Water Specific Therapy_Halliwick

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1. Introduction

Halliwick is a concept, originally developed to teach clients with a physical disability to swim and to make them independent in water: the Ten-Point-Programme. Independence is an important prerequisite for participation in therapeutic, vocational or recreational activities, individually or in a group. The willingness to lose balance and the ability to regain it are core elements of this independence. This Ten-Point-Programme is used to reach these goals and developed to include Water Specific Therapy (WST), which is focused on treating impairments of body functions or body structure. Possibilities and constraints of the client are analyzed in order to use a systematic intervention (WST) to help the client increase function, independence and participation (McMillan, 1975; McMillan, 1977; Gamper, 1995; Stanat, 2001; Lambeck, 2001).

The Ten-Point-Programme as a swimming method will not be explained.

WST is active and mostly dynamic in order to facilitate movement and sensory input. WST also has a static component, in which selective activation of muscles and stabilization of specific joints is exercised. WST can be used to address objectives at all components of the ICF. and has vast applications. In musculoskeletal, neurological and pediatric rehabilitation, clients can experience early mobility. The fluidmechanical advantages of water support the abilities of the trunk in a mobilizing and stabilizing way. These properties have been described in chapter 1. Many activities can be repeated and varied and clients can learn
balance strategies which have carry-over effects to dry land (Bae, 2005; Getz, 2006-a; Getz, 2006). WST also enables a graded activity programme with low mechanical impact and increasing physiological demand. For example, patients with chronic low back pain can increase their functional capacity in a gravity reduced environment. WST has focused traditionally on postural control, a basis for adequate swimming performance. This postural control can be translated as “core stabilization”. Indeed many exercises that have been developed for WST can be seen currently in Pilates.

At present, WST has worldwide recognition as an approach that has therapeutic, vocational, recreational, competitive properties and that also can be combined with other concepts in aquatic therapy. (Figure1)

Figure1. WST and related concepts
Table 1 provides the sequence of the Ten-Point-Programme, the static and dynamic points and the ones that are considered to be a preparation (pretraining) for WST.

Table 17.1. Ten Points: dividing into kind of activity and pretraining

<table>
<thead>
<tr>
<th>10 Points</th>
<th>Activity</th>
<th>Pretraining</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA: Mental Adjustment</td>
<td>Dynamic</td>
<td>Preparation for WST</td>
</tr>
<tr>
<td>SRC: Sagittal Rotation Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRC: Transversal Rotation Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LRC: Longitudinal Rotation Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRC: Combined Rotation Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MI: Mental Inversion/Upthurst</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIS: Balance in Stillness</td>
<td>Static</td>
<td></td>
</tr>
<tr>
<td>TG: Turbulent Gliding</td>
<td>Dynamic</td>
<td></td>
</tr>
<tr>
<td>SP: Simple Progression</td>
<td>Dynamic</td>
<td></td>
</tr>
<tr>
<td>BM: Basic Movement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In table 2, Halliwick specific elements to progress and vary an activity are described under the header “disengagement”.

Disengagement means that the therapist withdraws manual and visual support. At the end of every disengagement process, the client should be independent and skilful in that particular activity. Disengagement therefore, is an ongoing process in all of the ten points. Reduction of manual (and visual) support means that the balance difficulty of a particular activity is
constantly challenged in relation to the possibilities of the client. Challenging the performance of an activity not only means that an activity becomes more difficult, but also that the activity can be varied. This is the basis of open skill motor learning.

Challenging can also be done by using other principles than reducing manual support or eye contact. See Table 2 for “the tools” that the therapist can use as well.

Table 17.2. possibilities to vary and to progress

<table>
<thead>
<tr>
<th>Variable of an exercise</th>
<th>Easy</th>
<th>Variation or more difficult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water depth</td>
<td>Around Th11</td>
<td>More deep or more shallow</td>
</tr>
<tr>
<td>Basis of support (feet)</td>
<td>Wide</td>
<td>Unipedal</td>
</tr>
<tr>
<td>Support: poolside, therapist</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Attention</td>
<td>Focus on balance</td>
<td>Focus on environment</td>
</tr>
<tr>
<td>Visual control</td>
<td>With</td>
<td>Without (even eyes closed)</td>
</tr>
<tr>
<td>Kind of support</td>
<td>Full foot support</td>
<td>Partial foot support</td>
</tr>
<tr>
<td>Multiple tasks</td>
<td>Without</td>
<td>With</td>
</tr>
<tr>
<td>Disturbance: waves, turbulence, metacentric effects</td>
<td>Without</td>
<td>With</td>
</tr>
<tr>
<td>Velocity, acceleration</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Use of hands</td>
<td>With “swim” movements</td>
<td>Without “swim” movements</td>
</tr>
<tr>
<td>Use of arms</td>
<td>Arms wide (large radius / much inertia)</td>
<td>Arms close to the body</td>
</tr>
<tr>
<td>Direction, symmetry</td>
<td>Without rotational movements</td>
<td>With rotational movements</td>
</tr>
<tr>
<td>Rhythm</td>
<td>Steady</td>
<td>Changing</td>
</tr>
<tr>
<td>Repetitions</td>
<td>Few</td>
<td>Many</td>
</tr>
<tr>
<td>Range of Motion</td>
<td>Small</td>
<td>Large</td>
</tr>
</tbody>
</table>
Most WST techniques are based on the used of fluid mechanics.

### 3.1. WST and ICF

WST provides various treatment applications, from stabilizing a knee joint to competitive swimming. A way to give structure to these possibilities is to use the ICF (International Classification of Functioning, Disability and Health)

WST aims and objectives for any client should be related to particular domains. A strict difference between the Ten-Point-Programme and WST cannot be given. For example, therapy at the level of *body function* might be used to change a muscle tone function and therapy at the level of *(table 3)*. Maintaining e.g. a squat position could be used to influence muscle tone. Therefore from a therapeutic point of view, both systems in WST are complementary and do not have fixed sequences. WST has to be adapted to the needs of the patient

<table>
<thead>
<tr>
<th>Components</th>
<th>Included in the 10-Point-Programme</th>
<th>Included in WST</th>
</tr>
</thead>
<tbody>
<tr>
<td>b440: respiratory functions</td>
<td>All points, mainly MA</td>
<td>*</td>
</tr>
<tr>
<td>b710: mobility of joint functions</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b715: stability of joint functions</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b730: muscle power functions</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b735: muscle tone functions</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b740: muscle endurance functions</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Functions</td>
</tr>
<tr>
<td>------</td>
<td>-------------------------------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>b755</td>
<td>involuntary movement reaction functions</td>
<td></td>
</tr>
<tr>
<td>b760</td>
<td>control of voluntary movement functions</td>
<td>All ten points</td>
</tr>
<tr>
<td>b770</td>
<td>gait pattern functions</td>
<td></td>
</tr>
<tr>
<td>d410</td>
<td>changing basic body position</td>
<td>SRC, TRC, LRC, CRC</td>
</tr>
<tr>
<td>d415</td>
<td>maintaining a body position</td>
<td>MI, BIS, TG</td>
</tr>
<tr>
<td>d420</td>
<td>transferring oneself</td>
<td>Entries and exits</td>
</tr>
<tr>
<td>d430</td>
<td>lifting and carrying objects</td>
<td>MA, SRC, BIS</td>
</tr>
<tr>
<td>d435</td>
<td>moving objects with lower extremities</td>
<td>MA, LRC, BM and beyond</td>
</tr>
<tr>
<td>d440</td>
<td>fine hand use</td>
<td>Most of the ten points</td>
</tr>
<tr>
<td>d445</td>
<td>hand and arm use</td>
<td>Most of the ten points</td>
</tr>
<tr>
<td>d450</td>
<td>walking</td>
<td>MA, SRC</td>
</tr>
<tr>
<td>d455</td>
<td>moving around (d4554: swimming)</td>
<td>SP, BM, beyond point 10</td>
</tr>
<tr>
<td></td>
<td>also bicycling, jumping, somersaulting</td>
<td>MA, TRC</td>
</tr>
<tr>
<td>d465</td>
<td>moving around using equipment</td>
<td>MI and beyond point 10</td>
</tr>
<tr>
<td>d510</td>
<td>washing oneself</td>
<td>MA</td>
</tr>
<tr>
<td>d920</td>
<td>recreation and leisure</td>
<td>Beyond point 10</td>
</tr>
</tbody>
</table>
3.2. Function level

Specific applications of WST at the ICF function level will be discussed here. The most important applications will be reviewed, but understand that many additional applications exist.

3.2.1. Respiratory functions

Mastering breath control, especially exhalation, is of utmost importance. The client is instructed to “blow” whenever his or her mouth gets close to the water, so “blowing” becomes automatic when the mouth touches water. This prevents swallowing and choking. It also facilitates head control, as the head comes forward when one blows, reducing the risk of a loss of balance. The therapist may cue manually by bringing the head into good alignment and/or the cheeks into good position (Figure.2). Blowing, humming, singing and talking are variations of breath control. Rhythm is used to facilitate movement. Speed of singing or talking (rhymes) can be adapted to change velocity of movement in water.

Breathe, head and trunk control must be considered simultaneously (see Activity and Participation level: Introduction and Mental Adjustment)
3.2.2. Mobility of joint functions

Originally, WST was not designed as a mobilization concept. But the large rotational movements that occur, stress connective tissues (both the ground substance and the collagenous fibres) in its normal anatomical orientation. This can decrease the tissue stiffness and enhance tissue remodelling.

3.2.3 Stability of joint functions

Classically, the Ten-Point-Programme starts with supports at the upper extremities. This has led to the development of a series of exercises to enhance stability around joints, especially the scapular joint (Figure 3). In many stabilizing exercises, the point of fixation and the point of mobility are reversed. This gives the possibility to stabilize in another way than on land and can change the patient’s awareness of his body (Figures 4, 5, 6, 7, 8, 9).

Fig 4. Muscle power and stabilizing in Transversal Rotation Control
Fig 5. Mobilizing or stabilizing in Combined Rotation Control

Fig 6. Gait function stabilizing in Balance is Stillness

Fig 7. Single stand metacentric effects
Almost all WST activities require trunk stabilization activity. This is related to the notion that during swimming, the trunk must be stable enough to permit arms and legs to effectively propel. In the development phase of WST, a series of special exercises (based on the Ten-Point rotations and used during “Balance in Stillness”) were created that specifically address core stability (Figures 3,4,7,9). WST techniques are used intentionally and reactively, using
counterforce activity when working metacentrically or with turbulence. This also allows incorporating eccentric muscle activity in rhythmic stabilization-type exercises. When patients perform WST activities, abdominal activity is obvious. (Bae, 2005) showed increased dry land torque of the back extensors after WST transversal rotational exercises.

3.2.5. Muscle tone functions

The possibility to make large rotational movements in a gentle and continuous way, facilitated by buoyancy and homeostatic pressure effects, helps to normalize tone (Figures 5,111). This can be regarded as a prerequisite to allow normalized kinaesthetic information to the central nervous system, the basis of plastic adaptations. The effects on patients with tone dysregulation were amongst the first observations by McMillan in 1950. Anecdotally, the first group of swimmers showed better symmetry, better selective extension and better mouth functions on land.

Fig 10 Single stand turbulence
3.2.6. **Muscle endurance functions**

Muscle endurance can be addressed through prolonged activities (high repetitions with low resistance) like swimming or walking. Since most of the WST exercises do not really need high power, all activities can be repeated quite easily and muscle endurance can therefore be trained over the whole range of the Ten-Point-Programme.

3.2.7. **Involuntary movement reaction functions**

Physical properties of the water create instability, minimize the need for muscle power to facilitate a movement and slow the speed of positional changes. These characteristics are the prerequisites for intervention options to address equilibrium reactions, righting reactions and supporting reactions (Figures 5, 6, 7, 10, 12). Visual, vestibular and proprioceptive righting reactions can be exercised during all rotational points.

3.2.8. **Control of voluntary movement functions**

In ICF, this is a general term for coordination of any movement, including left-right coordination or eye-hand coordination. During all WST exercises and activities, patients need control of voluntary movements.
3.2.9. Gait pattern functions

Walking or running patterns and their impairments like asymmetric gait belong to this item. Walking in water differs from walking on land. Kinetic and kinematic parameters are different than land-based walking (Barela et.al., 2006) In the past this difference led to assumptions that shallow water walking cannot be used to prepare for walking on land. Clinical research has shown however, that patients are able to transfer elements of their gait pattern and increase land walking skills (Alexander et. al., 2001)

3.3. Activity level

While function refers to interventions directed at the system level, the activity level refers to interventions directed at the level of the whole person.

3.3.1. Changing body positions

In the WST, this domain is made operational through rotational activities.

3.3.1.1. Sagittal Rotation Control

Sagittal Rotations are movements around sagittal axes. These movements include lateral flexion of every part of the spine and abduction and adduction of the extremities. Sagittal rotation control is required for movements in place, as well as moving activities such as walking sideways and changing direction. Sagittal rotations are most functional in upright positions (Figures 8, 12), but also are seen in supine position as lateral flexion of the trunk in sea weeding activities, or in swimming a crawl stroke (in the latter as a compensation of insufficient longitudinal rotation control).
Unlike the other rotations, sagittal rotation is usually performed through a small range of motion. The main focus is on shifting the centre of gravity or shifting weight in the frontal plane. This can be done in any functional position, such as standing or sitting and normally includes a reaching action of an arm, a hand activity and looking at that hand.

Sagittal rotation can be used therapeutically to mobilize or stabilize the spine with lateral flexion movements, to lengthen the trunk, to facilitate optical righting reactions and equilibrium reactions (reaching out), to stimulate abduction of arms or legs; or to shift weight from left to right.

3.3.1.2. Transversal Rotation Control

Transversal rotations are movements around any transverse axis in the body. Transversal Rotational Control (TRC) can start with small movements, such as head anteroposition when blowing out, but become more functional when the client starts shifting the centre of gravity in a forward-backward direction, usually combined with reaching and a hand activity. Range of motion can be enlarged by adding longitudinal rotation to increase the reaching distance. (Figure 8). This is also a principle from disengagement. (see table 2)

Another application of TRC is sitting down or squatting into a “chair position” and reverse. In WST the client is cued to “sit in your chair with your hands on the table.” Standing up again is the second phase of this movement. Depending on water depth, during this activity the critical anatomical point of the eleventh thoracic vertebrae (T11) is immersed and comes above water again. In WST, T11 is used as a marker for the change from gravity dominant to buoyancy dominant equilibrium, with resulting effects on leg/foot control or head control, respectively. The chair position is the starting point for the important positional change from upright to supine and reverse. Supine is favoured for safety reasons, as the nose and mouth are
free of the water. Later, the prone position (a very stable position) is introduced as a challenge. Rolling out of prone is quite difficult.

In the supine position, the body behaves like a canoe. The main and fastest rotation takes place around the longitudinal axis. Loss of balance/midline symmetry, or even the feeling of loss of balance, may result in massive (pathological) equilibrium reactions, combined with increased extension and/or flexion of the spine. The reasons are obvious: fixed points between feet and floor have disappeared, normal visual input has changed, communication is more difficult (ears under water), fear of swallowing water arises, and the body rotates quickly around the longitudinal axis. Therefore, transversal rotation must be taught slowly, gradually increasing the client’s range of motion toward supine in small, manageable stages. It is equally important to teach the client how to stand up independently, as inability to achieve a stable vertical position is a major source of fear.

Cues for transverse rotation are: head forward, reach forward with the arms, catch an object above the water, blow out, tuck in head / hips/knees and try to sit on the floor of the pool.

In later stages the client should be able to stand up independently from prone and turn from prone to supine vice versa around a transverse axis. However, the pool side can be used as well to include activities as reaching, gripping and releasing the bar, pushing off from the side. Forward and backward somersaults would be the ultimate transversal rotational controls.

Therapeutically, transverse rotation is a kind of selective extension. All elements of this selective extension can be used therapeutically: positioning of the head on the trunk, alignment of the spine, extension of the dorsal spine, achieving appropriate scapular depression, controlling pelvic tilt, eccentric contraction of the abdominals, inhibition of associated reactions, and developing symmetry of movement (Figures 3, 4).
3.3.1.3. Longitudinal Rotation Control

Longitudinal Rotation takes place around the longitudinal axis or midline of the body. This rotation is most important in supine. Preparations can begin in upright positions like standing and passing an object in a circle of clients (shift the centre of gravity) or when turning around while walking. The first movements in a horizontal plane are symmetrical with a gradually decreasing radius (arms at the body, legs together). Support is provided preferably at the centre of balance (around S2). Balance control is focussed on (contra) rotational head activities of the client. Next, the client actively rotates by using the head in rotation and crossing the midline of the body with the arm and leg. Ultimately, the goal is to roll 360°, back to the supine position. Basically, this is a safety skill, as supine position is considered a safe position for breathing.

Each of these skills is taught separately, then all are executed together to accomplish the full rotational pattern. This analytical approach is necessary, because longitudinal rotation requires maximal disassociation between head, shoulder girdle and pelvic girdle, during a fast movement tWST also involves a breath skill.

The therapeutic application of longitudinal rotation is facilitation of the head-to-trunk righting reactions. The abdominals, which are active during this rotation, are important rotators; increasing their selective and stabilizing function is one of the major therapeutic objectives in longitudinal rotation, important for both swimming and walking. This rotation may also be used to reduce muscular tone of spastic trunk muscles, such as the quadratus lumborum and the latissimus dorsi muscles.

3.3.1.4. Combined Rotation Control

Combined rotation control includes both transversal and longitudinal rotations during a forward roll, and sagittal and longitudinal rotations during a sideways roll. (Figure 3-10)
Combined rotation might seem more difficult to accomplish than the individual rotation patterns, but actually is rather easy as it combines those previously mastered patterns. The goal is to roll out of trouble when one loses balance and end in a supine position.

In fact, all rotations in water have a combined character. Bodies move three-dimensionally requiring control in three dimensions. (Figures 3,5,11) Moreover, clients with impairments usually have asymmetric distributions of shape and/or density (specific gravity). This increases the need to teach combined rotation control by putting separate rotations together.

The most important therapeutic use of combined rotation is teaching clients how to fall and stand up again. Water allows one to “dare to make errors,” losing balance without the risk of pain or injury. Begin in deep water and work progressively to shallow.

3.3.2. Maintaining basic body positions

Body positions that can be maintained include supine or prone lying, squatting, sitting, kneeling, standing or gliding and applied in a variety of techniques outlined below.

3.3.2.1. Upthrust or Mental Inversion

Understanding the concept of upthrust - that one cannot sink, but always will rise to the surface again – is fundamental to comfort and safety in the water. Many people are afraid to submerge, or of being unable inhale air when they need to do so. With simple activities, a client can learn that the body will generally always float up to the top. When a client understands and can demonstrate this concept, he or she is considered to be waterfree. The client should learn to wait in different positions while floating up to the surface after a deliberate submersion. This can be done in any of the aforementioned positions.
This point concludes the first part of the Ten-Point-Programme that is focused on mental adjustment and rotational control. While this portion has important therapeutic potentials in itself, it is the foundation (pretraining) for the more advanced work of WST.

### 3.3.2.2. Balance in Stillness

Balance in stillness is the most static point in the Ten Point Programme, the point at which the client begins to perfect rotational control. The focus is on posture, equilibrium and stability in the mentioned positions. The client must react with motor activity of axial structures such as head and trunk. Compensations such as hand movements, widened base of support or muscle stiffening are not allowed. The therapist disturbs balance with manual turbulence around the swimmer, asking for metacentric effects or using a wave during step-stop activities. Because this is preparation for swimming, positions progress from upright to supine. In the supine position, the client might be supported, a departure from the disengagement the therapist maintains when the client is in other positions. The therapist uses counter-rotational muscular activation in any of the previous rotational controls to achieve stability in this point.

Balance in Stillness can be used therapeutically when stability (co-contraction, isometric activity) is needed. The most important regions to work on are the shoulder girdle, the trunk, the pelvic girdle and the hip region (Figures 3 till 10).

### 3.3.2.3. Turbulent Gliding

Turbulent Gliding is a “dynamic” follow up to Balance in Stillness. The client maintains static balance while being moved. The client is supine and controls all rotations (good alignment of the spine, hips extended, trunk symmetrical, with no lateral flexion or abductions). The therapist tows the client in a wake of turbulence, which challenges balance.
Therapeutic options are restricted and mainly focussed on facilitation of dynamic trunk control during this specific activity.

3.3.3. Transferring oneself

WST uses also variety of entries and exits, which is especially important when the client’s objectives are to participate independently in recreational aquatic activities. A full description falls outside the scope of this chapter. Further information on these techniques can be found in the Additional Resources listed at the end of the chapter.

3.3.4. Lifting and carrying objects

Lifting and carrying skills are used in many exercises and activities. When the patient needs to use the body function elements introduced in WST in a functional way, task specific activities are developed. Originally this was done when using games in the Ten-Point-Programme. Later obstacle course like activities in which lifting and carrying objects are integrated were developed. An example is shown in Figures 8 and 14. A specific way in which “objects” are carried is during group activities when patients are helping one another, such as the jumping activity. (The client lifts both feet to jump as a frog, supported by another client)
Fig 12. Obstacle course training of involuntary movement reactions

Fig 13. Moving around using equipment

Fig 14. Lifting and carrying objects, plus hand and arm use while negotiating obstacles
3.3.5. Moving objects with lower extremities

ICF specifically mentions kicking and pushing. Apart from the leg kick in various swimming strokes, legs are used in this way during bicycle games, push offs from the side for prone or supine glides and kicking or pushing objects on the bottom of the pool.

3.3.6. Fine hand use

Fine hand use is incorporated into activities such as working with plastic flutes when training breath control. Passing objects in Longitudinal Rotation Control, picking up objects from the pool during Mental Inversion or manipulating rings or a tray (Figures 8 and 14) are also examples of fine hand use.

3.3.7. Hand and arm use

Hand and arm work is used mainly in Mental Adjustment where manual supports are provided. Classically this would be the point to address the use of hands and arms during pushing, pulling, reaching, lifting of water or splashing. (Figures 3, 8, 12, 14, 15). Rotational control generally takes place in a “hands-free” fashion. After these points, when pretraining
has been achieved, use of hands and arms become important again when clients start to use equipment in a kind of task-type training approach.

Fig 16. Reaching with a metacentric effect

Fig 17. Hurdles of different heights cue various step characteristics

3.3.8. Walking

Relative to the ICF, walking is addressed only over relatively short distances. Water specific walking utilizes fluid mechanics. Three examples of using fluid mechanics during walking are:

1. using buoyancy: ask clients to lope (walk on the moon) and to softly catch weight when landing, a difficult task on dry land.
2. using the inertia of water (waves), ask clients to walk, then stop without loss of balance when the wave hits the body.

3. using drag: ask clients to walk like a soldier with extended legs and resist the reaction forces on the other leg. i.e. the hip of the stance leg must be held in extension.

Different surfaces or obstacles can be included in formal or informal obstacle courses. See the section of falls prevention for possibilities of the formal aquatic obstacle course.

Aquatic therapy allows clinicians to use various depths in order to control weight-bearing and to vary the ratio of lower extremity activity to head activity. Many clients automatically choose to walk in depths around their sternum. This obviously provides the best combination of gravity support and buoyancy support. When changing depth, focus can be given to more weight-bearing or to more flotation effects with consequent head reactions.

3.3.9. Moving around

This topic of the ICF includes all swimming techniques, but also jumping and bicycling as is done in Mental Adjustment. Moving around also means that the client learns the three-dimensional properties of water while somersaulting, cart wheeling or other movements. In the Ten-Point-Programme, two points belong to moving around: Simple Progression and the Basic Halliwick Movement. This will not be described in the framework of this chapter.

3.3.10. Moving around using equipment

The Ten-Point-Programme classically does not use any kind of equipment that offers additional stability, like neck collars or arm wings. For the more severely affected clients however, a flotation device might be the only way to move independently. Being able to use custom made equipment, therefore, is a skill that can be included in WST. Floating
equipment like noodles or kickboards can be used to increase the difficulty of a balancing activity when the client sits or stands on it. This is consistent with the use of metacentric effects and fits with the ideas of WST.

Also, other kinds of aquatic equipment like fins, masks, snorkels, scuba or a wetbelt can be a functional extension of balancing skills in or under water and is related to the participation level of the ICF (aquatic fitness clubs, recreation, vacation)

3.4. Participation level

McMillan started Halliwick with the idea to integrate the girls of the Halliwick School with the local population. Quickly, some of the girls learned to be independent in the pool and gained the ability to swim. This was the start of swimming clubs (the first one was the Halliwick Penguin Swimming Club in 1951). The goal was to provide swimming possibilities for people with disabilities. In other countries like the Netherlands, Finland and Germany, Halliwick is integrated in swimming clubs of Associations of Sports for People with Special Needs or clubs of the Life Saving Association.

4. Research

4.1. Evidence Based Practice

The implementation of research is the effect of what currently is known as Evidence Based Practice. As for every concept in physiotherapy or aquatic therapy, the amount of patient related research of moderate to high quality, also in WST still is limited, but growing. In recent years some studies on the effectiveness have been published however.
4.2. WST and the Halliwick Concept: some recent studies

Bae (2005) looked at the effect of aquatic therapy on improvement of balance in stroke patients: 26 persons with a subacute stroke were given a hydrotherapy programme, based on WST. There was no control group involved. The measurements were done with the Berg Balance Scale, with a clinical relevant increase of 6 points. The author concluded that aquatic therapy should be an effective treatment to improve the recovery of balance control, symmetrical posture, strength of the trunk muscle and arm reach function through the improvement of trunk stability.

The effect of aquatic therapy on balance and weight-bearing ability in people with chronic stroke was assessed by Noh (2008). The purpose of this study was to compare the effect of a combination of Halliwick and Ai Chi with dry gym exercises on balance. This randomized clinical trial had a relative small total sample size (n = 17), but was nicely designed and could easily be repeated. Balance was measured with the Berg Balance Scale. The Halliwick / Ai Chi group showed significant improvements in comparison with the dry gym group. The author concluded that Halliwick with Ai Chi may be effective in promoting balance and weight-bearing ability on people with stroke.

Getz (2006-a, 2006-b) wrote a dissertation, called: Aquatic Intervention in Children with Neuro-Motor Impairments. She addressed the influence of aquatic interventions (Halliwick) on motor performance in a functional context on land. Emphasis should be placed on water orientation skills like breath control, walking across the pool, entering, exiting and other skills that ensure habituation to water. These skills represent daily activities in a different environmental context (according to
the ICF and the dynamic systems model of motor learning). The aquatic intervention resulted in an increase in cardiovascular endurance and mobility skills performed on land as demonstrated in the PEDI (Pediatric Evaluation of Disability Inventory) mobility domain. There were satisfying correlations between the PEDI /GMFM (Gross Motor Function Measurement) and the AIM water orientation test, more recently also shown for the WOTA. This means that a relation exists indeed between certain domains of motor development in water and on land. Getz also found that the advantages of Halliwick especially showed up in the more severely disabled children (GMFMCS).

5. Clinical applications and clinical reasoning

5.1. Case: an adult with multiple sclerosis

Mr. Cools is sent by the neurologist in order to see if a movement programme in water can relieve his problem. The neurologist is advisor of the Multiple Sclerosis International Foundation, which advocates aquatic therapy at their website (http://www.msif.org). Mr. Cools is 45 years of age and the medical diagnosis is multiple sclerosis, which started 7 years ago. It is the secondary chronic progressive subtype. His rating on the Expanded Disability Status Scale (EDSS) = 4.5/10.

The Patient Identified Problems (PIP's) are:

Mr. Cools walks without an assistive device in his house, but uses a cane outside. His walking distance before he has to rest is 150 meter. He has slight spasticity, mostly in his lower extremities. He is afraid to fall and prevents to go to crowded places like the market to buy his groceries for the week. He also tells that he has difficulties to reach and maintain balance.
when performing his hobbies: painting and cooking.

He is also quickly fatigued and out of breathe. He attributes this not only to the MS, but mainly to his lack of movement..

He is software developer and works at home. He isn’t married. He feels lonely from time to time, but 2 times per week he is meeting a small group of neighbors to participate in their cooking club. He orders materials for his painting online because it is too tiring to take public traffic to the paint materials shop that he favors, he has no car and can only afford a taxi once in a while

Mr. Cools has a somewhat blurred vision, but minimal disability in bladder and sensory functions (e.g. no thermo sensitivity).

Mr. Cools could swim moderately, but that has been some years ago. It is not his sport, he says. He is a bit apprehensive to go into a pool again.

His goals are to:

- walk safer, faster and longer distances
- better balance during painting and cooking
- “get more breath”
- decrease his fatigue

In order to quantify his statements and make them also more objective, various measurement instruments are used.

At first his specific goals are asked by means of the Patient Specific Functional Outcome scale that ask to list 2 or 3 important activities of daily living that are (still) difficult to perform and rate that difficulty (0 = unable to perform and 10 = no problems). In his case:

- walk over the Saturday market  4/10
- take public traffic to the paint shop 2/10
- painting concentrated and standing for at least 10 minutes while balancing well enough
to have a stable hand for painting or cutting 3/10

Clinimetrics at the ICF level of function show:

- Modified Ashworth Scale legs: 4/12 (mostly in both adductors)
- Spirometry: vital capacity is 3000 cc (norm value is 4800 cc)
- MRC: strength in the legs in general is 4/5, only the anterior tibs le/ri: 3/5

Clinimetrics at activity level:

- Timed Up and GO (TUG) = 14 seconds. Normal would be < 10 seconds
- 6 min walk test: 190 m with a heart rate of 135 (less than 82% of the norm value, which 480 meter).
- 10 m walk test: comfortable = 17 sec (2.1 km/h), fast = 13 sec (2.8 km/h)
- Berg Balance Scale (BBS) = 45/56 (cut-off fall risk = 48). He scores low mainly at numbers 8,9,12,13 and 14 (reaching forward with outstretched arm, retrieving object from floor, placing alternate foot on stool, standing with 1 foot in front, standing on 1 foot)
- Fatigue Scale of Motor and Cognitive Functions (FSMC): the motor subscale shows 4/10/ which is under the cut-off score of neurological fatigue
- Beck Depression Inventory shows mild depressive signs (15/63)

Facilitators:

- Mr. Cools is friendly, sociable and understands his disease
- Mr. Cools used to smoke, but has stopped. He also intends to take care of his overweight.

Barriers:

- Mr. Cools works mainly from his desktop work at home
- Mr. Cools uses anti-depressants
There are no aquatic red flags. He is not thermosensitive and, according to the doctor, no cardiac malfunctioning.

**Mr Cools – RPS form**

<table>
<thead>
<tr>
<th>According to patient</th>
<th>According to therapist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor spasticity</td>
<td>EDSS 4/10</td>
</tr>
<tr>
<td>Lonely</td>
<td>MAS-legs 4/12</td>
</tr>
<tr>
<td>Weakness of leg muscles</td>
<td>FSmC 4/10</td>
</tr>
<tr>
<td>Tired and out of breath quickly</td>
<td>MRC LE 4/5, tibialis anterior 3/5</td>
</tr>
<tr>
<td></td>
<td>Low condition ..........</td>
</tr>
<tr>
<td></td>
<td>Lung capacity PVC 3000 (61.5% of predicted)</td>
</tr>
</tbody>
</table>

**Functions and anatomical characteristics**

- Walking distance less
- Walking speed less
- Balance impaired

**Activity**

- 6MWT: 190 m (HR 135)
- 10mWVT: 17 sec (comf)
- BBS 45/56
- TUG 14 sec

**Participation**

- Not going to market and to the paint shop

**Personal factors**

- Gentle, approachable, understands disease
- Stopped smoking
- Anti-depressants

**Environmental factors**

- Sitting job PC

Figure 18RPS form

We conclude that Mr Cools has problems with self initiated static and dynamic balance, as well as slow walking velocity, which is (partly) related to a decrease in lower extremity strength, spasticity and limited cardiovascular capacity.

The treatment objectives can be related to the following ICF categories:

B730 muscle power functions

B735 muscle tone functions
B455 exercise tolerance
D415 maintaining a body position
D450 walking
D469 moving around in different locations

This case will be limited to an intervention that focuses on static and dynamic balance and therefore will not address an intervention that focuses on increasing his aerobic capacity.

In order to find external evidence to support (or reject) the choice to start with aquatic therapy, a literature search can be done. Because of time constraints, the search only has been done in PubMed with the keywords ‘Multiple Sclerosis, Aquatic Therapy, Aquatic exercise, Hydrotherapy’ in order to answer the PICOT question related to the goal of the intervention: Increase control over self-initiated balance perturbations in stance according to the deficits in the BERG assessment and his specific problem while painting and cooking. Only articles from about 2005 to be included.

(PICOT means: Patient, Intervention, Comparison, Outcome, Time)
P: an adult with MS
I: movement programme in water
C: therapy on land
O: increase balance parameters
T: 6 weeks
PubMed shows 4 group studies, which also have moderate to good quality (Salem, 2010; Castro, 2012; Marandi, 2012; Bayraktar, 2013). Castro only measured pain, but the other authors measured static and/or dynamic balance during posture and gait with various instruments and claimed to have statistical and clinical significant results.

Key elements of their programmes were walking, weight shifting and reaching in all directions (Salem, 2010), walking and balancing without specifications (Marandi, 2013), weight shifting and reaching in all directions using Ai Chi (Bayraktar, 2013).

Mr Cools could fit in the patient’s profile of those in Salem’ study and, together with the information from the other articles, it is decided that Mr Cools could also benefit from an aquatic programme. The programmes also show enough elements to justify use of exercises and activities from WST.

The first session starts with assessing his water skills and you find that the WOTA (Water Orientation Test Alyn) scores 47 points out of 81. The problems like exhaling with the nose, standing up alone, performing a longitudinal rotation and floating in supine were exercised (although quality isn’t optimal) and Mr. Cools apprehension decreased.

You decide to start with the therapeutic intervention at the second session in which muscle power of the foot dorsal flexors, muscle tone of the adductors, static and dynamic stability in stance and gait training will be included. Gait training is focused on reacting to unexpected perturbations, as will be explained in the table.
<table>
<thead>
<tr>
<th><strong>SMART Goals</strong></th>
<th>Characteristics of WST exercises and/or activities</th>
<th>Rationale</th>
<th>Disengagement / progression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase power of the foot dorsal flexors</td>
<td>Transversal rotation with fix points at the feet: figures 4 and 5. Walking with fins: figure 13</td>
<td>Flexion activities of e.g. head and arms facilitate dorsal flexion when given a fix point. Walk with fins stimulates dorsal flexion because of the enlarged surface</td>
<td>Increase contraction time and speed. Increase metacentric effects. Faster dorsal flexion, larger fins, “cross country ski” and keep fins clear of the bottom</td>
</tr>
<tr>
<td>Decrease tonus of the leg adductors</td>
<td>Large, smooth rotations in standing with continuous changes of the COG Figure 11</td>
<td>Slow rhythmic movements with gentle adductor stretch will reduce spasticity</td>
<td>No progression, Mr Cools should find the good rhythm and rate the relaxation</td>
</tr>
<tr>
<td>Increase balance during standing with a narrow base</td>
<td>Stand with feet together or tandem or on 1 foot with use of turbulence and metacentric effects Fig 6 and 7</td>
<td>Mr Cools shows narrow base problems during the BBS. In this position, postural supporting activity is facilitated</td>
<td>Decrease supporting surface Increase time of balancing Add e.g. metacentric effects</td>
</tr>
<tr>
<td>Increase functional reach in various directions</td>
<td>Change the COG in all rotations while standing and going to the limits of reach, figure 16</td>
<td>Large movements in all directions without the fear of falling regulate the control of the COG</td>
<td>Increase ROM Increase time in the end position Add metacentric effects</td>
</tr>
<tr>
<td>Train walking with unexpected perturbations</td>
<td>Walking (with turbulence by the therapist) when using obstacles Fig 13, 14, 17</td>
<td>Mr Cools has to adjust posture, speed and more when walking at the market which partly is unexpected</td>
<td>Change turbulence: faster, unexpected, closer, anatomical position. Move the obstacles and include multi tasking</td>
</tr>
</tbody>
</table>

The exercises and activities will follow the rules of physiology and motor learning when applicable. Force is trained at about 70% of the 1 Repetition Maximum: after about 10 repetitions, signs of local fatigue should show. A series of repetitions is done 3 times.

Each balance and walking exercise is repeated for 1 to 2 minutes. Many variations are possible, but about 3 variations for one “theme” (like SRC, TRC) could randomly be mixed.
A 30 minute session could include 15% of tonus decrease, 15% of strengthening, 60% of balance and walking and 10% of rest in order to adhere to the concept of distributed practice (Vearrier, 2005) Mr. Cools would be invited to attend 2 times per week for 3 months.

After 3 months, clinical important effects should have been reached. The Minimal Clinical Important Improvement (MCII) and the Minimal Detectable Change (MDC) have been established for several of the used measurements (not in M.S., but other neurological diseases, see Rehabmeasures, 2014). This means that (apart from a 2 point change at minimum on the Patient Specific Functional Outcome scale, also these changes should be expected:

- TUG from 14 to 10 seconds or less (MDC)
- BBS from 45 to 51 or more (MCII)
- 6 MWT from 190 to 240 or more (MCII)
- 10 meter walk from 17 to 15 or less (MCII)
- Modified Ashworth from 4 to 3 or less (MDC)

Other elements that could be included are Clinical Ai Chi, which will be explained in another document

6. References


Alexander MJL., Butcher JE, MacDonald PM. Effect of a water exercise program on walking gait, flexibility, strength, self-reported disability and other psycho-social measures of older individuals with arthritis. *Physiotherapy Canada*, 2001:203-211.


Rehab Measures: Rehabilitation Measures Database,


Additional resources

The Halliwick Concept :


Obstacle course: www.ewac.nl