



Obstacle course in water

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Fall prevention is an important topic for the geriatric population as well as for patients with neurological, rheumatic or orthopaedic conditions. One approach to train strategies and mechanisms for fall reduction is the obstacle course.

An obstacle course first was described in literature by K. Means in 1996 and more recently by H. Rijken in 2004. These courses mimic obstacles that one meets in daily living situations, both inside and outside. They also can include cognitive challenges at the same time, like carrying a tray with glasses, listening to a story and memorize the amount that a specific word is mentioned etc.

An obstacle course in water tries to follow the abovementioned idea. The pool offers restrictions (it's not a real daily living situation), but also offers advantages. The pool is a safe exercise environment and loss of balance does not result in falling that easily. Patients therefore are more ready to increase range of motion, to reduce the use of the hands etc, Literature has shown that indeed training of balance during stance and walking in a pool increases balance and walking variables on dry land as well.

- The theoretical background and references to literature has been described in a separate paper.

When designing exercises to prevent falling, two themes are important:

- being able to keep a standing position during activities of daily live
- being able to ambulate

The International Classification of Functioning, Disability and Health (WHO, 2001) describes the following categories, related to fall prevention, in the chapter Mobility.

- shifting the body's centre of gravity (d 4106)
- maintaining a standing position, irrespective of surface (d 4154)
- pushing and kicking with 1 leg (d 4350 and 4351), thus standing on 1 leg
- walking (d450), like strolling, sauntering, walking forwards / backwards / sideways, subdivided in e.g.
 - o walking on different surfaces (d 4502)
 - o walking around obstacles (d 4503)
- running (d 4552)
- jumping (d 4553)
- moving around with equipment (d 465), e.g. walking (carrying objects)

Some activities related to balance have quantified norm values that can be used as well in the pool as a kind of target or guideline. The Berg Balance Scale gives the following values as normal (maximal rating of 4 points):

Standing with eyes closed	10 seconds safely
Standing with feet together	1 minute, feet together safely
Reaching forward with outstretched arm	> 25 cm confidently
Turning 360 degrees	in 4 seconds or less
Placing alternate foot on stool	complete 8 steps in 20 seconds
Standing with one foot in front	place foot tandem and hold 30 seconds
Standing on one foot	lift leg independently and hold >10 seconds

Exercising balance should also follow the balance strategies that are described in literature:

1. Intentional movements: related to balance, the following categories are described: :
 - a. Initiate or stop a movement
 - b. Maintain weight-bearing during any kind of task
 - c. Move towards the limits of reaching with clear eccentric muscular activity
 - d. Stand on one foot (unipedal stance)
2. Non-intentional movements: related to balance, the following mechanisms are described:
 - a. Reactive or corrective strategies, back-up for unexpected balance loss
 - i. Ankle strategy: corrections mainly with the muscles around the ankles
 - ii. Hip strategy: corrections with hip flexion or -extension



- iii. Insecurity strategy: the "careful" position with flexed hips and knees
- iv. Stumble
 - 1. Forward
 - a. Suspension strategy: "stumble leg" is placed forward
 - b. Stepping strategy: other leg is placed forward
 - 2. Backward
 - 3. Sideways, with leg abduction or legs crossing
 - 4. Step and reach strategy
- b. Predictive or preparatory strategies. These are static mechanisms when disturbances are expected while keeping a position:
 - i. Increase of basis is support
 - ii. Stiffening joints
- c. Contra-weight strategies. These are dynamic equilibrium reactions that accompany the anticipated perturbations of intentional movements as in 1.

Always, intentional movements and non-intentional strategies will be used together. As an example: a contra-weight strategy accompanies a reaching movement, also using a hip strategy. Balance is lost and a forward stepping strategy is used to correct.

Balance loss in general is not expected; therefore unexpected elements should be included in a fall prevention programme as well. The easiest possibility is to have clients work in pairs, and they have to react to each other. As an example: throwing a ball to each other: different heights, sides, angles etc. Standing on a wobble board makes that activity even more difficult.

Every exercise should progress in difficulty. There is a wide array of options:

Variable of an exercise	Easy	More difficult
Water depth	Deep	Shallow
Basis of support (feet)	Wide	Unipedal
Support: poolside, therapist	Yes	No
Attention	Focus on balance	Focus on environment
Visual control	With	Without (even eyes closed)
Kind of support	Full foot support	Partial foot support
Multiple tasks	Without	With
Disturbance: waves, turbulence, metacentric effects	Without	With
Velocity, acceleration	Low	High
Use of arms	With "swim" movements	Without "swim" movements
Use of arms	Arms wide (large inertia)	Arms close to the body
Direction, symmetry	Without rotational movements	With rotational movements
Rhythm	Steady	Changing
Repetitions	Few	Many
Range of Motion	Small	Large
Leverage and frontal plane	Short and small	Long and large

Obstacles can be used to avoid (step over) them or to walk / stand on them

Balance beam

1. walk on the balance beam
 - a. wide position, narrow position, straight, in a rectangle, combined wide and narrow positions, different depths. Possibilities:
 - b. walk forward, backward: small steps and going to strides, tiptoes, heels, lift knees, swing leg straight to next stance, bring heel to buttock first, increase stance time, close eyes and feel the beam, hands on head, carry an object or push a ball under water, little jumps, change direction, like a soldier, like a stork, dribble, walk on hot sand, slope up/down
 - c. walk sideways, without or with crossing the legs
 - d. stand: throw or push objects, move arms through water, look around shoulder, change base of the feet till standing on 1 leg, close eyes, feet in front or next to each other, reaching activities, pelvic movements, belly dance, Bavarian dance, Russian dance
 - e. walk on the floor and step over the beams: left to right, with crossing the legs, forward / backward, jump over the beams,



1 & 2: swing one leg forward and backward



3 & 4: swing one leg diagonally



5 & 6: cross steps



7 & 8: walk over the beam, with double task



9 & 10: stand: catch an object, turn and reach for the pole



Wobble board

2. Stand on the wobble board
 - a. Sideways shift; skiing, samba
 - b. Forward / backward shift: Possibilities
 - i. Small – large shifts of weight like rocking horse
 - ii. Combined movements like belly dance
 - iii. Expected – unexpected to facilitate corrective strategies
 - iv. Different bases, to single leg stance, eyes closed, double tasks, arm movements for balance or reaching, supported / unsupported (bar, therapist)
 - c. Ai Chi movements



11 & 12: shift sideways



13 & 14: swing arms sideways and keep balance



15 & 16: react to unexpected movements: stumble sideways





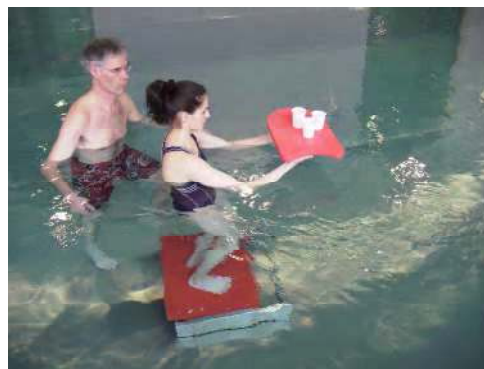
17 & 18: react with a hip strategy to unexpected movements



19 & 20: voluntary shift forward - backward



21 & 22: stance variations during unexpected movements



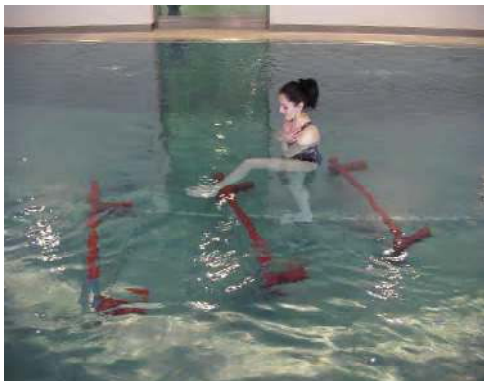
23 & 24: reactive strategies with a double task

Hurdles

3. Walk over hurdles
 - a. Different heights and inclinations, different distances
 - b. Combinations with the balance beam. Possibilities:
 - c. Step over hurdle(s): forward, backward, sideways, legs crossing
 - d. Step over 2 or 3 hurdles at the same time
 - e. Rocking horse
 - f. Jumping, loping (walk like on the moon)



25 & 26: jump from left to right



27 & 28: strides over hurdles of different heights



29 & 30: cross steps or cross jumps





31: stumble strategy forward



32: manual turbulence



33 & 34: cross steps with double task



35 & 36: combining elements



Reaching pole

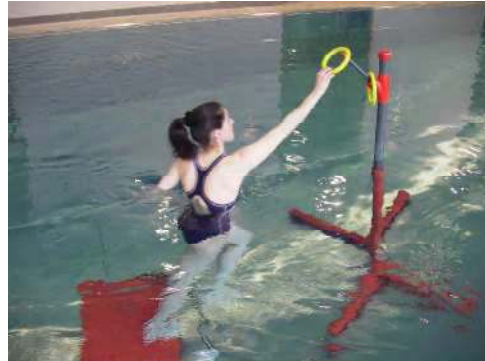
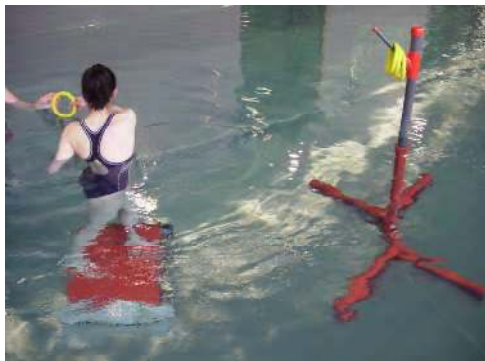
4. Reach

Important is to stimulate the client to reach as far as possible and find the (comfortable and safe) limits of reaching.

- a. Hang rings on / pick rings off the hook. Possibilities:
- b. Change distance from the pole, change the height of the pole
- c. Throw
- d. Change hands
- e. Different stance positions
- f. Combine with balance beam or wobble board



37 & 38: catch, turn, reach and control the wobble board



39 & 40: reach and step forward



41: reach and balance

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Literature

Means KM. The obstacle course: a tool for the assessment of functional balance and mobility in the elderly. *Journal of Rehabilitation Research and Development*, 1996, 33, 413-428.

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