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## Rehabilitation of the upper limb after an stroke. Part 2.

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## Abstract

*Part 1 started with the chains, the base for exercising the arm/hand function. Further we discussed the most affected form after an stroke and what we must do to prevent further loss and build an base to an optimal result. That treatment content: 1) Hold the mobility in all joint. 2) The trophic of the arm /hand must be optimal. 3) Try to reduce the high tone and be aware, that when the head of the humerus shift, that tissue also must change of place. Tone in the pectoralis and latissimus will give an pressure and stretch on the n.medianus, that lies behind the pectoralis and that can damage this nerve. Sometimes the tension on the n.medianus is so high that the nerves lies not behind the m.pectoralis but under or even in front of the muscle 4) Be aware of the low perception and extinction. 5) What does the tone of the back diagonal – to the shoulder blade position. 6) Try to exercise in an closed chain and build up an support function in different position. 7)And try to give stimuli that enter the damage brain, but be careful. The mobility has written down in part 1, but this isn't only for the individual with an severe stroke but all person after an stroke must have this treatment. Of course will the possibility to make movement on his own, makes this an lot easier, but still asked this for an frequently assessment . Part 2 goes further with the trophic of the hand/arm and shoulder because this is often for many person after an stroke an moment that the recovery stops and an lot of pain will influence the quality of life. When it is possible will active movement be introduced because that is the best way to hold the mobility, prevent trophic problems and get the best result. And we go to train the arm that has no or little function with the chain rules .* **Citation.** Jan van de Rakt , Steve McCarthy-Grunwald; The “Pusher “ syndrome, assessment and treatment. Part 2. - Ita. J. Sports Reh. Po. 2023; 10 (22); 1; 2; 2243 -2277 ; ISSN 2385-1988 [online] ; IBSN 007-11119-55; CGI J OAJI 0,201)]. Published online. Authorship credit: “Criteria authorship scientific article” has been used “Equal Contribution” (EC).

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## The Flexion Attitude Synergy. An multi-eclectic approach.

### The trophic of the arm /hand must be optimal.

Trophic disturbances will have an great influence on the selectivity, pain and therefore on the tone and that can have an effect the recovery of the arm/hand after an stroke. The whole body will involve as we say in Part 1 with the mobility of the arm and his connection with diagonals.[1,2,3]

Trophic will often end in the hand/wrist or shoulder and sometimes an foot but is far less.

We know out the orthopedic falls, what an minor damage can do with the vegetative nerve system and what for treatment there are that try to stop or treat this disease[4]

There are medical treatment but also exercise treatment like the Macedonia method[5] that try to reset this disease.

There is still much discussion, what the reason is, why some had this and what the best treatment is. But by individual with an stroke and certainly the severe one is this disease and disaster and there is still no evidence what is caused but there are direction that little damages often is one of the reasons. That is pointing on the shoulder pain, when the scapula isn't well moving, this will give little pain and often no pain but little damage that can created an base for an trophic disturbances.

The whole system had an ( individual) border and individual with an great loss of perception will go faster over that border than individuals with an good perception. They will feel that the movement is not good and will give an sign. An subluxation isn't the reason for this trophic disturbances but an subluxation makes the shoulder joint well vulnerable. An when the whole treatment team and the family isn't careful, this can end in an disaster.

The same we see in the hand and wrist, when the wrist is bended till the end of his possibilities in an palmar flexion than the transport of venous blood[6] and lymph isn't possible to the axillar region and this fluid will build up in the hand inside and later on, on the back of the hand.

Immediately treatment will prevent further damage but one or two days to late will almost never restore the damage complete and there can be created an reason why this or the next damage the system will be dystrophic. And then we have an shoulder-hand syndrome what is an very difficult disease to treat especially by individual with an stroke because often there is no active movement and only passive is possible and you must be very sure that the movement is possible on the right way otherwise we make things worse.

The symptoms are often very clear. They are edema , redness, pain, strange nail, strange hair etc.

The edema and redness can be extreme.



**Photo 1**

#### **Photo 1.**

Very acute stage of dystrophic (CPS-1) and the edema is high. Here is only treatment cooling and careful and medical and wait !!

This isn't comment by individuals with an stroke but when it happen the problem is great. This is an reaction that is so acute that medication will be needed to decrease the symptoms.

Wrapping to push the edema up or other technique are dangerous in this stage.

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

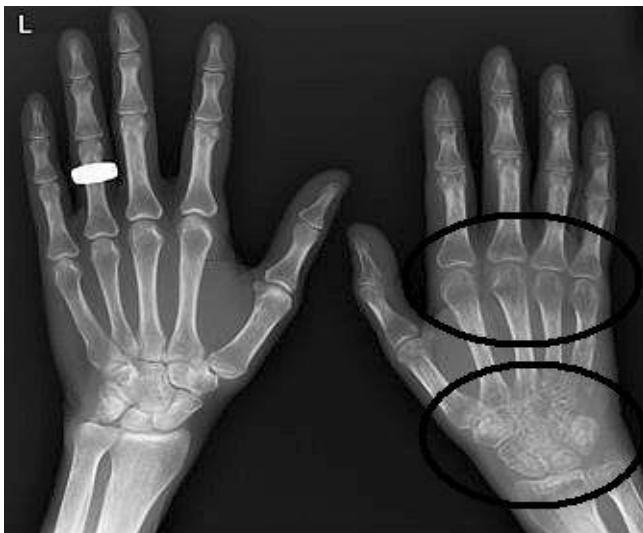
In the acute stage no treatment except careful cooling, splinting , medical care and rest are possible . When the edema and redness is less start with mobilization and if possible active and on cover of the pain. But here is the first problem by stroke patient, because often the movement cannot active, therefore the therapist must do it several times on an day passive and in the first 3 till 6 weeks every day minimal of 5 times a day. Than we see that the acute stage is disappearing and that the mobility can be restored. The mobility must be restored when possible as before and when that succeed the consequences are limited. But often is after one week the treatment not continued or to weak or too hard and then will tissues suffer from this dystrophic and changes.

It is good to give this individuals an simple sling, but that is part of the resting part of the treatment, the mobilizing part is equal important and can make the difference.

And again 3- 6 weeks every day thus also on Saturday and Sunday !!

This treatment must prevent that there are changes in the tissues. We see in loss of bone-tissue but that is only one part , we see also bone- tissue in the joint, creating stiff and immobile joint especially in the fingers.

That means no use for the hand anymore but also an danger that only an slight incidence gives an fracture with all consequences.



**Photo 2**

**Photo 2.**

Rö – photo of an affected hand comparing with the not-affected hand. The right hand show darker and less border of the bones, especially by the metacarpalia. This part are very fragile and can easy give an fracture. On this Rö- isn't the reaction in the joint visible, but we see than that the joint are not clear anymore and that with ( bone –tissue) goes over the joint part. That gives an irreversible contracture. [7]

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



**Photo 3**

**Photo 3.**

After the tick hand-period, the hands of two individual after stroke. The left one has little movement in his metacarpalia but also the other joint of the fingers are restricted. And after this, the hand function recovery started but he cannot use it. The other hand(right) has no function, the thickness are joint that are “bones”.

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

The impact is very great, individuals can have so much pain that they don't want to exercises and stop with the treatment. That means often that the rehabilitation is stopped for months and that the outcome is very poor. And there is by this group an great change of rehearsal.

The best way to treat this, is to prevent it. And that means that the whole team must be alert on edema in the hand and pain in the shoulder and that all members inform each other what the complaints are of the individual with stroke.

And when there are complaints, please react on time that will prevent the greatest problems.

The edema and the pain of the shoulder will be discussed in another article.

### **Be aware of the low perception and the danger of extinction.**

Perception and tone have an effect on each other. NDT-Teacher Jacques van der Meer[8] said : "When the tone is low and stay low than is the perception exceptional low". Perception is formed in the brain by all the input, that we receive, but your arms and legs have greatest benefit from the input that comes out the arm and leg itself. The variation on input is very great from tactile , proprioceptive and gnostic, hot and cold till pain, all that input makes the perception of the arm in the brain. That process of information of the hands and feet is an continue process and the brain asks for this amount of information. To hold the projection in the brain optimal this needed an continue information otherwise will this projection decrease or change [9]. That is the base for using the arm on automatic level as in ADL. We look to the clothes, to see how it is construct but the arm goes on his own, we don't think on the movement that we must make and that means that the movement of the arm are automatic and need no extra visual contribution. And the arm give input back also through the muscle spindles and that feedback is very important.

Only when the clothing peace is extra ordinary, we can have problems with how to do this on but still this isn't an arm /hand problem but an praxis problem.

Loss of perception means also that this awareness of the position of the arm in the space isn't there and now we see that individual with an stroke have difficulty to do things with "his" arm/hand.

But there can be more reasons that this can be an big problem ;

1. The individual don't recognized the blouse and don't know where he must put his arm /hand
2. He don't know how he must performed that action.
3. And he feel not his arm/hand and when the arm /hand is in the sleeve, he don't see him anymore and the arm /hand is gone. This we see often when the hand and underarm is in the sleeve than is the visible part of the arm gone and the individual start with lifting the blouse over his head but the sleeve isn't high enough and he get in trouble.
4. His attention to his affected side is less and he is constantly looking at his unaffected side for an solution.
5. All disturbances can also interfere with each other or has influence on the whole complex picture.

Perception is here an major problem because perception is the base of recognition[10]. With the right input know what some thing is, is better possible certainly when all input canals can used. Without the perception of the arm, it is an job of the visual perception to recognize. When there is also an perception problem than we have two canals that given 't the perception his input that is needed.

Perception loss gives an poor selectivity and an low tone. Spasticity is often an sign of more perception than an long period of low tone.

This period of low tone will mostly change in an flexion attitude synergy and that means no movement and also very little input to form an new perception image.

When this tone is on certain muscle more than others and the mobility is decreased than there is not only an low perception but also an extra problem in the ADL.

That is the reason that therapist must work at the top level to hold the mobility and try to increase the possibilities of the affected arm to an movement level. Movement even poor movement will always give more information and will build up an projection in the arm/hand and movement will also decrease the tone[11]. Problems with action (praxis) recognition (gnosis)[12] can have an direct

relation with the perception and thus with input that the brain receives and can work with. When the attention is an problem than can an bad perception change the picture in an neglect[10]. When there is still movement in the arm possible than there will be input come in the brain from the muscle spindles. When this is only tone-increase will this give an poor input. And regrettable often occur this, when the individual do something that is extreme difficult with his not-affected side.The reaction on the affected side is an tone increase that isn't "felt".

That means that this arm is in extinction[13] for the greatest part of the day when no treatment will be given that enter the brain .

Therefore work on the arm because you work than also on the perception [14,15]

**What does increasing activity of the back diagonal, with the tone and the shoulder blade position.**

The flexion attitude synergy is an synergy in which the individual after an stroke cannot initiated movement. Often is the keypoint shoulder out of line ( subluxation and high tone in adduction /retroflexion muscles) and that pull the gleno-humeral joint out of his normal position.

Changing the tone of the trunk will affected always this attitude synergy and often makes movement or total impossible by increase the tone in that muscles or possible when it act as an inhibition.

Especially movement as walking, balance[2,3] but also standing up and turning in bed[16,17,18,19]. But in an sitting position washing and dressing can also have that effect and that means that there are so many moments on a day that the tone will increased that therefore there must be moments that this increase is inhibit and that the mobility is restored.

An individual with an stroke with an flexion movement synergy can fall back to an attitude level synergy by only exercise on walking and balance. When there is no attention for the arm/hand than will this arm/hand increase in tone and will that inhibit the possibility to move and that makes the arm movement less and more vulnerable.

**An often after years this will be the greatest problem !**

In the start all are focused on balance, standing up and especially walking.

Of course must all therapist working to fulfil that desire, but the responsibility for the upper trunk and arm is still the responsibility of all therapist.

The person after an stroke is no expert in treatment.

That are the group paramedic around him and they must work on the arm /upper trunk to get the best result. Example what care taken is:



Photo 4

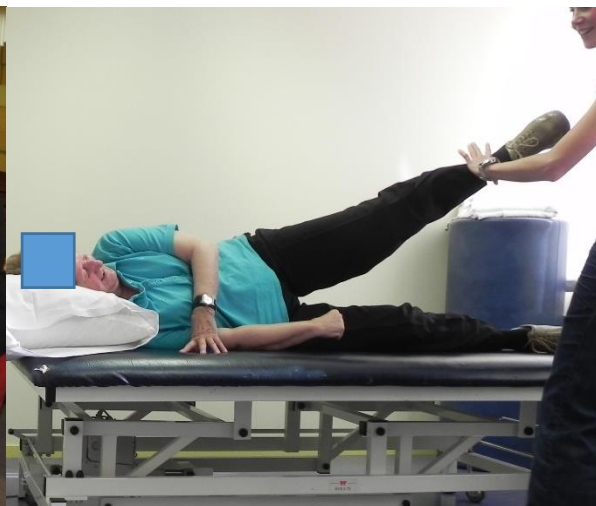


Photo 5

**Photo 4 and 5.**

This lady has when she is walking or exercise in side lying position an flexion attitude synergy. It look like an extension synergy but all component of the flexion attitude synergy are there only the extension is different. This occur after the exercises in bed on her affected, there is now an “active” extension movement in the elbow. And after that she was capable to lift her arm in abduction, exorotation with retraction in the shoulder girdle ( Therefore no attitude but an movement synergy) . The increase of her capacity in walking and balance and the exercise pushing the chair to the front has an positive effect on the tone of the back diagonal and decrease the retraction and increase the front diagonal from the unaffected leg to the affected shoulder. Every time she was walking or moving in bed or standing up the tone increased but decrease when she walk behind an chair or special rollator frame and in sitting position there was more movement possible ...

Photo 4 and 5 published with the responsibility and permission of the author by j.v.d.Rakt.



**Photo 6**

**Photo 6.**

In sitting position there is an full attention for the arm /hand and there is an immediately decrease of tone in the arm /hand.

The wrist is moveable and the fingers are bring into extension and then there can be support on the knee of the therapist and push with the arms.

Standing up with support in front of her with weight on two hand is also possible . That means that the tone isn't increase and no decrease of mobility.

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



Photo 7



Photo 8

**Photo 7 and 8.**

An flexion attitude synergy and on the photo visible that there is some awareness of the arm is present and then the tone is lowering. The attitude-synergy in sit when he hold his affected hand with his unaffected hand, makes it possible for him to give the brain input where his hand/arm is and he can decrease the tone though the input with the other hand. Through light strike or squeeze he inform his affected arm/hand. This phenome is very important because that gives us an sign that there is an increase on perception compared with the start of the treatment because therefore he was always shouting : "where is my arm !" After walking he decrease the tone.

Photo 7 and 8 published with the responsibility and permission of the author by j.v.d.Rakt.



Photo 9

**Photo 9 and 10.**

In sitting position talking with an therapist is whole different world compared with walking with that therapist. In sit no attention for the hand, the tone is lower, but when she is walking is her attention focus on that and the tone in her arm is very high. In sit no input on her own to the affected arm/hand, her perception is lower.

Photo 9 and 10 published with the responsibility and permission of the author by j.v.d.Rakt.



Photo 10

Difference between the photo 7/8 and 9/10 is that after walking (photo 9/10) there is no inhibition of their own. That means that this arm will be an great obstacle for her staying at home because washing and dressing will be very difficult for her husband.

Her focus was on the contrary, always on new method of independent walking and she found that treatment of their arm /hand wasn't important. Keep explain the importance of the treatment and mobilization of the arm /hand. And be aware of the tone developmental of the arm when there is an poor balance. The dominancy of the back diagonal through the unaffected leg is so great that the affected arm is pressing against her body and asked every time for an long treatment to hold the mobility at his highest level.

The man on photo 7/8 has more perception and "feel", that amount of tone after walking and start with an inhibition by striking and squeezing movement over his affected arm.

An assessment of both person though assessment of touch sense, propriocepsis sense, gnostic sense position sense and movement sense ... [20,21,22] give an clear difference between this to person in favor of the man on photo 7/8.

Not always is it possible to assess the perception and then it is important to recognize elements of action that individuals makes out himself. Someone, how is always "forget his affected arm and has an low tone, will have an low perception. But an higher tone an no or little "concern by his unaffected hand give also an hint that the perception is low and that the projection in the brain is very poor.

This are the people that must be helped with their control of the arm/hand and must have an good treatment to help restore/stimulated this perception[15,23], when possible and an treatment that mobility and the tone secured. But always make place in the treatment-plan to train on support training in an closed chain and inhibit the flexion (attitude- movement ) synergy.

### **Try to exercise in an closed chain and build up an support function in different positions.**

The treatment of the flexion attitude synergy must have an goal. An realistic goal! It isn't realistic to try with an treatment to restore the complete arm /hand function, therefore there is often to many damage in the brain. For the hand function ( normal) we need the cortico- spinal tray intact otherwise the selectivity of the hand will never be possible.

Investigation of Prof.G.Kwakkel has shown that when after 72 hours there is no arbitrary abduction in the shoulder and extension in the wrist and fingers, this arm/hand isn't recovery completely . But that means not that other projections in the brain in an lower part can play an roll in the function of arm and in the hand. But the normal selectivity will be very difficult and most likely impossible.

The goal that can be obtain for the flexion attitude synergy is that the mobility of the joint will be secured and that there is an possibility to get arbitrary movements in the arm.

That will be movement that are part of the flexion movement synergy ( in the shoulder girdle - retraction, gleno humeral - abduction with exorotation, elbow flexion with supination and in the wrist and fingers dorsal flexion and flexion fingers).

When an individual after an stroke is capable to move his affected arm the change that there is pain in the shoulder or dystrophic disturbances is compared with the attitude synergy much lesser.

An higher goal is than, to obtain part of the extension synergy as well (shoulder girdle protraction, gleno humeral anteflexion , adduction , elbow extension pronation and in the wrist fingers dorsal flexion and flexion fingers) Why higher, because the individual can now move his arm in an direction and that makes dressing easier.

This must be exercises and to obtain this result there must be create an projection in the brain and that must be possible. The perception of the arm must be stimulated and till today there are methods [6,15,23] but never well investigated. Dr.Sato [25,26,27] has investigated that flowing water on the skin and especially on the hair on the skin give an reaction in the brain. And the plasticity learn us that the brain is capable to create new networks in damaged networks and that means that the perception can increase and that therefore arbitrary movement in an synergy are possible to retain.

There are two important issues to obtain the goal: Arbitrary movements in the affected arm /hand.

1. There must be an possibility to get support on that arm /hand that will enter the brain . That means that there must be an reaction in the muscle of the arm that make that support

possible. In the beginning this will be always very heavy that means always almost 100% R.M. (Repetition Maximum[28] )and rehearsal will be very difficult but try, hold and that rest and try it again, will push the muscles to the limit and addressed all attention to that goal.

2. The individual must use this possibility to move and now is the relation with the ADL or IADL very important because when the individual use this movement the amount on stimuli that got in the brain is much greater and that isn't achievable in only an treatment.



**Photo 11**

**Photo 11 .**

From this position with the unaffected foot from the bench, the push must come out the affected elbow (extension) to get in an sitting position.

This is heavy and therefor the shoulder girdle the elbow and the hand /wrist must be well protected.

She is capable to extend but this is an almost 100% R.M. and can also be done one time.

An technique that looks like forced use[29] but had as an consequences that the extension of the elbow was possible for her in other situations as pushing the special frame rollator and through that double support the flexion synergy was lesser strong.

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



**Photo 12**

**Photo 12.**

Another form of forced use.

When this individual with an stroke lift his unaffected leg from the bench than he will feel that he is falling to the front. The bracing reaction must come from the affected leg that must try make exorotation in the hip to push back but that reaction take place in the foot and mostly there is too little selectivity to created that push. The damage brain will search for an solution and that is on lower level often as the damage has taken place and we see than two things

1. The unaffected arm rotated to the back and
2. The affected arm makes in the elbow an extension . That extension we can give an resistance and make it an task specific resistance exercise that will increase the muscle power but also the coordination and that will often end in an extension of the elbow that can use also in other moments.

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

In side lying position this bracing reaction is basic and here we use is to get an extension in the elbow and create another movement as only the movement possible in the flexion movement synergy.

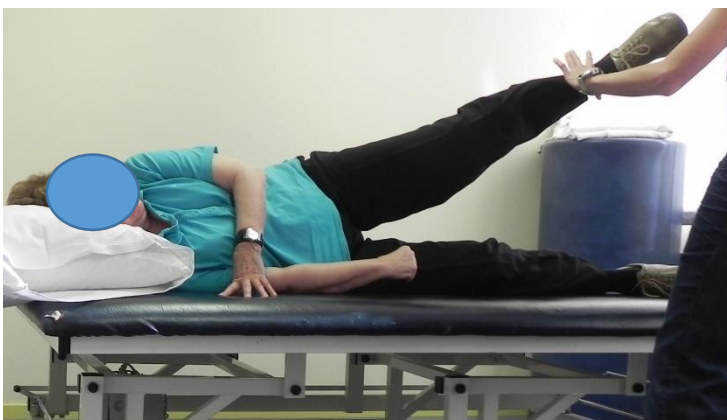


**Photo 13**

**Photo 13**

Normal reaction when the upper leg is placed to the front. Look to the foot under and the elbow under. That are the keypoint, that are necessary to hold the body on the bench with the diagonals , front and back together with the homolateral structures. And in the spine we have an rotation.

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



**Photo 14**

**Photo 14.**

When we make the exercise to difficult that will this occur. There is extension in the elbow but this lady has now no greater stability to brace the movement, because the foot doesn't react and the arm goes in adduction. And the unaffected hand is needed.

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

She must react with the unaffected hand to catch there body because otherwise she will roll of the bench. This isn't an forced use we want, because there awareness is total not on here affected arm. By creating an saver situation ( photo 12) by placing an hard pillow in front of her and an pillow under her stomach[30], the movement to the front is much slower.

Furthermore by placing her body "behind "the scapula, she has an inhibition of the scapula retraction and will easy give in the shoulder 90° anteflexion. When the therapist hold the affected hand than the chain is closed and bend the elbow so far as possible and now ask : "Lift the unaffected leg an little bit and feel the reaction of the arm"

We have than the awareness of the extension in the elbow through the patient, we feel how must the action is and we can exercise with task specific resistance therapy 3 × 10 ( by 8 muscle fatigue ) and that 3 times an week and that will give an extension that she can use.

Again the treatment with an flexion attitude synergy must focus on movement and the first goal must be an flexion movement synergy with an tone that is to controlled.

Control can be when we think in chains.

Side lying with the scapula fixated under the trunk to the front give such inhibition because the muscle that take care of the retraction are elongated and through the weight of the upper body is this retraction further inhibited.

But photo 14 an reaction that we don't want because this is to heavy and the awareness is gone but also the reaction in the gleno-humeral joint let us see that the retraction muscle are active and this exercise is too heavy.



**Photo 15**

**Photo 15.**

Pushing the therapist away and you can go further, even to try to get up when pushing someone away and make it an support training and an standing up training with always 6 chain working.

Chain one – between the legs

Chain two – the affected arm and the unaffected leg

Chain three – affected arm and affected leg .

Chain four - between the arms .

Chain five – between the unaffected leg and arm.

Chain six – between the affected leg and arm

Which of the three is the most important chain ?

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

When we want this exercises – pushing away, what means enough “Vorlage” to get up and standing and support on the arms and later on one arm, than the position of the individual must be perfect.

Answer on which chain the most important one. The diagonal is the important chain.

Was is so difficult to go over from pushing away to and standing position with support on the arms (photo 15) ?

1. The position of the feet isn't right, must more to the back.
2. He sit to far on the bench and will make contact with bench when he is standing up and cannot hold the support to the front.
3. The bench stand to low , he must have the power in his both legs and this is too heavy.



**Photo 16**

**Photo 16.**

Another example. With an good mobility of the whole arm and upper trunk try to set that extension that exist in forced use situation in an extension to hold an chair on two legs.

Still an closed chain also because he put his unaffected hand on his unaffected leg and create so 6 chains with the diagonals as the center. But this will change the flexion movement synergy in the shoulder (active protraction with extension in the elbow.

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

When individuals after a stroke are capable to change their flexion attitude/ movement synergy in a movement synergy with some dissociation, than the arm and hand is less vulnerable and will have a contribution in the washing /dressing , the ADL and also in de IADL.

Of course is this arm and hand not on an high level but it isn't anymore the arm that always hurt, that makes it impossible to live independent because ADL isn't possible without assistance .

The reason that there is now more independent is because the arm can move and help with the ADL instead obstruct that .

And when we tested this arm /hand on his perception after this treatment than is often there an great different with the flexion attitude synergy arm /hand.

Dr,G.Verheyen [31] together with his team has investigated the correlation between somato- sensoric and motoric and that correlation is great!!

### **Try to give stimuli that enter the damage brain but be careful.**

Very difficult and often is looks like pain evoking to created that stimulus, but the reaction will tell what it is. An individual with a stroke demonstrated this on the students by an NDT Bobath course and the whole group had chills on his back. He take his affected hand with his unaffected hand and squeeze extremely hard in the fingers of that hand.

You can see on his face that it hurts, but the reaction wasn't an withdrawn reaction, on the opposite the fingers are going in an total extension and he was capable that to repeat 3 times. After that the reaction was gone and no movement in the extension direction was possible. The reason for that reaction is that the stimulus is so strong that it activated the damage brain and that give an extension reaction that regrettable not through the cortico spinal pathways take over. Zatron[32] spoke over the rostra-spinal pathway, an pathway lower in the brain that now react without the interference of the cortex.

Miss F.Affolter [33]reported that children with loss perception had benefit though hard stimuli but often the therapist dare not to give such an hard tactile stimulus.

We therefore start with tubes of PVC in the palm of the hand and there were special reaction to observe. Not only by individual after an stroke but also in the last stage of the diseases as Parkinson and dementia. Putting an tube, an hard tube, in the palm of the hand gave by 75% of this individuals after some time ( 15 minutes till 4 hours ) an extension in the fingers and the tube fall out of the hand[34].

The hand stay in that extension and sometimes the individual could make some movement but the reaction disappear after an few seconds – minutes. But often when there was no effort the relaxation stay for some time ( 1-2 hours ). When individuals go to do something with great effort, than were the associations reaction very fast present.

Affolter use this by her treatment and give this people an hard object in het hard and go than with this individual performed an ADL- activity and what we say was an relaxation but also an great awareness of the affected arm/hand that help to inhibit the tone of the flexion attitude synergy and makes the start to an flexion /extension movement synergy possible.

This treatment she calls Tactile Kinetic Accompaniment ( Guiding, in German Führen ).

It is very difficult to explain this therefore read their books and follow their course.



**Photo 17**

**Photo 17.**

An treatment according Affolter. With Tactile Kinetic Accompaniment the two hand of the individual with stroke were guide by the two hands of the therapist to cut an zucchini. Why an zucchini ? Because this is an hard vegetable and in this case also could because it came out the refrigerator and both together inhibit the tone of the palm of the hand.

The task of the affected hand was to fixated and give the possibility to the other to cut. But there happen much more !!

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

Look to the individual what he is doing. He has lay done his knife and with his unaffected hand he pull the zucchini further under his affected hand to cut all.

That means that he not only feel his affected hand but also see that further cutting can harm this hand. Furthermore his flexion attitude/movement synergy is change because his upper trunk is in flexion and the shoulder girdle is in protraction and the cutting create no more flexion in the elbow because this stay on the cutting board.

This cannot be done by himself alone, he need the input from the therapist but as Affolter always say: " Without verbal instruction looking together for an good solution".

Further look at his face, his attention is complete by his work and hands and that after 6 mounts of therapy in which he often was "lost" his affected hand.

"Hard" materials give therefore input in the damage brain but that "hard" is not for every individual the same. Therefore not all need an hard PVC tube, someone must have less hardness to give to right reaction. That right reaction is an decrease of the tone in the fingers especially the flexion and more awareness, where that hand is.



**Photo 18**

**Photo 18.**

An Tube of PVC what is very hard and the unaffected hand has found the affected hand very easy. This was here attitude when she was sitting and talk with someone else. There was an awareness of the affected hand.

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

The reaction was poor, no great extension but after an few hours, she let the tube with their unaffected hand glide out the affected hand. And that she can without for one half hour. Even before the tone increased, she put the PVC pipe back , because she "Loose the hand feeling ".

When she loss their tube, she had after one night light edema, because she was lying on here affected hand in her sleep and disturbed the transport.



**Photo 19**

**Photo 19.**

Another example but here no hard tube but an softer one. Because the reaction on the hard one was an increase of tone in the flexion attitude synergy and no relaxation or better awareness.

Making the tube softer there was now an reaction that decrease the tone and often after several hours the tone was so low that the tube fell out of there hand.

The tone stay than low for about one hour and then increase the tone in the whole body and of course in the flexion attitude synergy and the individual was restless. Till the tubes were again in her hands.

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Meaning that this “hard” in here hand had an effect on the tone and there whole body react when it was gone. That means that it gave input to the brain and the brain react ( maybe recognized?) To get an tube in this hand there must be an good mobility and we must be able to decrease the tone. In the flexion attitude synergy in the beginning the hand isn’t so extreme of tone but that will change. And when than is no good treatment given and the individual is starting to working on balance, even searching for stability in bed will increase the tone of the whole synergy and also the flexion in the hand. It is therefore very important that the hand will be mobilized [34]and that we try to lower the tone when individuals are not exercise.

Not every time, there is time to exercise according Affolter[33] but she pointed out in which direction the treatment must go;

“Inhibition trough input stimuli is far more better than trough stretching. Stretching inhibit the muscle spindle that they don’t fire anymore and the tone decrease but there isn’t an real reaction from the brain. By input à la Affolter[33] there is an reaction of the damage brain that decrease the tone!

Now there is activity in the brain and that can be used to make new projections ( Brain- Plasticity !)

Give input with an hard object

And it may be cold (P. Davies [6,8] use immersion ice water )

Furthermore is there the technique of the NDT-concept[6,8] to give pressure on the thumb base and after the reaction of less flexion , try to create an activity.

But another approach is to give hard information in the palm of the hand. That seems difficult because the hand is closed and to give this pressure you must inside but with an spoon(picture 1) it is easy to do.

But very important;

Don’t crack the hand/fingers open but give pressure in the palm and wait till the tone decrease and sometimes this pressure must be very great and is the time that the brain react, is more than one minute.

When an hand is closed with an high tone than mostly the thumb is under the fingers. This create on the ulnair side of the hand by the little finger an little space in which an spoon fit and then we slide the spoon in the palm of the hand.

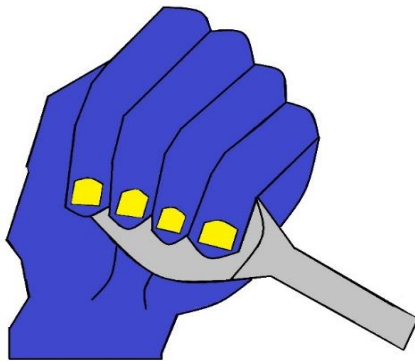
Now give pressure in the palm of the hand by placing our thumb on the spoon and make no movement. Often we see that therapist makes an movement of the wrist and especially an movement to palmar flexion, that makes the tendon of the extensors of the fingers long and the closing is less firm but the tone is the same and we give an stretch on the muscle to inhibit the tone in the hand.

That isn't the goal, we want an tone decrease by enter the damage brain and give "good " information that this high tone isn't necessary. Of course can this effect – stretching of the muscle - after an reaction, but it is important to watch what the reaction is on pressure before the doing the stretch technique.

And always look to face, what you see? On the face an sign of discomfort or even pain and look to the hand what all are good reactions.

Increasing of the tone is an sign that you asked to much !

Decreasing of the tone is an sign that the stimulus is right for the brain but that the individual with an stroke don't have an full perception and that is alter. But this stimulus is necessary to give an tone decrease and is therefore an important stimulus even it is an little bit "painful".



**Picture 1**

**Picture 1.**

On the side of the little finger in the hand palm and careful glide in the whole palm

There is room to placed your thumb on the surface of the spoon and press on the spoon. Hold this pressure and that pressure may alter. After one minute the first symptoms of decreasing tone are present and glide further and make tone further decrease. Than good to an support exercise !

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

**ADL exercise .**

Independency can by an flexion attitude synergy not be the first goal. This is almost impossible because the arm/hand is so "out of the brain" that this ask for an "unhuman" attention to do this. In the practice there are limit what an person after an stroke can handle. Too much correction will decrease the motivation and in practice you test this by asking yourself;

"How often say we - therapist – that something is wrong ?

Therapist and all care givers must be aware of that phenome, every time get the individual feedback what he is doing wrong !! How many times say you against an individual with an stroke : "that's not good !" How often on an day will the individual this hear !

But we can try start to get some ADL- relation in the exercise for the arm to get also more perception and movement in the arm en hand.

The method Affolter[33] has exercises that are done with the therapist and has the goal to create more perception and motoric and can have an clear ADL relation, that can give more motivation.

Again the exercise is an guiding of the arm/hand of the individual in par example an shirt and handle the situation together and seek for solutions.

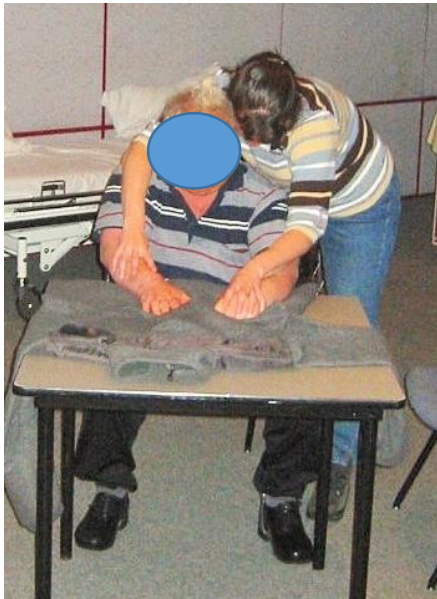
Regrettable often must the person try on his own, with verbal and tactile assistance to learn an sequence how to put an shirt on. But when the arm is in the shirt no information comes out the arm anymore because the arm isn't visual anymore present.

Normal is, we do this with the sensoric and we feel and know where the arm/hand is and how far we must go to get the hand out the sleeve. This can this individual not yet, he must therefore with very great attention look where the arm/hand is. He must stay relax because when is angry on the shirt the arm goes in retraction, and the shirt didn't move anymore, because the affected arm is fixated against the ribcage .

Often there are neglect symptoms, is therefore also the attention not perfect and there is "always" an reason to look up to something and ..... the arm hand is forgotten.

Every day this struggle ask for an very, very good individual with an strong motivation after an severe stroke.

Choose the other way and make the assistance also an exercise and make sure that the solutions are there because now had the patient create an good feeling about the possibilities of clothing in the morning in the future.



**Photo 20**

**Photo 20.**

Starting with dressing together of an vest. An individual with an stroke on the left side of his body.

First the vest lies with the back side to him. Like with little children when the must learn to get on their coat, they lie it on the ground and then arms in the sleeves and over the head in the coat.

Placing the vest on this way makes it easy to recognize the upper and lower part and left and right and easier to handle the vest. First the affected hand goes in the sleeve and the unaffected hand pull the sleeve over the affected hand till the hand is visual and the sleeve near the shoulder.

The therapist applied pressure when there is not enough information or to stop the movement for an moment.

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

Now the unaffected hand glide in the sleeve, who is in front of this arm and grasp the vests and pull it over the head. And the affected – hand! with the assistance make sure that the vest is pulling down on both side. Mostly the pulling down on the affected side is forgotten because often on that side there is no sensor feeling, therefore no information that this isn't good. He must look every morning of his vest is down and such an high attention he hasn't.

The element – not talking- is important because often individuals hear only what the doing wrong, the word no , not right, wrong, we must try again etc. isn't the right way to hold the motivation of an individual. And in this stage it is an exercise that must create more “feeling” and understanding how this is done, not an training toward independency.

The approach of Affolter isn't an training to independency of the ADL. It is an approach to “learn” what the affected side together with the not-affected side can achieve.

The choose to do this with exercises that has an great affection with ADL and IADL is important to get an recognition of the situation and what must be done.

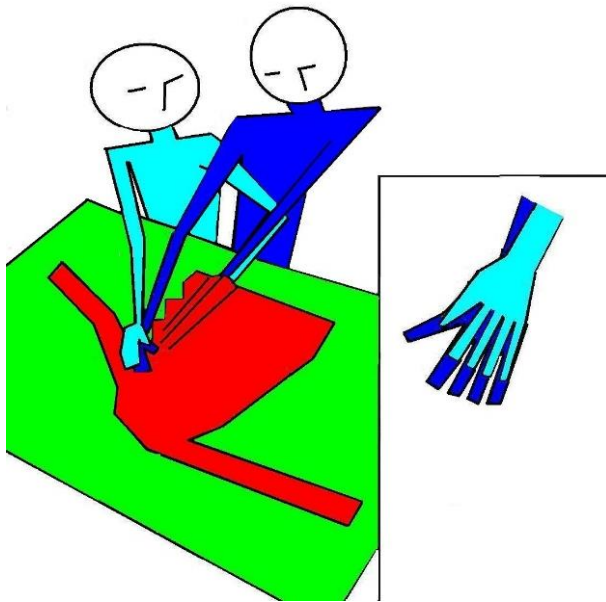
Many exercises has that element much lesser and that makes that often there is an great amount of instruction necessary and that is for this people very difficult because there lies always many limitations.

Through this approach we train the perception, the motoric of the affected side and train also the rhythmic and cognition, praxis of all kinds of ADL elements.

Not the ADL or the independency is standing central but the recovery as far as possible of the damage brain.

In the rehabilitation is the focus of the ADL to fast on doing on their one without often assistance , mostly verbal instruction and this isn't an training but see what the patient can on that moment.

The Affolter approach is working on an further stepwise recovery.



**Picture 2**

**Picture 2.**

There are different way to handle the two hands of the individual with an stroke. Often you must control two arms/hand because the individual will some go to fast with his unaffected side and then there must be an way to relax. Affolter[33] use than an little pressure and that often works, no voice! Here the unaffected hand controlled where the affected hand is in the vest and in the little picture the hand keeping according Affolter and when the tone is high than get the fingers between the metacarpalia of the hand. All clothing and washing can on this way, also by putting on trousers, than there must be very good sitting and an base standing power be present.

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

This individuals with an flexion attitude synergy that has in the beginning an low tone, but that will increase. And when there is no treatment or an treatment to short and with an wrong frequency, this arm will end in an grotesque with an lot of tone in several muscle, no movement, often fast against the body and with contractures. Often this contractures are reversible[7] but on the end this is often not possible and will hurt individuals very much and make the quality of life far decreasing. Again, keep treat this patient till the end and make sure that the quality of live stay on highest possible level !! And the Affolter approach is good way to hold control over the tone in combination with ADL exercising.

Movement evoke association reactions[35] often also association movement trough the unaffected side. That evoke an tone increase in the back diagonal and gives in the upper trunk on the affected side an extension rotation with an retraction of the shoulder girdle.

Especially by the flexion attitude synergy and also by the flexion movement synergy is it very important to treat after the exercises in and out bed and by standing up, walking and balance, the arm and the hand.

Not only decreasing the tone and restore the mobility but also try to get an function in the arm/hand. Support is than often the easy way to achieve that and support training can also on the elbows. That will alter the trunk in an upper trunk forward and will decrease the tone on the backside and then it is possible to give resistance task specific on the front of the trunk and create more power and coordination in the front diagonals, thus also in the muscle that bring the scapula to the front and make movement of the gleno-humeral joint possible. The combination of the Affolter approach and support training is also an treatment possibility to get this stimulation and through the ADL component it is often an exercise in the “real” world.



**Photo 21.**

When there is an possibility of flex the upper trunk with the head down. Placing of the unaffected elbow on the leg of the individual or somewhat further on the knee of the therapist and we ask an little push, this will give an activation of the front muscle and makes it also always possible to place the affected elbow on the knee and get support on two elbow.

Push the elbow back to the trunk or pull on the elbow, this will give an muscle action in the front diagonal and will change the position of the scapula to more protraction. An dissociation technique.

Photo 21 published with the responsibility and permission of the author by j.v.d.Rakt.

**Photo 21**

An example of an association reaction and the use of static reaction[35] to get standing in an assisting standing device.



**Photo 22**



**Photo 23**

**Photo 22 and 23.**

Standing up with an standing up device. His arm is low of tone, there is edema and he has an sling to support the arm. But on photo 23 we see more flexion and extension rotation of the upper trunk and he makes an great attempt to get up especially with his unaffected leg and the back diagonal give this extension rotation in the upper trunk.

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



**Photo 24**

**Photo 24**

Here you see why we can better **not** use this devices !!

He stand “behind” his feet.

But he think that he standing perfect and also his unaffected side react not on the right way.

He must feel that he is hanging on his unaffected arm/hand and cannot lose that hand, but his unaffected foot give no sign. The sign must be an clear dorsal flexion and we see nothing.

He learn an wrong sensoric- motoric track and will therefore always get problem with balance!! With an reaction in the affected shoulder.

Photo 24 published with the responsibility and permission of the author by

**Flexion movement synergy**

The first goal for an treatment of the flexion attitude synergy is to make it an flexion movement synergy, make it possible to move with his affected arm/hand. The next step is to make dissociation possible and that can always start together using all approaches.

An flexion movement synergy is;

- a. Retraction of the scapula, that means an extension rotation in the upper trunk and mostly we see that with an high activity in the unaffected leg because there start the back diagonal necessary to produce this extension rotation and therefore the retraction[2,3].
- b. In the gleno-humeral joint there is an movement possible; an abduction with exorotation
- c. In the elbow flexion with supination
- d. In wrist and hand /fingers , dorsal flexion with flexion in the fingers.

There is still discussion[36] what an real flexion movement synergy is and that has to do with what the individual doing self.

Is he walking and has he an poor balance than will an flexion attitude give adduction but when the flexion movement synergy occur, this will be an movement with abduction. But when we ask the individual to lift his arm/hand he say that he is not able to do this and with walking well.

Therefore an real flexion movement synergy he must be able to lift his arm on his own not as an reaction of an balance exercises.

But when that reaction is present be aware that there is an great opportunity to create movement and in this case this movement will be an flexion movement synergy.

The reaction of the arm by walking and balance on this way is an sign that the back diagonal isn't so dominant.

The amount of effort for an individual after an severe stroke is so great by walking etc. that the flexion attitude synergy occur. When he has walking /balance problems and still movement in his arm than is the back diagonal not so dominant and will the possibilities to move the arm in sit or lying position be greater.

Movement will be make things easier from ADL but also to exercise to hold or stabilized some things but also the perception will be better and the chance that the shoulder will hurt isn't so great as by the attitude synergy.

The perception is better as in the first stage ( low tone) but comparing with normal isn't righth. Especially the interpretation of the information is disstrubed in the damage brain and the tone increasing gives almost always an attitude synergy and no movement.

By movement the information will come also out the muscle spindles [37] and still must this information be translated in the damaged brain.

Walking with movement in the arm give also an sign that the balance isn't so bad as walking with an flexion attitude synergy.

Than the back diagonal is to dominant and again is the question must an person walk through the whole day on that highest level? Because than will be an treatment to get the arm /hand in the correct shape be impossible.



**Photo 25.**

An real flexion movement synergy but look at his hand and fingers, this is still easy !

That means that this lifting of his arm isn't so heavy because the fingers are not complete in flexion and that means that there is more possible. Maybe he is capable to make also an extension movement synergy by altering the trunk attitude ( upper trunk forward with flexion) and maybe he can move in the flexion movement synergy with some dissociation.

The lift start with an upper-trunk backward with extension rotation and that is the action of back diagonal.

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

**Photo 25**

Photo 25 is an flexion movement synergy, but he can also alter it. Par example the flexion in the elbow or the abduction in more anteflexion. When he is capable to do an exorotation with adduction that there is very good dissociation and more selectivity. And is this not an clean flexor movement synergy [38].

Important is to test this!

This can be test in stand but our preference goes to an assessment in an lying position.

“Passive” and active lying on his back.

Active ; let him try to lift his arm and observe because when it is an flexion movement synergy than he will start with pushing his unaffected leg in the bench and the arm goes not in anteflexion ( gleno-humeral) but his upper trunk goes in extension rotation and the arm in abduction exorotation.

“Passive”; let him relax his arm and placed together the arm in 90 ° anteflexion ( placing ) ( gleno-humeral) and ask him to hold the arm there with the elbow straight and see or he is capable to do that ( holding) . When it is an flexion movement synergy than he will be not capable to hold this position and fall back in the first position he achieve, doing it self . And again observe where the movement start, often every time in the unaffected leg with extension and sometimes there is an part of flexion movement synergy in the affected leg ( an static reaction[35] )

The movement will therefore be evoke by the back diagonal that has an connection with the affected side. The pull on the fascia thoraco-lumbalis of the unaffected leg is well crossing the spine to the other side but the muscle close to the spine and the muscle latisimus dorsi will response. This gives an extension rotation of the upper trunk and an retraction medio-rotation and adduction of the scapula. This position of the cavity of the glenohumeral gives the reaction in the head ( gleno-humeral) an abduction /exorotation and that gives the reaction again in the elbow.

**Casus :** Not capable to move the arm himself but we see movement, when he is walking, in this case we say even anteflexion in the arm and retroflexion together with much abduction when he was walking.

Walking is the only think he can do. When we talk to him, he must stand still to listen ( Stop Walking When Talking S.W.W.T.)[39]. Both together isn't possible .

That means that his capacity what his brain can is very limited.

*Casus :*



Photo 26

Photo 27

Photo 28

**Photo 26,27 and 28.**

Walking with an cane we see an lot of movement of the arm in abduction, but also some movement in anteflexion direction. But when he is sitting, he is not capable (yet) to move his arm up. Lying on his back, he was not capable to hold the position over the 90 ° anteflexion. But there is movement, this is no attitude synergy and therefore there must be an action in the trunk that alter the movement of the shoulder girdle.

Photo 26 he placed his unaffected leg to the front but he fall back. He moves his upper trunk to the front and we see an anteflexion reaction in the arm that correspond with an balance reaction upper trunk forward.

Photo 27. He stand now on his unaffected leg and try to lift the affected leg and put him further forward. That means that the unaffected leg work very hard and that this evoke the back diagonal and therefore the arm/hand is against his body.

Photo 28. Show the stand phase om his affected leg and we see that the foot isn't stable and that he search for an "stable" moment to set his unaffected foot very fast an little bit to the front . He never passed with his unaffected foot the affected foot. This gives an reaction in the arm an upper trunk backward ( falling to the back), an action in the back diagonal and an abduction/some anteflexion in his shoulder. Therefore no Flexion attitude synergy but part of an equilibrium reaction in part of his arm and in part of the front diagonal.

That evokes an movement in the active front diagonal initiated through his unaffected leg !! The equilibrium reaction makes the differences and activated the front diagonal and part of the arm moves. That means that the back diagonal influence is decreased.

Photo 26,27 and 28 published with the responsibility and permission of the author by j.v.d.Rakt.

But when he sit on the edge of the bench, he was not capable to create movement in his shoulder but when he bend to the front and experienced that he could fall the arm react but he has no attention for this arm, only for not falling.

Therefore we try to do this from an starting position supine position and then move to lying on his affected side. This was for him very fearful in the beginning but after two –three attempts he was capable to attend more attention to the movement of his arm.



**Photo 29**

**Photo 29.**

Movement on his affected side to the therapist gives an extension in his elbow and an opening of his hand. We say an elements of the flexion movement synergy when he walk. In sit, he was not capable to move his arm in that synergy, but when his trunk is stabilized and especially the scapula we see an extension in the elbow with what extension in his fingers.

Photo 29 published with the responsibility and permission of the author by j.v.d.Rakt.



**Photo 30**

**Photo 30.**

His first arbitrary movement was flexion of the elbow. For the extension he need to move his body further over the affected side. But in the position he was able of flex the elbow on his own.

Because the shoulder girdle was looked, there was only activity in the elbow and hand, both flexion. With the trunk movement to the front there was an extension as part of an equilibrium reaction in the elbow and the hand. On his own he could make than flexion in the elbow and hand but for the extension he need the trunk movement (equilibrium reaction)

When he after the exercise on the edge of the bench sat, he try immediately or he was capable to move his arm without walking because he had seen on photo's that his arm moves.

He know that his arm than move, it was also aggravating but his walking was so difficult that all his attention go to the balance and walking .

Now he try to move his arm in an sitting position and that means an open chain.

But he was very pleased that he had movement in his arm.

Together we were capable in side lying position and in long sitting position to get extension with resistance in his elbow.

Start of an possible dissociation.

Photo 30 published with the responsibility and permission of the author by j.v.d.Rakt.

Conclusion : Often there is only the flexion movement synergy with no variations and this variations are very important to get some use for the affected arm and maybe the hand and then is this strategy maybe an solution to get this work. This reaction in this case isn't so strange because the placing and the position of the scapula determined also what the reaction of the gleno- humeral joint can do and also the elbow. The gleno-humeral joint stand in this position in an anteflexion and scapula in an protraction. Retraction ( scapula) and ( glenohumeral) abduction isn't possible. Through his position is the front diagonal situation present. Not with the correct muscle pattern but through the weight of the body on the affected side. This means that when the position of the shoulder girdle is correct and there is an restriction of the flexion synergy is present, than we will see elements of the extension movement synergy. Working with fixed points and chains will give us an possibility to change the flexion movement synergy and make dissociation possible **but** that will be very difficult in an open chain. In this case this exercise is use to give the individual the feeling that when he moves over the affected side to the edge of the bench, he don't fall of the bench because the extension of his affected arm will brace the falling movement. Further is this an exercise to give him the feeling that his affected arm will move when he want that the arm move. An arbitrary action to give him an feeling that he has some control over his arm. Now only in this situation but he must try this also in other action to achieve. In sit with closed chain of half-closed chain with dynamic and an the end also in an open chain.



**Photo 31**

**Photo 31**

What are the possibilities to create an better coordination and better projection in the damages brain that this extension of his elbow is an movement that he can use – support function. Further an movement that he can initiated in an lying position on his affected side and maybe also in other positions. In this situation he must brace his falling movement with maximal extension of his elbow and against resistance.

Photo 31 published with the responsibility and permission of the author by j.v.d.Rakt.



**Photo 32**

**Photo 32.**

Resistance treatment against extension of the elbow. In long sit position to give him the feeling that he can stretch his elbow in this position.

After exercising it lying on his affected side as part of an equilibrium reaction, we want to see what he could in this position.

And by holding the hand there is half-closed chain.

After the session in side lying he was capable to this but we know that this will be for short time. Rehearsal will create an projection. But this is the start for an search to an extension in the elbow that he can use in his ADL /IADL.

Photo 32 published with the responsibility and permission of the author by j.v.d.Rakt.

Task specific resistance treatment by using as an start the equilibrium reaction.

Start than this is almost 100% R.M. thus much rehearsal wasn't possible, but from this point on, there is an possibility to create more coordination and power ( strength × speed). Now is it also possible to train out of the flexion movement synergy an movement of the shoulder –girdle toward protraction and thus the front diagonal activation. This is the most important part and when this is possible than the inhibition of the back diagonal will be greater and when the walking capacity will increased than will this have also an effect on the arm- tone /movement when he is walking !

Inhibition of the tone of the back diagonal is important to get the greatest effect in the front diagonal. This inhibition will give the front diagonal muscle pattern more power to create more coordination and strength by task –specific resistance exercises. Through the reciprocal inhibition of the back diagonal muscle pattern the front diagonal muscle pattern have more possibilities to get work on an higher level and that the treatment has an good result. (Reciprocal inhibition [40])

When an flexion movement synergy, is dominant it is very important that the therapy is focused on an change of this synergy. That means that in an open chain only this synergy movement will take place and that there is no variation.

This synergy will therefore occur always when he try his arm to move and he has no use for this hand. Furthermore the synergy will be stronger not only when he try to move his arm but also when he is walking. Training to change the stereotyped movement in the shoulder girdle, gleno-humeral and elbow is very important to give this arm an possibility that he can use him. Or that it is easier for him to get dress. Par example to get your arm in the sleeve it is important that the arm moves in an extension in the elbow and that in every position because normal we do this in an standing position. More variation will also have an positive effect on the complains of the arm by the individual with an stroke.

When movement by the individual in an flexion movement synergy is possible, the moment is there to try to get variation in that synergy.

**Flexion movement synergy is possible because through the dominance of the back diagonal who start in the not-affected leg.** This dominance will rotated the spine in the upper trunk on the affected side to an extension rotation. The vertebrae rotated to the not-affected side.

That will not always be an concentric muscle activity often it is an eccentric activity but observe when an individual will **try to lift his affected arm**;

- He will stand on his not-affected leg.
- He start with an turn of the upper trunk in extension and rotation and this is dependent of the tone that is present. Low tone than will the upper trunk start in an lot of flexion and see we always no real extension in the upper trunk, because he start in flexion to little less flexion. But this is than still extension.
- This extension rotation will give an adduction, medio-rotation of the scapula with an variation of depression or elevation .
- This pull the cavity of the gleno-humeral joint to the back and place the humerus head in abduction. The exorotation of this joint is an activity that occur because the position of the cavity and the head of the gleno-humeral is total changed and the selectivity of the little muscle isn't there. In the keypoint shoulder is often the muscles that are active on the gleno-humeral joint not direct active but will react on stretch. Often we see an subluxation that will occur when the position of the cavity is wrong and there is no muscles that act on the head of the gleno-humeral.
- The muscle of the elbow react in an flexion but the muscle react with no selectivity, this will be flexion with supination.
- The wrist and hand/fingers will go in flexion but as we say in the individual on photo 26 till 32 that there is some different what this hand can. That means not that the cortico- spinal pathways are well, but there are other pathways that goes to the hand. But the hand will not have the selectivity that someone had with an intact cortico-spinal pathway.

### **Extension movement synergy or better an combination of Movement Synergy flexion and extension.**

Is an extension movement synergy sec possible and this occur without an flexion movement synergy than is damage in the brain lesser as by an flexion movement synergy.

Meaning, that there is mostly first an flexion movement synergy before there can be an extension movement synergy. Never is mentioned in the literature that there is an extension movement synergy sec and no flexion movement or attitude synergy.

That means that an extension movement synergy give us an picture that the brain has more possibilities to control the arm that when an individual has only an flexion movement synergy and on an lowest level stand the flexion attitude synergy.

From the perspective of the diagonals we know that the back diagonals are "stronger" as the front diagonal and in the developmental of the human movement the homolateral structure is the last one. Recovery of the brain after an stroke will be take place first in the back diagonal and of course is than the most active side – the not-affected side- and is the unaffected leg the first that will try to move . To change the attitude in bed is the leg more important than the not-affected arm and will therefore give more reaction through the diagonal on the affected arm.

That reaction will be extension rotation and therefore the base for an flexion movement synergy. To create an extension movement synergy there must be activity in the front diagonal from the affected side upper trunk to the unaffected side lower trunk ( front diagonal [2,3]). Otherwise there will be no protraction in the shoulder girdle and this protraction is base on which the an extension movement synergy can develop.

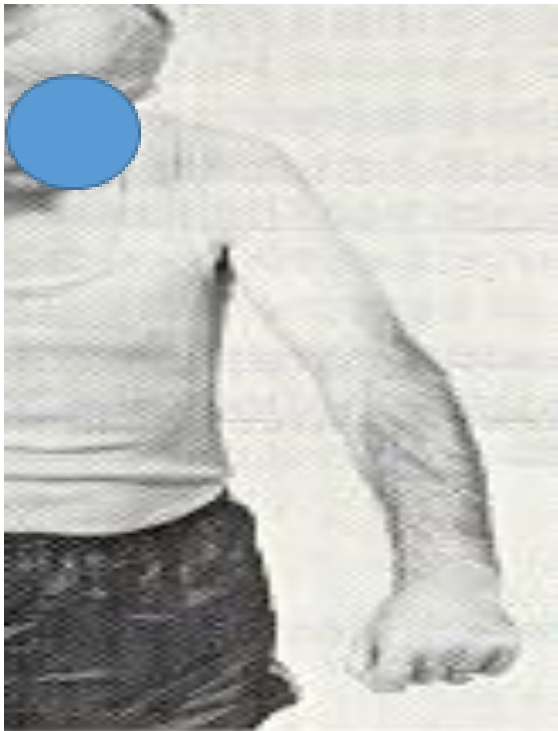
When we observe an individual with an stroke, trying to stretch the arm and especially the elbow we always see an upper trunk flexion and an activity of the muscles of the stomach.

That is necessary to get the scapula in the right position.

The m. serratus anterior must pull the scapula to the front, that gives an latero- rotation combined with abduction of the medial border and depression.

This can only when the ribcage is stable and that is only possible when the stomach muscle hold the ribcage down and this activity evokes the individual by pulling his upper trunk in an flexion /rotation. Is there by the flexion movement synergy an variation possible from the scapula in an elevation or depression, by the extension movement synergy there will be an depression because the front diagonal must be active.

Also will the unaffected leg important to help to get optimal muscle power. That means that the individual stands on that leg to give the front-diagonal an fixed point.



**Photo 33**

**Photo 33.**

Observe this is the same gentlemen that we say by the flexion movement synergy.

The position of the upper trunk is now flexion from the upper trunk to the ground and that gives an activity of the front diagonal.



The posture that he has by the flexion movement synergy is an upper trunk extension with rotation. And that is an action of the back diagonal.

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In both the synergys there is no control in the gleno-humeral joint, we see an exorotation with abduction in the flexion movement synergy and an endorotation with adduction in the extension movement synergy. The perfect placing of the cavity determined the action of the muscles in the gleno-humeral joint and that created the position of the glenohumeral joint.

The power of the back diagonal will created an lift but with abduction and exorotation and the power of the front diagonal can inhibit the back diagonal but placed the gleno - humeral joint in an adduction and exorotation and no lift.

When we asked this man to lift his arm he use an flexion movement synergy but when we asked to extend his elbow than he will use an extension synergy. There is an dissociation possible between the two synergy by using the back or the front diagonal but the selectivity to cooperate together front and back isn't there. Therefore the keypoint muscles in the gleno-humeral joint cannot participated because through the damage in the brain but also through the dominance of the diagonal on the two "movements", that inhibit the fine tuning in the shoulder keypoint.

**Extension movement synergy ;**

In the trunk is the attitude an flexion of the upper trunk.

The scapula stand in latero rotation, abduction and depression; - Protraction.

The gleno-humeral joint gives adduction with endorotation and no lift.

The elbow stand in extension with pronation.

The wrist and fingers flexion with adduction

The thumb has flexion and adduction and often is the thumb inside the fingers.

This movement makes it possible to get easier in an sleeve of an shirt. Because the extension of the elbow makes it easier with the upper trunk flexion to get full through the sleeve.

### **Perception.**

The difference between the perception in the flexion attitude synergy and the movement synergy is present but when we test this with no movement the individual has no benefit of his possibility to move and created input. Therefore is good to test passive but also active.

The problem is that the movement that this individual can make is so little and has no or small variation that he only can “feel” that movements .

Still will the result be better after movement with the arm as the test from the flexion attitude synergy. An individual with an extension movement synergy will have an better perception in the shoulder and elbow than the flexion attitude/ movement synergy.

The perception of the hand is very different.

Only increase of tone in the thumb and fingers in an attitude synergy would point on an very poor perception. But we know that often this high tone is created by poor balance and walking difficulty and that is an increasing of the tone through another reason.

When this individual is resting and the tone in the hand decrease is that an sign that the tone has his origin in the high capacity, that is needed for the other activity.

But observe, is there contact between the two hands or is there no contact. Need that contact visual control or not , that are elements that give an picture of the projection in the brain that is still there.

No visual control needed gives an positive view about the perception.

But the test of;

1. Proprioception[37,41] , with no visual control feel how the fingers/thumb and wrist stand and that with less than 5° deviation, in the greater joint ( shoulder elbow ) this is 11° . Passive feeling an position but also feeling of the start of an passive movement. Be aware that tone is reduced before because the stretch gives input . Movement is only possible in the synergy , always in an open chain and after two attempts , no reducing of the tone but placed the hand in an position and asked on the individual this also to do with the not-affected wrist /hand and the difference we can measured in degrees. Of course no visual contact but when we are finished ask always with visual control to get the attitude perfect with the not-affected hand. This tell us something how the perception is translated with the cognition of the individual, that tell us something about the translation of the difficult perception of the hand in the other projections of the brain all away to the cortical level.
2. Two point discrimination[42] test important to get an view about the feeling of movement in the arm/hand .
3. Vibration sense[43] tell something about the possibility to recognize objects in the arm/hand/fingers , this test will performed with tune fork on the bone parts of the wrist, fingers, elbow and shoulder
4. Of course test the feeling of hard- soft and temp.

There is another test that is the reaction on an stimulus that is very hard (photo 18). Give this an extension reaction in the hand/fingers that there are lower pathways in the brain still there but that means also that the fine motoric of the fingers has no pathway or an damaged pathway.

Of course this test also for the shoulder and elbow but this will be better when an individual can perform an extension movement synergy.

But the perception of the wrist and hand will often be disturbed in all three synergy. Therefore it is important to test the reaction on an hard stimulus and when more is possible than the synergy sec than will also an test with an “painful” stimulus important to see how much extension this will give and

is the individual capable to take over this movement and created more stimuli in the brain to stimulated the “poor” hand projection in an lower level in the brain.

### Diagonal.

There is now an activity in the front diagonal from the upper trunk on the affected side to the not-affected side. This is important and ask for exercise that stimulated this diagonal but also the other front diagonal and so will support- technique always have an important place.

The goal must be, that this capacity can be used to set the affected arm in support activities and give the not-affected hand the freedom to do something or the affected hand can give stability of hold an object secure.

The basic principles of the treatment of the flexion attitude synergy are still present but there must also be an treatment that is pointed on the creation of movement.

- Outside the synergy dominancy - Dissociation
- Hold the mobility in all joint
- The trophic of the arm /hand must be optimal.
- Be aware of the low perception and extinction.
- What does the tone of the back diagonal – to the shoulder blade position
- Try to exercise in an closed chain and build up an support function in different position.
- Control of the synergy by activity as balance and walking all directions on floor or walking the stairs.



**Photo 34**

### Photo 34.

An attempt to inhibit the flexion movement synergy especially in the elbow and wrist and fingers.

In this case is chosen for an part of the PPAM (Pneumatic Post-Amputation Mobility Aid) – system use by amputee to exercise for that the prosthesis is ready [24,44,45].

Blowing this device up around the arm there is an continue pressure on the arm and this gives an effect that “looks” like the reaction on circular casting. But the effect of circular casting is bigger on the tone[46]. In this device the pressure is maybe too little to give that tone decrease as much as by casting.

But after walking with facilitation and *giving pressure with the not-affected arm on the stomach of the therapist* is this an exercise that is very difficult for him and without the device would the affected arm be in an flexion synergy and now this is less.

Photo 34 published with the responsibility and permission of the author by j.v.d.Rakt.

*Giving pressure to the back with the not-affected arm on the stomach of the therapist Photo 34.*

This technique with facilitation is to increase the amount of power in the affected hip extensor and make the movement over the affected hip better. Through the pressure with his not-affected hand against the stomach of the therapist, he activated the back diagonal on the not-affected side and create more power in this diagonal to get more power in the standing affected leg in the stand phase.

This is very heavy and will give association reaction and tone increase in the arm and that is inhibited somewhat through the pressure PPAM system.

After this walking exercise it is possible immediately to start with active arm exercise without an inhibition of the tone. The tone is still increased but he is capable this tone to decrease with movement out of the synergy and that even in an walking exercise .



**Photo 35**

**Photo 35.**

Pushing an cane away with both arms in extension.

The dissociation of the flexion and extension movement synergy is present in the upper trunk and scapula. There is an protraction with an active stomach muscle in both the front diagonal starting from the upper trunk .

The scapula stand in an protraction but the direction isn't to the floor but straight forward with pressure on the cane.

Gleno-humeral joint: this joint stand in the middle of the adduction-abduction and the rotation movement and an anteflexion about 70° and that is also an "dissociation".

The elbow is in extension with an stand in the middle of the supination and pronation. The wrist stand perfect and the hand / fingers are good around the cane.

Both elbow are active in extension and remarkable is the placing of the affected leg to the front and the extension in the affected arm when he push with his not-affected leg.

An example that both diagonals are working together.

Photo 35 published with the responsibility and permission of the author by j.v.d.Rakt.

Pushing this cane ask for an cooperation of the front and back diagonal and must give an dissociation of the synergy. Through the active push the whole diagonal will be active and we see also activity in the keypoint on shoulder and hip level. This created an greater step length and the possibility to create an task specific resistance treatment with an endurance component.

The flexion movement synergy and the extension movement synergy are changed by using an closed chain for the arms. In total this is an closed dynamic chain, because there is an pushing away movement. The whole success lies on the fact that the individual is capable to get enough pressure on the stick and often is that visible in an larger step length.

Is this gentlemen now capable to move his arm better in an open chain ? Maybe one or two times but realised that the input that this cane gives is needed to create this reaction. When there is no pushing

point in the chain than will every movement again based on the flexion or extension movement synergy, see photos below. Therefore support exercises are so important to create more coordination and make the endpoint dynamic .



**Photo 36**



**Photo 37**

**Photo 36 and 37.**

Impression of the tone after exercise with the pressure device around the affected arm/hand. There is still too much tone in the flexion of the thumb and the fingers but compared with photo 37 is there a great difference. Walking with a cane he has a flexion attitude synergy and no movement in his affected arm but when the tone was inhibited in a sitting position than he was capable to walk and push. But his step stay greater !  
Photo 36 and 37 published with the responsibility and permission of the author by j.v.d.Rakt.

One of the first signs that the tone is changeable by the individual himself is, when he has walk, he treated his arm passive but also active and decrease the tone automatically. Another sign is the movement of the affected arm when he is walking, an movement in the diagonal rhythmic. That can be the sign to try to cooperate this extension in the elbow in the walking by giving the individual a rollator frame with a bar on the height of the end of the grab bars . This is the best position to support on the rollator frame. Often we see bars more to the front but that means that support isn't right possible and there is less stability.



**Photo 38**

**Photo 38.**

An example of this kind of a rollator frame with the bar on the right spot. We see an individual with a stroke, affected side right, there is obviously too less extension power in the buttock therefore she walks with an upper trunk forward to elongate the back diagonal especially in the m. gluteus maximus. But there support on the rollator frame is good and there are no signs that the flexion movement synergy, therefore we can use this support to create an walking to an independent level. Further Task-specific resistance treatment than will the support on the frame decrease and here walking ability much better. And without the increase of the synergy in the arm.  
Photo 38 published with the responsibility and permission of the author by j.v.d.Rakt.

That is one of the goals create an walking possibility that isn't too difficult for the individual. By the individual on photo 34-37 this wasn't possible because the flexion movement synergy was too great and was supporting with two hands not possible in his walking pattern through his home. And was he only capable to control his surrounding and walking with a cane and the flexion attitude synergy.

That can mean that this is the highest level he can reach but that means that all exercise must try to create more coordination and strength in his affected leg because than it is possible that he had not so much power needed from the not-affected leg and that will decrease the tone of the flexion attitude synergy.

Again we see that the flexion attitude synergy is to change in an movement synergy, but that ask movement capacity that has not to many influence on the tone of the affected arm. Movement as in and out bed , standing up , walking etc. will be have an great effect on the arm when the not-affected leg must do much[16,17,18,19].

Often is the function in the affected arm very little and stand this arm always in the attitude synergy position. When the therapy for the arm is too little than will this arm never change to an movement synergy and when the movement capacity stay low than is changing of the attitude in movement synergy very difficult.

This group, often individuals with an severe stroke, will have great difficulty to move without increasing the tone in the attitude synergy and that ask for an therapy that is on the right level and pointed on the whole body.

And that will be maintained the rest of this individual life !!

When it is possible to get this attitude synergy change in an movement synergy, will be the goal of the arm treatment this to change in dissociation of the synergy and try to make this capacity greater and useful in the ADL.

The greatest result will be obtained when the individual use this every day!!

When this dissociation of the synergy is obtain than will the next goal be, to get more control over the keypoint of the diagonal , in this case the shoulder.

Still is the possibilities of the wrist and the hand/fingers always another story, this because the influence of the cortical cortex ( figure 2). But there is always an possibility that an poor hand function can be realized and that the individual can open and closed his hand( figure 3,4,5).

That makes ADL possible that someone pick up things with two hands and maybe hold things and give the unaffected hand possibilities to do other thinks.

The dominancy of the synergy is often very strong but always it is possible to dissociated. Certainly when the position is so that part of the synergy is closed. And that gives the individual the feeling that he has some control over his affected arm and that will often free this person from shoulder pain.

**The greatest error is to try to fast to move in an open chain!**

The best performance is to move in an half open chain with an dissociation of the both synergy and the highest level is an sway movement that hit the goal object, but this is an movement that start in the trunk but ask for some control in the arm.

When we look to the projection on the cortex than it is clear that the fine hand movement and skills need that base.

But be aware that under the cortex there are still projection that have control on the hand and that give hand movement that are simple:

Open and closed but still is this an possibility to give this hand an function but that is depending what the remaining part of the arm can .

And till today the researchers are not able to declare why some people with an clear damage of the cortical spinal pathway have still hand function and others with clear less damage haven't.

The search for the biomarkers is still going and also the MRI (Magnetic resonance imaging) gives an image that not explain everything.

## **Conclusion ;**

This individuals after an severe stroke must have an good treatment the remaining part of their live, not only the arm but the whole body.

Because the investigation of Dr. Fiers [48] is also counting for this individuals:

Exercise on high level till the end of our life, will give more quality of life than little or no good exercises. And this group cannot perform on their own and have need of good therapist that know how to get more out the affected side.

The responsibility for the treatment we can never give the individual alone. Than we realized not how much an stroke can change the possibilities on all levels in people.



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