Hydrotherapy in adult neurology

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Introduction

Neurology is the medical field that focuses on treatment of the nervous system. In this text we will focus mainly on the central nervous system (brain, cerebellum and spinal cord). Neurological disorders that can be seen frequently in this part of the nervous system are cerebrovascular accident (CVA) or stroke, traumatic brain injury, Parkinson's disease and Multiple Sclerosis. Aetiology in these diseases is quite different, still common symptoms and treatment principles can be described.
We will also comment a little on an important disease of the peripheral nervous system - polyneuropathy or Guillain-Barré.
In this document the main problems and treatment goals related to the above diagnoses will be discussed in general. We will also briefly explain how the principles of immersion and hydrotherapy can help us achieve these treatment goals and present some of the most well-known hydrotherapy methods used today. Finally you will find a case history of a client who has suffered from a stroke, together with a reference list.

Abnormal neurolocomotor function

Problems can occur in many central nervous subsystems such as the sensory systems, neurolocomotor systems, neuropsychological systems and cognitive systems. The results are a variety of problems on all levels of impairment, activity and participation. Here we will focus on the neurolocomotor system.

The abnormality of the neurolocomotor function is due to a different activation pattern of the muscles, which results in a combination of the following problems:

- A decreased muscle activation and weakness, which results in a difficulty to
  - elicit and sustain muscle activity
  - generate and time force
  - generate and control synergistic muscle activity
  - support, propel and balance the body mass over the feet
  - show a proper dexterity/skill
- Hyperreflexia or spasticity (clonus, tendon jerks, extensor/flexor spasticity). Hyperreflexia will also influence the above-mentioned difficulties but at the moment it is believed that decreased muscle activation is more disabling than hyperreflexia (Carr & Sheperd, 1998).

Spasticity & stiffness

Spasticity is an important phenomenon in clinical rehabilitation but in neurological physiotherapy this sign is often misinterpreted. Spasticity should always coincide with the other signs - clonus and increased tendon jerks. However, in clinical practice the word spasticity is also used when weakness is apparent and clonus etc. is not present. In these cases, groups of muscles tend to become stiff in order to guarantee body stability.
All the established methods of neurological physiotherapy have for a long time been focusing on reducing this spasticity by using specific “inhibition” techniques in order to normalise muscular tonus. In many cases patients were not really spastic, but stiff.

Hydrotherapy: spasticity vs. stiffness

Spasticity as such can not really be influenced by hydrotherapy, stiffness can!
In general, stiffness can be reduced through:

- activity: repeated lengthening/shortening
- passive stretch of muscles before activity, both of these interventions change the visco-elasticity of connective tissue.

Research showing that hydrotherapy (or immersion in warm water) doesn’t influence spasticity has been done by Bovy, (1991) on 10 spastic patients. After 20 minutes of immersion in warm water, he found that the extensibility (stretch) of the spastic hamstrings lessened and the excitability (spasticity) didn’t. He concluded that immersion affects the visco-elasticity of the connective tissue in the muscle.

Hydrotherapy provides both options: all kinds of balancing activities and stretching in the warm environment of water decrease stiffness. This decrease of stiffness is a starting point to increase the quality of motion, increase range of motion and to balance.

Balance

Balance is a process to control equilibrium for a given purpose, or ability to control the centre of gravity relative to the base of support. Goals are:

- to support head and body against gravity
- to maintain the centre of gravity aligned and balanced over the base of support
- to stabilise parts of the body while other parts of the body move

Figure 1 shows a task-oriented model of equilibrium. Balance has multiple aspects and depends e.g. on the environment.

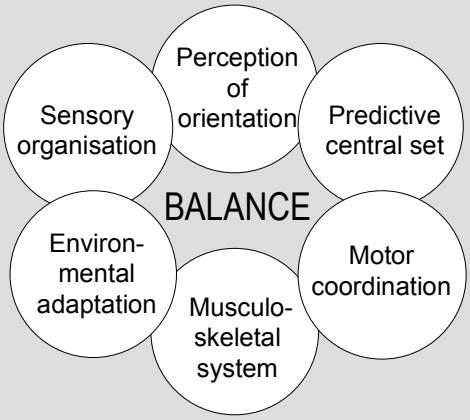
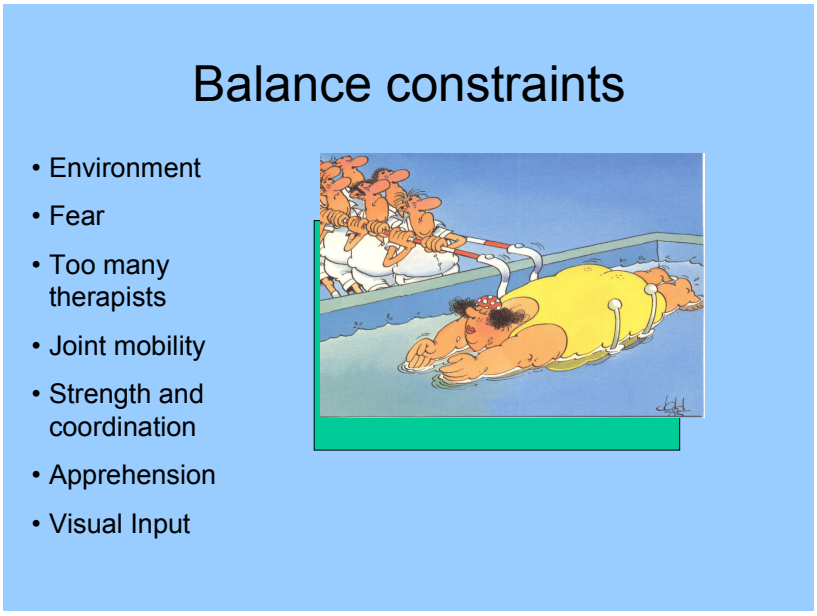


Figure 1 A task oriented model by Horack, 1991

The most important goal in rehabilitation of clients with central nervous disorders is to regain independence, or to prevent dependence. For all skills of daily living (standing, walking, reaching, self-care, sitting etc.), postural control is a central topic. In other words; one has to be able to balance/keep stable to be able to perform ADL tasks safely. Balance constraints must therefore be resolved. Constraints due to the impairments can be:

- reduced joint mobility and reduced muscle length
- abnormal motor control: changed activation and strength
- an altered physical environment (wheelchair, hospital)
- an altered visual, tactile, proprioceptive and vestibular perception
- fear, depression and lack of apprehension
- adaptive motor behaviour



Adaptive motor behaviour

The body has several mechanisms to protect its stability and when going into a new environment (like a hydrotherapy pool), these mechanisms are used. This is however not a problem. As long as the client is able to use disassociated head movement to steer balancing activities, as basis to learn is present. The motor behaviour that can be observed, may consist of:

- Widening the base of support
- Using the hands for support
- Stiffening of the body
- Avoiding the threat to balance
- Shifting weight to less affected parts

Adaptive motor behaviour in the pool

In the recent past this adaptive behaviour has been a reason for some therapists, observing the stiffening, to deny hydrotherapy. However, going through a proper programme of teaching how to balance (see Halliwick) changes this adaptive motor behaviour quickly into motivation and movement.
The most important reason is that fear of falling ceases to exist and therefore activity can be evoked.
The changes in motor skills that can be seen when training balance in water can also be carried over to dry land, according to many experts in the field. This is also confirmed by clinical research on this topic (see Poteat, 1999). The change in motor skills will have qualitative and quantitative features that have been listed below. The principles of acquiring motor skills are a result of a motor learning process, but will be restricted because of pathology.

Principles of acquiring motor skills

- Variable movements become more consistent
- Coordination becomes more precise
- Skills can be made at a faster speed without deterioration
- Fewer synergist will be recruited and co-contraction will be less
- The client needs less (or even no) visual control when performing the skill
- The client needs less attention for the skill and is able to be distracted
- The client can perform more tasks at the same time
- Postural adaptations become less visible

Acquiring motor skills in water

The well-known Dutch psycho-neuro-pharmacologist Lex Cools (Cools, 1999) states that hydrotherapy "warms the neurological system up". The reasons for this are that:

- Hydrotherapy forces a patient to return from a higher-order neurological system, allowing to balance around the transverse axis (= extension against gravity), to lower-order neurological systems that allow to balance around the longitudinal axis.
  The brain contains certain centres that are involved in the coordination of these balances. The "oldest one' is the longitudinal balance system. This kind of balance can be exercised in the pool very well, so hydrotherapy prepares (warms up) for the normal extension against gravity
- Hydrotherapy reinstates earlier stages of ontogeny with successive activation of higher centres, using extero- and proprioceptive cues. This means that hydrotherapy should have a prominent place in early neurological rehabilitation.

Two studies have been published about the effects of hydrotherapy on balance in the elderly (with minor problems) (Lord, 1993; Simmons, 1996). Both found that balance on land improved after participating in a hydrotherapy programme. The clients were able to stand with less sway and to reach further without loosing balance. They had learned to move and to correct movement errors in a safe environment. They also got a chance to vary their practice, which is very important in motor learning.
Morris (1996) measured the balance of three stroke patients on dry land after going through a programme of hydrotherapy. He found a small increase in balance ability and reaching, but the number of clients was too low to draw any firm conclusions

Physiological effects of immersion

Immersion in water elicits a range of reactions in the human body. Effects of immersion occur because of the hydrostatic pressure on the body and because of temperature effects of water.

The physiological effects of immersion evoke:

- a mobilisation of interstitial and lymph fluids to the central cavities
- an increased blood supply to the muscles
- a reduced sympathetic output
- a increase in elasticity of connective tissue
- a decrease of muscular contraction forces
- mechano-sensory effects on nociception/pain transmission: less pain
- a decrease of joint compression forces
- isokinetic resistance, provided by turbulent drag
- an altered proprio-/exteroceptive input
- effects on the vestibular system

Temperature

Temperature effects are responsible for changes in stiffness (visco-elasticity) of connective tissue and thus provide the basis for the increase of joint range of motion, muscle length and relaxation. Especially stiffness related to the elastic part of the muscle, which is 90% of the total stiffness, can be influenced by warmth (warm water). This is shown in the next three graphs (Fig 2, 3 & 4).

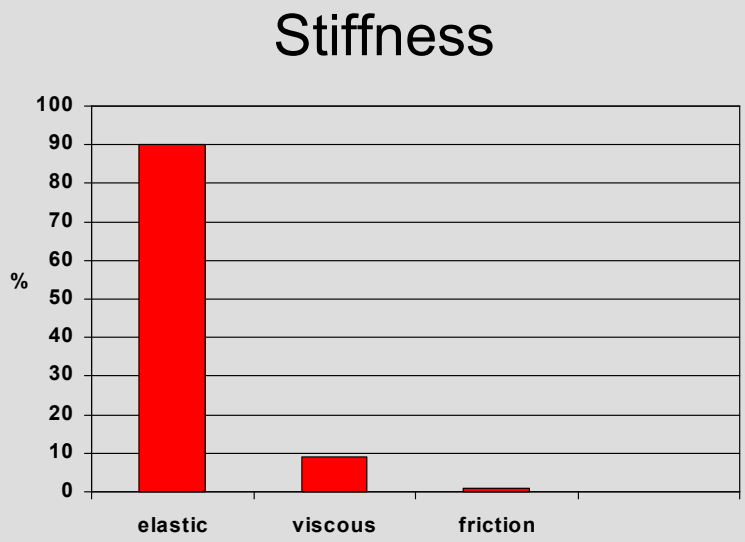


Figure 2 Wright, 1961

Alteration of stiffness with temperature

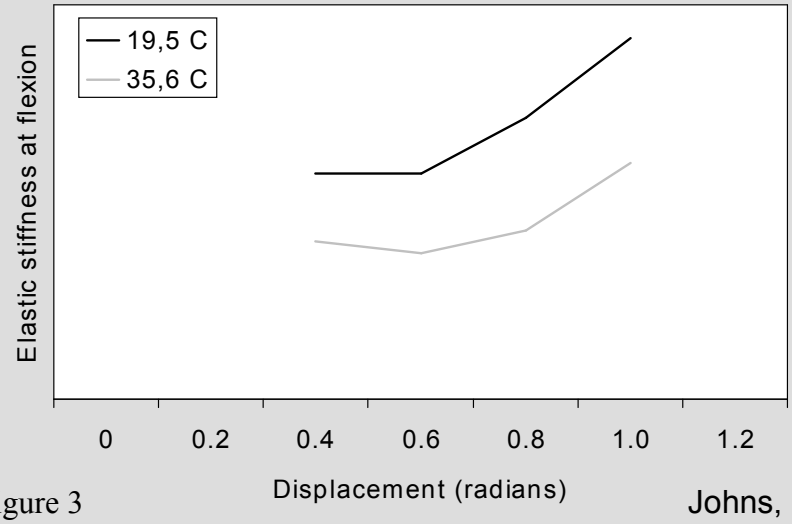


Figure 3 Johns, 1961

Tendon extensibility and temperature

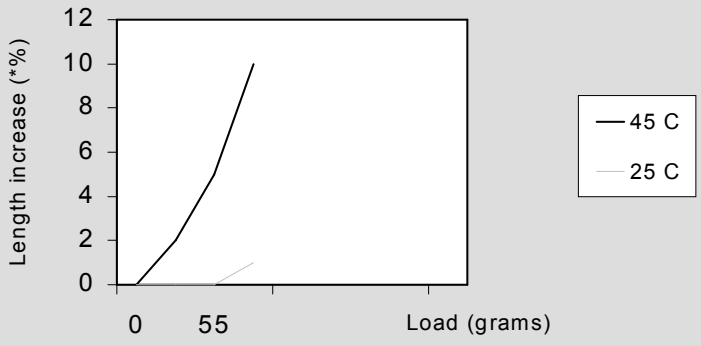


Figure 4 Lehmann et al

Pressure and buoyancy effects

Pressure and buoyancy effects are responsible for the fact that:

- Circulation is increased in all muscles. This is enhanced by warm water (Baldinn, 1971).
- Muscle and Skin Sympathetic Activity decrease with depth of immersion. This can be seen as a change in EMG (electromyogram) output (figure 5) (Mano, 1985 & 1994). The effect of buoyancy will also add to this effect. The decreased EMG output in water compared to dry land has been seen in various studies (Erbe & Rusch, 1982; Mano, 1985; Camus, 1987; Clarys, 1990; Poteat, 1996; Fuller, 1999; Pöyhönen, 1999). In other words, less strength is required in order to perform a certain task in water compared to on dry land.

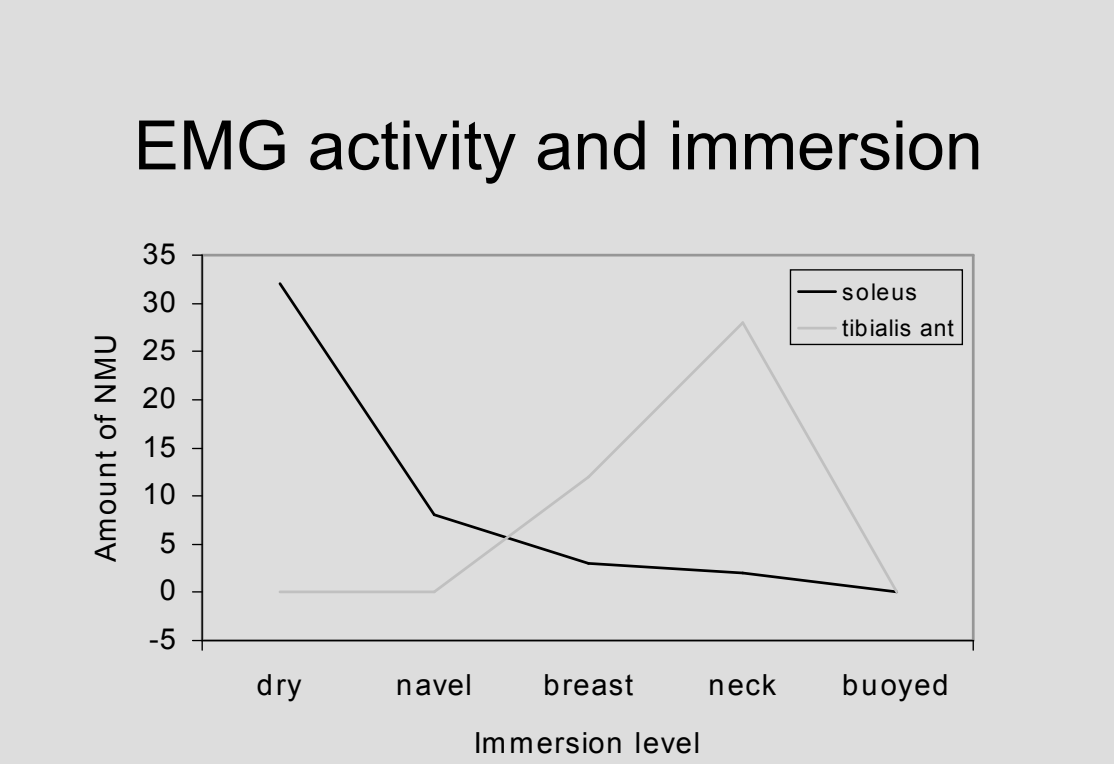


Figure 5

Mitarai, 1972

This means that in water clients can make movements with less effort than what is required on dry land. Hydrotherapy provides an early initiation of muscular activity and decreases the amount of co-activation (spasticity) when clients try to initiate a movement, because less force needed for a movement means less need to use (co-activate) the spastic muscles. The increased circulation will warm up the muscles and connective tissue, provide nutrition & oxygen and deplete metabolic waste products. This is an important basis for tissue training.

One of the most important functional goals of hydrotherapy is walking. The effects of buoyancy help to facilitate both swing phase and stance. In general, clients are able to walk independently in the pool earlier than on dry land, especially in cases of severe weakness. When comparing walking on dry land to walking in water, the following can be observed:

- Less antigravity muscle activity is needed when in water (see the EMG studies). Weight bearing will however depend on the velocity of walking (see figure 6).
- Stance will also become slower and one has more time to correct foot position in the water (see figure 7).
- An active swing and hip extension of the stance leg will be facilitated.
- Stance time is increased in water.
- Either an ipsilateral or a crosslateral gait pattern may be provoked.
- Forward trunk inclination increases and the abdominals are activated.

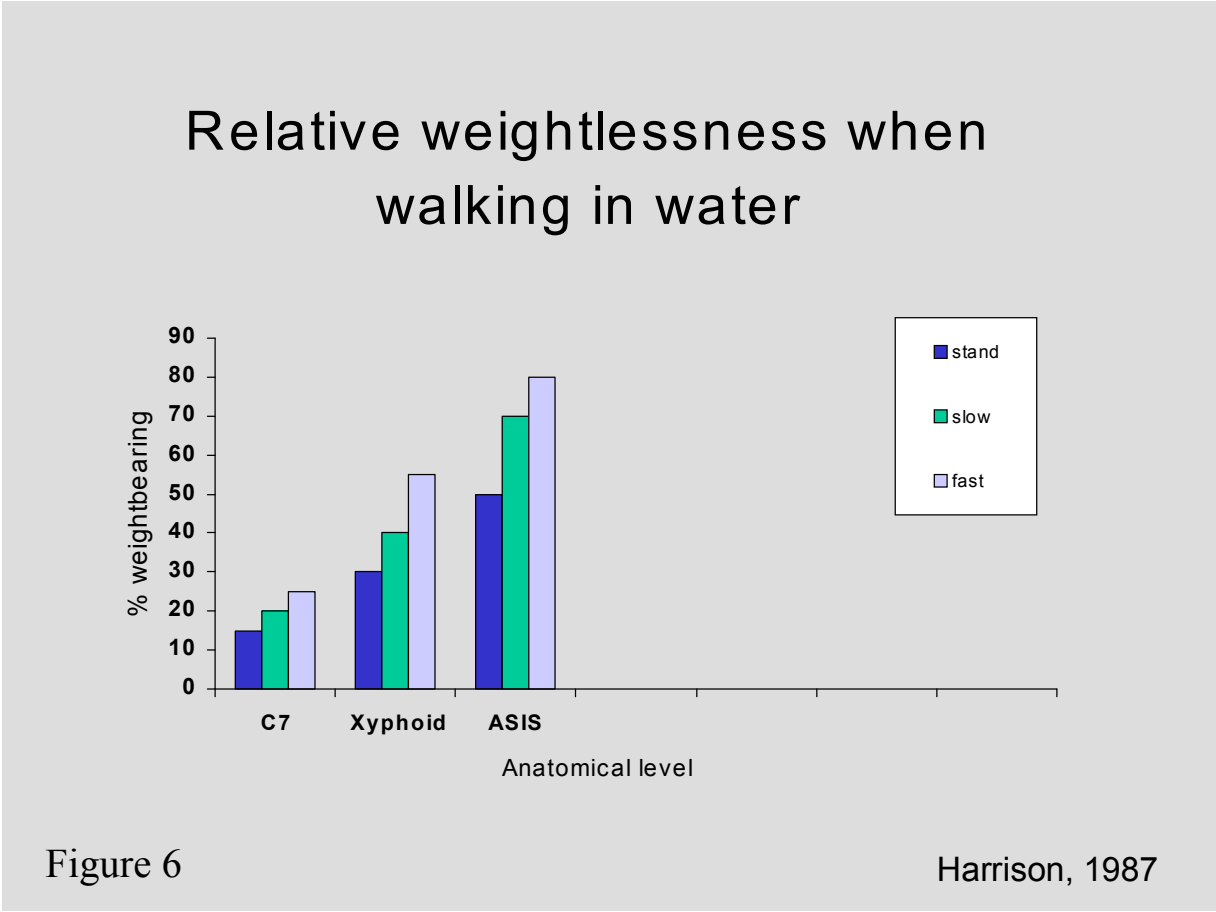


Figure 6

Harrison, 1987

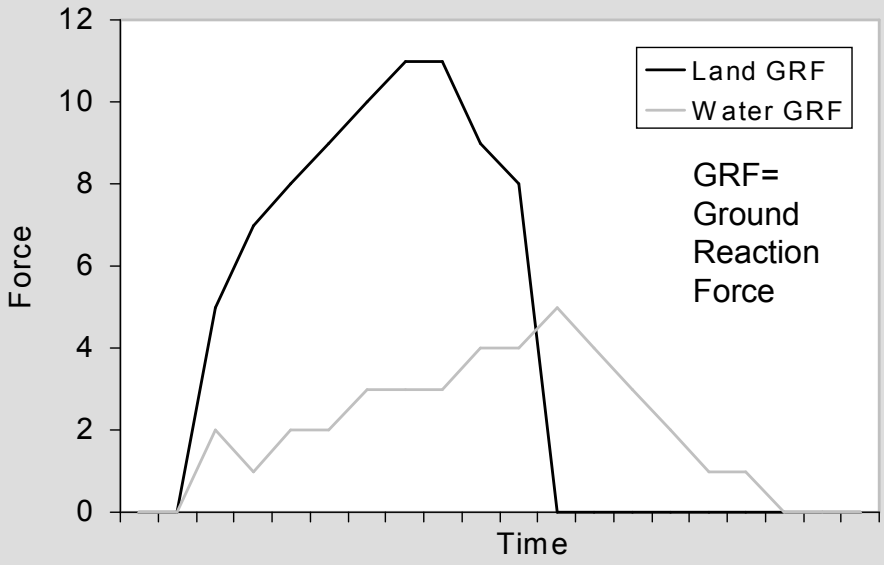


Figure 7

Becker & Cole, 1997

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Research has revealed that walking with simulated weight reduction, i.e. suspended walking on a dry land treadmill or walking in water, will result in the following effects:

- Increased stance time of the hemiplegic leg.
- Trunk symmetry and increase of stride length.
- Increased walking velocity (up to 3 times compared to dry land).
- Less activity in hypertonic postural muscles.
- More activity in weak antagonists
- Facilitation of the swing phase.
- After 6 weeks: 40 % greater speed on dry land than with conventional therapy.
  (Hassid, 1997; Hesse, 1997; Pillar, 1997)

These changes have also been indirectly confirmed by the researches of Zamporo (1998) and Pagliaro (1999). They found that even though the stretch reflex activity (spasticity) had not changed after hydrotherapy, the clients showed a decreased gait energy consumption, which reflects a more physiological gait pattern

Neurological disorders & hydrotherapy

General training principles for neurological patients are:

- to prevent soft tissue contractures and mobilise stiff joints, preferably by active means
- to elicit muscle activity by e.g. compensating for gravity (use of buoyancy)
- to train motor control using concrete goals as standing, walking, reaching etc.
- to increase muscle strength: repeat with relevant movements
- to change the environment to modify maladaptive movement strategies
- to train endurance
  (Adapted from Carr & Sheperd, 1998)

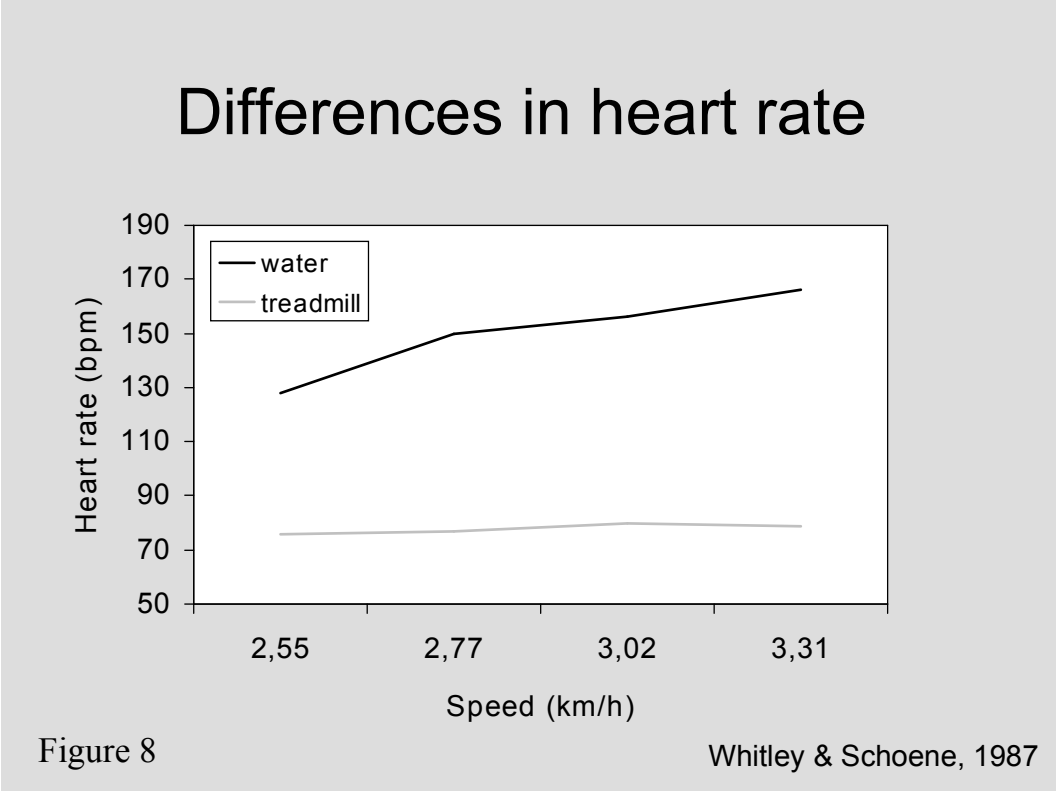

Figure 8

Whitley & Schoene, 1987

By using hydrotherapy we will get the following advantages:

- Increased movement ability thanks to increased joint ROM and relaxation
- An easy way of strengthening weak muscles
- Movements can be made with less force and irradiation
- Cardiovascular endurance can be enhanced with a low mechanical impact (figure 8)
- Equilibrium, stability and adequate balance reactions can be facilitated (water is safe and provides “time to think”)
- Early ambulation can be achieved to prevent loss of “software”
- Proprio- and exteroceptive input can be increased
- Subjective complaints can be decreased, e.g. shoulder pain
- Abnormal tone and stiffness can be normalised
- Mood, motivation and self-esteem can be increased
- Body image can be improved (no use of sticks etc.)
- Socialisation can be increased

Stroke

A stroke, or Cerebro-Vascular Accident (CVA) generally results in a locomotor problem called hemiplegia. The abovementioned training principles and advantages of hydrotherapy all are valid for stroke patients. Other problems will however also be present, depending on the localisation in the right or left hemisphere of the brain. A person with a right sided hemiplegia (stroke in the left hemisphere) can suffer from an aphasia, which is a problem in the reception and / or the processing of language. Communication with the patient might have to be changed to alternative ways as the use of symbols, showing movements, guiding the activity to be done etc. Left sided hemiplegic patients may have problems with orientation in space, perceiving the affected side of the body, or sequencing complex skills as dressing and undressing. This will need additional help in the changing rooms, but will also influence motor learning in the pool. In these cases, guidance from an experienced neuropsychologist might be necessary to structure the hydrotherapy session adequately.

Multiple Sclerosis (MS)

Most of the abovementioned training principles and advantages are valid for MS patients. MS is a progressive disease that can affect various parts of the central nervous system. Most prominent is the spasticity that may cause the patient to use a wheelchair. The patient has time to adapt to the symptoms, other than with a stroke. Hydrotherapy will mainly focus on prevention of function and skills: endurance, strength, balance and ambulation
The main topic of discussion in multiple sclerosis is water temperature. Most patients favour cool water, but negative influences of warmth on progression has not been shown yet. So, it’s up to personal preference what temperature can be tolerated best.
In one study (Gehlson, 1984) with multiple sclerosis patients, a marked increase in strength could be proved after a 10 week hydrotherapy programme.

Parkinson disease

Parkinson's disease progressively affects certain centres in the brain, causing a rigidity of muscles and a "slow" kind of behaviour. Because of the gradual change, therapy can be used to prevent deterioration to a certain degree. Hydrotherapy is focussed on the same goals as with multiple sclerosis. In the pool, Parkinson patients perform well, the fluidmechanical influences facilitate motion and seem to stimulate alertness.
As yet there is no evidence that Parkinson patients can carry over the skills, learnt in the pool, to dry land, but Parkinson patients benefit from the general advantages: muscle and joint stiffness decrease during a session. This lasts for some time afterwards.

Traumatic brain injury

The traumatic brain injury causes, just as in stroke, a wide range of problems in all central nervous subsystems. The motor control shows in general a combination of spasticity, weakness and ataxia. The principles, described in the sections on general neurology and stroke can be followed. Special attention should be paid to breathing control, partly due to an intubation/tracheotomy that often is needed in the IC unit. The ataxic component can be addressed appropriately through hydrotherapy and shows a good carry over to dry land. In early rehabilitation, hydrotherapy can be used to increase alertness by using debalancing techniques (Halliwick) or stimulating the input by using Watsu with lots of movement and turbulence. A hydrotherapy advantage in this patient group is the ease of handling in the water in comparison to handling on dry land.

Guillain-Barré

Patients with the syndrome of Guillain-Barré can benefit enormously from hydrotherapy. An inflammation of nerval roots leads to severe paralysis all over the body. As soon as the acute symptoms have been resolved, the client has to gain strength. This is a long-lasting process, depending on the rate of nerve sheath regeneration, which may take many months. Hydrotherapy provides an environment in which clients with hardly any strength can make movements and thus it is the therapy of choice in the early phases of rehabilitation. Later on, hydrotherapy still is of value: balance, gait training and swimming are activities to gain a wide range of tissue effects and functional skills. The therapist should take into account the fact that patients can be fatigued easily, which might affect the disease negatively. Since hydrotherapy is tiring, treatment time should be short (15 minutes) to start with, and be increased carefully.

Note

Many neurological patients will show a deterioration of their symptoms (increase of stiffness and a worse gait pattern than before hydrotherapy) when they leave the pool. This is quite normal. The patients generally are tired after a pool session and have to adapt to gravity again as well. This difficult combination often increases the problems. After about one hour patients feel well again. This is the time when dry physiotherapy should start to repeat the learning experiences in the actual daily environment on land.

Different hydrotherapy methods

In this chapter the most important hydrotherapy methods are being presented. We will also discuss their relevance for the neurological population. One technique may be chosen or a combination of them, depending on diagnoses, hydrotherapy facility and personal preferences.

Halliwick

Halliwick is the most suitable and used method in neurological rehabilitation.
The Halliwick programme is a motor learning system where postural control (=balance) is of utmost importance. Task- and goal-oriented activities can easily be incorporated, allowing a very functional kind of hydrotherapy.

James McMillan started to develop the Halliwick concept in 1950 as a swimming method for people with special needs.
He based the concept on his knowledge of fluid mechanics, together with observations of the human body's reactions in water. This combination of fluid mechanics and the neurobiological response of the body led to a sensori-motor learning sequence called the Ten-Point-Programme.
The Ten-Point-Programme leads a person from water adaptation to a basic swimming stroke. A central topic in the programme is to get control of rotations around the various body axes. These rotations occur because of the so-called "metacentric" effects, i.e. the relationship between gravitational and buoyant forces. This relationship is altered by changes in shape and/or density, which occur in the disabled body. A thorough assessment of both changes in density and shape is therefore needed in order to predict the rotational problems that a swimmer with special needs might have.
The Ten-Point-Programme includes three stages of motor learning; adjustment to the environment, balance restoration and movement, which show the process-oriented philosophy of the concept. The concept is therefore very popular in neurological and paediatric rehabilitation and is often said to be "Bobath in water".

The order of the different steps in the Ten-Point-Programme is shown below.

1) Mental Adjustment and Disengagement	Adjustment to the environment
2) Sagittal Rotation Control 3) Transversal Rotation Control 4) Longitudinal Rotation Control 5) Combined Rotation Control 6) Upthrust or Mental Inversion 7) Balance in Stillness 8) Turbulent Gliding	Balance restoration
9) Simple Progression 10) Basic Halliwick Movement	Movement

The Bad Ragaz Ring Method (BRRM)

The Bad Ragaz Ring Method has been developed in its basic form in Germany around 1950. It started as a way to strengthen muscles in simple one-dimensional patterns, e.g. just asking for an abduction in the shoulder.
Patients were put in flotation devices and were being exercised in a supine position. The therapist would give resistance to the movement and the patient would move through the water.

The patterns can also be used passively. The three-dimensional patterns provide an excellent possibility to stretch soft tissue in capsules, ligaments, muscles and nerves. When applying the BRRM passively, definite resemblances with Watsu can be seen. Because of the use of floatation aids in BRRM, a therapist is able to work more local compared to the possibilities offered by Watsu.

In 1957 the method was introduced to the Health Spa Centre of Bad Ragaz in Switzerland. In the early sixties a physiotherapist named Bridget Davis started to include three-dimensional patterns to the movements, based on the ideas of PNF (Proprioceptive Neuromuscular Facilitation). The positions were increased; prone and side lying was included.
Since BRRM can be quite exhausting for the therapist, alterations based on the mechanical principles used in Halliwick were made at the end of the seventies. The physiotherapist in charge of this renewal was Beatrice Egger, who 1990 wrote a book about the *New BRRM*. In the *New BRRM*, prone and side lying was left out (although still in use in some countries) and patterns with so-called counter resistance were added. These patterns are a combination of isometric and isotonic contractions, which makes it easier for the therapist to give a proper resistance with her own body mechanics.
In recent developments prone patterns using mask and snorkel have been introduced together with more passive initiation techniques, allowing all kinds of tractions and translations of the spine and peripheral joints.

Important features and considerations concerning BRRM:

- The three-dimensional patterns are adapted to the floating patient.
- The therapist forms the fixed point in the chain.
- The therapist should choose an adequate depth of water
- The resistance given is optimally adapted to the patient's capability. It can be both isometric and isotonic.
- Handholds should be correct.
- Approximation and traction are used as stimulation techniques for stability and movement.
- Short, precise commands are important.
- Stretches can be applied.
- Passive initiation is used.

Goals of treatment:

- To strengthen muscles and re-educate.
- Increased range of motion, incl. traction and elongation.
- Tone reduction and relaxation.
- Improved alignment and stability of the trunk.

(Parts of) the Bad Ragaz Ring Method are of limited use in neurological rehabilitation. The client has to generate a relatively large amount of muscle force; therefore spastic patterns can be evoked easily. When properly applied, the above mentioned goals can be applied to the neurological population.

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Watsu

Hydro-relaxation techniques are based on the facts that warm water together with gentle movements and good support has tremendous effects on both somatic and psychological relaxation.
There is a wide spectrum of different hydro-relaxation techniques but the one best described so far is Watsu.
Watsu was developed by Harold Dull in the Health Spa Centre of Harbin Hot Spring in California USA. As a Zen-Shiatsu master, he began to apply some of the stretches (used to influence the body's meridians) in water. He found that the combination of these stretches together with Shiatsu massage and gentle movements could bring about deep relaxation effects. He describes Watsu as a nurturing intervention, where being together is more important than providing a specific technique. Watsu was simply created as a wellness technique.
When the method became known to physiotherapists, they immediately saw the therapeutic potential of Watsu. Apart from the relaxation effects, fine possibilities to stretch and elongate were seen.
Watsu started as a method where the therapist (giver) fully supported the patient (receiver) but a clear development towards flotation aids can be observed. This enables therapists to be more precise and localised in their techniques.
Also the normalising of energy flows in meridians is of minor importance today.

On the one hand, people both in and outside the health profession apply Watsu for relaxation reasons. Here Watsu may be combined with dry land Shiatsu, meditation and other (alternative, Eastern) techniques for well being.
On the other hand, there is a lot of resemblance with methods from physiotherapy:

- Neurotension or manipulation of the peripheral nervous system
- PNF (its passive initiation techniques)
- Basal Stimulation and Snoezelen
- Spiraldynamics and other “dry land rotational systems”

Features and considerations concerning Watsu:

- The patient is passive
- The therapist should provide adequate support
- Joint instability should be handled carefully
- Vestibular arousal should be avoided
- The therapist should be aware of the emotional effects

Goals of treatment:

- Relaxation and pain relief
- Elongation, traction and translation
- Muscle stretching
- Stimulation or sedation of the reticular formation

Relaxation in neurological rehabilitation is generally used as an introduction to more active hydrotherapy methods. The client can be prepared to various balancing activities through the large mobilising and stretching movements.

Conventional hydrotherapy

Conventional hydrotherapy includes various techniques and exercises that do not have a specific philosophy amongst them. The exercises are classified in:

- Buoyancy assisted exercises
- Buoyancy resisted exercises
- Exercises with neutral buoyancy
- Exercises that make use of a change of lever
- Exercises that make use of a change of speed
- Exercises that make use of a change of frontal plane

In many cases these exercises are focussed on one joint and/or one muscle group. This is why the exercises with these variables can be easily used in group therapy and self-organised exercise schemes.
Specific equipment as chairs, plinths, bars and smaller aids belonging to the conventional land based exercise are often used.
Conventional hydrotherapy will also give neurological patients the opportunity to continue hydrotherapy independently after rehabilitation. The therapist should carefully programme exercises to customise these for the individual client.

Aquatic fitness

During the last decade, aquatic fitness has become popular. The origin can be found in the publication of Glen McWaters, United States. He tried to walk in water with the use of a flotation belt, when having a leg injury from dry land running. His experiences led to the Deep-Water Walking method or Aquajogging.
This method was initially used for injured athletes but was later also applied to other patient groups in orthopaedics, rheumatology and cardiology.
Principles from the conventional hydrotherapy are used to increase difficulty when walking through water. The programme is generally focussed on increasing aerobic capacity.

During the last few years, many other aquatic fitness programmes have been developed as variation of Aquajogging. Here are some of them:

- Shallow Water Walking
- Aqua-aerobic
- Aquasteps
- Aquanastics
- Hydrorobics
- Hydropower
- Aquadynamics

Most of these methods can be done in shallow water and can also be applied to the neurological population. The “workouts” should however be tailored to fit the clients’ locomotor abilities.

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Case History

History and present state

A 63-year-old truck-driver suffered from an apoplexia (CVA or stroke) 2 months ago. This resulted in a right-sided hemiplegia with minor phatic problems. After a short period in the acute hospital, the man was referred to the rehabilitation centre for clinical rehabilitation. The method of rehabilitation, used by all disciplines is Bobath/NDT.

At this moment, the patient is able to ambulate slowly with manual facilitation by a therapist. He needs an AFO (ankle-foot-orthosis) to hold the right foot in dorsal flexion. Both physiotherapy and occupational therapy focus on posture training since there is a marked tendency to shortening the affected side of the trunk.
In daily activities he still needs a wheelchair. Transfers are independent, so is personal care. The right hand is spastic. The arm shows some signs of recovery, although the shoulder hurts, despite wearing a sling.
Before the patient got a stroke, he swam on a recreational basis.

Treatment plan in water

The physiotherapist suggested hydrotherapy to support the sensori-motor rehabilitation. The objectives are:

- to facilitate independent head to shoulder movements, i.e. to facilitate righting reactions
- to relax the right shoulder and arm in order to decrease tone and pain
- to work on trunk symmetry and to train the affected abdominals (these are hypotonic)
- to disassociate hip-pelvis-thorax-head activity
- to reinforce sensory input and vary experience in order to enhance motor learning
- to increase aerobic capacity / stamina
- to work on independent ambulation
- to teach the patient to swim again
- to present an enjoyable situation that distracts from dry land rehab and motivates to move.

Considerations

- Immersion in water prevents the mechanisms that can occur to compensate for the “normal physiological” extension against gravity
- Immersion in warm water, and added slow movements promote relaxation that can be used as a preparation for stretching (neurodynamic) techniques.
- The relative unstable position in the pool (fixed points fail) force the body to actively balance, especially around the symmetry-axis of the body
- Lack of fixed points also facilitate the use of the head during balancing activities
- The tactile input of water is a different source of feedback, compared to dry land, and is important in motor learning
- The patient will go into a sedentary lifestyle. There is a clear need for a kind of physical activity that he favours, which is swimming.

Choices

A pool is needed that can give space to ambulate and swim. The water depth should be about waist-deep, because it enables:

- The patient to swim, including a safe way to stand up (make a vertical rotation)
- The patient to ambulate in such a way that both the advantages of buoyancy (weight reduction) and gravity (working in a relatively closed kinetic walking chain) can be combined.
- The physiotherapist to use various techniques

Water temperature should enable the methods of choice as well. The patients should be in thermal comfort during the hydrotherapy time (of 15 to 60 minutes). A temperature of some 32 ^{0}C makes both relaxation and low impact endurance training possible and generally is chosen as the most optimal temperature for hydrotherapy.

Methods to choose

1) Relaxation (e.g. in concordance to Watsu) of the right arm and shoulder. The therapist gently moves the patient through the warm water. Flotation aids can be used to enable the therapist to localise stretching and mobilisation.
   The BRRM also offers passive stretching and mobilisation possibilities, when flotation aids are being used. In BRRM, stretching can proceed to rhythmic initiation to active movements.

2) The Halliwick Method can be used for all other objectives.
3) Adapted swimming, e.g. according to Halliwick.
4) The Bad Ragaz Ring Method can be used for increasing strength of the hypotonic abdominals; care should be taken to prevent co-activation of spastic muscles. The BRRM also offers passive stretching and mobilisation possibilities, when flotation aids are being used. In BRRM, stretching can proceed to rhythmic initiation to active movements.

Programme

Start with Relaxation and Halliwick, continue with Halliwick and Bad Ragaz Ring techniques and finally proceed to swimming.
The frequency should preferably be at least twice a week to establish proper progress.
Duration of a session could be 30 to 45 minutes. The patient should continue the swimming in a swimming club for people with special needs.

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