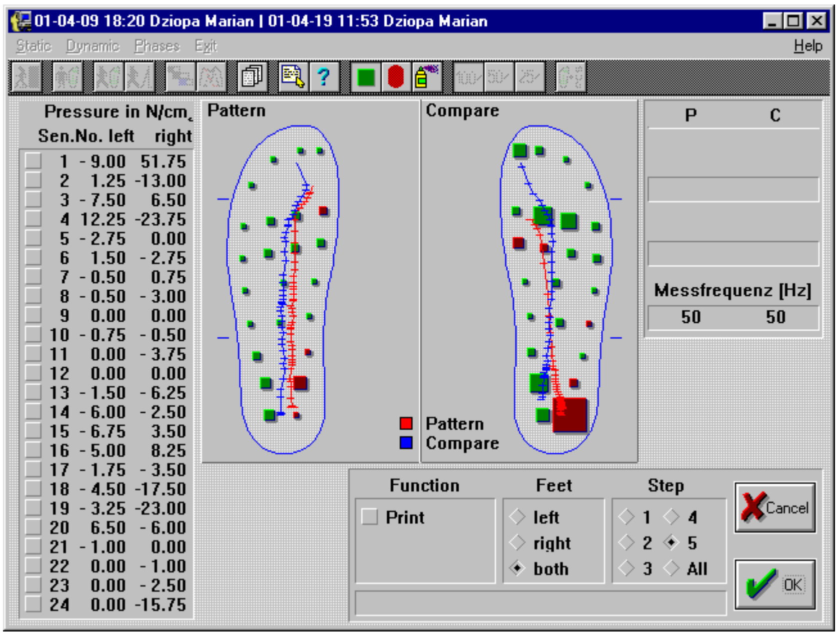

Fig.2. The gravity centre trajectory elongation on an affected limb as a result of rehabilitation

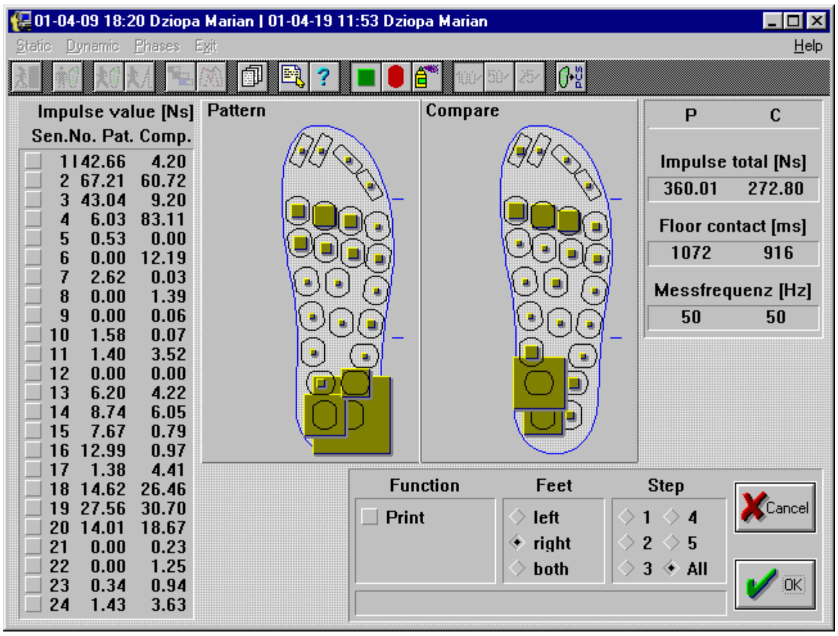

Fig.3. The impulse and floor contact time reduction after the rehabilitation cycle

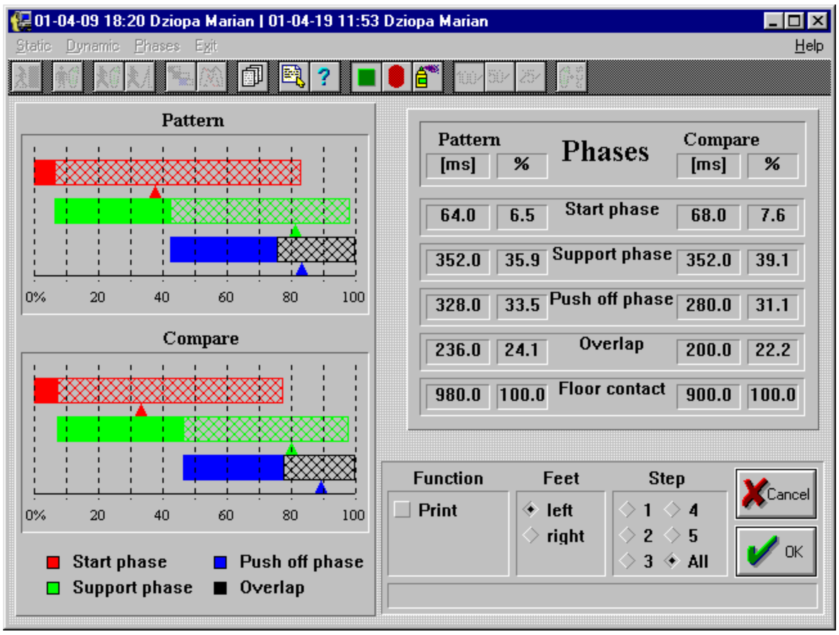

Fig.4. Phases for not affected foot before and after rehabilitation.

The same check up has been done for the affected limb, where after rehabilitation cycle a visible improvement has also been noticed. In the illustration presented in Fig. 5 minor but visible changes can be appointed within all three phases – especially for push-off phase.

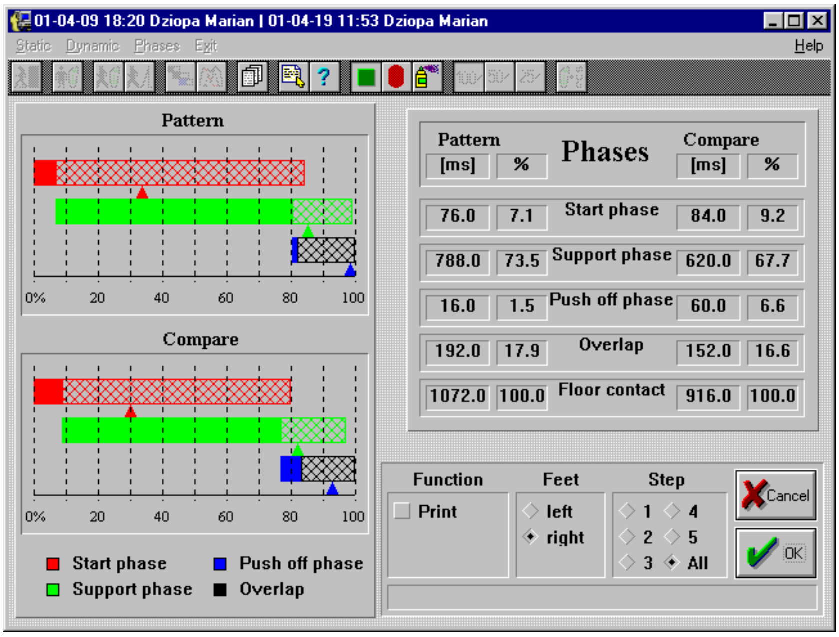

Fig.5. Visible elongation of push-off phase after the rehabilitation

3. THE SCIATIC NEURALGIA DIAGNOSIS

The term “sciatic neuralgia” concerns a cluster of clinical signs implied by pathology of nucleus pulpous; called lumbar disc herniation. At the disease early state patient feels pain, (in majority of cases) first chronic with not visible progress, finally more acute with sudden onset.

This character of pain is a signal of a lumbar prolapsed out disc within spinal column space into a vertebral canal direction. Nucleus pulpous prolapsed centrally or laterally into left or right side. The lumbar pain was radiating to the left or to the right lower limb.

This pain, called sciatica or sciatic neuralgia was caused by a compression of spinal radix with one or more of lumbar discs. The sciatic pain causes sometimes impossibility of any movement that lasts from two to three weeks with bed - pharmacological therapy.

The patient walk was slow with strong tendencies of avoiding positions changing of sciatic nerve and movement of lumbar region. In majority of cases, predominantly in lumbar region, the lateral curvature of spinal column - called scoliosis, was observed. It was a result of nervous root injury, as well as reflexive side bending of spine (scoliosis), The direction of the movement depends on the surface of radix, whether the disc presses external or internal radix surface [11].

The earlier observations assure characteristic proprieties of the walk. The sciatic neuralgia causes:

- the centre of the body weight (in 66% cases) was moved into direction of the affected limb,
- a frequent overload on the heel zone, the increase of impulse values and floor contact on the affected limb were noticed.
- in a remaining 33 % of cases the directed lateralisation was observed on a not affected side. This phenomenon corresponds to the direction of convex part of scoliosis.

Visible reactions were observed after the pharmacological treatment and rehabilitation processes. In a static part the overload on the heel decreased in the same time the burden in toe zone (Fig. 6) was remarkable bigger.

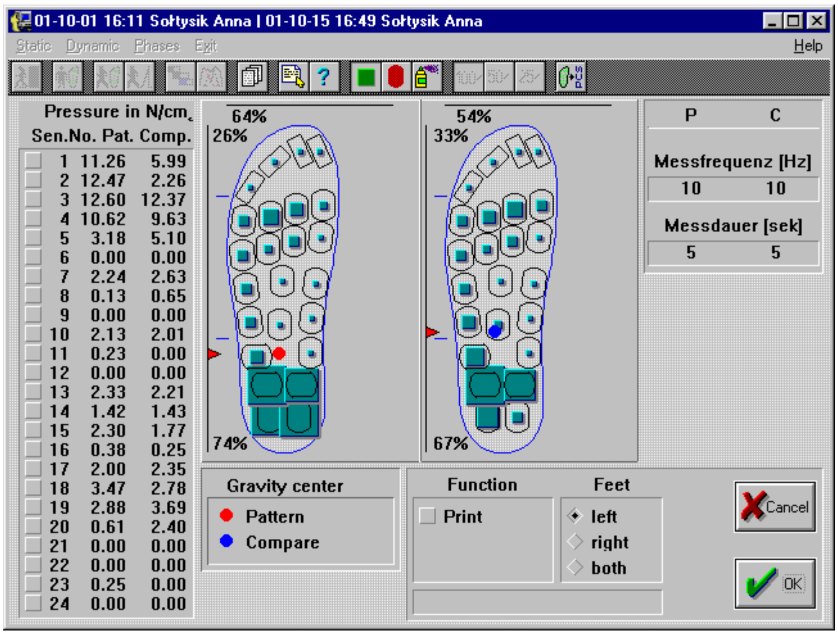

Fig.6. Sciatic right-sided neuralgia with a heel overload

The centre of the body weight for the same case of the rehabilitation moved closer to a proper position (Fig. 7).

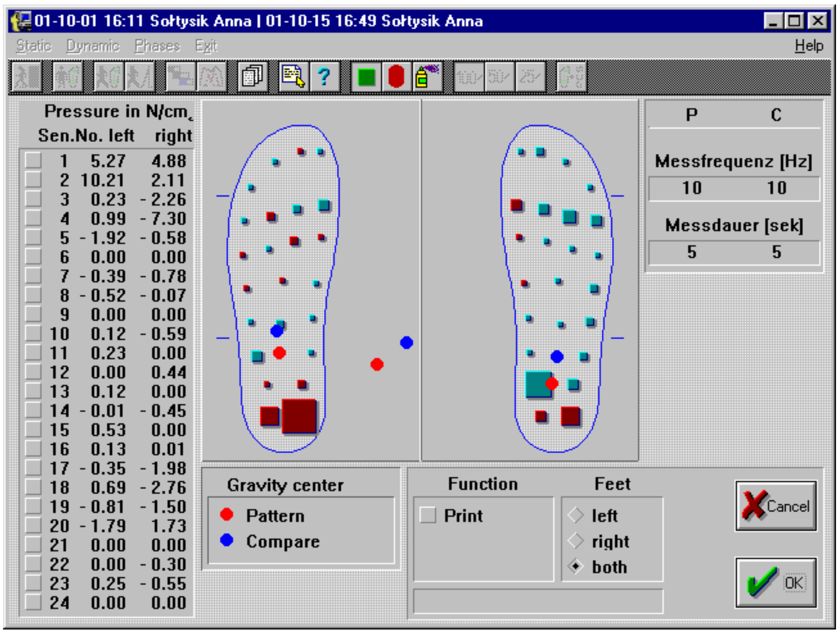

Fig.7. The body weight and a foot load centres movement after the rehabilitation

The dynamic part of interfaces illustrates visible progress of recovery during the time of medical treatment. Elongation of a foot weight centre movement trajectories (Fig. 8), with increase of impulse and floor contact values on the affected side (Fig.9) - joined with retreating of pain.

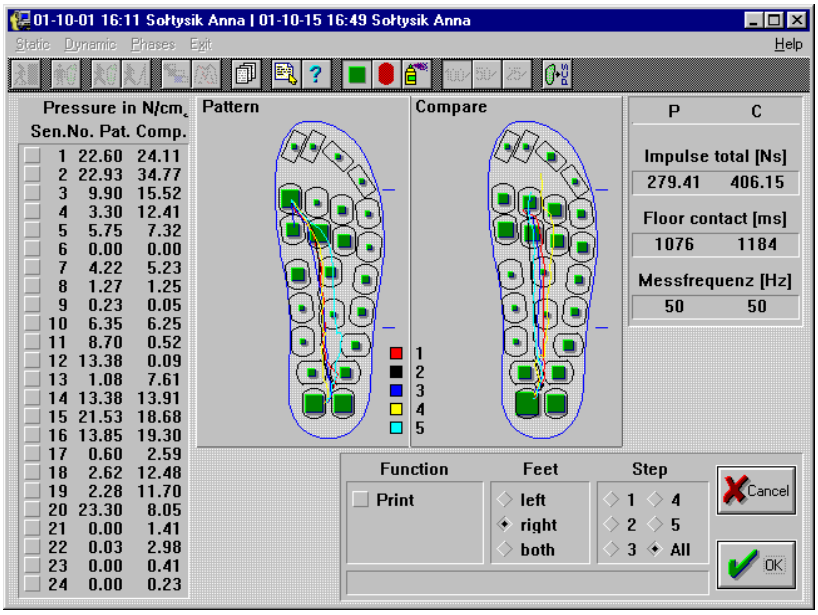

Fig.8. Clear extension of trajectory of centre of affected foot's weight into a toe direction

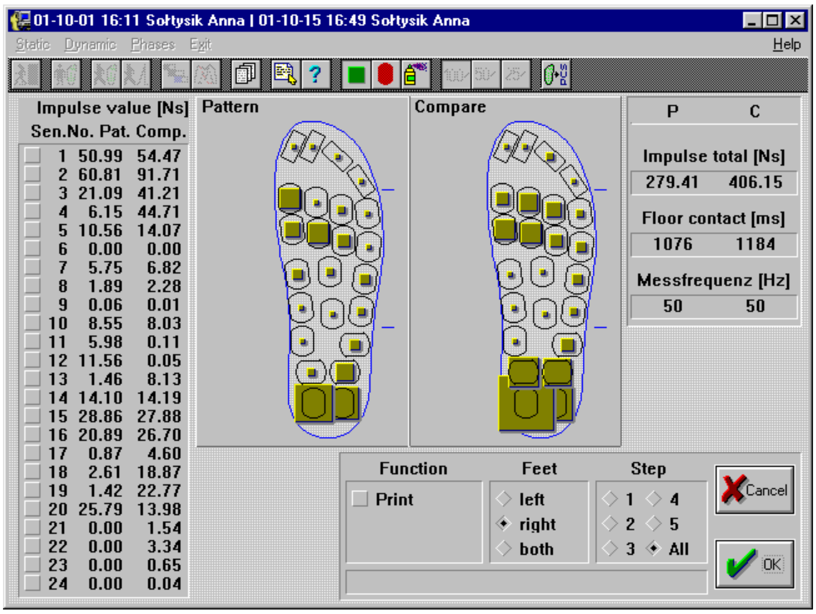

Fig.9. The impulse values and floor contact time increase on affected foot after the rehabilitation process

The same reactions are observed on step phases interface (Fig.10), mainly within the push off zone. The characteristic reaction of the affected limb is visible on a very short push off time (pattern phases). The rehabilitation implied the push off time increase.

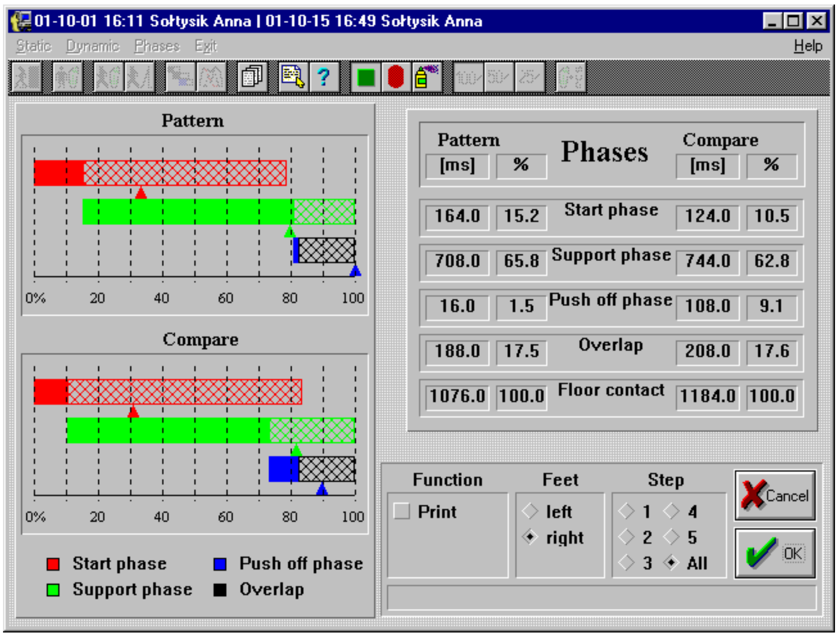

Fig.10. The push off phase increase on an affected limb after rehabilitation

4. CONCLUSIONS AND DISCUSSION

The carried–out clinical experiments provided us with very fruitful results that proved possibilities of PSW equipment usage for hemiparesis and sciatic neuralgia rehabilitation monitoring, what can be very important step towards the medical diagnostics of neurological diseases.

All evidences and monitoring the recovery by rehabilitation is a unique tool that neurologists could have for their disposal.

The discussed cases and diagnostic methods can be applied as a measure of improvement of muscular strength at hemiparesis or measures for walk stability control in sciatic neuralgia.

The earlier investigations established stereotypes for motor disorders in several groups of diseases. For several cases, with small symptoms of gait disturbances further investigations are needed then additional software units overworking. However the monitoring process of motor disorders rehabilitation provided us with satisfactory conclusions.

The rehabilitation processes can be guided optimally for every patient [7]. This evidence can also be recommended for medical jurisdiction giving aims for disability level description excluding simulation.

The collected evidences can also be fruitfully used for very precise monitoring of pharmacological treatment effectiveness that touches the walk characteristics [1,10]. The comparison possibilities allow observing actions of patients using medicines that help the doctor to choose a proper dose as well as to define an objective portion for new pharmacological products.

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