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## Rehabilitation of the upper limb after an stroke. Part 5. Dissociation to an “open “ chain and hand treatment ! An multi-eclectic approach !!

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### Abstract

**Introduction:** Part 4 show what the skill must be to achieve dissociation and with the hand on-facilitation we say amazing results with the possibilities to create an goal in the ADL and often with some hand possibilities. To get the hand on the right spot we need the arm therefore also the trunk and the diagonals.

This part we go further with this dissociation and search for an “open “chain but we see also the possibilities that sciences have created. The science has stoke much effort in the developmental of robotic and F.E.S. stimulation techniques but still today it isn't clear of this the answer is for the recovery of the arm and especially the hand and it isn't also clear or this is an better way to get more function in the hand than the “old way”.

**Design :** But obvious there is much more possible to get an better arm-hand function by using this inventions, but than for all stroke survivors with arm and hand function decrease.

An eclectic approach will use everything to get an better result but always with an good base of science and with the training and motoric learning rules in the head.

To get an result in the damaged brain, there must be an amount of intensity to get the brain working on his plasticity. The question remain that we not know how much plasticity an damaged brain can obtain and obvious that is different for every stroke survivor.



**Conclusion :** Therefore therapist try everything what you think can help but also science keep on searching !! And this can also be done in the chronic stage of this disease.

In this part will always the care for the diagonals (Whole Trunk), the shoulder all away to the hand be central because you cannot forget an part an think that this has no influence on the goal that you are exercising.

Hands-on – hands-off, electro treatment , incorporation in the ADL, mobility care for all tissues and tone control etc. make that the outcome is maximal !!

**Keywords.** *Arm-hand rehabilitation, electro treatment, swing approach , tone control.*



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## **Introduction.**

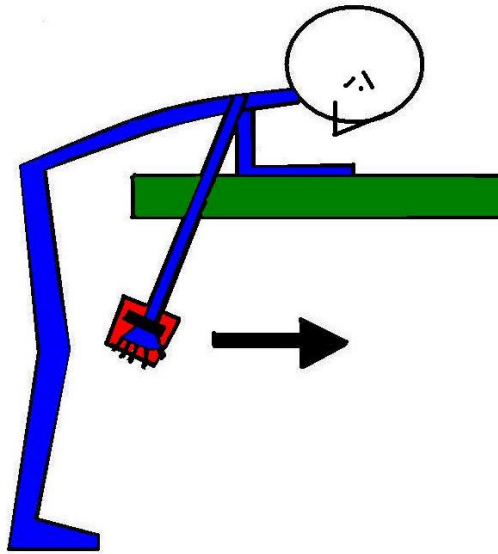
Many colleague have asked me why I think that this dissociation with all stroke patients is possible ! Of course I know also that great infarct in the brain can give so massive symptoms that it is obvious that much recovery will be not possible. Working with this people, I see that after time there was more possible than I taught.

Even some one with an infarct that was devastating for any arm /hand function ( in the corpus callosum) with an low tone and almost no perception but still it was possible to get an arm training on an level that there was an contribution by the ADL and what is very important – till the end- no mobility impairments en no pain. But there [1,2,3,4] is an way to use all knowledge and skills to get the arm /upper trunk to his optimal function and then is an form of dissociation almost always possible. Still I know that not all is possible but using alone the robotic or FES to hold the arm/hand on an good level isn't the answer[5], because it isn't only the amount of movement but also the using of the arm/hand and when that is to little there will be an adaptation and sometimes that adaptation in all tissues can be very fast. The elbow and especially the supination with full extension is one of the first in the arm and the toes in the foot to lose their normal mobility. That asked for an treatment that is optimal [6] and I know that not always it is possible to hold all under control. But no trial no effect, therefore I asked for an life time treatment on an good level for all stroke patient that need it !! Now we search how we can create an open chain or part of the arm /hand place in an open chain and create an higher dissociation and try to get more out the affected hand/wrist.

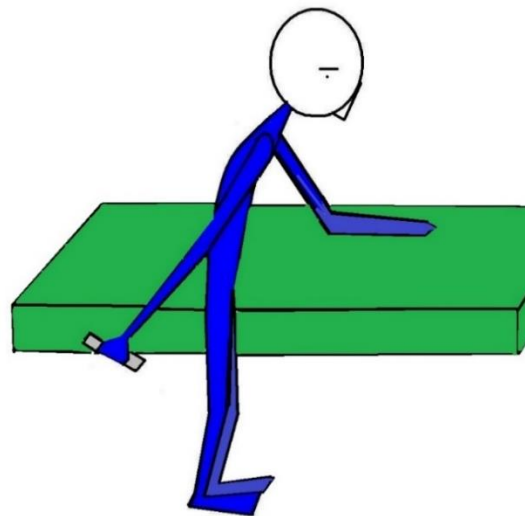
Let's start swinging !!

## **Swinging with the affected arm !!**

This is only an part ( an very important but extreme difficult part) that can be important for an optimal recovery of an individual after an stroke and it purpose lies especially to move the arm in the shoulder and create an “Open chain”. The individual must move on his own with the optimal control over his arm and hand that ask for exercises that stimulated the brain to search for solution also in the ADL and IADL, but ask also for task specific resistance therapy to create more coordination and power to decrease the influence of the synergy. The closed and half closed chain (dynamic or not) give the muscle pattern possibilities to rule out the small muscles. Now with this swing exercises isn't that so easy anymore.



Picture 1



Picture 2

**Picture 1 and 2.**

Regrettable forgotten exercises. Swing exercise to make the step to the open chain and especially with an load will this give an increase on power an coordination in the keypoint.

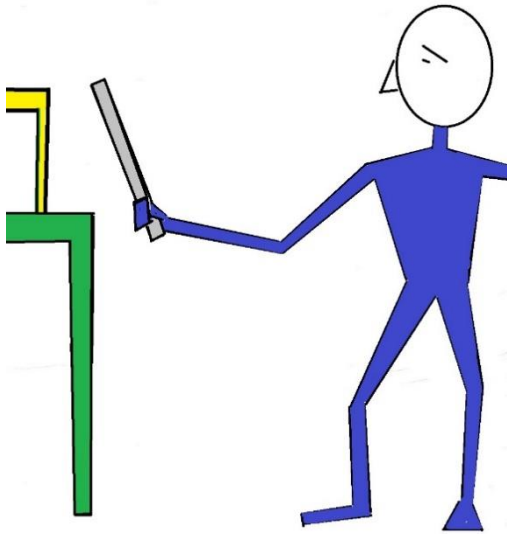
And through this weight will also the perception of the arm increase.

Start with an maximum of an upper trunk forward with an support on the not-affected elbow and often is the swing to back possible and then it is only : "let go" first.

After that the individual can try to reach an higher point that is standing in front of him. In picture 3, this person was able with an stick in his hand with this swing get an crutch from an bench. There must be knowledge of result to increase the swing. (Goal-directed exercising [7,8,9])

The flexion in the upper trunk must be active because otherwise there is no activity increase in the front diagonal and therefore hold the support with an bended elbow and the swing always far to the front. The first goal is to hit the underside of the bench or the side of the bench. Tried to get also exorotation in the swing, place an chair on the other side and asked to hit that. Let the person search for an solution.

Picture 1 and 2 published with the responsibility and permission of the author by i.v.d.Rakt.



Picture 3

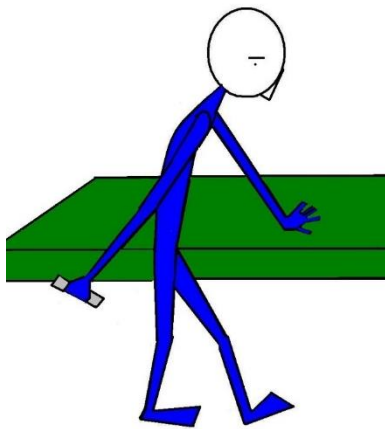
**Picture 3.**

With an stick swing against an crutch and get him down in 10 strikes. He stand sideways and use elements of the flexion movement synergy to hit the crutch but on the same time he is increasing his coordination because the stick has an amount of sand that is increasing. Furthermore in this case he increase his grip ability to hold the stick .

This are therefore important exercise because the first step to control the movement in an open chain and will also help to use this coordination in half and closed chains. There are therapist who are afraid that an load will luxate the gleno-humeral joint. The load will prevent this when it is an **active swing** and that means that the individual is capable to stop the swing movement in the front. Not hold on an high point but decrease the velocity down back, that is enough. Furthermore swing along the body than there must be some control over rotation ! Picture 3 published with the responsibility and permission of the author by j.v.d.Rakt.

In picture was enough control to get in this standing position but especially the goal and concentration was marvelous in this exercise!

Swinging can also be an part of the walking exercises and will therefore working with the diagonals.



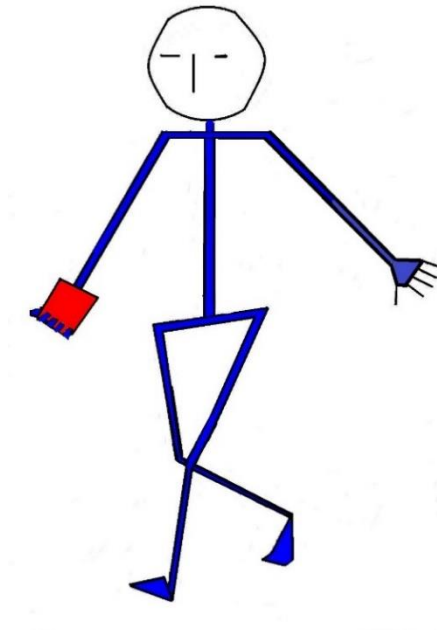
Picture 4

**Picture 4.**

Start with walking along the bench because the balance will than less interrupt the movement and see this picture the swing of the hand isn't in good connection with diagonal because the not-affected foot is already to the front and the hand is still back. This will in the beginning be necessary because the front diagonal has not the tone and the selectivity to react on the same time . By letting this delay the front diagonal will be elongated and that will give the individual to swing the arm to front[10,11]. Again, for perception and task-specific give an load in the hand and increase that load when the swing movement increase. Picture 4 published with the responsibility and permission of the author by j.v.d.Rakt.

It is an misunderstanding that the arm swing must be equal with the not-affected foot because the not- affected foot has in that leg and lower trunk often more selectivity and power and will be in the lead. That is important because now the affected arm may come later and can we start with an inhibition of the dominance of the back diagonal on the upper trunk and scapula of the affected side. Be aware with balance deficit can do on this diagonal dominance. Therefore walking without support is possible as an arm exercise when the walking and balance are on an S.W.W.T. – stage (Stop Walking When Talking[12] ) And again there will be an delay in movement to the front and the movement to the back is often an option when the strength in the affected leg is good. Because the swing of the not-affected arm to the back is far more important.

The swing to the front is the reason for this exercises, This can also hands-on but make not the mistake to swing the affected arm to the front on the moment you think he must come but when you feel that he is started.



Picture 5

#### Picture 5.

It is never the purpose to get an military mars!

It is an method to created more power and tone in the front diagonal and it help to increase the speed of the walking capacity. By using an load in or on the affected hand the reaction of the front diagonal will be increased and the perception of the movement to by the increasing of the muscle spindles reactions. Load in the hand in an open chain makes this chain perceptual less open.

In this picture the affected arm and not-affected leg are equal but that is never the purpose.

The purpose is the front diagonal from the not-affected leg to the affected shoulder to stimulated and by that increasing of the tone and power of the upper trunk there will be an better movement be realized in the upper trunk. An better scapula movement and an increasing of the capacity to get the arm in the gleno-humeral joint higher in anteflexion and then there is an possibility to start with movement above the 90° .

Picture 4 published with the responsibility and permission of the author by j.v.d.Rakt.

#### Movement of the shoulder above the 90° .

What will there be needed to created that movement?

The flexor movement synergy stop at 90° and in abduction with some exorotation. Further increasing of the movement above the 90° will be impossible because by increasing effort the tone in the flexor movement synergy will also increase and that will an movement of the scapula brake by the high tone of the dominant back diagonal and then the part close to the spine.

The extensor movement synergy gives an protraction but in the glenohumeral joint this is alter in an anteflexion with adduction and endorotation. And the combination of anteflexion with adduction and endorotation will close the gleno humeral joint and makes movement further impossible.

Movement above the 90 ° ask for an dissociation between the two movement synergy.

First an spine that stand in an upper trunk forward will inhibit the movement. The last 30-40 ° ask for an spine that is erect and rotated ( upper trunk backward) with no brake on the scapula movement because that must go to the end position and then stand the inferior point of the scapula in the front axillary cavity[14].

In this position can the glenohumeral joint go to the maximal anteflexion but that ask for an exorotation to get the best opening in the joint.

All together have we on all parts in the upper trunk dissociation necessary to get an movement of the arm above the 90 ° and when we want to go to the maximum must there also an extension in the whole spine , also in the lumbar part.



**Photo 1**

**Photo 1**

Testing of the inferior point of the scapula almost on the end of the anteflexion.

The spine is erect and there is an rotation of the vertebrae to the other side where the arm is lifting. This rotation will not be possible when both arms are lifting and that means that the one arm lift will go further than two arm lift together, because by two arms the rotation in the spine isn't possible. The gleno humeral joint stand in an exorotation position because than there is the most room for the head of the humerus to move.

Endorotation will makes this room smaller and can lead to shoulder pain. This is call the impingement syndrome[15] and probably the reason for the shoulder pain by individuals after an stroke and often that movement is not done by the individuals self but by the caregivers.

Important is to control or the inferior point of the scapula stand on the right spot. He must stand in the front part of the axillary cavity. Than the scapula has makes his total laterotation and stand the cave of the gleno-humeral joint perfect for the head to reach the optimal anteflexion.

Photo 1 published with the responsibility and permission of the author by j.v.d.Rakt.

To create the possibility to lift the affected arm so high and work above the head ask for an approach in which the dissociation is very important. An dominancy of an movement synergy will always make this movement difficult and even almost impossible.

But part of the synergy can be allow when they not inhibit the movement.

An increasing of the tone in the fingers ( flexion in both synergy ) will indicate that the movement is very difficult but when the movement is still possible, there is no reason to cut this exercises and with an hands- on approach and manipulation is this often very good possible.

When the head of the humerus goes in an endorotation/adduction than the extensor movement synergy will have an important part in the movement and will therefore inhibit the movement above the head but also make the room in the joint smaller.

Again this can be done with an hands-on approach by taking what of the weight and correct the alignment of gleno humeral joint[4]. Both action will have influence on the tone and the present of the movement synergy and make the movement above the head possible.

In this movement the keypoint muscles of the shoulder play an important role. The deltoideus group but also the small muscle that take care for the rotation and ab- and adduction are often not properly working. Some scientist believe that their connection with the cortex is of an higher order and/or has more placed in the cortex[16].

That is also the case in the hip but the shoulder has much more mobility and the muscle must not only move the joint but also setting the head in the right way in the cavity and make even translation movement to get the best position of the head. That ask for exercise that increase the coordination and that must start below the 90° and then increase to 90 ° and higher. Coordination is only increasing by task-specific resistance treatment and is only possible when the connection with the brain is present. When there is an connection than will exercises with load always give an reaction and that reaction we can use to get an better movement and more dissociation.

An example :



Photo 2



Photo 3

**Photo 2 and 3.**

What is the best exercise for the gleno humeral joint in strengthening for an movement above the 90° and with increasing load get more coordination in the small muscle in the keypoint shoulder?

Photo 2 and 3 published with the responsibility and permission of the author by j.v.d.Rakt.

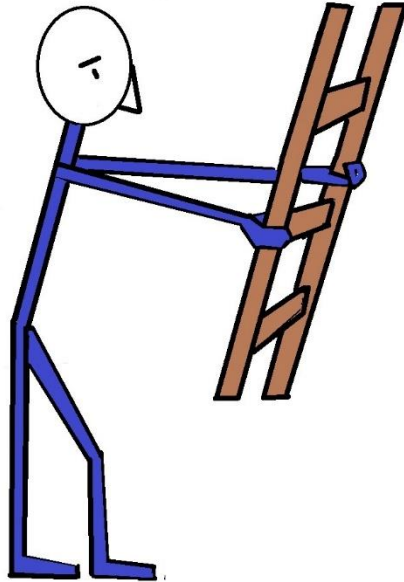
Look to the elements that are linked with the movement synergy and at the contour of the muscle of the gleno humeral joint . Of course is the position on photo 3 never the right position to lift the ball but him was ask to lift his arm and place him on the great ball.

The photo is to late but the elements of the extension movement synergy are great and the contour of the m. deltoideus is very poor.

In the photo 4 he sit on an ball and lift with two hand an stick with sand ( load) and now we have an lower anteflexion stand compared with photo3, but there is exorotation and the contour of the m. deltoideus is obvious and that is necessary to get an reaction in the muscle pattern and build up an task specific resistance treatment that can lead to an better coordination and power in the muscle pattern that are necessary to lift the arm above the 90 °.

The dissociation, that here must started, will only be possible as the muscle pattern that are necessary for this movement are there and can cooperate on such an way that the scapula will come in the best position and that the muscle of the gleno-humeral joint are stimulated to contract and help with the movement. That this is very difficult is obvious but it isn't impossible when there is more dissociation possible. Again start with closed chain and here it is often an half closed chain and often with no dynamic elements. But half closed chain have always the problem that the other hand will do the job. Therefore be sure that the affected hand must work on his limit and feel the contraction of the muscle that must do this movement. With hands- on the control over the trunk and scapula /gleno humeral can be greater and give the possibility to get an better result.





Picture 6

**Picture 6.**

Working with an ladder and in this case with two hands and no support on the floor is an half closed chain. Lifting this ladder so high as possible will be an major action or the not-affected side and the affected side must be able to hold the ladder and go with the other hand up. For the endorotation and an extension- adduction in the affected arm elbow are done by parts of the extension [17] movement synergy but the movement above the 90 ° ask for an further movement of the scapula with an extension in the spine and that is the dissociation part. The next step must be, the keypoint muscle activated in the shoulder and try this to increase by load to an reaction of the muscles of the keypoint. Working in an chain will always give less respons of the small muscles. But the respons is there and with load this can increase the coordination and working with an ladder will an stimulus for the brain to search for an optimal solution. Picture 6 published with the responsibility and permission of the author by j.v.d.Rakt.

First part is the lifting part and the following of that affected arm above the 90 °. But when this is possible we must have an activation of the keypoint muscles.

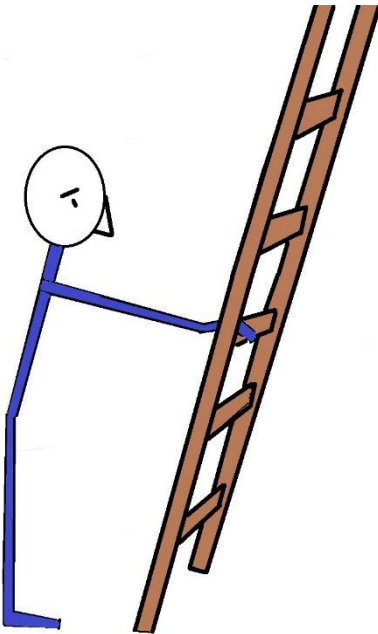
Start with an eccentric contraction[17]. In the highest position ask to change the hand of the not-affected hand/arm. The hand must release with the thumb and fingers and try to hold the position with only the palm of the hand and then slowly set the ladder on the floor. Eccentric is also an brain action and can be more difficult than concentric. Of course is there also the muscle action eccentric that is easier and give an activation of the muscle also the small ones [18,19]. This will be often an R.M. almost 100% therefore search what the best hand position of the not-affected hand is to get also an concentric movement and hold the structure that is necessary to get an increase of power (Strength × speed ) and coordination.

Be sure that the rehearsal is correct. That isn't equal but that the structure are well alignment. Because otherwise there will be an change on an impingement and that can lead to pain in the shoulder and makes progression and motivation lesser. To stimulated the keypoint of the shoulder on another and with load even heavier level is to "walk " with the ladder. When the ladder stand on the floor, we have an closed chain but an walking movement ask for an minimal lift on one leg of the ladder and rotated the other leg to the front and placed the weight on that leg.

Than this closed chain becomes an dynamic closed chain.

But far more important is the fact that this an movement is that must be done in an standing /walking attitude and that the movement of the ladder ask for activity that must be done in the shoulder. See picture 7, holding an rung of the ladder with the shoulder in par example 90 ° anteflexion ask for an abduction movement with rotation(exo) and with control of the movement and then move with hand /whole arm the free part of one leg of the ladder to the front and let down (let down is an eccentric part) but with the hand in the same position, now must there be an adduction with rotation ( endo to get the other leg free and again an movement with hand/whole arm to get that leg in the front. This ask for small but great contraction in the keypoint muscles in the shoulder especially when this an large and heavy ladder. The correction and the control is very difficult and concentric, isometric and eccentric must be active and an important part must be done by the exo- and endorotation muscle.

Placing the on one side of the leg of the ladder and “walk “with the ladder will also activate the rotators of the shoulder.



Picture 7

**Picture 7.**

Ladder walking.

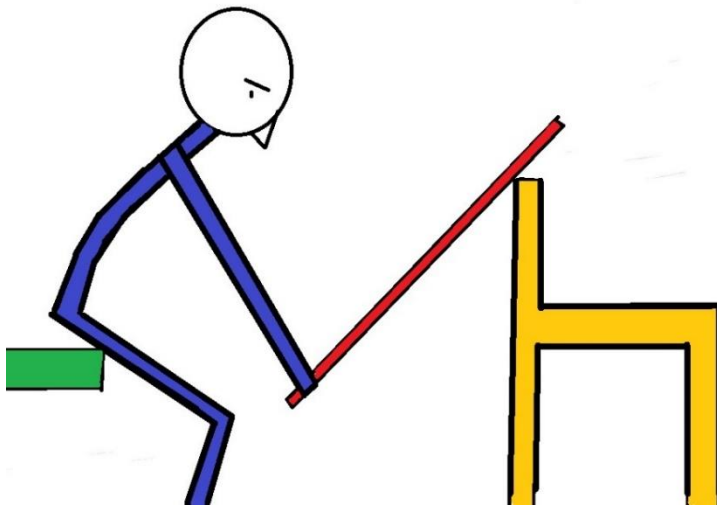
This can also be done backwards and sideways.

And backward with an arm in extension the ladder must be controlled on a total different way.

First the leg on the other side of the ground and getting to you cannot be done without controlled flexion in the elbow. That means that the hand/whole arm must act with flexion elbow, wrist movements and when the wrist movement are not available with shoulder/elbow – abduction/exorotation and flexion but still with a good protraction.

Sideways ask more from the homolateral structure . Marvellous exercise because the purpose is immediately clear for everyone.

And the hand function has to be moderate even a slight bandage makes it possible for a hand with little possibilities. Picture 7 published with the responsibility



Picture 8

**Picture 8.**

Exercise with an heavy load stick; Bringing an stick with load on the back rest of an chair from booth side of the ground or less. That ask for an anteflexion, exo or endo and adduction or abduction and hold that stick in that position .

This will often give use of part of the movement synergy but holding and go up ....Picture 8 published with the responsibility and permission of the author by j.v.d.Rakt.

First the stick on the back support of the chair. This is heavy but starting with pushing far away with an upper trunk forward all away the end of the possible movement. Than stand the gleno-humeral joint on the end of his possibilities and this is moment to try to lift. When this is possible than with an isometric contraction ( hold) and back movement out the lower trunk with the stand of the upper trunk in flexion and place the stick on the back rest.

Of course will this not succeed but start on the floor with low lift and make an “stair” to get to this back side or start with facilitation on the backside and start with hold this position. But this movement bring the structures that are working in the gleno-humeral joint to control also the small movement through the small muscles and still there is an half closed chain that isn’t control through the not-affected side and we are through the 90° anteflexion and close by open chain movement.

When the sick lies on the rest of the back-rest of the chair is the first problem holding him on that spot.

That means that none of the movement synergy may dominated and that the exo /endo adduction /abduction must be controlled. There must be an protraction activity to hold pressure on the back rest otherwise the stick will fall or slide away.

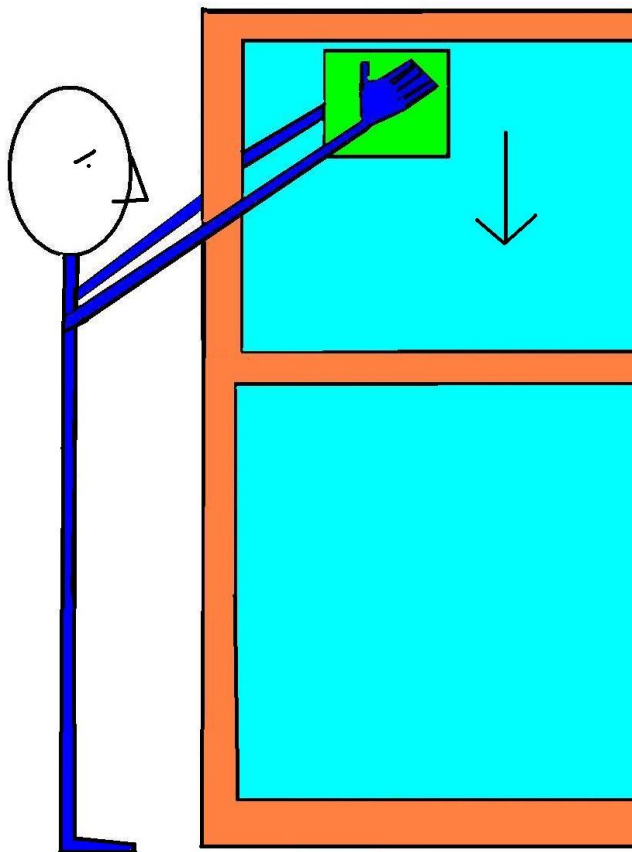
The next step is to get more anteflexion.

Often is starting with an eccentric contraction the best way, but this asked for an holding of the trunk ( upper trunk forward) with an active protraction but certainly when there must be more anteflexion an action in the scapula to get more movement in the scapula because the cavity must go up and more activity in the gleno-humeral joint to hold the position and give more anteflexion.

Often is the R.M. almost 100% therefore be careful with load in the stick. Many of the patient have after this exercise the next day muscle pain, therefore be careful.

The start is often eccentric and that means that the affected hand is placed in an position that the shoulder above the 90 degrees through the other hand or by hands-on facilitation or combination of both. Than the next step[ is an isometric contraction, thus hold that position and last step after hold try to get higher.

That can with the stich on the back support of the chair (picture 8) but an nice method is the use of an door (picture 9)



**Picture 9**

**Picture 9.**

Starting with exercise to get an strengthening of the keypoint muscle and further dissociation in the movement synergy.

Place the hand against each other and in between an door often is an glass-door the best solution. Often an towel can be needed because the door is otherwise to slippery and the hand is often not so relax and an towel protect the fingers and give more grip on the door.

The hand are of both side on an equal high and start with eccentric contraction .

Ask to hold so long as possible and so slow as it can the hand in the highest stand.

An be sure that the keypoint muscle are working, feel !. Picture 9 published with the responsibility and permission of the author by j.v.d.Rakt.

To hold the arm in this position (picture 9) means that the scapula must stand good often al in optimal protraction but that the spine is erect. Be sure that the head/cervical spine- stand in an neutral position because otherwise this can evoke more back diagonal dominancy and therefore another scapula position.

Gleno-humeral **muscles** give anteflexion with endorotation and adduction and the elbow are in extension and that wrist and hand/fingers neutral and in extension. This last part is often difficult because the labour that must be done can be very high and will evoke associated reactions or movements. The first reactions will be evoke the movement synergy and that is often the flexion

movement synergy and then will more occur than only flexion of the fingers . Only flexion of the fingers and an good position of the rest of the arm is an associated movement .

Start eccentric but be aware of the rules of task specific resistance therapy 3 times rehearsal of 10 times by an Repetition Maximum(R.M.)[20] of 75 % , an eccentric contraction is an contraction that is often above the 100% therefore will the amount of rehearsal by far less but work to an point of muscle fatigue and try after that immediately again.

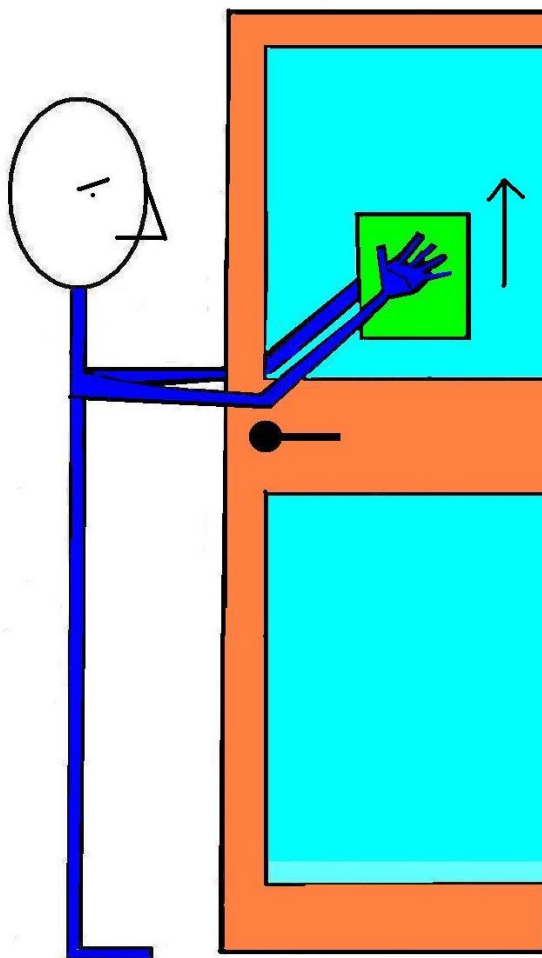
Going up can be stimulated by using the diagonal starting in the feet but often is the placing of the not-affected foot to back necessary, to get more symmetrical push from the lower part of the diagonal. With the not-affected leg will often give more tone increase and more disturbances.

Eccentric and holding moments are on every height possible and especially the hold position are also the position to reverse the movement in an concentric contraction.

The best concentric contraction with be possible after an eccentric contraction that has elongated the muscle in the keypoint and an hold can give the sign that reverse is possible.

But pushing the arms up will give immediately an flexion in the elbow, that is normal but this must be done with little or no exorotation movement in the gleno-humeral because that the flexion movement synergy will take over and the dissociation is gone.

Doors with no glass but with no structure are also possible but the individual will have not the same view.



Picture 10

**Picture 10.**

Concentric exercise for the keypoint muscle of the diagonals.

The elbow are flex but the rotation in the gleno humeral joint is controlled exorotation by the endorotators of the keypoint muscles, together with the anteflexion muscle the push the arms glidding over the surface of the door to an higher level.

Of course and that count for all this exercise will an hands-on facilitation be possible and will have an good impact on the performance but be certain that the amount of effort ask from the muscles is on the right R.M. and that the rules to improve the coordination and muscle power are obey.

Other movement are also possible as the elbow stretching and reach to the other part of the door and cleaning movement of the whole upper part of the door.

But the amount of help of the not-affected side is must larger than people often image.

The power of the "Ramiste" phenomena is also strong in "normal" people but in individuals after an stroke often extreme.

**To must adduction will make an movement impossible !!!!** Picture 10 published with the responsibility and permission of the author by j.v.d.Rakt.

In this exercise still we using closed or half closed chain with dynamic when possible. The reason that the open chain isn't use is because the perception of the arm has always need of input and that is impossible in an open chain or we must exercises in water.

Of course has closed or half closed chain benefit of the other arm as an example the Ramiste phenomena but when it leads to an concentric contraction of keypoint muscle will increase the coordination and will this benefit the open but the difference can be very large.

**Too much adduction makes an movement impossible, is this than for this individual an good exercise ?**

No, when no movement can occur than this is no exercise to stimulated the keypoint muscles. But an eccentric movement is an movement according Dr. Lieber [22] : eccentric contraction comes from an “lower” level in the brain than concentric. It is therefore possible that the damage in the brain is so high that this is still possible. But Fang[23] reported that reaction in the brain are mostly first eccentric to control and that eccentric has need for more brain and of an higher brain level. Still we are searching for an movement that can be stimulated by task specific resistance to improve the coordination of the affected arm. Even eccentric training of muscle isn’t always so safe but movement restoration asked for movements and movements with load because that will give fatigue and that stimulated the muscle and the brain structures.

But that counts for al exercises, keep looking for an contraction of the muscle of the keypoint of the diagonals.



**Photo 4**

**Photo 4.**

An example what difference it can be between an closed/half closed chain and an open chain.

This gentleman was capable to place an crunch with two hands against the wall (picture 12) but when he use his ability to lift his arm in the gleno humeral joint he could only free his arm from his body with an amount of 40-50 degrees anteflexion.

Of course he had also an problem with his balance and had need of the wall as an support and of course he must do an few things together. But in this open chain the amount of power he initiated was so great that the inhibition of the protraction was immediately present.

That because the perception of the affected arm is so poor when there is no input from other sources that he must rely on the input of the synergy movement and that evokes an synergy movement and inhibit the dissociation and the activity of the keypoint muscles. Still the exercise ( picture 12) give him with the upper trunk and the support against the wall the possibility to lift the shoulder sec.

Photo 4 published with the responsibility and permission of the author by j.v.d.Rakt.

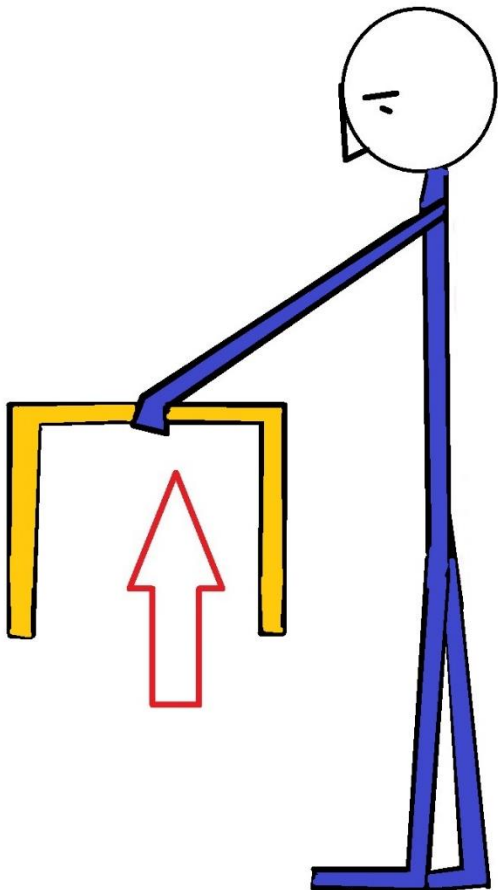
The training (picture 9 and 10 ) are exercises that asked for activity in the shoulder muscle and when there is an possibility to make an movement concentric will this activity be transferable to other situation.

Especially in the ADL because than will be the use much higher and will the automatic of the movement be stronger. Photo 4 give the best image because the lift of the arm isn’t the most important part of this performance. Handling the coat and standing in balance are the most important goal. This independency with his coat was very important and when he was able to lift his affected arm, he asked and searched for an solution that his can put on his coat. The solution was simple, standing with his affected shoulder against the wall, he can handle the coat and put first the sleeve among his arm and

by lifting the arm in the shoulder the sleeve was placed till the beginning of shoulder and over the shoulder, he did with a little abduction (gleno-humeral) .

The way to the open chain isn't direct. We want to have an movement above the 90° and then is it important to stay on training with an half closed chain to get the movement in the muscle and the "brain".

Therefore training lifting things with two arms. The first example was the case of beer or other things that are needed in the daily live.



**Picture 11**

**Picture 11.**

Lift an crunch !

Start with an movement of the trunk – upper trunk flexion to get the dorsal diagonal inhibit and therefore an good movement of the scapula.

Be aware that when bend to pick up something this is an flexion of the upper trunk and that gives an protraction of the scapula but that is often an eccentric movement.

The gleno humeral joint will stand against the 90 ° when the crunch is reached.

Than help the individual to get his hand around the crunch( when the crunch is to heavy or the surrounding too hard the hand can be hurt and that can evoke an flexor synergy movement but we can also see an suddenly extension of the fingers).

But in both cases the hand will be not able to hold and lift the crunch, thus that is to heavy or too hard.

Placing the hand on the side is often the best position for the hand and the arm in the beginning. Picture 11 published with the responsibility and permission of the author by j.v.d.Rakt.

To activated the frontal diagonals pushing over the ground to the front can be necessary (closed chain dynamic). When this is possible let him lift the crunch and hold him against the stomach and move him away and hold this position or hold and slow back to the stomach.

Isometric contraction and eccentric contraction. Hands-on facilitation is perfect but there must be an contraction in the keypoint muscles.

In the scapula there must be protraction and room for more protraction. In the glenohumeral joint the muscle that give anteflexion , adduction and endorotation are active and we start with elbow in extension when this possible.

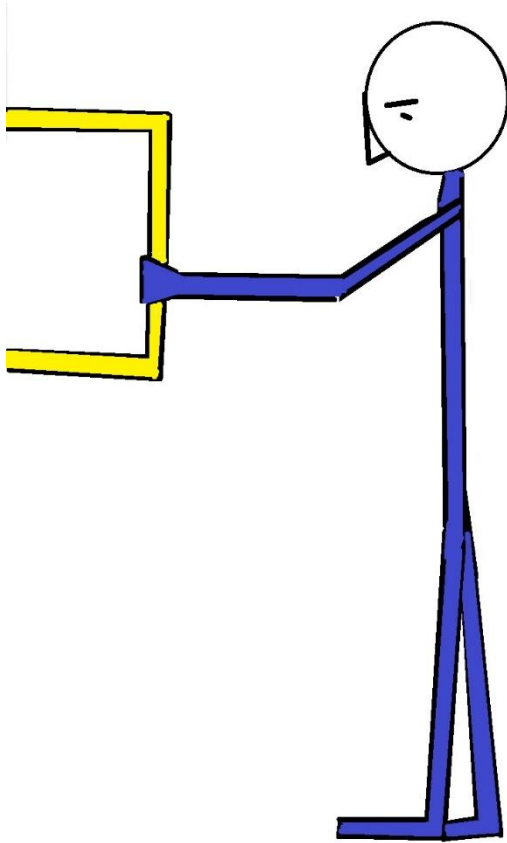
The first goal is placing against the wall.

Asked for an lift moment and be aware what the working is of the not-affected arm.

This can be change by placing the not-affected hand with open fingers but be aware of the "Ramiste – Phenomena"[21] that will stimulated the adductor muscles and make movement very difficult.

We want movement to the top with optimal action of the anteflexoren of the affected side with control over the synergy and that means that the exorotation must be controlled.

Exorotation in the humeral joint is the sign that the flexion synergy movement is active and much exorotation will stopped the lift immediately.



**Picture 12**

**Picture 12.**

From 11 to 12 is a small step but there must be power in the keypoints to get the attitude in which the crunch is against the wall.

The movement in the keypoints are now concentric with adduction and endorotation but the elbow must flex because it is very difficult to place the crunch against a wall with the elbow in extension.

In the wrist there must be a position change because otherwise the crunch will be standing on two instead of four legs against the wall.

(Radial deviation) In this position there are a great possibility of variation. We can hold this position and push against the wall and move with the scapula without losing the pressure. We can take the crunch from the wall and bring him back on the same spot.

We can hold him there but also let go an 10 cm and try to go back against the wall (eccentric and concentric over a small distance, etc.

Picture 12 published with the responsibility and permission of the author by j.v.d.Rakt.

We can also change the position of the not affected hand. Of course will the hand do the most of this carry and placing but when we lose the fingers and the thumb and only the palm against the crunch now we ask very much of the affected hand and also of the affected keypoint .

Flexion of the elbow is a part of the flexion movement synergy and therefore be focus on turning of the elbow outside, because that is a sign that the flexion movement synergy is used to lift the crunch and again when the lifting is going on that the influence of the synergy isn't too bad but when the lifting is stopping that it is clear that this is too much !!

Is a task specific exercise . Remember the rules about the 1.R.M. and the rehearsal.

It is an exercise to stimulate the brain to solve the problem. Therefore look what for solutions the individual find before alter the exercises and use facilitation.

So simple task: take a crunch with both hands and lift him against a wall.

And see the possibilities of all kinds of things in and around the house that must be handle with both hands.

But also the start can be used to support exercise and inhibit the tone but also take care for the mobility of the especially the wrist and fingers joint.

From this support we can go to an pushing to the front of the crunch ( dynamic ) and that will be stimulated the protraction and activation of the front diagonal and the balance.

Even dissociation between protraction and retraction is possible.

Reach to the front so far as possible and then lift through an movement in the lower trunk toward more extension in the spine.

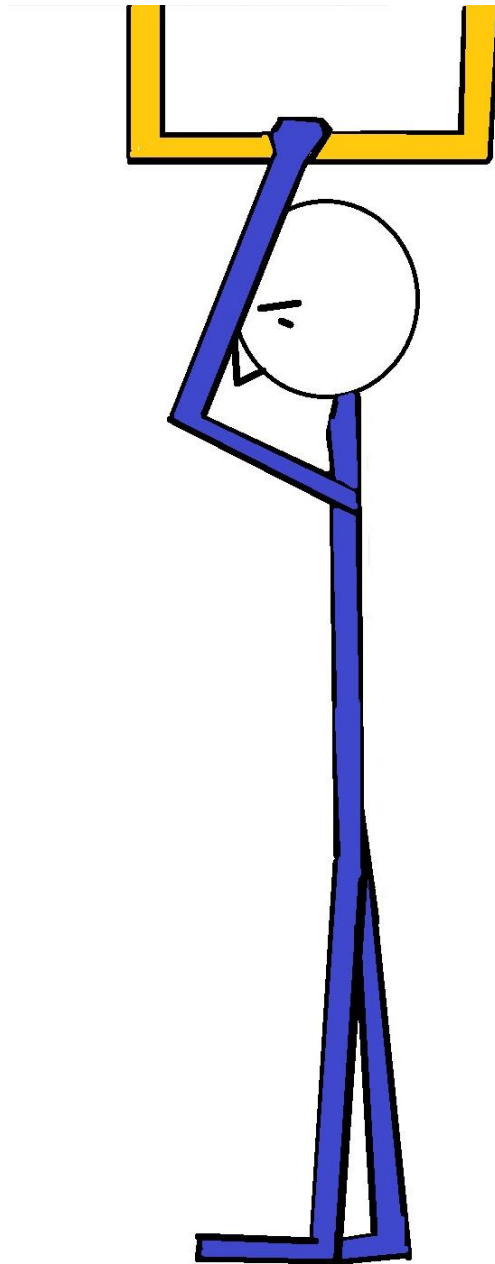
To the stomach and stand complete straight.

From the stomach and hold , place a little down and lift again.

And now the placing of the crunch against the wall.

Here must be activity in the wrist and that can be exercised when that crunch stand against the wall and against the wall means that there must be activity to hold.

We go for through the 90°.



**Picture 13.**

Lifting to the ceiling. And back on the head .  
From pushing against the wall ( picture 12) lifting to the ceiling can mean that all movement possibilities in the keypoint are be used and when that isn't possible choice for a place on the head.

Again the lifting will evoke components of the flexion synergy movement but when the movement is going on and the elbow is coming outside this can be tolerated.

But it is often an 100% R.M. therefore try to use the rest on the head for and recovery and restoration of the balance in the keypoint and decrease the influence of the synergy.

Then first an eccentric contraction and make the distance to the head smaller and try it again often go the movement easier and can the rehearsal and are we training an task specific resistance treatment that able the individual to lift something over his head.

Search for an ADL activity that able him to use it each day.

Example : take the collar of the sweater from the backside inside with two hands and lift this over the head.

The same movement but with no load. Doing this with two hands will give an better fitting on the head compared it doing it with one hand.

The variation in weight, in distance, in speed even in direction are so large that this will be stimulated the brain to search for solution.

The same can be done in IADL : take something out the kitchen cupboard, but we assure that it must be done with two hands. Picture 13 published with the responsibility and permission of the author by j.v.d.Rakt.

**Picture 13**

The goal setting of exercise in ADL and IADL must be that it can only be done with two hands working together.

An movement that not require two hands is nice but will never transfer in the ADL or IADL because everyone is faster with one hand.

When the movement is progressing in speed and execution than we can changes the position of the hand on the not-affected side and /or we can go to work with an higher load.

When this keypoint has the ability to act concentric it is important to get the keypoint on the affected side be able to act on his own. The influence of an chain with the other hand/ arm in huge and for an further developmental it is important that the movement can be done on the affected side alone ... but that means often an open chain and often that step is to great.



In the literature in sciences and in physical therapy there is little attention to investigated, train and exercises on this way.

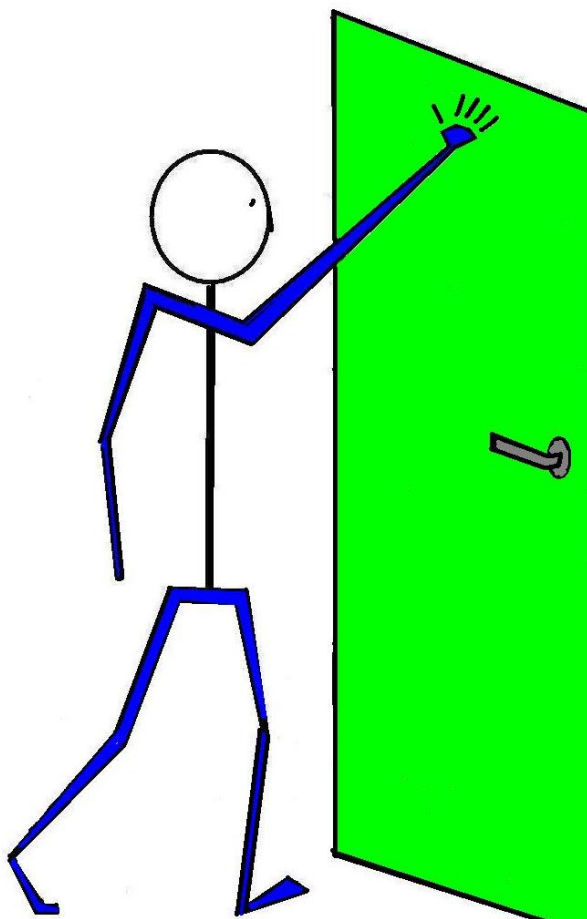
There is also little attention to exercise the shoulder movements at all. Therefore it isn't investigated and prove that the task specific resistance way can be affective for restore the keypoint function.

That is also concerning the keypoint of the hip, nobody has investigated what there is possible with task specific resistance therapy to restore the active rotation movements of the hip.

This is now what experience of an small group of physical therapist who has try to increase the coordination and power on this way. And of course when there was no muscle reaction and especially no concentric muscle reaction than will lifting of the arm be possible but together with the not-affected arm/hand and that part will do 75% or more. But when there was an concentric contraction the increase an power and coordination lead to an lifting possibilities that was amazing.

But still there will always an barrier to do for the individual and that is the possibilities of the hand-function. When there is no function in the hand (only grasp and hold is sometimes enough) this exercises are perfect but the goal setting and using it in the ADL is very difficult.

Therefore is the electro treatment so important because when the science is able to make an apparatus that make the grasp and hold and release possible we have more reason to exercises the affected arm so long as possible to learn him again to lift above his head or on his head.



**Picture 14**

**Picture 14.**

Placing one hand on an door or wall and we start with holding or when this is too difficult with an eccentric contraction of the keypoint muscles.

Than the holding part and then working to an concentric contraction.

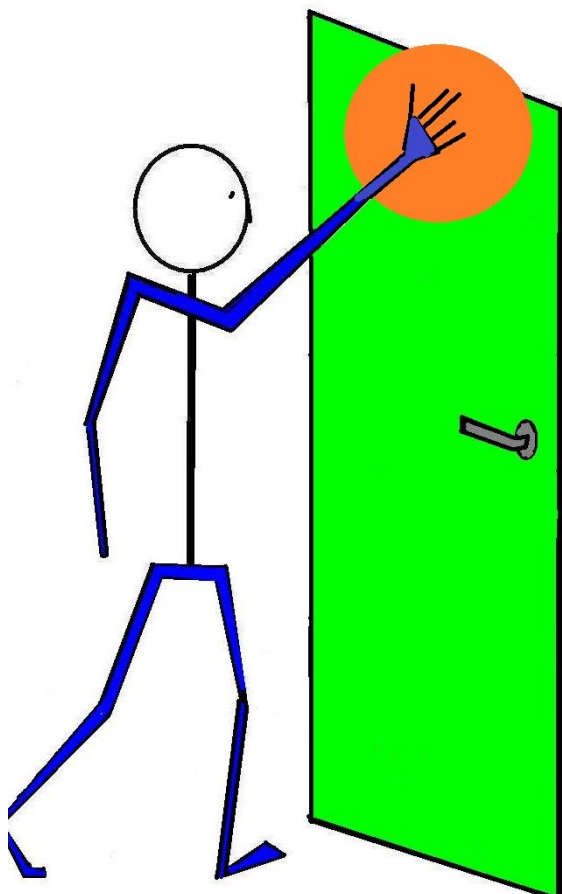
Starting at the highest level is difficult because the muscle are shorter , therefore is sometimes better to start an lot lower.

In this picture the attitude is changed, in an attitude with not-affected leg behind and that weight on the affected leg. This because the homolateral muscle structure will then be extra active and that can have an positive effect.

The not-affected leg can also have an effect by pushing in the not-affected leg will that activated the diagonal to the affected arm.

But when the push is too hard, there is no movement. Picture 14 published with the responsibility and permission of the author by j.v.d.Rakt.

But the same exercise can be done with both legs side by side and of course with two hands against the wall/door. In the hands can also an towel be placed and together she make the movement of cleaning the door.



Picture 15

**Picture 15.**

The same exercise but in this case there is an difficulty that if it is possible, an huge amount of coordination of the keypoint and control of the elbow and wrist and hand.

The individual is capable to hold his hand on the wall/door but now is between the wall/door an great ball.

An the instruction is first hold that ball in that position, an holding exercise .

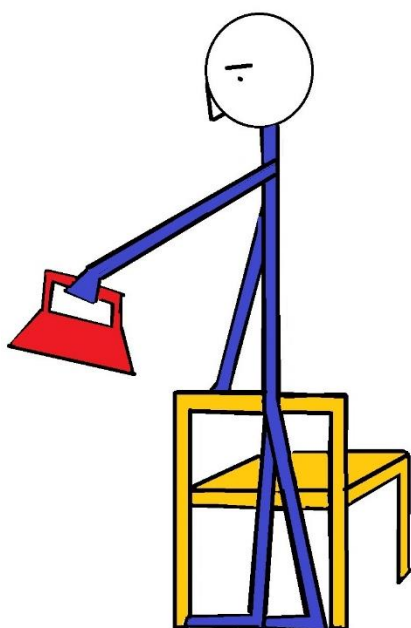
The next step is to roll the ball to left and right and start with very small movement because the initiation is difficult but the brace and the restoration of the position is much more difficult.

Start with the highest position that the individual can and no eccentric movement only left and right. Because the wrist and hand have now an good position and that will be changed when the ball is going done than the control over the hand /wrist and elbow is so difficult that this is often much to heavy and difficult.

An greater movement to the left and the right is an better goal.

Picture 15 published with the responsibility and permission of the author by j.v.d.Rakt.

Here it is important to seek what is the best position of the not-affected leg and of course this can also be done with two hands but than it is an lifting exercise for the keypoint muscle and not an controlling exercises for the small muscles in the shoulder.



Picture 16

**Picture 16**

Starting with an open chain. Use load in the hand and when the hand is not capable to carry that weight, it is wise to make it fast on the wrist .

The load will help the individual to move in his keypoint and get more perception. In the picture the individual stand straight. But an little upper trunk bending can help to hold the scapula in the right position.

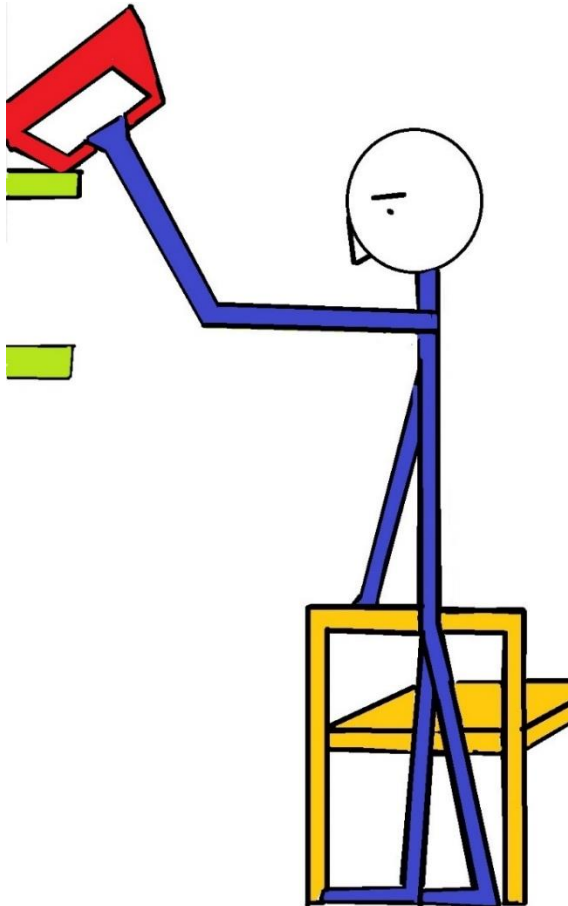
Further it is wise to give the other hand an resting point and placed the feet in an front diagonal position. That is not always the best solution, the not-affected leg further behind will elongated the front diagonal but standing on the not-affected foot to the front give the front diagonal an better anchor and often more tone.

Start with swing and hold and slow release (eccentric).

Picture 16 published with the responsibility and permission of the author by j.v.d.Rakt.

Also in this exercise hold the principles of task specific resistance therapy in your mind. Be sure that there is an R.M. from 50-75% . 50% because swing with the arm is difficult and the weight increase from 50 -75% when the arm comes higher and then the hold is 75%. Think on the amount of rehearsal and the frequency through the week. Only then there is an stimulus to increase the power and the coordination.

The problem with swing is that there is only an goal in holding therefore created an goal in which the swing is important.



**Picture 17**

**Picture 17.**

Goal setting.

The goal is: Try to place the weight with the swing on the upper green shelf.

This will asked for an increase of power in the keypoint muscle to reach that level.

Now the not-affected leg must stand in front because otherwise the decrease length of the front diagonal will brace the swing and therefore is reaching the goal impossible.

The best performance is to do it with the weight in the hand but especially in swing exercises the individual must count on his hand otherwise this exercise isn't possible.

And only an hand with the power to increase the flexion in the fingers will can do this. This means that this can be an exercise to increase the power of the keypoint muscles but without an firm grip in the hand this will be never an exercise that the individual will use in his ADL and his IADL.

This can well use as an exercise to hold the arm /shoulder in best condition and preventing complains about the hemiplegic shoulder. But an goal in the ADL must be always the most important one. Picture 16 published with the responsibility and permission of the author by j.v.d.Rakt.

**Hand – Decreasing of the tone and stimulate the extension of the fingers .**

The hand that had no or little projection on the cortex and thus no or restrict connection through cortico spinal pathways.

This hand isn't capable to make fine movement, independent movement between the fingers and no pincer grasp etc. No or little connection than there is often the possibility to make an grasp and no release. But some time there is an way to learn an form of release and that means that the hand can be use in grasp and hold some things.

Problem often is that when the load is to heavy the grasp can vanished and that the object is falling out. The control perception isn't present and also the capacity to feel and increase the power on that feel. This problem is also there by individuals that have an reasonable hand function but need their eyes to control the grasp of the hand.

The use of the hand will therefore different by all stroke patients.

When there is no possibility to open the hand, the therapy must focus on that part. Because a hand that is not regular open will give problems as stain and will lead to trophic disturbances.

Often will that happen in the individuals with an high tone and only an flexion movement/attitude synergy.

The best method to open this hand is pressure in the palm of the hand and/or the use of ice – water and then after than try to get an exercise with support.  
Further it is wise to teach the individual or caregivers how to open het hand on an regular base. And an hard PVC- pipe can help to hold the hand on the right level.



**Photo 5**

**Photo 5**

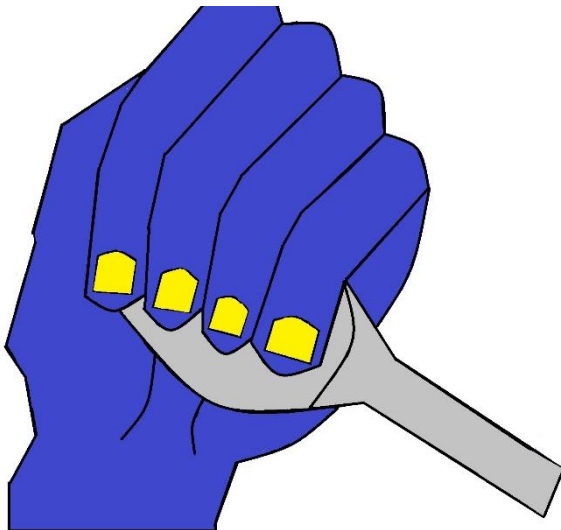
A hand in closed flexion posture with the thumb inside.

To open this hand we can use an spoon that enter on the hypothenar side (picture 18).

The spoon will give an reaction through the pressure that will be given on the hand inside.

On photo 6 is the use of an pvc pipe visual but make the pipe not to great that inhibit the opening reaction and often stimulated more tone in the hand.

Photo 6 published with the responsibility and permission of the author by j.v.d.Rakt.



**Picture 18**

**Picture 18.**

The spoon is an instrument to give pressure in the palm of the hand. But to get there, we enter on the ulnar side. The ulnar will have less tone because the thumb is under the fingers and there is the enter possibility. Than place your thumb on the inside of the spoon and give an dynamic pressure that must be enter the brain! Look of there is an reaction on the face and realize that this must be done for more than 1 minute to get an reaction. The pressure can be very firm. Picture 18 published with the responsibility and permission of the author by j.v.d.Rakt.

**Photo 6****Photo 6 .**

To give an longer stimulus an PVC- pipe can be the answer as the reaction on the “spoon “- treatment is positive [25] but there are restriction. Too long in the hand but with an tone regulation can, but asked for an good control on hygiene. Often the hand will open after an while and then it is important that the tube is out the palm of the hand. This relaxation is an perfect moment to train the hand and often the tone will increase when the tube is directly put back in the hand. Therefore be careful with an Tube continue in the hand because the tone can increase.

Photo 6 published with the responsibility and permission of the author by j.v.d.Rakt.

**Photo 7****Photo 7.**

The use of ice water to give an inhibition to tone. This can be heavy therefore go with the hand of the individual in the ice water. When the individual feel the cold than there is still an perception system active and can this lead to an reaction that inhibit the tone of the flexor and maybe is there an possibility to stimulated the extensor. 3 times 3- to an max. of 10 seconds.

Of course after this inhibition effect let the hand work and that is possible to create an support that activated the arm/hand muscles.

An combi of all activities to decrease the tone is possible but then start an active treatment.

Photo 7 published with the responsibility and permission of the author by j.v.d.Rakt.

When the tone of the flexor are less than there is the possibility to stimulated the extensor to give an extension in the fingers. Often will this an mass extension of all fingers and can this happen also by “pain” on the fingers but to learn from this possibility we must try everything that gives an extension of the fingers.

Again is will be an mass extension and when after 6 months this extension isn't possible by the individual which way isn't important, than there is little change that the hand will have the possibility to extend and will the focus lie on holding the tone and mobility under control.

**Stimulation can on different ways;**

**“Pain” on the fingertip give sometimes an extension in the fingers.**

**Photo 8****Photo 8.**

Another Inhibition can be done with pressure on the fingertips, looking to the face is important because you must know or the stimulus enter the brain. When the extension occur the extension will be stimulated in this case by lifting his no-affected leg from the pillow because that stimulated the keypoint of the affected arm to increase the amount of extension also in the fingers. Photo 8 published with the responsibility and permission of the author by j.v.d.Rakt.

That increasing of the extension in the arm has also an little prognostic element because that means that there is an extension movement synergy and that is an “poor but an dissociation” of the flexion movement synergy.

This is called the “overflow” of the mass extension in to the arm and this we want to feel the individual and learn him to evoke that overflow. Still this is an extension of the fingers that hasn’t control in the brain, therefore also not can be done by the patient himself but there are moment that he has the feeling of extension and can cooperate. Therefore it is an possibility that must be done to get an brain reaction because often there is some projection that isn’t “awake “- The Use or Lose it –principle [26]

**Photo 9****Photo 9.**

Now there is given by the therapist an pressure on the third fingers and the therapist is looking to the hand and the face to see or this stimulus enter the brain. Often the change in the face is almost an painful look but be aware that the perception of the hand in the brain is changed and look to the reaction. And be prepared that when there is an reaction you can stimulated that reaction by using “overflow -principle[27,28]. Photo 9 published with the responsibility and permission of the author by j.v.d.Rakt.

**Photo 10****Photo 10.**

In this case the overflow works and there is an extension in three fingers and immediately give the therapist an pressure on the elbow in the gleno humeral joint and ask the individual to push away.

That means he must make an extension from the upper trunk with this trunk in flexion and activated the extension movement “synergy” to get the overflow to the fingers and try to hold that and to rehears that .

Not every time combined with the stimulus because that isn't nice !! .

Photo 10 published with the responsibility and permission of the author by j.v.d.Rakt.

**Photo 11****Photo 11.**

Another rather heavy stimulus is against the fingertip but in an attitude that makes it easy to get an extension movement synergy from the upper trunk and now the push is clear : “touch “the ground and the therapist gives an resistance. In this position is often very difficult to control the reaction on the face.

Photo 11 published with the responsibility and permission of the author by j.v.d.Rakt.

When we know that the individual react on ice , we can use that stimulus but then the stimulus must be very short and after that immediately seek an extension overflow.

This are possibilities to get an extension reaction but keep in mind that this an reaction on an lower level in the brain . Often the insula area[1] and only when there is somewhere an connection with the cortico-spinal tract this can help to get an “own” extension of the fingers. Still this is an mass extension not an selectivity of the fingers that it should be but there is an reaction and maybe there is more possible.

Some individuals after an stroke will this experience every time but when there is no projection in the brain capable to deal with it, than this has no value after an while .

### **Stretch on the tension of the hand muscle/tendon and then especially the long extensor of the hand and the wrist.**

Because this muscles have an double function that will not be possible for the individual with an stroke to differentiated but the extensor of the wrist can help to create an extension in the fingers and that is on this level the most important issue. When there is an further dissociation than always it is possible to exercises on an higher level of differentiation.



**Photo 12**

**Photo 12.**

The hand of the therapist goes from the underarm to the top of the fingers.

This fast strike will give a firm stretch on the extensor of the wrist and the hand/fingers and that will give a muscular reaction .

That reaction can be stimulated by tapping on the belly of the extensors of the wrist and hand/fingers and again ask the individual to push to the front to try to get an overflow of extension in the whole arm starting in the scapula to the end and that is an extension in the fingers. Photo 12 published with the responsibility and permission of the author by j.v.d.Rakt.

This stretch stimulus will give a reaction of the Golgi receptors in the tendon and the muscle spindles in the muscles and will give a direct loop over the spine back and create a muscular action in the extensors.

That means that there is little or nothing of input that goes to the brain. But when the stretch is firm sometimes individual give a sign that they feel this stretch and then there is well an entrance in the brain and can the reaction be supported by parts of the brain that are active with muscle reaction , when they are present.

When there is such a reaction, try the "overflow" by ask for an action of the upper trunk front diagonal, an protraction of the extensor movement "synergy" and see if this overflow give him the opportunity to get an extension in the fingers.

This will be a mass extension and when the stimulus isn't necessary to evoke this extension but only an extension movement push that there is an overflow that create possibilities to get more control over the hand extension. Still a total extension on a lower level in the spine and lower part of the brain but a reaction. And again what has the damaged brain for a residue to cope with this extension and maybe more is possible.

Try it !!



**Photo 13****Photo 13.**

The stimulus on the tendon is done and now he is capable to extend his fingers.

After 3 times giving the stimulus over the underarm and down so that the wrist and fingers are stretch in an maximal length, he was capable to lift and hold this position.

The next step was an little stretch and then he can lift his wrist and fingers and every time with an push to the front ( " touch the wall on the other side ")

The attention to hand is great, he see it but he don't "feel" it and that is the next part that is working on. What is he feeling and how he can see and feel that his fingers react!! He has feeling but don't know that this was finger-extension, but he call it : " My hand was awake "!

Photo 13 published with the responsibility and permission of the author by j.v.d.Rakt.

**Photo 14****Photo 14.**

The push in the extension "overflow "is now given in the wrist and that means that the muscle that give extension in the wrist and fingers are no longer in maximal extension. The fingers stand against the leg of the therapist and the individual try to make an extension in the fingers without seeing what he is doing.

He must concentrated himself on the feeling of the movement and feel also the resistance of the leg of the therapist. And was able to give an extension against the leg and feel that resistance but he say : "is so different with my other hand "! He try it also with his not-affected hand, instruct himself !

Photo 14 published with the responsibility and permission of the author by j.v.d.Rakt.

Here was extension function in the fingers after stretch impulse and after that there was also an reaction in the brain but the recognition wasn't there. But there was an projection in his cortex.

He was waiting on an feeling that compared with his other – not-affected –hand and must learn that the feeling he feel was different but that he had control over that feeling and can use his hand. He play the piano therefore we make an chair with an support for his affected arm and he work on movement of his fingers on the edge of the table as was this an piano. After this we have search for an piano because now he exercised much more.



**Photo 15**

**Photo 15.**

His “piano “ exercise on his table.

His control over his arm and especially his shoulder was still poor, therefore the side of his chair was adapt and was he able to move with his fingers and wrist without moving his fingers.

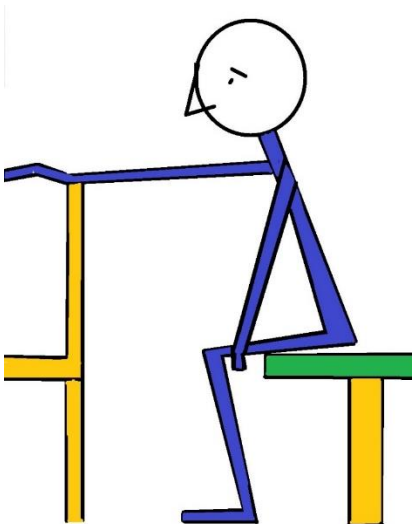
To get the best sit position also his chair was adapt in height. He try also to get this table as an drums and exercises on that way more his wrist movements.

The amount of extra exercise was great and that was also the reason to get an piano to have more attention to the play as on his hand.

But there was an adaptation necessary to control his arm /shoulder.

This was be done by placing this chair with arm support for the piano and the piano was adapt in height . The greatest advantage was that much more trunk movement occur.

Photo 15 published with the responsibility and permission of the author by j.v.d.Rakt.



**Picture 19**

**Picture 19.**

Another example to get an the extension overflow. And in this example the chair stand on four legs but when he set the chair on two legs than there must be an continue action in the front diagonal affected side upper trunk and an continue protraction in the scapula.

The chair is holding with the last part of the under arm not with the wrist. With the wrist is also possible but then will be the stretch on the extension muscle be lesser.

In this position he must get an maximal extension and still pushing against the chair .

Next step is extension with no pushing any more .

Or move in the wrist and fingers to get extension in fingers and wrist, this can be the first step to some kind of control.

Photo 19 published with the responsibility and permission of the author by j.v.d.Rakt.

When “pain-feeling “can teach an individual what extension in the fingers is, than it is obvious what an change of perception there is in the hand.

We see often that when there is object in the hand the extension that occur without an object isn't possible anymore.

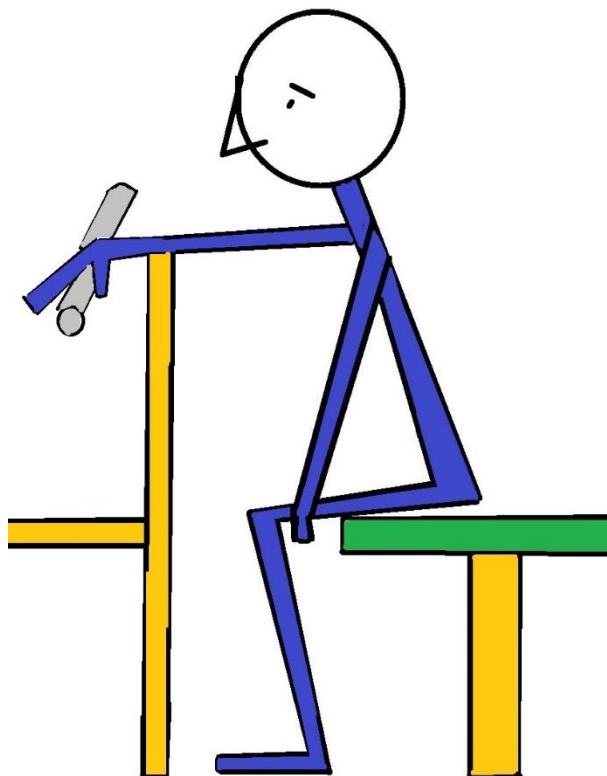
That means that the object gives an input to the brain and the brain react with flexion instead of extension, an primitive kind of grasp-reflex [29]

Here is an disturbance in the perception and this is the most difficult part because now we try to change in perception in the brain with an change of input but also with an control of the output.

Par example we can give this individual an treatment starting with ice water and that will influence the tone on muscle spindle level but also change the feeling in the hand and try to exercise the release of the object in the hand.

That will succeed but when the individual must have first an ice water treatment every time, than will this stay on that level because the perception isn't change enough and then other activity must be done and one of them can be electro therapie (F.E.S.[30,31])

Another example is to give an individual something with an load in his hand that is so heavy that he must concentrated continue on an concentric contraction to hold that object in his hand and when he is an little tired we start the release manoeuvre. But also here we create an input that is normal for the release manoeuvre, not directly an extension but to get the feeling in the hand this can work to regaining feeling of les tone or grasp..



**Picture 20**

**Picture 20.**

Holding and release.

Knowing that the flexion of the fingers is inhibit, when something is in the hand, that the best way to act is to give something with load in the hand.

Now the individual must work to hold the grasp and give him also the opportunity to lower the grip( flexion) and let the stick fall. When the stick is out of the hand start immediately with exercise to get the active extension back in the hand, because release is not the same as active extension. Try with an light touch in the hand palm to stimulated the hand but ask also to hold the active extension so long as possible.

So he can learn to control the grasp reaction and can object in his hand let go without there is an need for an extension overflow and use of object with load.

Picture 20 published with the responsibility and permission of the author by j.v.d.Rakt.

This an very difficult exercise and ask for very high concentration. Therefore it is wise to make from this an combined treatment.

Not only use the overflow but also all stimulation technique and the technique with electro or with support training as an inhibition of the tone.

Ice water will also inhibit this reaction but know that there is then also an change of perception in the palm . This is than an situation in which the grasp reaction is inhibit and will not have the resemblance with practice of every day.

When there is more power to release and there is enough insight than we can use an glass.

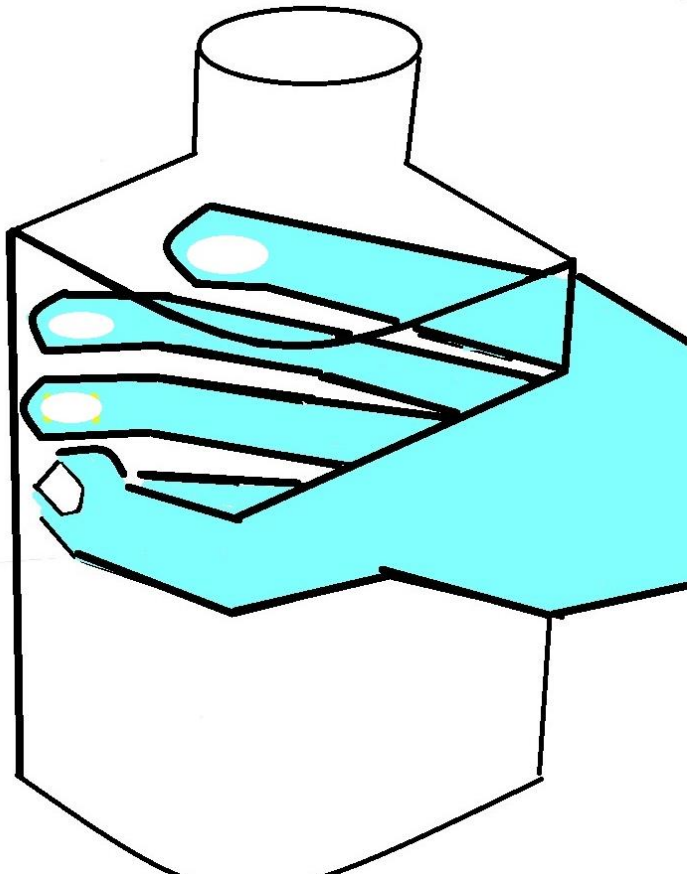
Holding the glass the individual can see on the marks that come on the fingertips how much pressure he use to hold the glass.

And now he must try to lower this grasp without losing the glass.

Then place him on the table and make the hand open by first release and then an little extension.

You can discuss of this is possible with no cortico - spinal pathway but in the practice is that very difficult to see the borders and must the therapist try everything to get the best results.

For the arm is an hand that can grasp and let go the most important capacity because now is there an "USE "for the hand/arm. Combination with F.E.S.[32] is this perfect exercise to learn what the feeling is in hand and by hand actions.



**Picture 21.**

The marks on the fingertips are white and that is an sign that there is too much pressure on the glass and that the flexion power is too high.

The individual must try first to lesser the pressure and have no white fingertip and try than to release with an active extension.

This can be done in combination of extension overflow by sitting on the table and then stretch the glass as far as possible away eventually with the chest against the edge of the table what give the flow.

We can also start in that position with pressure of the chest against the edge of the table. Photo 21 published with the responsibility and permission of the author by j.v.d.Rakt.

**Picture 21**

**Support exercise on the hand and then pressure on the flexor muscle of the underarm to get an further inhibition and stimulated the extension of the fingers.**

Starting with an heavy support exercise, heavy because we place the hand in such a way that the muscle of the flexor are almost maximal elongated and that inhibition we use to facilitated the extension of the fingers together with an extension of the wrist.

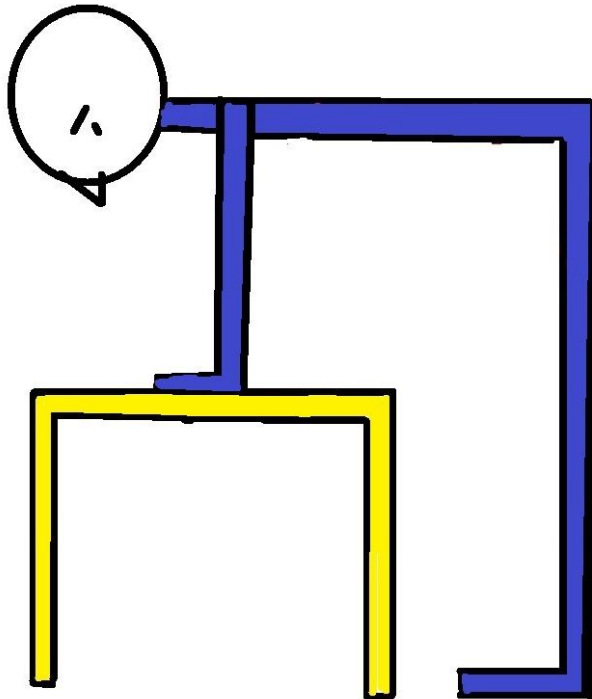
This inhibition through support must be done on an hard crunch and with an flat hand when possible. Of course is it wise first to give an treatment with the hand in the ice water and go with the individual hand in the ice water and feel of the relaxation of the tone occur.

In the ice water cub you can start with support activity by opening the hand and place the hand and fingers/thumb so flat as possible on the bottom of the cub.

When the relaxation is there go to an hard crunch and paced the hand so flat as possible and ask for an full support.

The best way is the support in standing with the upper trunk in flexion and with an total closed chain without dynamic.

And try to move with the body further to the front to get the best elongation.



**Picture 22.**

An example of the support to relaxation of the tone of the flexor of the underarm /wrist and hand fingers and also the thumb.

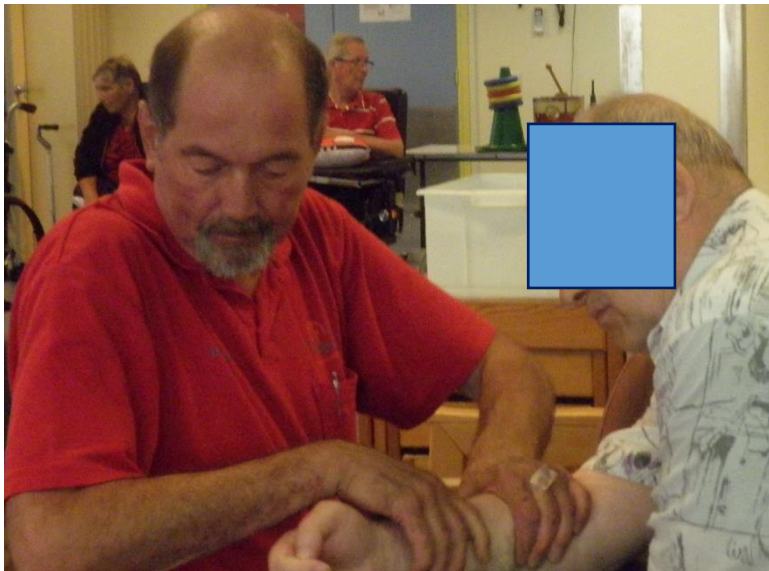
And in this picture the hand is flat on an hard surface and almost on the end of the mobility of the wrist.

Still of give more stretch ask of the individual will move further over his wrist to front to make the inhibition bigger. But stay alert because the structure of the wrist can be hurt. Than work with the fingers over the edge of place something in the palm of the hand.

Photo 22 published with the responsibility and permission of the author by j.v.d.Rakt.

**Picture 22**

This extreme inhibition can with every treatment of stimulation be use but here is now an special one. The inhibition of the flexor is keeping alive when the stimulation of the extension of the wrist/fingers occur.



**Photo 15.**

By giving pressure on the flexor muscles of the underarm it is possible to sustain the inhibition and stimulated the extension of the fingers. Often is the inhibition so fast gone that this technique is very useful to hold the inhibition longer sustained.

Photo 15 published with the responsibility and permission of the author by j.v.d.Rakt.

**Photo 15**

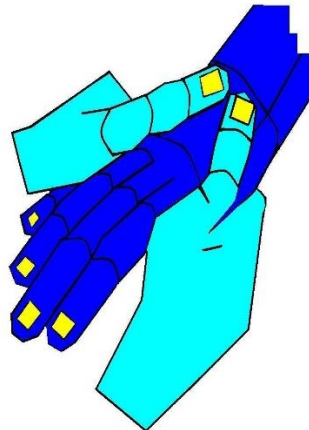
And of course are all combination to inhibited and stimulated possible, but releasing through the perception of the hand palm is very important and that this must change will the flexor grasp by holding an object vanish or be lesser dominant.

In this will elongation, tone relaxation, releasing heavy object, ice water and electro therapy be very important. Even casting will have an contribution but then is must be clear that there is some active extension otherwise the effect will be minimal or total zero. [33]

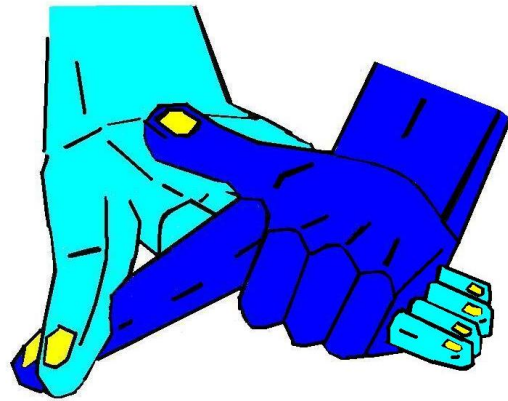
An special technique to handle the hand, wrist and fingers when we start to go in the ice water. This is all an inhibition but by holding the hand in this way the placing isn't so difficult and you have one hand free. With two hands you can give special attention on the thumb and the part of the thumb in the hand palm ( thenar) will response very well on pressure inhibition on the muscle together with elongation .



**Photo 16**



**Picture 23**



**Picture 24**

**Photo 16. Picture 23 and 24.**

Three technique to obtain inhibition and hold the hand/wrist in such a way that good placing is possible. Good inhibition will also give an change in the perception because the muscle spindles fire in another way and that must be enter the brain.

Photo 16. Picture 23 24 published with the responsibility and permission of the author by j.v.d.Rakt.



**Photo 17**



**Photo 18**

**Photo 17 and 18.**

After the treatment was this the position in which he was able to give an very slight extension But he can this the first time only two times than he can give extension but not so far anymore. In photo 18 we are 4 months further and now he is able to do this 20 times without losing extension range. But still was the need for an inhibition program before reaching this goal.

In the ADL he feel that his hand will " listen "better and release faster but the active extension wasn't there that still had the need of an mass inhibition.

Photo 17 and 18 published with the responsibility and permission of the author by j.v.d.Rakt.

Effect after the inhibition treatment with ice water, support and maximal elongation and inhibition with pressure on the underarm muscle ;

The solution was for him the hand master, now the release goes faster and he can that also in the ADL when he exercise in the morning before the ADL.

### Electro treatment

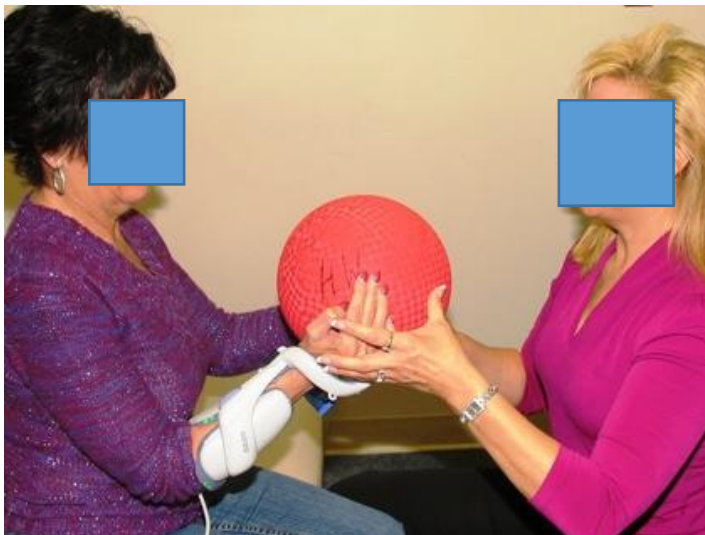
Combination with electro therapy (hand master[32] ) can also train the muscle and the brain what extension of the hand is but that will ask an active participation of the individual because otherwise only the muscle react and is there no problem-solving situation for the brain and therefore no “brain-therapy”.

There is now an growing evidence that the combination electro on the extension of the fingers and exercise in which that ability is use, has an positive effect on the extension ability of the hand. That means that electro alone will benefit only on muscle level and hold the mobility and the tone of the hand, but will not stimulated the brain to solve problems and will not create an projection of an hand on the brain on any level .

This an “law” that looks like the “RED”- wire, when we want hand function on an higher level. Not Robotica or FES alone will do the job, but all together in the right context and task specific and ...necessary for the independency in the ADL.

To long have investigators in laboratories focus on alone Robotica without making the step to All Daily Living - elements and then is the exercise in the lab. beautiful but meaningless. This conclusion was also done by the Stroke Round Table Conference in 2016 and by an Congres in 2017 in Paris.[34,35,36] Still the reality stay that to get an hand function back on the normal level there must be an cortico-spinal pathway and otherwise this will be an hand-function on an lower level but be sure that is an hand-function that can be used!

Therefore combined all kind of therapy and look and measure what it does.



**Photo 19**

#### **Photo 19.**

This the most important issue that there is in using electro to achieve an better hand function. Not the movement that this electro make will enter the brain but the problem solving approach that will enter the brain. Holding an ball between two hands and give the ball to another and let go is the problem that will be solved in the brain.

Photo 19 published with the responsibility and permission of the author by j.v.d.Rakt.

#### **Is only using the hand master of other electro so useless?**

When you had as goal for an better hand function that is useful for the individual after an stroke than is the answer YES !

When you want the muscle of the underarm, the trophic and the mobility holding on that level than is the answer NO!

But in the last case than must there be an impossibility, that the hand function ever occur and therefore always try to combined the electro treatment with other exercises.



Photo 20



Photo 21

**Photo 20 and 21.**

The action that is possible through the electro makes that the hand is useful and make that happen that will change the projections in the brain and the brain will learn. In 21 this is done in an CIMT (Force Use[37] ) exercise , therefore the only solution that is possible is by the affected hand. Photo 20 and 21 published with the responsibility and permission of the author by j.v.d.Rakt.



Photo 22



Photo 23



Photo 24

**Photo 22, 23 and 24.**

Examples of using the electro only to get an movement of the extension of the wrist and the fingers.

Of course it is fun that your affected hand moves again but the fun will far more greater when you can use your affected hand.

Photo 24 give an example of an hand that isn't good in his alignment and then can this electro treatment especially when he stand very high gives this rare extension of the fingers. Further is the brace not properly placed because the movement of the wrist isn't good possible.

Photo 22, 23 and 24 published with the responsibility and permission of the author by j.v.d.Rakt.

**CIMT ( Forced Use)**

In 1976 has Ostendorf [37] written an article about forced use. That was an method to get the affected hand/arm in an situation that the individual must do the job with the affected hand alone. This idea was born after an investigation of Ogden in 1917 that he discover by monkeys [43].



When the hand of the monkeys injured in the brain the recovery go faster as only the affected hand can be use and that is the base of the forced use method. In the years 90 of the last century Taub did this investigation again and from that day on was CIMT born (Constraint Induced Movement Therapy)[38,39,40,41]There are now an lot of investigations done with CIMT and the result are very good, but this investigation are done by individuals after an stroke where the cortico-spinal pathways were intact or almost intact. The first group were individuals with an “neglect” for the affected arm/hand, they had the function but because of perceptual/ neuropsychological disturbances the use this hand not. CIMT was the solution to create an situation that the focus of attention goes to the affected hand and the results were very good.

After that there are different types of CIMT created but the group of individuals with an stroke was always limited to that individuals that had an good prognostic.

That means within 48-72 hours after the stroke has an abduction in the shoulder and an extension in the wrist and fingers of more than 10°. And the question arise of this hand function with other therapy (that as so long and intensive as CIMT) has go the same way and what will be happen by individuals with not that prognostic sign or with more disturbances of the cortico –spinal pathways.

There are investigation that also treat chronic individuals with an stroke but the function of their hand was relative good and often this was an neglect or an loss of perception with an good hand /arm function of both. But this result were also good, when this people had received the electro therapy with ADL exercises or task-specific resistance therapy, was this result than also possible.

This questions are still today not the main topic in the research of the rehabilitation of the individual with an stroke but there are sign that the focus will be changed by the TIDieR guideline[44] and the round table[35] group to intensify the investigation for all individuals with an stroke.

CIMT ask for an good team. There is an exercise time with the affected hand of 1-3 hours and there is an daily time that the not-affected hand/arm is restricted from 1-9 hours a day. And that ask for an team that is available the whole day. That is possible in an rehabilitation centre where in the Netherlands 9% of the individuals get their treatment but the others are at home or in an geriatric rehabilitation centre ( Nursing Home) and that is often not possible or not done so long in time.



**Photo 25**

**Photo 26**

**Photo 25 and 26.**

By children or adult the principle is the same. The not-affected hand/arm is immobilised and the individual must try to do all things with the affected hand/arm.

That means that the difficulty is very clear and that gives an high intensity with an high intensity on cognitive function especially attention. The different is the length of the exercise that is different from 30 minute up to hours an day, Sometimes 3 times an week but also 7 times an week is done and in some protocols is wearing of the immobilisation also the remaining part of the day.

Photo 25 and 26 published with the responsibility and permission of the author by j.v.d.Rakt.

CIMT is now one of the most investigated intervention of the affected arm/hand but the level of this hand /arm function in this investigations had, is very high. Almost every intervention has an hand function that gives an picture that the cortico-spinal pathway is not totally destroyed.

An example is the hand/arm that isn't used through the neglect syndrome.

But there are an lot of exercise possibilities that can be done with and without CIMT. Especially the hand activities that need two hands acting together are important because that is very much the activities of the ADL and the IADL.

### **Conclusion:**

To treat an arm after an stroke is an difficult task. Fingers and hand function recovery has possibilities as there is an cortico-spinal pathway and therefore an connection with the brain cortex. By the most persons after an stroke isn't this the case or is it not clear what there is. That means that in the beginning all person must receive an optimal treatment with all possibilities and the demand of an action in hand/fingers an shoulder after 72 hours makes that many therapist makes choices and that means that many persons will not have the optimal possibilities to recover.

And the most important part is the combination of the whole body in this treatment and that the shoulder is the base of the arm and need the support of the remaining part on both side (Diagonals). Further is an combination of treatments is essential. An inhibition has no value as there is after that is no facilitation and stimulation and there must be an relation with the ADL. That what the hand/shoulder can, must be used by this person.



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