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Review Article

Physical (Hydrotherapy) Treatment for Individuals with a Severe Neurological Disease. Stroke – Training of the Trunk

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Abstract

Introduction and severity determination.

Not all patient can exercise in an group and there are people that have more on an treatment with the therapist in the pool. Especially people that are not capable to move and/or walk on land, will give the water the opportunity to learn to move again and that asked for other skills in the water from the therapist. Especially neurological diseases are in water better to treat than often on land, because the upward pressure is one of the elements that make movements easier. Of course, there are an lot of robotic apparatus that give an "kind" of loss of weight and make stand and walking safe and possible but the possibilities in the water are often much greater but that asked for an skilled therapist. Purpose and goals: To describe what the possibilities are by people with neurological disease in water. In the water are aspects as coming to an lying position and control that position possible and the variation is very large. Regrettable, there are alwaystwo points that makes therapist scaring to go into the water with these patients: The amount of work pre – and post the treatment. But that part is also an important part of the total treatment that patient need to do, to get their maximal independency and that is called ADL. Methods, approach and skills. The skill to facilitated the patient in that way that he moves safely and with best possible self-control. The technique that people has learn on land (the neurological approaches as Bobath, Kabath, Carr etc. or an eclectic program) are base to get an treatment started in the water. But also, the skills out the Halliwick/ Water Specific Treatment etc. are important to manage this group of patients. In this article the mean focus is on patient with a severe neurological disease with problems on all aspects from the brain. From cognition till senso-motoric problems, but the focus lie on the restoration of movement that the patient can control. Conclusion. Often the first movements that occur has taken place in the pool and after manage that on good way, the translation to land is possible. The translation of the therapy will come when this is possible, but the base -the movement- is present.

Kew Words: halliwick; capacity; hydrotherapy; stroke; parkinson; neurological diseases; aquatic therapy

Introduction

Every treatment with patients asked for an education of he therapist. It isn't so easy to treat people with severe neurological diseases in water because it asked for an amount of knowledge and for all, skills to do it and get the right results. In the world of therapy is in the last decades the believe growing that many treatments must be done - hands-off- or done by apparatus/robotic. But many patients will need the hand-on facilitation to perform a movement that enter the brain and stimulated recovery or compensation/adaptation. The possibilities to facilitated an movement will be the base to get an movement "learned" and possible. The learning principle: student – teacher [1] is for the practice still the best way to learn and master the skills that are necessary. Furthermore is knowledge about the basic principles about motor learning and training essential [2,3,4,5,6] and of course is knowledge about the guidelines important but most of the guideline have almost no investigation in their program that goes over this group of patients and most guidelines have an lot of articles that don't fit with TIDieR criteria[9] That gives the therapist not the knowhow and the skills necessary to go successful with this group of patients in the water. Treatment in the water asked for practice skill training through an practice course with patients as the Halliwick –approach [10] but also other techniques as the Water Specific Movement therapy [11], Bad Ragaz Ring method [12] etc. but we need by these patients also practice as the NDT -Bobath[13,14,15,16,17] approach, Brunstromm –approach [18], Carr and Shepherd [19,20] and Motor control [21] principles but for all practice training with neurological patients and knowledge about their disease and knowledge about synergy, tone, selectivity and how this can be

control. We are aware that this approach has according the science [7] no **more** value as the approaches that sciences has found, but their approach isn't also perfect and the value is strongly subject of discussion [22,23]. Recently in an article, in which the predicting of upper limb recovery was explained, was a remark what the limitations were of this investigation and that is often the case. We quoted [23]: "Limitations of the present study include the lack of severely affected patients with a hemiparesis in the dominant hand, the restricted generalization to patients with upper limb motor impairment after a first-ever ischemic stroke, and the focus on stroke recovery rather than deterioration". Therefore, created the possibilities for yourself to handle this group and start and you will see that the success will come.

Halliwick Ten Points!

To get patients safe in the pool, we must create an environment in which the patient can handle the water and is capable to train in it. The Halliwick concept has an ten points program that we need to get control over the body in the water and when that control is there, this can be an start to better movement in the water and later on land. In this article only the 10 points with some explanation, for further explanation see articles and books [10.11.12].

Mental Adjustment 1: Being able to respond appropriately to a different environment, situation or task. The learning of breath control is an important aspect of this work. One such example is adjusting to moving in water compared to moving on the side of the pool. Or working on breath control can be used to get more control over the mouth and an better swallowing performance.

Disengagement 2: An ongoing process throughout the learning by which the swimmer becomes physically and mentally independent.

Transversal Rotation Control 3: The ability to control any rotation made about a fronto-transversal axis. This are exercises that stimulated the front- and back diagonals [25,26]. Neurological diseases has an common problem. The lack on inhibition will create an higher tone in the muscle pattern that hold the attitude and will inhibit the movers and especially the fast movers. The back diagonal(s) are by neurological diseases mostly dominant but this dominancy is poor, because the selectivity are lacking in this back diagonal(s) and the inhibit the front diagonal(s). This is on land very difficult to treat and in water will the dominancy of the back diagonal(s) be less and therefore more possibilities for the front diagonals to act and of course also for the back diagonals and both can increase their selectivity.

Sagittal Rotation Control 4: The ability to control any rotation made about a sagitto-transversal (anterior/posterior) axis. This is the coordination between the diagonals and their – Keypoints- at hip an shoulder joint and asked for an good selectivity or for an coordination that use the possibilities of the body. Then it is important the weight bearing problem is less through the upthrust of the water.

Longitudinal Rotation Control 5: The ability to control any rotation made about a sagitto-frontal (longitudinal) axis. An sagittal or longitudinal rotation isn't possible as the diagonals don't work together with the spine as the axis. But that axis can also rotate.

Combined Rotation Control 6: The ability to control any combination of rotations. Only the approach *Proprioceptive neuromuscular facilitation (*P.N.F.) use this amount of rotation but this asked for more selectivity because this is done on land. Through the water the body hasn't the task to hold the body against the gravity and is it easier to move with less tone. Rotation are the summon of the possibilities that the body had and especially on the keypoint places this will be used to control all form of rotation. Also, the movement in the neck are part of this without the high tone to control the weight of the head.

Upthrust 7: Trusting the water will support you. Sometimes called 'mental inversion' (because the swimmer must invert their thinking and realise, they will float and not sink).

Balance in Stillness 8; Floating still and relaxed in the water. This is dependent on both mental and physical balance control. When balanced, other activities can be performed more easily. Imaging floating in water with no movement and that with an severe neurological or orthopaedic problem! Total control without any form of aid and this than the base for the next step movement in the water and the reaction that will occur through the whole body. This base of treatment can be so important because there is control and the possibility to move on his own initiative.

Turbulent Gliding 9: A floating swimmer is moved through the water, by an instructor, without any physical contact between them. The swimmer has to control unwanted rotations but makes no propulsive movement. After step 8 the instructor makes movement in the water possible through turbulence that move the body to the instructor without touching the patient.

Simple Progression and Basic Swimming Movement 10: A goal is to teach on this way to become one with the water and learn to swim. Treatment in the water can have of course another goal but still swimming should be one of it. This independency is so important for patient with an sever handicap. With an elevator in the pool and then ……. free.

These 10 points is the base to get the patient and his instructor train to get the maximum out the treatment in the water and with this base all other thinks are possible with an without aids etc.

Often the greatest mistake is that only walking in water is the goal but even this can be achieve with different levels of water and that makes an lot difference. Under the level of Th. (Thoracic) 11 the greatest control will be done by the lower trunk and has the greatest similarity with walking and balance on land. On the level of Th. 11 there is an different control of the lower and the upper trunk and in the Halliwick –Language – this is called the : "Panic Curve". Above the control must be done more through the upper trunk and will the movement of the upper trunk have an direct reaction with the lower trunk and must thus the correction come from the upper trunk. Bending too far to the front will lift the legs up at the back and the control will only be possible by an counter movement of the upper trunk to the back, otherwise this will end with the face in the water. [28,29,30] As the rule on land when we stand on one leg and bend the upper trunk to the front, will this a movement of the free leg to back. When we stand on one leg and bend the upper trunk to the back than the free leg will go to the front and side way will the free leg give abduction when the upper trunk makes an shortening and an addiction (crossing) when the upper trunk create an elongation with the lower trunk. These rules are especially for balance control essential and are therefore perfect to train in water without the speed that is require on land. Balance training is therefore better to exercise in water than in land and when an person failed, he is wet but no harm is done. One of the base problems by neurological diseases is to hold the body against the gravity and that asked for an composition of tone that makes movement and selectivity more difficult. The greatest effect of water is that this isn't necessary anymore and that the tone will decrease after patients are in the water for some time. The second greatest advantage is that the perception of the body is more stimulated than on land and that gives much more feedback and possibilities to react on disturbances. [31,32,33,34] and that reaction is slower through the resistance of the water. This all makes water an environment in which training and relearning is very good possible for everyone.

The Severe stroke patient is the water.

To give an picture how to handle an patient after an severe stroke, we choose for an combination of casus orientation and treatment techniques to reach the goal. That walking in water can be improve even better than on land has Tripp [35] investigated in his thesis and he the outcome was very clear! A patient with an T.C.T. (Trunk Control Test [36]) that never reach the independent level 100 points, will have on land with all his movements and transfers need of assistance and/or apparatus to transfer this person from bed to chair etc. The casus in this article has never more than 48 points of the 100 point that can be achieve.

The four elements are (T.C.T.) :1. Turning in bed to the right, 2. Turning in bed to the left. 3. Coming to an sitting position on the edge of the bed. 4. Sitting for minimal 25- 30 sec. without support.

By this group of patients will the first three often have an score of zero or maximal 12 points. The last item –sitting on the edge of the bed was sometimes possible for the 25 sec. but this was often only possible when there was no movement from the person and the support area. On land means that every movement must be controlled by others and that every sn transfer is an exercise that is "too" heavy for the person. Too heavy means that the power and the selectivity isn't there to control this movement and the power is to poor and this exercise has than an magnitude that is more than 1 R. M. Loss of selectivity makes the coordination and the strength also poor but that means not that this isn't treatable. Task specific can be used to stimulated the coordination and the power [40,41] of course is the training of transfers important but this stay for an long period on an training level and has little variation and the environment isn't rich enough to learn and create new movements. We need therefore new movement and more freedom and the first what we can do in the water isn't trying to walk – what everyone will- but start with movements in sitting position and control from this position to an start for equilibrium reactions in sit.

How? Transport with an douche-chair in the pool and then take the person on your "knee".

Photo 1: The patient "sit 'with his knee against the chest of the therapist. Of course, it can also with the legs of patients left and right over the upper legs of the therapist. The first position gives more possibilities in movement of the hip and makes the connection between the upper and lower trunk possible.

The position with the legs of the patient in abduction will fixate the lower trunk and will lie the focus only on the upper trunk.

This position with the knee against the chest gives an good possibility to control the pelvis and that will be the first exercise to move to the front and try to set the pelvis in an position that the thoracic- and cervical spine stand in the right combination. (Of course, when this is too difficult than start with the hip in abduction). The facilitation is also possible with the hand of the therapist that are above the edge of the pelvis. This can help the patient to make the movement of the pelvis and place the pelvis in an position that there is extension in the lumbar spine and that will give the thoracic –cervical spine the correct position and will able the head and shoulder to move free. *From this position the first exercises are:* 1. Movement of the pelvis to flexion and extension, first great and totally but later on with more selectivity. 2.Because the hip and trunk aren't closed, we can start with movement sideway and start with equilibrium reactions that has his origin in the trunk and hip. For older- and/or disable people the balance reaction has need of all system to come to an bracing of an fall and shift of the weight to one side and make an step strategy possible.[43] 3. Start can be made lying done and coming to the sitting position and that will an great amount of variation. This treatment of the front diagonals is almost impossible on land because than this movement is far above 1 R.M. and must be done with assistance and often the patient will use his back diagonals instead of the front diagonals. That this is possible in water almost directly and absolute not on land, has to do with the loss of gravity and the support that the water give also by fast movement.

Photo 2 and 3: The same person on the same day, the only difference is that photo 2 is taken when he is sitting on the edge of an bench. He sit with the feet free and must hold his position under control with his not-affected hand and with the whole trunk in flexion with an pelvis in position all away to back and the trunk stand in total flexion. That means that there is no correction movement possible in this whole trunk and hips.

The same day but now in the pool. This knee are against the chest of the therapist and he is capable of start with an movement of the pelvis to the front and build up an lumbar extension and is therefore working on his trunk possibilities. He is now capable to performed exercises and that is impossible when he sit on an bench even with the feet on the ground, because he will use his not-affected leg to push and activated the back diagonal to the affected side and will fall to the back. Perfect example what water can do and can make an start for training possible on the level of the severe stroke patient. The problem by stroke patients and balance is that we know from investigation that the control is done by the not-affected side [44,45]. This investigation are done in standing position and done by patient treating in an rehabilitation center and that is only 10 % of the stroke population [9,45]. That means that the control of the affected side must start in the foot and that has consequences for the possibilities of the joint above. [46,47,48] Balance training without the foot as base is only possible as showed in photo 1 and 3 and now is the focus on the trunk and hip that often must do the job because the foot is fixated by outside braces. On photo 2 you see an device that fixated the foot but when he is standing on this foot is this the base on which the balance must projected. Of course, will this also an part in the training in the water of the balance reaction and then it is important that the foot/ankle is rather stable or make his stable because otherwise he cannot use his possibilities in the lower trunk and hip. The focus by the person was more on an building of an trunk that is capable in sitting position to make movement to correct the attitude and react on pain but also capable to correct the thoracic – cervical spine to get optimal possibilities when he is eating [24]**.**

Photo 4

Photo 5

Photo 4 and 5: Both gentlemen are lying in the water with an "lower trunk support". But only one will be able to getting to an sitting position when the support stays on the same place.

The other difference is the "closed-chain" that the gentlemen on photo 5 needed to control his body and the gentlemen on photo 4 has no need for this fixation and move with his arms and upper trunk trough the water and makes active elongation and shortening in the trunk. Who is capable to get in an sitting position is visible when we look to the stomach-muscles. One has obvious loss of muscle power and we see that ribcage is high and the tone of the stomach muscle is low and an concentric contraction will be very difficult and need facilitation. But there is also an difference in treatment goal by both gentlemen. Photo 5 is searching for balance and by closing all chains he gets an balance in which he is capable to move his head on his one and create an better head position that is necessary for an good attitude when he is sitting and eat. The gentlemen on photo 4,6,7 can now exercise all movements of his trunk, initiated from his upper trunk to work on an better trunk coordination and restore his balance performance of the lower trunk /hip without his legs/feet.

Photo 6

Photo 7

Photo 6 and 7: Gives an impression what movements are possible. At the end an total extension in the trunk with an extension in the hip. This last part is very heavy because the gravity is counting. The schedule for the increase of the power and coordination is equal with the 1 R.M. (Repetition Maximum) because the top "lift" isn't possible after two or three times and that means that he performed almost against the 100% and therefore will the fatigue come fast and is three times of 5 rehearsal an good start to increase his power and coordination in this task specific exercise [37,38,39]. *

Too often is the only treatment in the water –walking. And of course, is this an important part of the treatment but when we try to create an therapy than is the trunk exercising essential for an recovery of the trunk movements. Walking asked for an stable foot or feet and often isn't that the case and must we search for a stabilization of the ankle joint. When that is done than this therapy can start and that will give an adaptation of the remaining part of the body on that stabilization. Working primarily on the trunk in sitting of lying position, the stability of the foot/ feet isn't so important and we can exercise the remaining part of the body that is essential for balance and walking especially the diagonals and the lower trunk and hips. Even is it possible in lying position the stability of the ankle to increase and make the walking possible with an stable ankle joint. Still, everyone has right when he said that walking and balance is only possible in the position that this is necessary – Task specific Element [40]. But stroke patient with so little possibilities, start with the sitting and lying position with a lot of assistance and create there the first movement even with resistance and make the walking part in the beginning small.

Photo 8 **Photo 9**

Another problem is that she is sitting during the day in an wheelchair. No lower trunk control on the affected side makes sitting and react on pain and pressure, poor. Also, in this case and the time she was able to change, was poor. After one hour she complains and she must be move through an nurse.

After the treatment in the pool, she experiences after the third time that she hasn't less complain and was able to correct their attitude better. We than decide to do an training of two patients both with an severe stroke and with almost the same complains. Lady A (photo 8,9,10,11) get an treatment in the pool of 45 minutes 2 times an week in which the trunk training was an essential element and was done with almost 100% of 1 R.M.

Photo 10 **Photo 11**

Photo 10 and Photo 11: Here the treatment in the water with an very intensive (heavy) exercising of the trunk to get an shortening starting in the hip with active exhortation. But now is one photo 11 visible the active exhortation of the affected hip and the great reaction in the trunk. Only the upper part is still an little bit in extension rotation an sign that the back diagonal starting from the not-affected side is still used. To change this the not -affected leg was complete free and affected leg was the anchor and now was the extension rotation gone

This is so heavy that after 4 times she wasn't able to get this attitude under control but after an short break she could it again. That means: we were able to get here muscle fatigue and that will stimulate the coordination and the power of the muscle and created more tone and muscle power in the affected buttock. That will translate in an better control and variation in the sitting position and less complains and pain. We compare the results with Lady B that has the same complains and the same TCT. She receives also an treatment of 45 minutes and 2 times an week over an period of three week. But here treatment was focus on the transfers in bed and sitting against resistance. [49,50,51,52]

Lady B	**T1**	**T2**	**Lady A**	**T1**	**T2**
Turn right	12	12	Turn right	12	25
Turn left	0	0-12	Turn left	0	12
Coming to sit	0	0	Coming to sit	0	25
Sit (30sec.)	25 ?	25	Sit (30sec.)	12-25	25

Table 1: TCT

Remarkable was the fast recovery of the ability (lady A) of the turn over the affected side and coming to sit in 3 weeks. Both are active movements of the lower trunk and hip and asked for endorotation (coming to sit) and exorotation (going in lying position). After this result we take lady B also in the pool with the same program to stimulated the lower trunk and the hip muscle and she also react perfect and was capable within 4 weeks to get on their own coming to sit on the edge of the bed. The sitting training in the pool is more direct than every training on land and we think that this has to do with the possibilities to move on the own and the possibilities to create an training model to improve the coordination and the power. The speed in which this occur give us the feeling that the possibilities were present but that the land –exercises cannot stimulate them enough. There was also an great different between the sitting movement possibilities and the complains of the both patients. T1means the first measurement point. T2 means the second measurements point after three weeks. 25? she manages to sit for 30 second but it was on the border (Lady B) and lady A was capable to sit on edge of bed but cannot sustain that attitude for 30 seconds.

Lady B	**T1**	**T2**	**Lady A**	**T1**	**T2**
To the front	0	0	To the front	0	10
On left	4 (Times)	5 T	On left	5 T	5 T
On right	0	0	On right	0	5 T
Pain	After 45 min	After 45 min	Pain	After 50 min	No pain after 2 hour
Cushion	present	present	Cushion	Present	No cushion

Table 2: Sitting movements measurement over 2 hours' time.

Regrettable the rehabilitation has not his focus on this part but more on walking. But for walking are the extension of the hip muscles essential and must be an extra training item to have an positive influence on the walking performance. As sitting must be trained by improving the power and coordination of the lower trunk (whole trunk) and the hip, we must this integrated as an part for the improvement of the walking performance. Walking only is never enough; we must change the difficulties and there is an part that must be strengthening in an task specific way. Learning is only possible as the possibilities of the body are change /improve because otherwise must the damaged brain react with that what it has. The case report shows possibilities to improve the independency of stroke patients faster and superior on land therapy but it is rare that no investigation of any guideline has investigate this dependency in and around bed. And the introduction of hydrotherapy as an better therapy to improve the movement in and around bed still very far away. Of course, is the angle of the hip not right for standing, balance in stand and walking. The buttock muscle has an longitude that isn't right for those movements. Only the "raising "out the water (Photo 7) gives an concentric extension in the hip that can be compared with standing etc. But on land this isn't possible by severe stroke patients because the gravity is too high and often the exercises to improve the coordination and power must be done on an bench in an lying position with an elongated gluteal muscle. And there is the problem that this patient often has in the mobility of the hip and the knee. [53,54] Often the hip has too much exorotation mobility and the power of the endorotation- muscles is almost zero. That will give an problem in the control of the swing phase with exo to the stand-phase with "push-off (endo) and therefore with the movement over the affected hip. That is on land very difficult because of the lack of power, coordination and the dominancy of the extension synergy. Often people think that this selectivity is gone after an stroke. We know that when people are able to stand with support the resistance against the swing leg (not-affected leg) give this an concentric contraction in the gluteal muscle and make the movement over the hip possible. By this group of patients is that stand performance very difficult on land. Another problem is de restriction in the knee extension through an too high tone of the hamstrings. This occur after an bad bed-attitude on the back in which the paretic leg is bending and fall in exorotation and create pain that increase the flexion and the tone. This can occur in one night !![49] We can counter this with plaster techniques [54], but hydrotherapy can sometimes do the job and certainly can help to restore faster after the plaster techniques [56]. The power that is necessary to get an movement over the hip during walking on land isn't now reached. That need further training with task specific resistance treatment and also walking in the pool against the resistance of the water or resistance of the therapist or both. This is an moment that gives us an view what there is still possible after an stroke when the gravity isn't there. From this base we go further to get more extension in the affected leg and therefore the best selectivity.

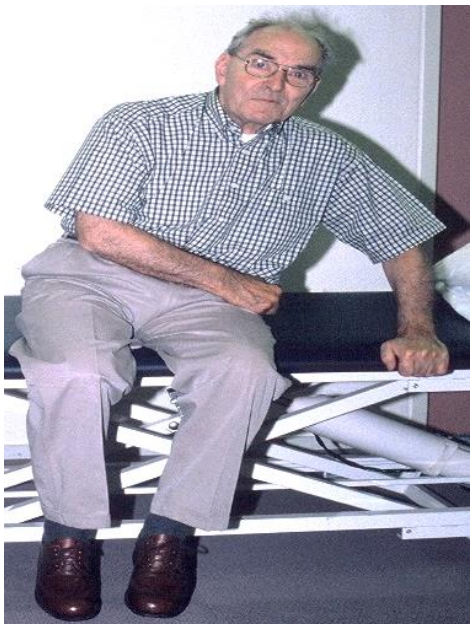


Photo 12: This gentlemen after an stroke with an paretic side left wasn't able to sit on his own without an support of his not-affected hand.

His T.C.T. was 12/12/12/12, he has for all this movement need of facilitation/assistance. He couldn't make an movement on his own in bed, but sitting in the wheelchair he changed his attitude but not from the lower trunk but from the upper trunk. His time sitting with no complain was maximal 2 hours than his affected buttock was hurting. But the greatest problem was the restriction of the extension of his affected knee. He has an treatment with plaster regression. [54.58.59]

Still after the plaster technique the tone and the length of hamstrings was better, but the extensor muscle of the knee were **"too Long "**in de sarcomeres and to shortening them we need to give concentric extensor training of almost 100% 1. R.M. to created hypertrophy and restore the reciprocal innervation and created an good knee extension. On land this was almost impossible even with an back splint.

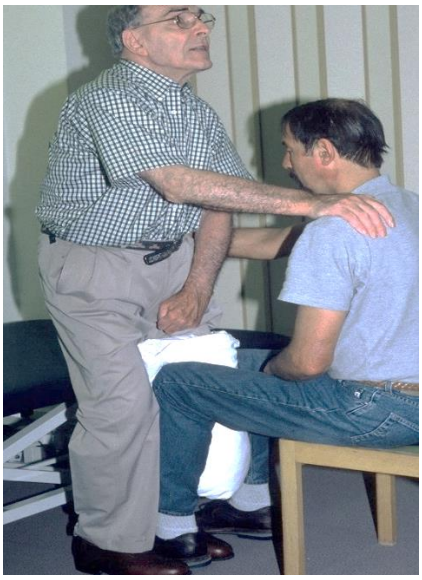


Photo 13 Photo 13: After the plaster treatment working on an "hypertrophy" of the extensor muscles of the knee. But this was almost impossible because the load that is need to activated the extensor muscle could only with an certain degree of flexion in his affected knee.
That means that he must bend his not-affected knee an lot and "hope "that the reaction occur in his affected knee. This was heavy and result often in total collapse and this photo gives a good image.
The amount of extension in his neck is very great and the extension in his affected arm also and that are signs that he used an Symmetric Tonic Neck Reaction (S.T.N.R.) [60,49,50]
And that means that the legs are flexed instead of extension and of course especially in the affected leg.

On land the only possibility was to make an back splint that allow some flexion and then let him stay on it and feel or there is an reaction in the muscle and try this to integrated in walking exercises. But in the water – lying ……

Photo 14: Amazing with an little support under the scapula his affected leg (right) makes an closed chain with his not –affected leg and both give extension.

We were capable to make the support on the heel of the affected leg and he react immediately with extension and that we could increase to an level of 75% 1.R.M. by resistance to the not-affected leg towards flexion. And after the third week he was able to walk in the pool with an water level higher than Th 11. The treatment program was therefore immediately changes and the most important part was aquatic therapy with the resistance part as the most importance part.

That means:

1. Two times an week in the pool with this (photo 17) resistance part in lying position and after an few weeks also in standing position (picture 1) [41] always 3 times 10 rehearsal and with the focus on signs of fatigue and that 3 times a week. 2. We search every time how we can increase the resistance to get the best progression. 3. We try to walk in the pool in all direction and with an slow decrease of the water level. 4. The extension of knee was the best when he walks ***backward***. 5.Of course, we try to translate this to the land but that was only possible when the water level was under Th 11 and with an back splint. And the backward walking was on land also the best way to get an reaction of the knee extensor. An example that land and water isn't comparable in this case because on land it was too difficult to perform and in the water the movement was faster an movement of his own.

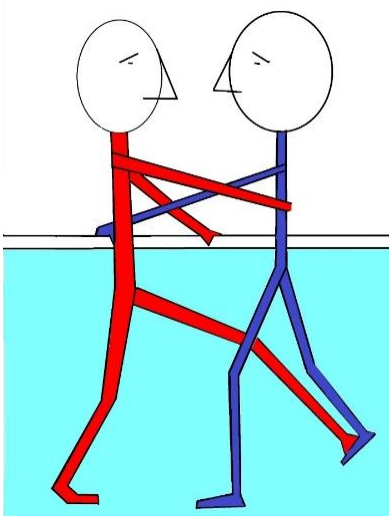
Compare water-therapy with land- therapy gives the conclusion, that only in water there was an possibility to recover! On photo 16 there is one person that support the lying person but never under the head. Let the head free because everyone will try of hold the head in the mid and let the diagonals work. By an patient with stroke the power that the affected leg can give, is determined for the amount of resistance and that count also for the amount of resistance against the stand phase as the resistance against the swing phase in this lying position.

Photo 15 and Photo 16: Remarkable phenome by severe stroke patients with an high perception loss in their affected leg and still there was always an closed chain [62]. The chain that this people make on his own, was also the reason that there was an active extension in the hip and that an hand under the heel, was answer with pressure and an increasing of the extension contraction in the hip. And that is the force we need as we walk. Photo 16. The power of the diagonals. Resistance against the heel of one leg and against the foot of the other leg, with 75% of 1 R.M. training of both sides all away through the diagonals of the whole bode, front and back, agonist and antagonist.

Stand phase (in lying position) resistance under the heel will give an extension in the whole leg with an action of the buttock muscle, but the reaction will continue to the other side and there we see an retroflexion in the shoulder. There will be immediately an reaction in the other –front diagonal -, we see there the arm in anteflexion and the leg in the hip in flexion. This is an instable situation with much rotation in the trunk and therefore it wise to give resistance against the heel (stand phase) and on the front of the foot (swing phase). The resistance that can be give, will be determined by the weakest part and mostly the emphasis lies on the stand phase. Therefore, will the resistance on the heel determined what amount of resistance is of an good R. M. (75%). Of course, will an patient after an severe stroke use his synergy and that isn't wrong but pay attention that the person holds the control over the lying position. The most often seen synergy reaction is plantar flexion in the ankle and endorotation /adduction in the leg but when the extension is good present in the hip extensor than will this have an good effect on the walking capacity. That the plantar flexion is present, must be counter by treatment to hold the muscle of the calf on prefect length [54]to prevent an striker foot.

Photo 17: Here without support training of the keypoint of the hip. Here the same rule the resistance on the affected is the base but be aware that the resistance against the other leg will increase the amount of power that the affected can deliver. This is called the "Ramiste – Phenome" and that can also for adduction.

Photo 16 shows an exercise against resistance to increase the power an coordination of the extension of the affected leg. And the amount of resistance that can be give on the not-affected leg determined the reaction under the heel and that is the important reaction because there we can increase the power and coordination of an concentric contraction what often isn't possible on land. **Photo 17** there lies the focus on the abduction activity. Now by giving resistance on the outside of the not-affected leg, we see an concentric contraction of the abductors on the affected side and can we build an better hip stability for the stand phase.



Picture 1: Standing on the edge of the pool, we give resistance against the swing leg (Not-affected). That can start with an very small swing but with an high resistance almost against the 100% R.M. We know what his affected leg can deliver on stability power and that is therefore 1 R.M. we can start with almost 100% R.M., then we need only an few rehearsals and variation can now occur in the amount of resistance, the among of the swing phase and the direction variation and this will always have the first reaction on the leg that stand.

Both resistance treatment can be altered in load and resistance but also in direction and variation and has always an total effect. It is always an task specific treatment and never an isolated muscle strengthening and that means that also the coordination will be improved and not alone the power.

Isolated muscle strengthening can be necessary when the task isn't possible for the patient [63,64].

But working in the pool makes always an task possible and makes the resistance training therefore more than only power improvement.

Photo 18: Here an combination of resistance against only one leg for extension leg with an dorsal flexion in the same foot. To hold the position under control and give resistance must he perform an combination of selectivity and power.

Conclusion

The part lying in the water is so useful to created more power and coordination and with the exercises on the edge and with the different water levels is walking and standing exercises almost always possible.

This is something that to little people has investigated.

What is possible for severe patient with an stroke in an training in the water, we say the effect on sitting but what is the effect on this patient, walking in the water and after that on land.

But the start wasn't possible when the water wasn't used. That means that this patient never experiences walking and that many people concluded that walking isn't possible. An pity all patient can walk in water!!! Even patient with only an stretch reflex!! And with the program [41] to treat fall problems, we can further improve the possibilities of the selectivity /power and coordination.

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