SWIMMING FOR PEOPLE WITH NMD

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Importance

- Swimming and other kinds of water exercise are highly suitable forms of recreation for people with any type of physical disability. The physical properties of water facilitate movement and for some people water represents the only environment where they can move independently.

Importance

PHYSICAL HEALTH

- Physical fitness
- Physiological functioning (internal organs)
- Sensory inflow
- Condition

MENTAL HEALTH

- Self-confidence
- Self-reliance
- Self-esteem
- Sense of autonomy – freedom
- Courage
- Will power
- Perseverance

Mental Health

Both bodies are beautiful!

Water - the physical properties

- Buoyancy
- Water resistance
- The hydrostatic pressure
- Thermoregulation

The force of buoyancy

Archimedes' law: $F_b = m\,g = \rho\,g\,V$

m = mass of displaced liquid
g = acceleration due to gravity
ρ = density of the fluid
V = volume of displaced liquid

- Body weight, immersed in a still fluid, is apparently (virtually) decreased by weight of the displaced liquid.
- The force of buoyancy is equal to the weight of displaced liquid.

Buoyancy

- Buoyancy of the body in a liquid depends on the density of the liquid and the average density of the body. If the density of the body is lower than the density of the liquid, the body floats, otherwise it sinks.

- When the swimmer inhales, his volume increases at practically unchanged mass of the body, this reduces the density of his body and helps keep him afloat.

- The density of a healthy person's feet is higher than the density of their upper body and consequently the feet sink.

- The density of the feet of persons with NMD due to muscle atrophy is usually lower than that of their upper body and consequently the feet float.

The force of buoyancy - effect on the musculature and skeleton

- The force of buoyancy unloads a certain portion of the body weight relative to the proportion of the body submerged in water, thus relieving the musculoskeletal system. The load on the bones, joints and their components is thus substantially lower.

- We are therefore able to perform many movements in water we are otherwise unable to perform on land, we can perform them on a larger scale and also with less pain than on land.

Water resistance

- We can also perform exercises against water resistance to strengthen the muscles.

The hydrostatic pressure

Hydrostatic pressure is the pressure in the stagnant fluid due to its own weight. The pressure increases directly proportional to the depth of water.

$$p = p_{\circ} + \rho g h$$

p = hydrostatic pressure
$p_{\circ}$ = air pressure
ρ = density of the fluid
g = acceleration due to gravity
h = depth of water

The hydrostatic pressure

- In a person of average height standing up to the neck in water, the hydrostatic pressure in the middle of the calves is 120 g/cm2, on the chest wall 30 g/cm2 and on the abdominal wall 40 g/cm2.

- Hydrostatic pressure pushes - pumps about 700 ml of blood from the lower limbs and the abdomen into the chest.

The hydrostatic pressure

- Effects on the cardiovascular system - heart rate
- Effects on the cardiovascular system - blood pressure
- Effects on the respiratory system
- Effects on the kidneys

Effects on the cardiovascular system - heart rate

- The hydrostatic pressure pumps the blood from the periphery towards the heart.
- Increase of the inflow of blood to the heart and increase of the pulse volume (by about one third).
- Complex reflex mechanisms (baroreceptive and others) **reduce the heart rate.**
- The heart rate is lower while exercising in water than on land (the same intensity and temperature).

Effects on the cardiovascular system - blood pressure

- **The increase of blood pressure in cold water** (peripheral vasoconstriction increases the blood flow to the heart and further increasing stroke volume, which consequently increases arterial blood pressure).

- **The decrease of blood pressure in warm water** (peripheral vasodilation increases peripheral blood circulation, resulting in a drop in blood pressure and an increase in the heart rate).

Effects on the respiratory system

- The influx of about 700 ml of blood into the chest reduces expansion of the thoracic cage and **reduces the vital capacity (VC) by 5 - 10%**.
- **Caution -** the decrease of VC for 10% could be critical in patients with severe respiratory insufficiency (feel shortness of breath or start suffocating).
- Expansion of the thoracic cage against the hydrostatic pressure strengthen the respiratory muscles and maintaining the elasticity and flexibility of the chest.

Effects on the kidneys

- **Increase of the volume of the circulating blood** (the hydrostatic pressure on the periphery pushes the fluid from the tissues into the blood vessels).
- **The release of the hormone called natriuretic peptide**, directing the kidneys to excrete more salt and water.
- **The decrease of some other hormones** (the anti-diuretic hormone, aldosterone) which prevent water loss from the body, is reduced.
- ***The result of all these changes is a greater excretion of salt and water from the body.***

Thermoregulation

Thermoregulation is the maintenance of internal body temperature (core body temperature) **within very narrow limits**. The mechanisms of thermoregulation ensure that the body's production of heat is equal to its loss. Thermoregulation is controlled by the centre in the brain (hypothalamus) with receptors in the skin.

MECHANISMS

- Conduction is the transfer of heat to another object through direct contact.
- Convection is heat transfer by the movement of medium surrounding the body.
- Evaporation is the vaporization through the skin; breathing.
- Radiation is radiation of electromagnetic waves (infrared spectrum).

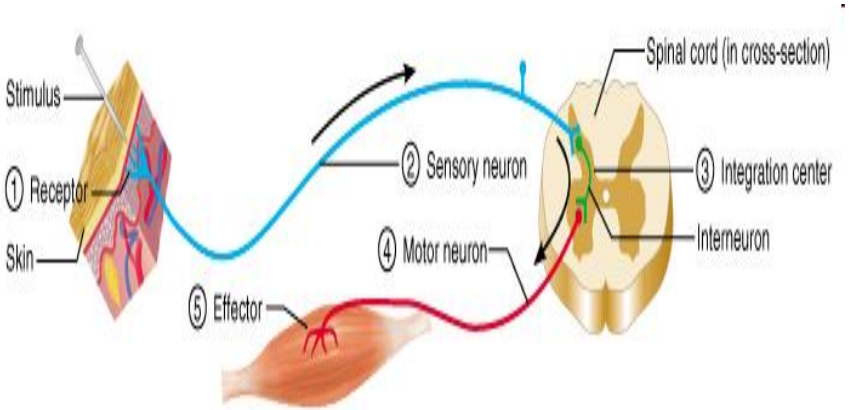
Thermoregulation

- **The risk of overheating the body in warmer water** (on land, most of the heat, when air temperature equals or exceeds 35° C, is lost from the entire surface of the body through perspiration, while in water it is only drained from the parts not submerged in water).

- **The risk of cooling of the body in cold water** (the body cools 4 times faster in water than in air of the same temperature; cooling in water is accelerated if the body is not moving, and therefore not producing any energy).

- **Shivering and vasoconstriction in cold water to retain body heat.**

Sensory inflow



- Especially in wheelchair-bound persons, certain parts of the body such as the buttocks, thighs and the back are constantly subjected to pressure. These areas are also deprived of various stimuli.
- Movement in water provides an important relief of these constantly burdened parts of the body and a very significant experience of different stimuli in these areas.

Swimming and exercising in water

It is recommended during any period of the year and day. It is important to exercise regularly and diversity. There are also some limitations.

Absolute contraindications

- Acute bleeding
- Acute diarrhea / vomiting
- Unstable state (3 months) after recovery CVI, DVT, PE, status asthmaticus)
- Proven sensitivity to chlorine
- Angina pectoris at rest
- Dyspnoea at rest
- Paroxysmal nocturnal dyspnoea (cardiomyopathy)
- Proven aneurysm
- Acute episode of fever, shivers
- Advanced renal failure

Relative contraindications

- Cancer
- Status after radiotherapy (irradiated skin)
- TBC
- Open infected wounds
- Poorly controlled epilepsy
- Unstable diabetes (hypoglycaemic attacks)
- Tachycardia
- Hypothyroidism
- Inflammation (bursitis, tendinitis, arthritis)

Caution

- Behavioral problems
- Controlled epilepsy
- Fear of water
- Large obesity
- Haemophilia
- Hypo / hypertension
- Impaired vision, hearing, feeling (contact lenses, hearing aids)
- Incontinence of urine and stool
- Stoma (traheo, gastro, etc.)
- Skin ulceration
- Pregnancy (in water above 35°C)
- MRSA
- Sexually transmitted diseases (HIV, AIDS, Herpes)
- Kidney disease
- Fungal / viral infection of legs
- Possible sensitivity to chlorine

THE ROLE OF THE ASSISTANT IN SWIMMING – SAFETY OF THE PATIENT

- **The assistant must have a good knowledge of the very limited physical abilities of people with NMD**, not only of the characteristics involved in swimming, but also of the ways and methods of entering and exiting the pool, adjustment to water, and assumption and maintenance of specific body positions in water.

- **The assistant should only provide as much help** as absolutely necessary while at the same time making the maximum use of the characteristics of water.

- **The assistant must provide assistance as soon as it is needed**, which is why the two must work together to establish a clear method of communication and trust.

- **Good cooperation and communication between the patient and the assistant is most important.**

PREPARATION FOR SWIMMING

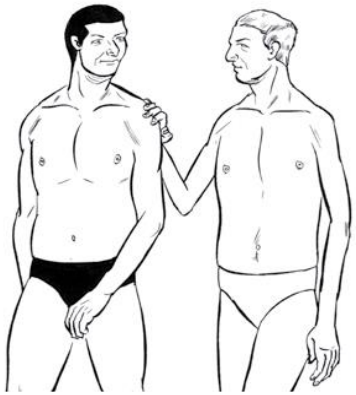
- Psychological preparation - overcoming the fear of water

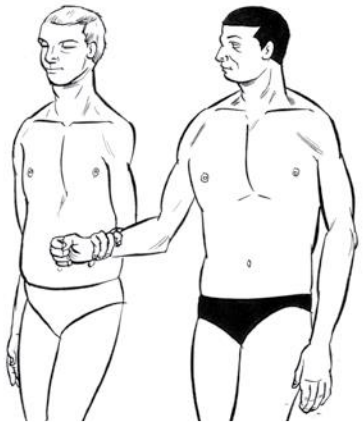
- Physical preparation
  - Breathing - practising breathing on land and in water
  - Balance

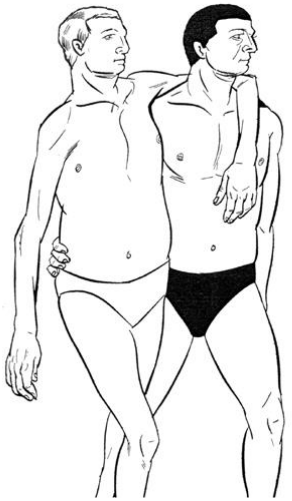
WAYS OF HELPING TO ENTER AND EXIT OF WATER

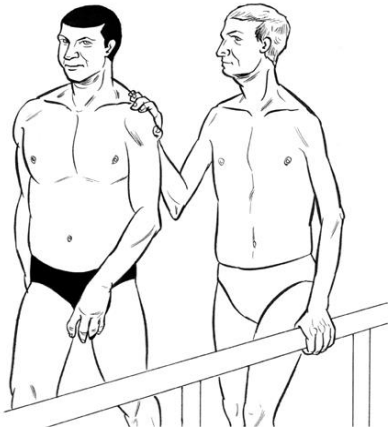
ENTERING THE WATER

Help by walking



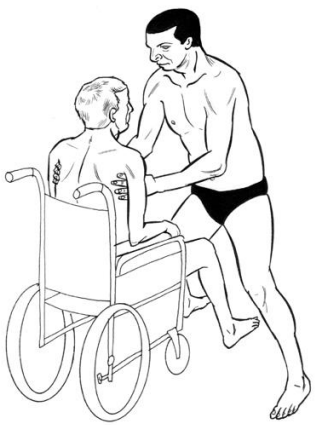






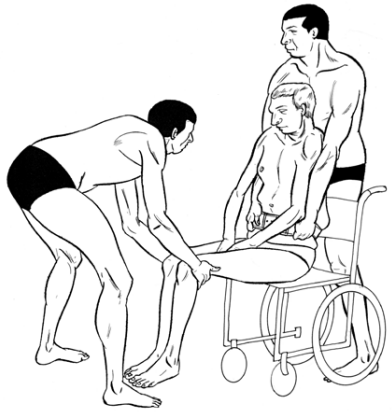
ENTERING THE WATER

Transferring the patient from his wheelchair



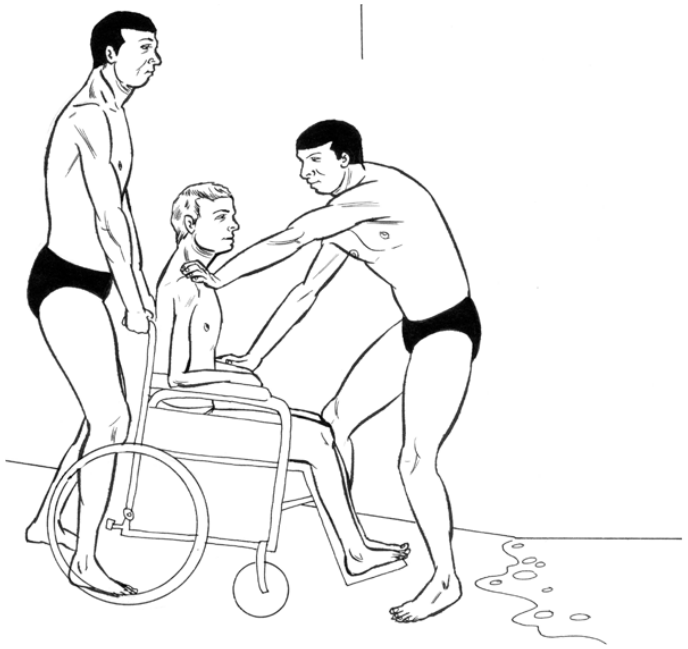






ENTERING THE WATER

Using a wheelchair ramp

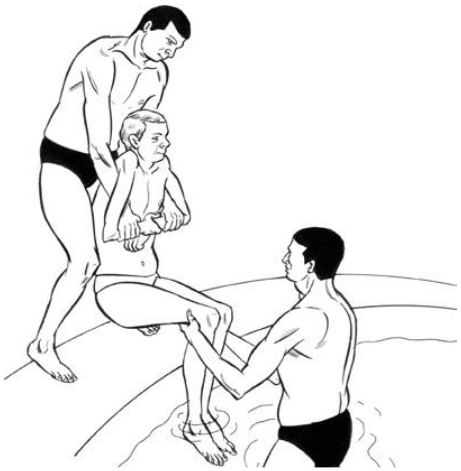


ENTERING THE WATER

Carrying the patient into the water

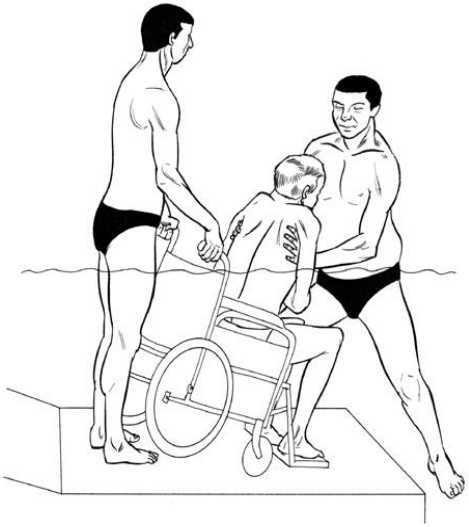
ENTERING THE WATER

Transferring the patient into water from the edge of the pool or using a lift



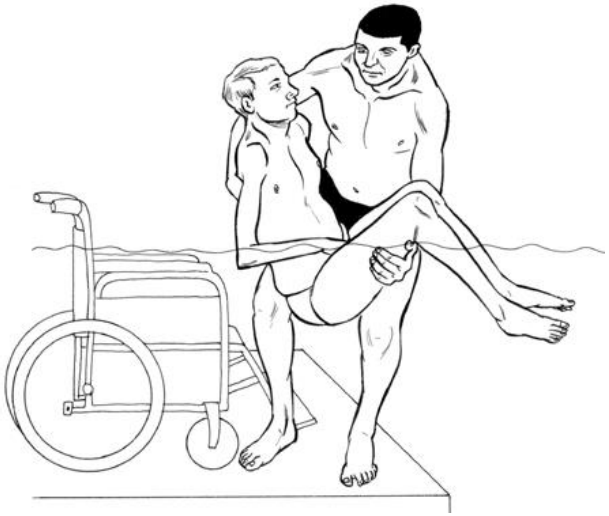
ENTERING THE WATER

Transferring the patient into water from a wheelchair



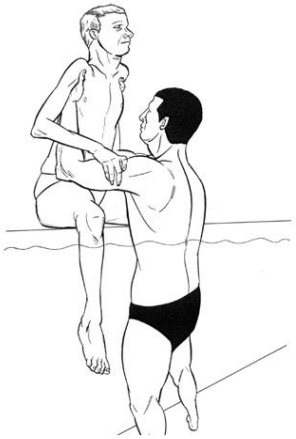
PLACING THE PATIENT INTO THE WATER

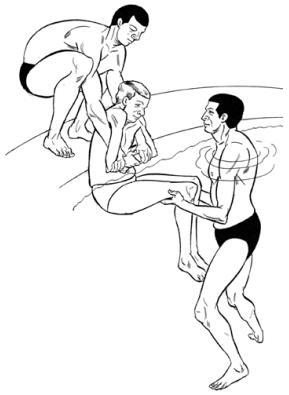
- The patient should always be placed into water in the supine or sitting position, never in the prone position - i.e., face-down in water (due to the weakness of the cervical and back muscles, he cannot raise his head from the water and can drown).

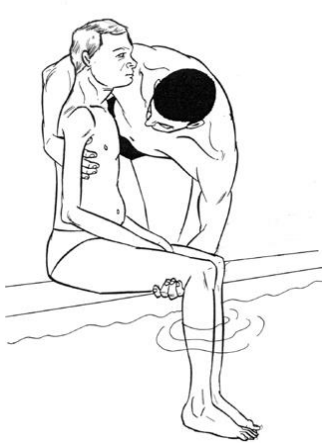


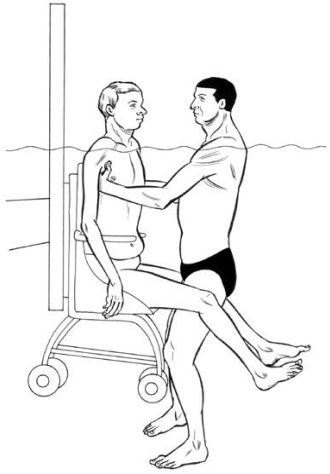
COMING OUT OF THE WATER

Lifting the patient out of the water onto the edge of the pool or using a lift



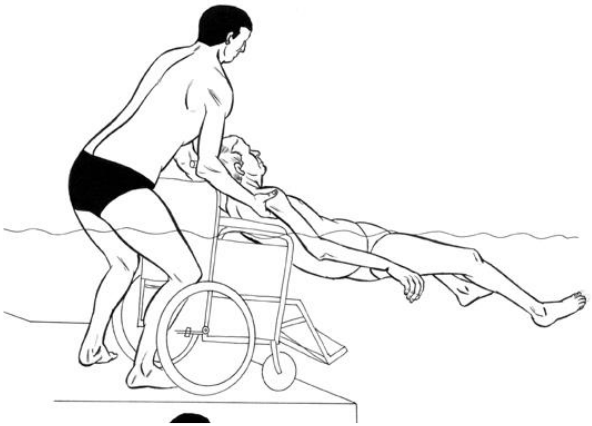


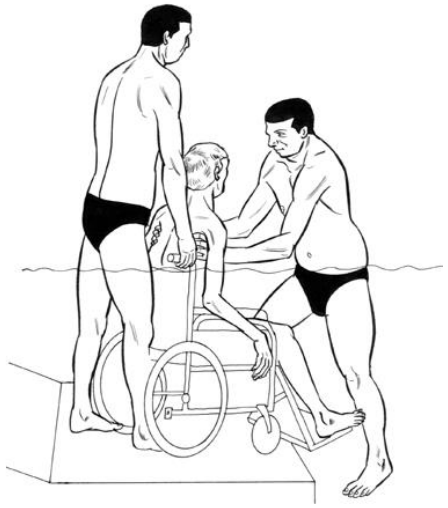


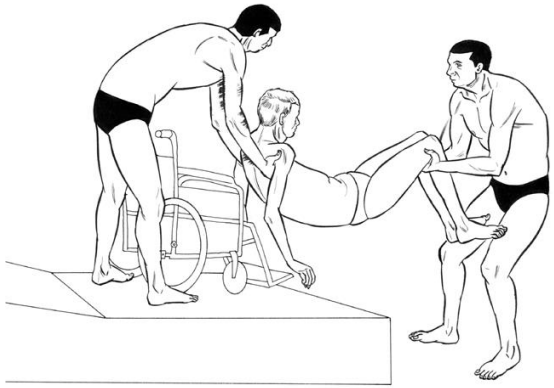


COMING OUT OF THE WATER

Lifting the patient out of the water into the wheelchair







SWIMMING INSTRUCTIONS FOR PEOPLE WITH NMD

Learning to swim should begin by adjusting to the water.

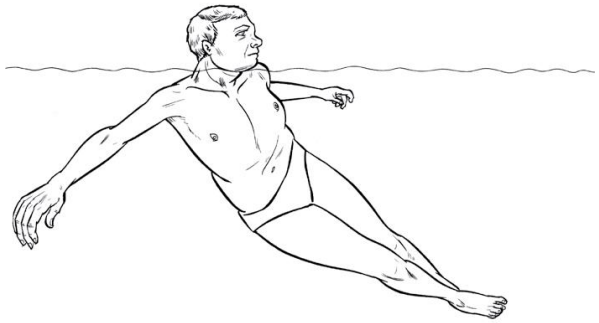
- Adjusting to water resistance
- Adjusting to submerging the head
- Adjusting to looking under water
- Adjusting to exhaling in water
- Adjusting to buoyancy
- Adjusting to gliding
- Practising rotation (vertical and lateral rotation)

SWIMMING INSTRUCTIONS FOR PEOPLE WITH NMD

- Regardless of the diagnosis, the degree of impairment, sex, or age, our aim is to teach each person to swim independently or at least to move in water as autonomously as possible, even if that means no more than the ability to maintain an extremely limited and uncertain body position.

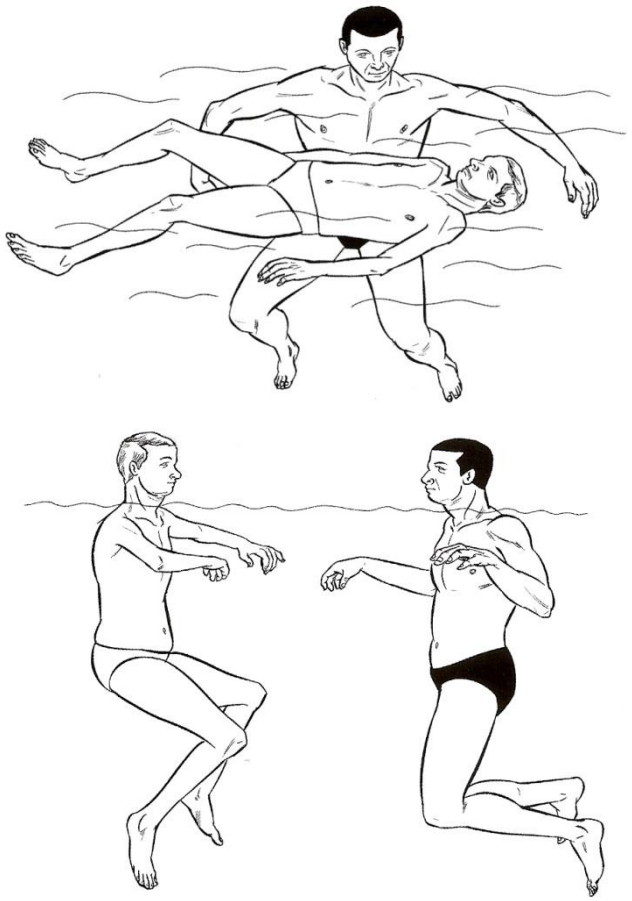
SPECIAL MODES OF SWIMMING OF PEOPLE WITH NMD

- In the initial stages of the disease most patients can perform the breaststroke and the backstroke, very few are able to do the butterfly or the crawl stroke.
- However, patients' swimming skills decrease with the progression of their disease. They first lose the ability to perform more demanding swimming techniques, such as the crawl and the butterfly, and later on also the breaststroke.
- The techniques they manage to use the longest are the backstroke, sidestroke and swimming in the sitting position.

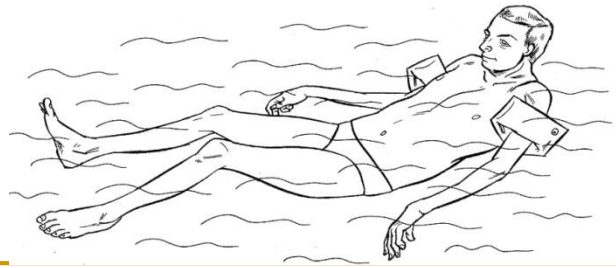


"FLOATING" – INDEPENDENT MAINTENANCE OF THE BODY POSITION IN WATER

- At a certain point in the progression of the disease patients with NMD are no longer able to swim, but many of them are still be able to maintain an independent body position in water – they can float in water with their head (face) above the surface or in a sitting or supine position.
- This independent maintenance of body position in water – floating - is very important from the therapeutic point of view as the patient is thus able to have a thorough physical and respiratory workout while experiencing diverse feelings and sensations.
- Maintaining an equilibrium position in water can be very unreliable, and there is also a high risk of drowning, especially if the patient is floating in a sitting position.
- For these reasons, such patients should never be in the water on their own, rather should be accompanied by an experienced assistant at all times, regardless of the depth of water.



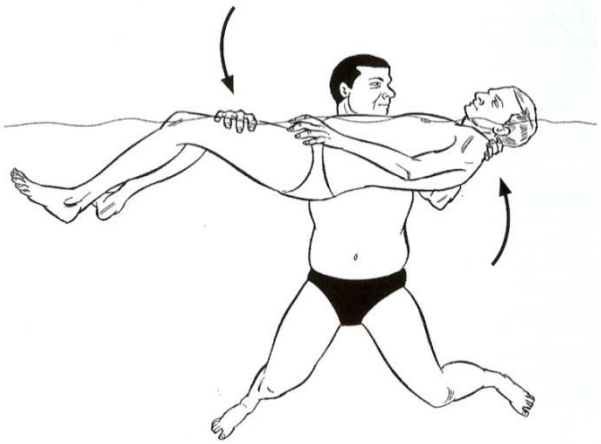
SWIMMING WITH FLOTATION DEVICES



SOME WAYS OF HELP IN WATER

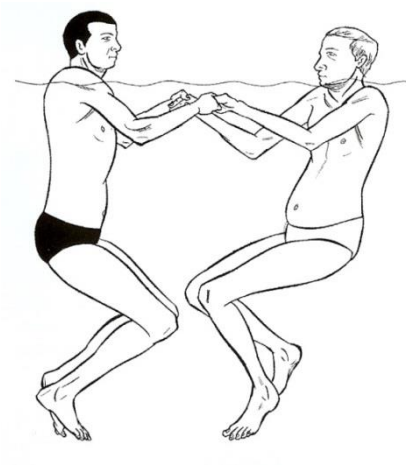
RAISING THE PATIENT FROM THE SUPINE TO THE SITTING POSITION

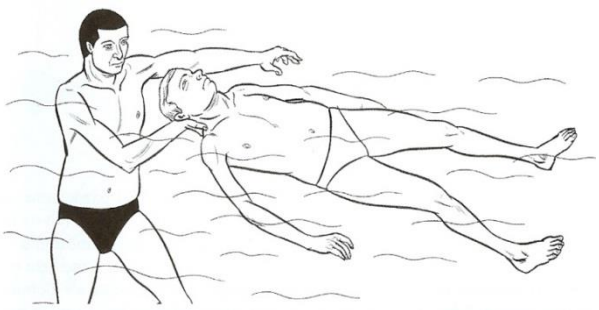
- At some point in the progression of the disease, the patient may not be able to turn into another position independently and thus needs the assistant's help.
- Typically, this is the shift between the supine position (initial position) to a sitting position in which the patient can still manage to swim or at least maintain an upright position independently.



HOLDING THE PATIENT IN THE WATER

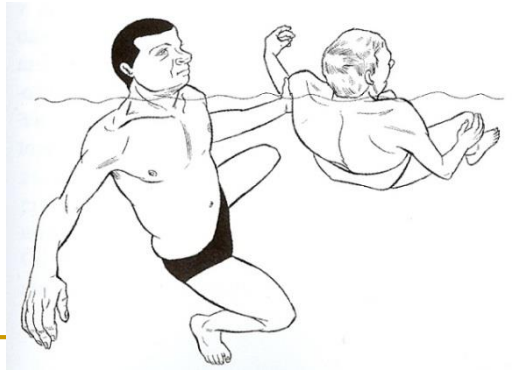
The patients with the most severe physical impairments who can not swim nor float independently can still do some physical (arm and leg movements) and breathing exercises in the water while being constantly held by the assistant.





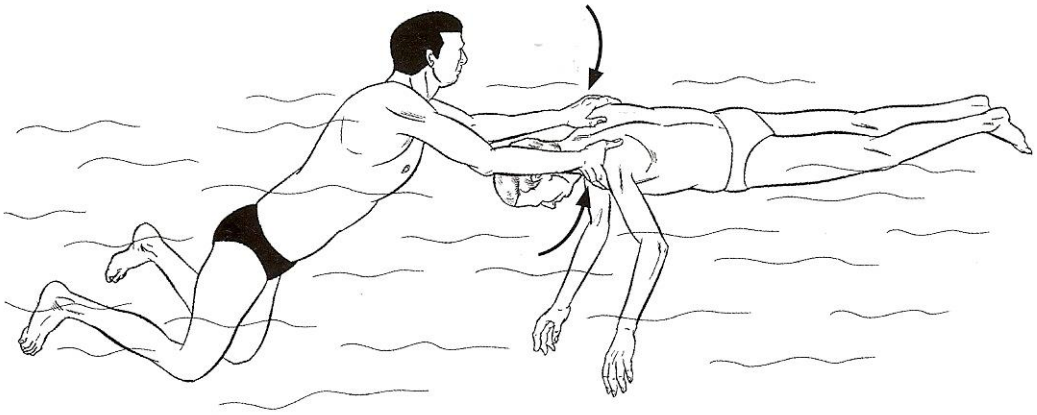
MOVING THROUGH WATER

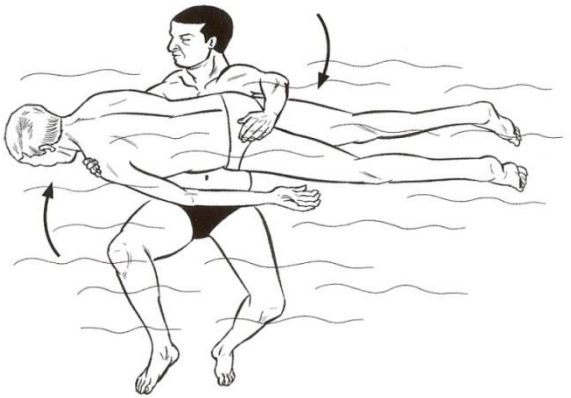
- Even if capable of independent swimming, the patients' movement through water will be slow.
- When swimming in sea water, patients will find it difficult or even impossible to overcome strong currents. In order not to be carried away by the current and to reach their destination, they must be pulled or carried by the assistant.
- This can be done in several ways. In all modes of movement in the water, the patient is in a supine position.



RESCUING – TURNING THE PATIENT FROM THE PRONE TO THE SUPINE POSITION

- If the patient falls face-down into the water, the assistant must act quickly, decisively and correctly and help the patient out of the water and to breathe, otherwise the consequences may be tragic.





CONCLUSIONS

- Swimming and other kinds of water exercise are highly suitable forms of recreation for people with any type of physical disability.
- The physical properties of water facilitate movement and for some people water represents the only environment where they can move independently.
- Swimming and water exercise can improve patients' physical and psychological scope, as well as their self-image and quality of life.
- The NMD patients should never be in the water on their own, rather should be accompanied by an experienced assistant at all times, regardless of the depth of water.