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Rehabilitation of the upper limb after an stroke. Part 1. The Flexion Attitude Synergy.
An multi-eclectic approach.

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Abstract

The rehabilitation of an arm after an stroke is the greatest problem the past centuries.
The prognostic of the recovery is very poor ,especially by the group that hasn't an cortical-spinal bane left. No activity in 72 hour after the stroke in the shoulder abduction and extension of the fingers means that the possibilities to an full recovery are poor. That has given many therapist no motivation to try to get the best result of his treatment for every individual after an stroke. And looking what therapist do, is an poor image what can be done by all individuals after an stroke. That means not that in this article you find the solution for full recovery but this will give so far as possible the possibilities that there are to get an optimal result. Even the "a- functional "arm need treatment to get an level that the individual has no pain and can handle this arm on the right way.
Walking and balance difficulties will have always an reaction in the upper trunk and therefore also in the shoulder blade and the arm and that asked for an proper treatment.
But there are an lot of possibilities to create an "function" for that "a-functional" arm/hand that makes that this arm/hand has an goal in the ADL and there are many books about this subject. Further one there are doubt that compensation in the early rehabilitation after an stroke is the best way to handle this problem, there are sounds that the amount of treatment isn't right and the amount of investigation on the CIMT-approach gives an picture that an lot of scientist are searching for an greater intensity and for an longer time. Together they expect an better result because only more time isn't the answer. But the most important issue that all arm/hand are treatable after stroke and that the therapist must assess what the level is and what the possibilities from there are.
This part start with an arm/hand that has an low tone with what activity returning but as an flexion attitude synergy and with great problems to hold the mobility on his highest level.

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Introduction.

The outcome of many arm of patient with an stroke is very poor [1]. We know that when someone is not capable to abduct the shoulder or extend the fingers and the wrist after 72 hours after stroke will be never get his normal arm and hand back[2]. Only about 8 -10 % of the stroke survivors will have that prognoses within the first 72 hours after the stroke.
Treatment of the arm that hasn't an good prognostic, has decreased. There are than only exercises to hold the arm mobility and preventing pain in shoulder, hand etc. But the effect of walking and balance aren't enough in the picture by many therapist [3,4,5,6,7,8,9,10,11].

Still there is than always an problem, because the arm will not cooperated often the arm makes things worse by being an problem in washing and dressing.
On this moment the focus of the investigators lies on the CIMT-Therapy (Constraint Induced Movement Therapy [12,13] an old but, beautiful therapy with an high intensity (difficulty) and an very long time of exercise namely the whole day. This is also the therapy that is investigated by individuals with an good prognostic, because bad prognostic and CIMT will give the individual after an stroke no ability to do something with their not- affected hand and make this person complete dependent.
The group that is most investigated, is the group that has an disuse[16] problem but have remain the function in the hand and shoulder.
The cortical –spinal tract is intact or for an great part by this group of individuals after an stroke, but there is an very large group, the greatest group (about 90%) that cannot participated with the CIMT therapy or other therapy such as the robotic approach, because the fulfill not the inclusion criteria.
That means that the patient must rely on an therapist, how want the best function of the arm and will import that function in the ADL and will prevent problem with the arm, because problems make the problem only greater.
In chronic stage the arm that has not the proper treatment, will show extreme proportions not only in "contractures " but also in trophic signs and that gives pain, osteoporosis with easy fractures and makes live less pleasant.

Photo 1

Photo 1.
Chronic stadium of a stroke patient.
He had pain, but when someone this arm move than he has more pain.
That means that washing, dressing etc. every day is an disaster.
Here the arm has an posture- not an movement synergy and is the arm against the body "fixated".
The shoulder, elbow, wrist and the fingers are in end position through high tone and that has effect on the joints . In the fingers is clear that there are sub-luxation but also in the shoulder.
Prevention of this picture must be the first goal and that is only possible when we give an good treatment.
Photo 1 published with the responsibility and permission of the author by j.v.d.Rakt.

The first question that will be asked is ; How long must this patient has this treatment? Answer: When you think that this patient can do itself, than is there an possibility that the treatment can be stopped but otherwise the treatment will never stop because this can no patient in the world do on his one. There is another point that cause this arm attitudes and that is the treatment of the patient from day one. The focus is on standing up and walking[3,4,5] and then there is the danger that the back diagonal starting in the not-affected leg will dominate and that will give in the affected arm an retraction of the shoulder blade what is the start of an flexion synergy or flexion posture (photo 1) When than no treatment of the arm is starting the arm will go in an posture with all consequences[17].Even patient with an good arm function will give an tone raising when balance treatment will be given with no treatment of the arm .

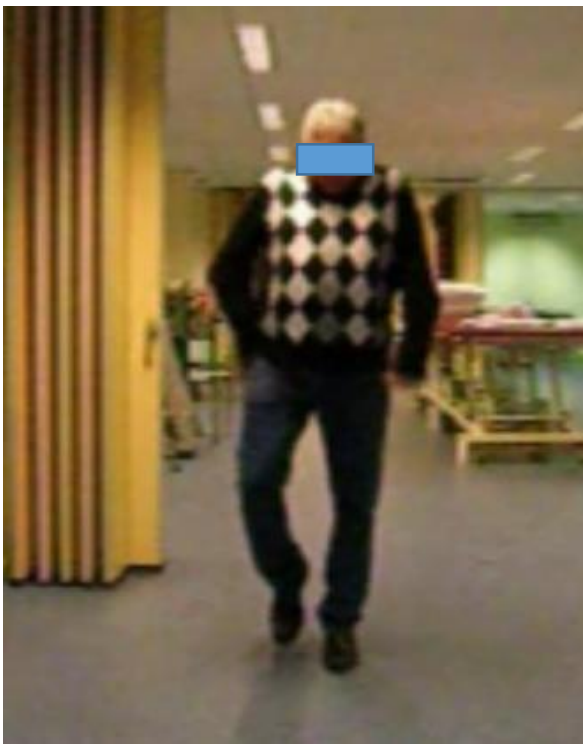


Photo 2

Photo 2.
Patient with an paretic side on the right. This arm/shoulder has an very good function .
In standing position he is capable to achieve the maximal score on the MI (Motricity Index [18]) of his arm/hand and even when he is walking. But when he must walk on his toe there was an problem and the back diagonal of his not-affected leg dominated the back diagonal and give him an flexion synergy that end often in an flexion posture. When he exercise this long, his arm was stiff and difficult to relax. Only treatment give him his affected hand back. Don't treat the arm/hand will give problems and that isn't necessary !
Always after an treatment for walking and balance an treatment of the arm/hand.
Photo 2 published with the responsibility and permission of the author by j.v.d.Rakt.

Photo 3.
Patient with the paretic side on the right side is exercise in an standing up system. The action he make to get standing up is with the not-affected leg and the not affected arm. But he will not succeed because the upper trunk goes to the back initiated with the head. An static reaction S.T.N.R. [19]and that gives an flexion in the leg and can give an extension in the arm. The affected arm turns to the back and goes in an flexion synergy /posture and this arm is vulnerable . The fingers have edema and the shoulder is in an sling. Thus the extension of the not-affected leg and the upper trunk extension with the static reaction makes that the tone of the muscle that give the retraction will increase and this gives problem with the arm and in this case , still no independent standing up.
Photo 3 published with the responsibility and permission of the author by j.v.d.Rakt.

Photo 3

Treatment of arm of the stroke patient isn't an case only for the occupational therapist, this must be from the beginning an multidisciplinary treatment to prevent that the arm will get worse because of treatment that focus on other goals. That means that every member of the team has the duty to treat the affected arm and work on the best function and the best mobility. C.I.M.T. (Constraint Induced Movement Therapy [12].

Photo 4

Photo 4.
An example of an CIMT .
The not-affected hand, in this case, sit in an large glove and no fingers and hand function is possible. There are other solution to inhibit the not-affected arm/hand, but the goal is that the activity will be done with the affected hand.
Often it is done in an group and can two people do things that require two hands. This is very difficult especially when the hand function is less and by doing this an great part of the day there is an great stimulation. But when this is not possible or not yet possible than is this also an demotivation , to try to open an drawer and that means that the hand must have an function.
That means not: No function, never CIMT but not at that moment.
Investigation of the CIMT are large but almost all by people after an stroke with possibilities in the hand and most in the early phase after the stroke. This stimulated the remains of the cortical - spinal tract but we haven't the possibility to train to get the cortical-spinal tract back. Therefore we must treat the arm/hand on his highest level to hold that possibility always open. And use CIMT also in the chronic stage when there is some return.
Photo 4 published with the responsibility and permission of the author by j.v.d.Rakt.

CIMT- therapy is great and has the right intensity and can be use through the whole day, but there must be some function be present, when this function isn't yet possible, than this never means that there is … no therapy?

The therapy must start with an the treatment of the affected arm with the connection with the trunk trough the diagonals and the importance of this homolateral structure. The influence of the diagonals [20,21] in the trunk is essential for an good shoulder function and that is the base for an useful arm /hand. Than we must know which rules there are to treat the tone and use support point to create an movement in the arm and of course in the hand but we know that the perfect hand function asked for an cortical-spinal track, still, it is the challenge for every therapist to try and create the best treatment and go for the best result. That asked for some rules to get so far as possible but also the knowledge on which level the arm/hand is and what we can do in that phase;

1. Chain rules for arm
2. Flaccid arm low tone and /or high tone only in few muscles. Flexion Attitude synergy.
3. Synergy only flexion.
4. Synergy flexion and extension
5. Dissociation
6. Keypoint problem in the upper trunk
7. Hand not cortical spinal
8. Hand with some cortical spinal activity

And asked for the knowledge and skill to recognized problems and know how to treat that the best way and prevent problems later on :

1. Shoulder
2. Shoulder pain
3. Edema hand , strapping wrapping
4. Shoulder –hand syndrome
5. Slings / strapping.

Chain Rules[23] .

The open chain is the most complex movement because all freedom degrees [24,25] are possible and that means that the agonist and the agonist must work together and that not only in flexion/extension but in all possible directions. And that will be very difficult in the keypoint of the diagonals and in the most distal joint the wrist, hand, fingers and ankle and toes. This is for many person after an stroke much too difficult and will the person only demotivated. Especially the severe affected arm will search for an position that an joint that can move in one direction and the reaming joints stand secure fixated in looked position (the principle of an attitude-movement synergy). And this position will be created often by high tone and will care for fast reduction of movement possibility and loss of mobility.

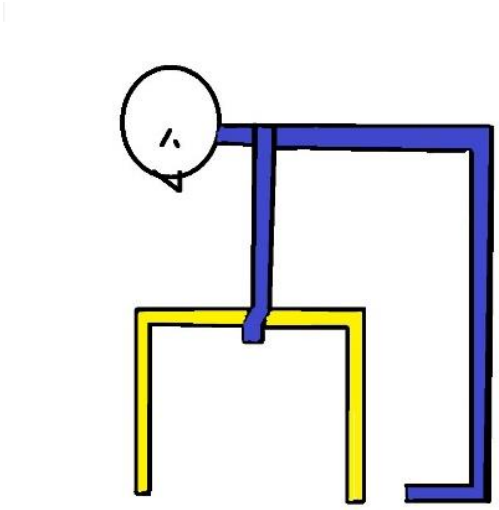
Using chain will created and an possibility to stabilized and decrease the freedom degrees. Working with individual that has little possibilities in the arm must always be done in chains. This has an tone decreasing effect but also give the patient possibilities to do something with his affected arm [6,7,9, 25,26,27,28,29,30,31]. And that ask of the therapist an creativity to find an good practical translation that the person this can use in his A.D.L.

Chain rules have an lot of variations and that makes it often different, but this variation makes more possible.

Chain with the distal end fixated (picture 1) gives 6 muscles pattern, that will lie the accent on the trunk /diagonal and the keypoint (homolateral structures build up out of the back and front diagonal). This is only possible when the distal joint can be fixated, when this is not possible by the individual than lies here the possibility of facilitation or search for an fixated point higher in the arm (Par example to support not on the hand but on the elbow) and build up the muscle chain and control the tone and the possibility to use this chain (picture 3 lifting something with two hands).

Picture 1 has 6 muscle chain;

1. Between the two arms, muscle on the front are the agonist.
2. Between the two legs, muscle on the front and inside the legs
3 and 4 The two diagonals on the front .
5 and 6 The homolateral structure on both side of the body.

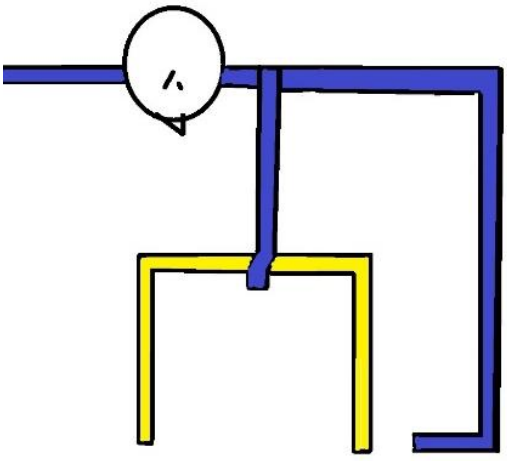


Picture 1.
By using an crutch it always possible to get the fingers around the edge and is the person capable to support on his wrist. Now the chain is closed also because there is an support on the floor. All chain of muscle are working and we can start when this can be hold by creating movement in the body. At the moment that there is movement, this chain is dynamic and we call it an dynamic closed chain. That movement can be done by walking and push the crutch or by moving the upper trunk further to the front or both or……
Picture 1 published with the responsibility and permission of the author by j.v.d.Rakt.

Picture 1

Picture 2 shows an closed chain on the affected side and an open chain on the other not-affected side. Even one arm lifting in the sky, is open chain for the shoulder but also for the elbow and wrist/hand on that side. The stability of shoulder (on the affected side) must be prepare by the cooperation of the keypoint muscle. Supporting on the crutch, but no longer 6 muscle chain but only three!
Muscle activity is 3 pattern;

1. Between the two legs
2. Homolateral there where the arm and foot are supporting on the crunch and floor and
3. Diagonal, agonist front, antagonist back diagonal from the supporting arm to the other leg and here will be the most loading be present.

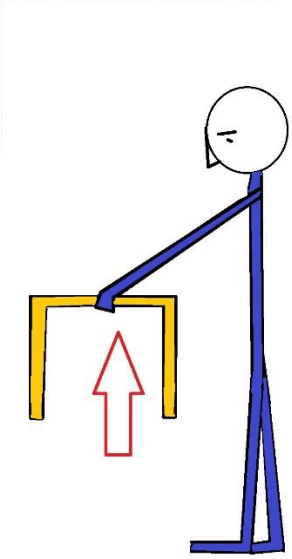


Picture 2.
Still on the affected side there is an closed chain but there is less stability on the affected side because the diagonal walks to an open chain (the affected leg to the not-affected arm). The control of the muscle chain is les but we have created an situation in which the person can support and reach with the other hand to grasp something. When he do so there will be movement in the body and some dynamic but the chain becomes dynamic as the crutch moves.
Picture 2 published with the responsibility and permission of the author by j.v.d.Rakt.

Picture 2

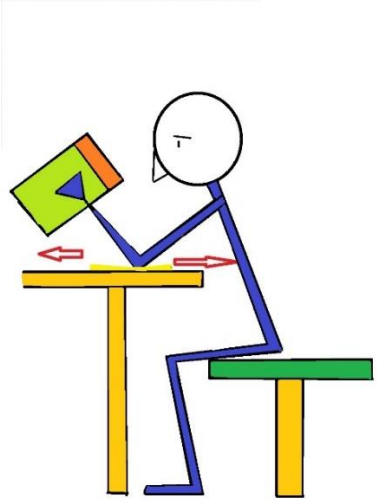
Thinking on an person with an stroke, who is supporting on his affected arm. This will evoke the diagonal to the not-affected leg and less to the affected leg. That is an normal reaction and the stroke

patient will of course have more confidence on the capacity of his not-affected leg as on his affected leg and especially on the homolateral structures. This is thus not an exercise that stimulated the affected leg, but give possibilities to build up an support function in the affected arm.



Picture 3

Picture 3.
Lifting the crutch with two hand asked for an closed chain in the arm/upper trunk. But because there is no contact with the ground this is no closed chain and also no dynamic closed chain but this called an half-closed chain. There is an discussion what is now the most difficult act (lifting as in picture 3 or moving as in picture 4). Picture 3 asked for less coordination and selectivity but greater amount of power to hold the crutch between two hands and picture 4 asked for less power but more selectivity and coordination. The power that must be reach in picture 3 can be done by the m.pectoralis on both side and that is "easy "when person are capable to use the Raimiste-phenomena[32].
Picture 3 published with the responsibility and permission of the author by j.v.d.Rakt.

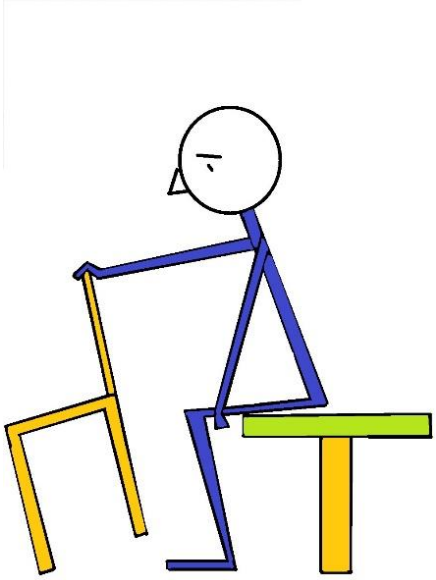


Picture 4

Picture 4.
In the hand half-closed and dynamic closed chain in the elbow. Half-closed because the hand are not on an support area and dynamic (but closed) because the elbow move on the table with an towel to every direction. Starting with moving to the front and back and do that with the trunk against the table this movement must come out the shoulder blade or less difficult the shoulder blade stay in the same position but the movement is done by the upper trunk.
Problem with this movement is that components of the flexion and extension synergy must be use to hold the box and move with elbow. This "dissociation" is the base of the therapy to create an better coordination and less dependency from bas movement by the synergy.
Picture 4 published with the responsibility and permission of the author by j.v.d.Rakt.

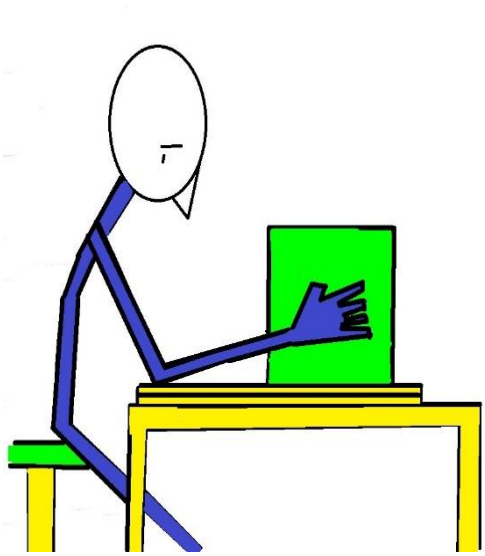
Picture 3 , lifting with two hands an crunch is an half closed chain because there is no fixation with the underground.
The chain of muscle pattern are:
1.Between the arms,
2.Between the legs,
3/4: Homolateral left and right
5/6 are the diagonals but now the agonist part is more the back diagonals and that was by the closed chain not the case. That makes it for an stroke individual difficult because to lift the crutch there must be an movement of the shoulder and shoulder blade and that is an activity that ask for an agonist in the front diagonal. When the back diagonal dominate the shoulder blade, this will go in retraction and lifting of the arm becomes very difficult.
Picture 4, this is an combination , the block between the hand is an half- closed chain and the elbow have an fixation on the table but is moving to stomach and to the front on an towel and that makes

this an dynamic closed chain. The muscle pattern that are active, are again 6, but the movement that he makes in the elbow trough an movement of the trunk /shoulder makes that no diagonal part can dominated.
This movement can be done through an movement of the shoulder blade – protraction (Front diagonal) but it can also be done from the lower trunk and then are muscle of the hip the prime movers.



Picture 5.
The hand on the chair is an dynamic closed chain, but on the other side is also an closed chain. Between not-affected arm on the not-affected leg.
Dynamic closed chain because the hand is on the chair and push that chair to an position that he stand on two legs. This asked for an continue amount of power and control. At the moment that he is able to fixated the chair in one position than the dynamic component is very less, but when he must move the chair to the front and an little bit back. It is dynamic closed chain when he is capable to place the chair on one leg we have , when he move, an half-closed dynamic chain. The not-affected hand on the not affected leg is to stabilize the diagonals.
Picture 5 published with the responsibility and permission of the author by j.v.d.Rakt.

Picture 5

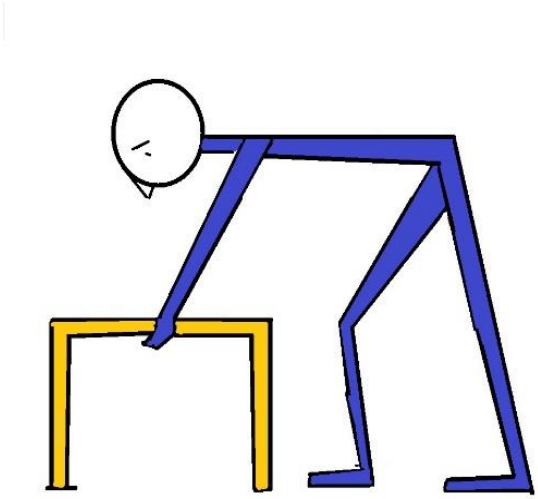


Picture 6.
"To make thinks more difficult" : Is an dynamic half-closed chain for the hand but dynamic closed for the elbow. Hand , because the hand hold the box and move over the supporting area but without having contact with it. The elbow have contact with the supporting area and therefore is that an dynamic closed chain. Always interesting and important what the leg do. Because they take care of the stabilization of the diagonal in the lower trunk and that have an impact in the upper trunk. Good stabilization is essential to get an better result. All exercises must give the individual the feeling having control and the possibility to play with it and the therapist has always the possibility to make it heavier . Task-specific resistance therapy!!
Picture 6 published with the responsibility and permission of the author by j.v.d.Rakt.

Picture 6

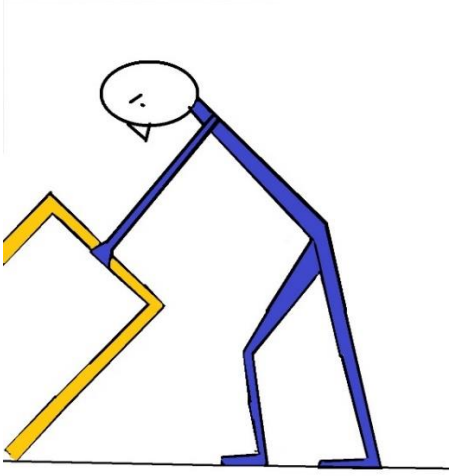
Picture 5. The hand on the chair must push from the shoulder and hold the elbow in the beginning in extension, this ask for an shoulder protraction. Protraction ask for front diagonal activity in the upper trunk and with extension of the elbow is this an part of an extension synergy. Look to the not-affected side, there create the person an closed chain by putting his arm on his upper leg and create so an base for the diagonal to the other side.
Again 6 chain of muscle when the person has in the sitting posture enough stabilization on the feet. When one foot haven't there are only 3 muscle chain remaining. That means that the difficulty is

increase because he must now more chain controlled with less point of fixation and that can be the problem to do this exercise good and create an situation in which he can variated and exercise with load etc.
Further one there is movement and that means that there must be cooperate between the diagonals/ homolateral structures to hold the chair in this position. And that he must changes his component of the synergy- dissociation.
Important to create an learning level that is correct for that individual!!



Picture 7

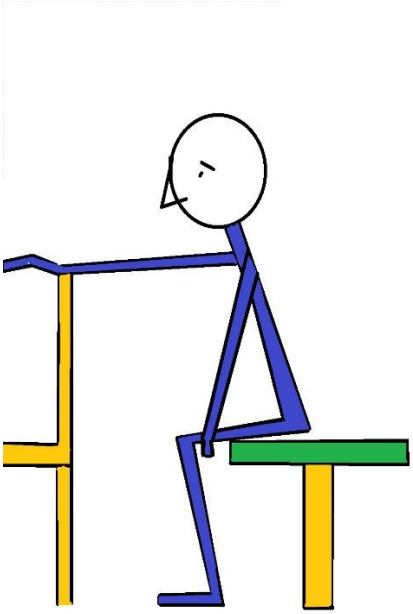
Picture 7.
Examples of dynamic closed chains.
But the difference with picture 1 (Closed chain that now the person push the crutch over the floor and walk. This walking pattern may be with no foot clearance but still this will askes for another muscle activation than in picture 1. There must be more coordination to hold the power on the crutch and push and walk behind it. This also the case with an walking aid as an rollator frame but there we have an half-closed dynamic chain. (no direct contact with the floor.) Try to start with backward walking!
Picture 7 published with the responsibility and permission of the author by j.v.d.Rakt.



Picture 8

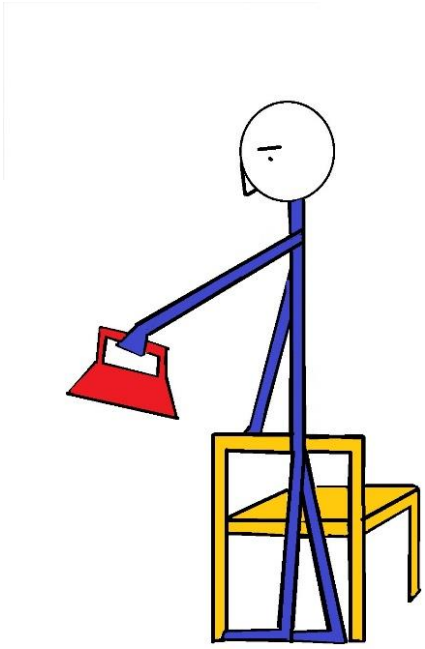
Picture 8.
Again an dynamic closed chain but now the support area of the crutch is less, only to point instead of 4 in picture 7. This asked more of the coordination of the shoulder/upper trunk because only support is enough, there must also be an control to hold this position. Pushing of the crutch is therefore another action because total support isn't possible. And again when we go to walk on this way, must there an stabilization there in the upper trunk when the feet are changing their position and will the swing or the stand phase of the affected leg will have influence on the capacity of the shoulder/upper trunk. *Picture 8 published with the responsibility and permission of the author by j.v.d.Rakt.*

Figure 7 and 8 are both dynamic closed chain. The 6 muscle chain are present but with the crutch on 4 points on the ground there is much more stability, than with two points and when one foot is in the air there are only 3 muscle chain. This foot can go over the ground without lifting, still this will change the muscle chain and more control and coordination is necessary. Without lifting the feet is backward walking easier!!
With this closed chain going in an dynamic setting there is an great amount of exercises possible that has also an resemble with ADL (All Day Living) and IADL (Instrumental All Day Living) and that will be very useful when an person has control over this and it can use though the day at home.
This is still not carry things because than we use an half-closed chain but taken an cooking pot, the person can slide with it over the buffet. But be aware that slide an crutch in the physical therapy room isn't the same as slide an cooking pan over the buffet and especially person after an stroke have great difficulty to translate what the can on the physical ward to their living area (Generalization[33])



Picture 9.
Closed chain of the whole body except in the hand/wrist on the chair- back support that is open.
Closed chain is formed by the feet that standing on the floor and the arm that have both support. (one the leg and one on the back support of the chair) That means that the chain is also closed between the arm and the leg and that the diagonals are closed.
This makes it easy to get an pressure on the chair without movement of that chair but this protraction (upper trunk) with extension elbow gives an extension flow in the arm all away to the wrist and fingers.
Now the extension that is there but cannot controlled in total open chain, has the opportunity to get now more possibilities and that an extension of the fingers occur. By more possibilities can this also be the start of finger movement at an higher selective level.
Picture 9 published with the responsibility and permission of the author by j.v.d.Rakt.

Picture 9



Picture 10.
An open chain on the side with the red bag but closed on the other side.
Here there is only one open chain but still there are 3 muscle pattern closed (picture 9, there it was 6).
Still the choose to create this base for exercise the shoulder with an swing exercise can be the start for working to an open chain.
Here the person is standing upright but with an flexion in the upper trunk this swing can even be easier.
Working with the closed chain on the other side makes that the stability is higher and that in the influence of the not-affected leg through the (back)diagonal is not too high. On this way it is possible to search for an stability that makes it possible to work with best normal tone and create the best normal movement .
Picture 10 published with the responsibility and permission of the author by j.v.d.Rakt.

Picture 10

Picture 9, total body is building an closed chain, again the hand on the upper leg till the wrist on the chair. That gives the person the possibility to concentrate total on the hand movement and often an push against the chair out the upper trunk-protraction – gives an extension in the whole arm even some extension in the wrist and fingers. But the movement of the fingers is an open chain. An example using the closed chain to stabilized the body to get movement in the hand/fingers.
Picture 10, an example of another creation of an open chain with the remaining part of the body in an closed chain or as there is movement in the legs , it is an dynamic closed chain than is performing along an high bench easier. The use of weight in the hand makes it easier to swing with the arm and teach

the person to learn the arm to move in an direction. The weight in the hand has influence on the input that the arm/hand have and that is more than nothing in the hand.
Therefore this chain is open but still will the reaction to move the arm be easier because there is information to and in the brain and the brain receive information through the visual system and through the weight, certainly when there is goal where this bad must go [34].

Closed chain: Means no movement and the hand/arms and feet/legs are on stable underground.
That will give 6 muscle pattern that cooperate with each other.
No movement and all end point are fixated.

Dynamic closed chain: The muscle pattern are equal as in the closed chain but because there is movement this asked for more coordination and control. Movement is always difficult because we must initiated, control and stopped this. Furthermore there are more possibilities though deviations and that asked again for more control.
Movement and that movement occur over the support area directly. That means that the pressure is pointed to the floor.

Dynamic Half – closed chain : There will be always an discussion which one must standing on this place. But it is the individual with an stroke and his possibilities that determinates what the best next step is. Half- closed means that there is no support is with the floor but between the two hands. Dynamic is the movement that this half closed chain makes and the most fine example is rolling pin (photo 6).
Movement occur not direct over the support area.

Photo 6

Photo 6.
What is here the difference between picture 7 and 8.The contact with the floor is both indirect, but holding and moving the rolling pin is there an combi . The hand build an half-closed because the hold something above the ground but the dynamic part is the movement that isn't direct.
Photo 6 published with the responsibility and permission of the author by j.v.d.Rakt.

Half-closed chain; Now the object is between both hand and free in the air . Of course between free in the air and the rolling pin are an lot of possibilities that makes the control different and that is the great opportunity to train and exercises the arm/hand.
Movement occur is the air but between the arm.
Open chain: This movement is free in the air and between complete free and an leading point etc, are so many possibilities. Also the focus on the point where the movement is going is important.
That give an Scala of possibilities to give an treatment on the level that is necessary and I which an person after an stroke get the feeling to achieve something.
Movement free in the air.

Flaccid arm low tone and /or high tone only in few muscles. Flexion Attitude Synergy.

Often is tone an long time low but in an later stadium there will be appear some tone but often not complete and this patient are often not capable to move the arm. That means there is no flexion or extension movement synergy present.

Low tone and certainly low tone over an longer period is mostly an sign that the projection of the arm in the brain is severe damaged [25]. The reaction of the muscles that created tone occur through pain, discomfort or associated reactions. This reaction are often created by the effort that this person must do to move (associative reactions, part of the static reactions [19,32]).

An great damage of the arm/hand in the brain give also an great loss of perception [25,35] and awareness of the arm especially when the attention must be elsewhere[36].

Thus will an personal neglect often be present and then is the chance great, that this arm/hand will be damaged through the movement of the patient in bed (lying on the hand) or by standing up and sitting or driving the wheelchair (hand arm along the wheelchair) and by walking.

Photo 3 give an option to secure this arm and in this case the fingers are wrapped to reduce the amount of edema in the fingers and hand.

Not only the hand is vulnerable but also the shoulder. There is often an subluxation (inferior) that isn't often an reason for pain but when people are careless, this can be develop as an painful shoulder.

Photo 7

Photo 8

Photo 7 and 8.

Photo 7 is an Rö- image of an subluxation, clear to see is, that the head of the humerus is leaving the glenoid cavity of the scapula and clear when someone pull on this arm the head of the humerus can go further down and that this can be an total luxation. But also the damage when this shoulder get further distal without complete leaving the cavity.

Also the position of the shoulder blade is clear, the cavity of the shoulder joint stand in the wrong position, too much medio-rotation of the shoulder blade.

Photo 8 give an image of an shoulder that has this subluxation. There is an great dip in the shoulder here more on the front under the acromion. That is the sign of an inferior subluxation.

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

The reason for the subluxation (inferior, anterior and superior [6,37,38]) will be discussed further in another article but the cause is complex but has to do with loss of muscle selectivity of the shoulder

blade /Trunk /Diagonals and the position of the glenoid cavity that has not the right position (photo 5) and of course also with the muscle around the head of the humerus. But till today it is not clear what the greatest reason is.
From diagonal point of view: Is the shoulder an keypoint and here the diagonals of the front and the back meet each other and we see the great amount on variation of movement that is possible and that means that there are an lot of small muscle with different function. Selectivity in this area ask for an greater (sub)- cortical area in the brain and that is damaged.
When then also the front and back diagonal not work together we see an different position of the shoulder blade and the subluxation will occur.
The individuals with an severe stroke and an low tone have almost all an subluxation. An because the perception is poor, the gnosis and praxis in the “arm-brain” will be also damaged.

Further one the difficulty in make movement and holding balance will give heavy associated reactions that change the mobility of the whole shoulder.
There is often, certainly after some time, an part of an flexion posture present. The difference between an posture- and movement-synergy[32] is, that movement cannot be evoke by the patient in the arm, but an reaction on an balance change is also an movement but without conscious, but still an movement. In my opinion that is also an kind of an movement synergy.
The small muscle will not appear (cortex) but the great muscle will have influence on the posture of the arm. Muscle that have also an projection lower in the brain or even in the spine region.
Through the back diagonal starting in the not-affected leg will almost always the back diagonal be dominant and that means that the scapula will go in an retraction [3,4,5]. Sometimes in elevation (pusher syndrome) but mostly retraction (Adduction depression and internal-rotation).
This great muscle are par example the lattimus dorsi, part of the back diagonal and that gives an retro-flexion / adduction and internal rotation of the affected shoulder. This is often follow with an tone increase in the m.pectoralis what will increase the adduction and the hand hang down in the front of the body. There seem in an flexion of the upper trunk and that is right, but it is no action of the front diagonal but an eccentric contraction of the back diagonal. This because the tone isn’t only low in the arm but often in the whole affected side of the body.
The elbow will give some flexion but we see that often only when the person walks and when he sit this flexion decreased, this in contrary with an active flexion movement synergy, than the patient try to lift his arm and the flexion of the elbow is often the first sign we see. Here this only will happen with great effort and when the person sit the tone is less.
And the hand and fingers are flex and this tone is often more high certainly later in time. Inhibition through stretch on the muscle is possible but very difficult.
And when you working on this hand pay attention on the reaction of the individual with an stroke, often he addressed his attention elsewhere.
An important sign that he is not aware of this arm/hand and the action we do.
That will also the case by higher brain function as washing and clothing. When no information of the arm will enter the brain, it ask an abnormal high attention to do this proper for the patient.
All neuropsychological problems will be there and that makes exercise or learning to deal or to work with the arm extreme difficult.

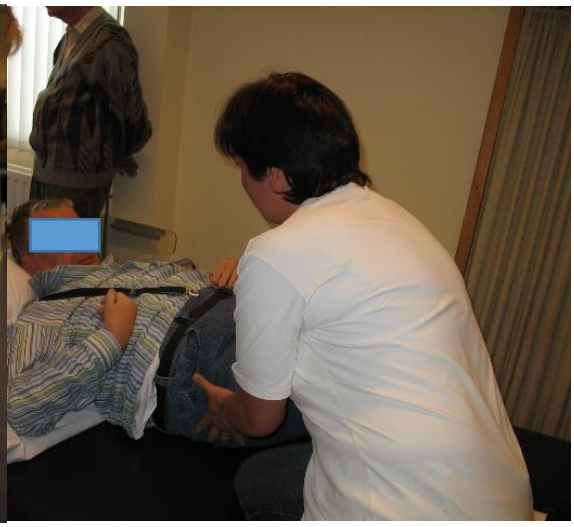


Photo 9 **Photo 10**

Photo 9 and 10.
Individual with an sever stroke of the right side.
The elbow is bend passive by the movement of the trunk to the front (The hand is "fixated"" between his legs and he don't "feel" it.)
On photo 10 by an activity of his legs, in this case:" lifting the pelvis, gives an increase in tone of the affected arm especially in the elbow.
Both moments are moments that he isn't aware where the arm is. When you ask him to take is affected arm , he must search and look where that arm is.
Further one the scapula stand is in an retraction and the caput of the humerus is subluxed.
Photo 8 and 9 published with the responsibility and permission of the author by j.v.d.Rakt.

In the treatment plan this must be clear. This person after an severe stroke can never be only responsible for the care of his affected arm/hand because the information that his damage brain receive is almost nothing and when he hold his hand with his other hand , he will feel his affected hand after an few minutes not because through an extinction of the stimulus[39].
Every attempt to learn him that will not succeed because it is too difficult. That may never be the reason to try an learn the person to take care over his affected arm/shoulder and hand but this is reality and need professional feedback, always.

This must be an assignment for all members of the treatment group over an longer period than by individuals with an less severe stroke.
Regrettable this is often not the case and then we will have great problems in chronic phase.

Treatment .

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.[21]
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 damaged brain.

Back diagonal base for the flexor synergy:

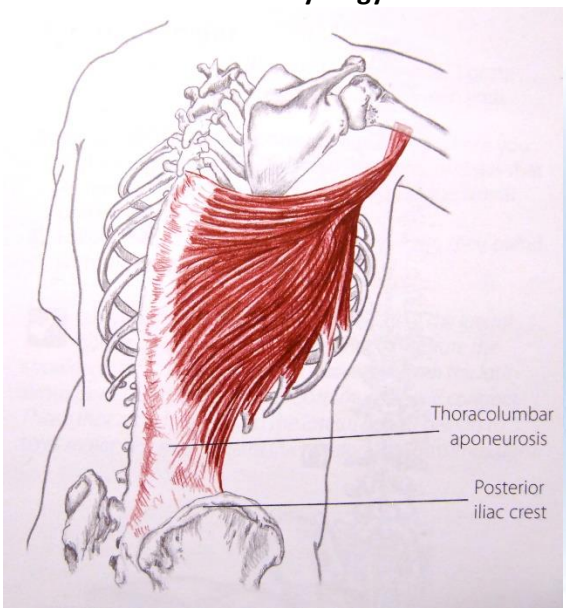


Figure 1

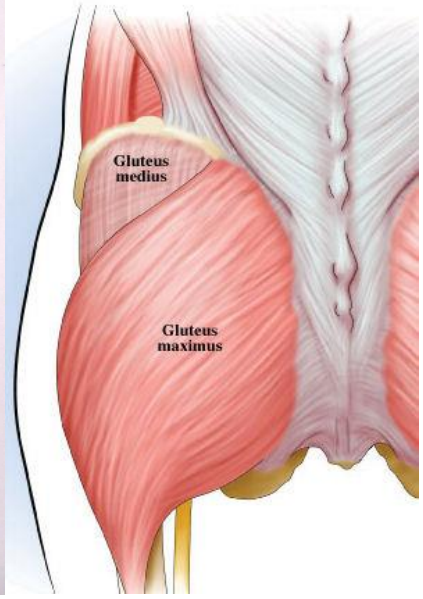


Figure 2

Figure 1 and 2.
The base of the back diagonal. An part of the fibers of the gluteus max. insert in de ilium edge, further on the sacrum , os coccygeus and in the apneurosis of the fascia thoraco lumbalis . An stretch on this muscle, by stand and hold balance on the unaffected leg will also give an stretch on the aponeurosis and that will react the m.lattisimus dorsi who start also partly in the aponeurosis and will give in the affected arm and retroflexion with endorotation.
The individual on photo 9 and 10 evoke an flexion synergy by performing an lift with two legs.
This is possible with one, but heavy. He has so little in his affected leg, therefore the lift will be done by the unaffected leg and give an stretch on the aponeurosis and that stretch will activated the remaining part of the back diagonal and one of the most active muscle is than often the lattisimus dorsi. That the elbow go in supination, is because there is al an alignment change in that joint.
Figure 1 and 2 published with the responsibility and permission of the author by j.v.d.Rakt.

By this arm function there is only an “partial” flexor synergy and on photo 10 there is as an reaction on the activity of the unaffected side an retroflexion but also an abduction and flexion, supination in his elbow. The activity of the lattisimus dorsi is there but not complete. Photo 9 seem to be an flexion attitude synergy and there is the lattisimus together with the m.pectoralis more active, but is the tone is lower in comparing with the action on photo 10. But still there is action because when he bend to the front with his not-affected arm he control his trunk with is unaffected leg. And that pressure activated the back diagonal to his affected arm.
That the activity of the shoulder muscle is activated can be done through the resitriction of the mobility of the nerve. In this case the nerve medianus because abduction/retroflexion can give an stretch on that nerve. Through the sub-lux of the shoulder can this nerve get another way . Not behind the m.deltoideus anterior but in front of this muscle en that means that the mobility of the affected arm in very limit and can cause pain.
And pain through an nerve will increase tone of muscle to protect the nerve and decrease the pain.

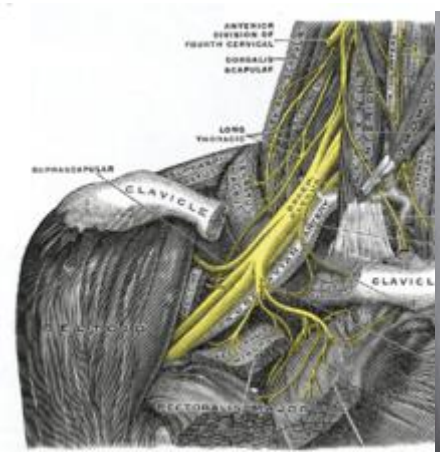


Figure 3

Photo 11

Figure 3 and photo 11.
Normal situation of the n.medianus and the pathological placement of the n.medianus . Every movement to abduction , exorotation will be provocative the n.medianus and the reaction by stroke individuals is more tonus m.pectoralis and m.lattimus dorsi. Thus more adduction and endorotation en still no good stand of the head of the humerus in the cavity.
Figure 3 and photo 11 published with the responsibility and permission of the author by j.v.d.Rakt.

This group of individuals with an stoke has an very bad perception, low tone in shoulder but still some elements of the flexion attitude synergy has an high tone. There is no or very little movement that the person can do with his arm active. His awareness of the arm /hand is minimal and often is the trofic of the arm/hand poor. He has no benefit of this arm, only burden and an high burden when there is pain. The projection of the arm is almost vanish in the brain on cortical level but lower levels can be present but than it is very difficult to use then because there are active by automatic movement. Par example walking and we see the increase of the tone in the arm as an sign that the unaffected leg works hard and that the whole back diagonal must participated.

This group of individuals after an stroke with such an very poor arm function will come in problems when there is not a team that treat them with care and don't stop.
In this arm is no movement that the individual can evoke in the arm, sometimes there is movement through the tone increase when they do something that is difficult. But then will all focus be at the task and certainly not on the affected arm.
The perception of this arm /hand is so poor that the awareness for the affected arm is very poor and often the arm/hand is complete out of "sight".
Training that this individual will mobilize his own affected arm /hand isn't realistic because this ask for an attention/cognition that is more than normal. Only when this arm/hand hurt will there an awareness but this awareness we want to prevent.

1. **Hold the mobility in all joint .**

All joints that means ;

- The scapula movement and especially the laterorotation, abduction and depend of the tone of the stomach the elevation or the depression.
- But also the mobility of the neck and that is the complete cervical but also the thoracic spine and with that also the mobility of the ribs.
- The increase activity of the back diagonal will depressed the activity of the stomach muscle and that will decrease the movement of the ribcage. The ribcage will stay high and stiff..

Photo 12

Photo 12.
Extreme loss of tone in the stomach on both side after two strokes.
That implicated that lifting the head isn't possible, but also that the ribcage don't move anymore and that has influence on the lung function. Often is this one of the reason that there will be often an pneumonia.
Photo 12 published with the responsibility and permission of the author by j.v.d.Rakt.

No movement of the ribcage will make it difficult for the shoulder blade to move to the front and will directly create more loss in the mobility of the shoulder blade and also for the glenohumeral joint.
No individual can hold his mobility of the ribcage under control without assistance of an therapist, therefore when this problem exist, this will demand treatment **always**.
The ribcage together with the shoulder blade can be exercise in side lying position on the affected side. When the shoulder blade is good in position than will movement over this side from the back to the front mobilize the ribcage and partial the shoulder blade and lying on right way on the scapula will also place the head of the humerus in the good position.
Furthermore lying on the side can be very good stabilized by pillows that the individual will feel secure and create no high tone. [43]

Picture 11

Picture 11.
Chosen for the maximal stabilization only the pillow under the stomach is removed[44,45]. But with this pillow there, this exercise can still be done when some movement is allowed. The shoulder blade lies to the front and now we ask the individual to try to touch the therapist who hold the affected arm in the right position. That create an movement of the upper trunk over the scapula but also gives an pressure to the inside on the ribcage. Turning back in the starting position will release that pressure but hold the scapula to the front. When this is going well there is always an opportunity to create resistance. *Picture 11 published with the responsibility and permission of the author by j.v.d.Rakt.*

Movement even with resistance can also inhibit the tone and help to hold the mobility optimal.
Resistance can be given on the unaffected shoulder and R.M. can be determined . Push against the unaffected shoulder to the front will activated the front diagonal from the unaffected shoulder to the affected leg. That means that when this movement is over the affected shoulder the back diagonal on the affected side will be stimulated and that can give an retraction. But because he is lying in the front of his scapula that isn't possible. But the movement can also be stopped in the neutral stand than the push and roll will inhibit the muscles from the spine to the scapula. More power will be needed when

we asked to lift his unaffected leg and move this to the front especially as we give resistance to the unaffected leg, now must the keypoint on the affected side work hard and must stabilized. Al this can be used to inhibit the tone and mobilize the scapula, ribcage and gleno-humeral shoulder joint.
Lying in bed is often the best attitude to get an maximal mobility. Sitting and certainly standing ask so much from this individuals that the tone is al increased at an higher level than in lying.
Therefore give this treatment in an lying position and use it as par example as an cooling down.

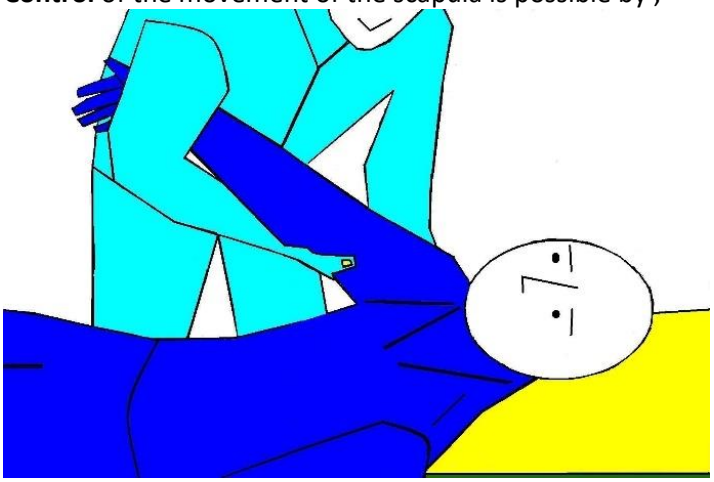
Photo 13

Photo 13.
Here this attitude in which he will lift his unaffected leg and try to move to the front. That evoke an rotation and the feeling of "fall" to the front but gives also and extension in the elbow and he feel that he can "push" back . First feeling of control in his arm ! *Photo 13 published with the responsibility and permission of the author by j.v.d.Rakt.*

Ribcage mobilization
Control of the movement and mobilization of the ribcage is possible by setting pressure on it with the whole hand and push and compared it with the unaffected side and feel the difference. Pushing rhythmic can also an method to hold the mobility. Can also be effective for lung clearance.

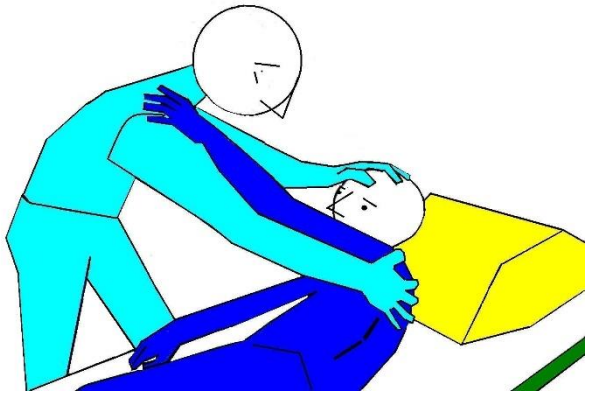
Tonus decrease upper trunk and scapula.
To decrease the tone of the upper trunk and the scapula there are an lot of effective inhibition technique but this isn't possible for the individual to do this himself, he must have guidance with it.

Control of the movement of the scapula is possible by ;



Picture 12

Picture 12.
Control of the mobility of the scapula[6]. Not the head but the cavity of the gleno humeral joint . Therefore it is important that the hand on the scapula makes an movement to the nose and that this movement is slow because otherwise the tone will increase.
On this way we are capable to feel what the effect of the treatment is.
Picture 12 published with the responsibility and permission of the author by j.v.d.Rakt.

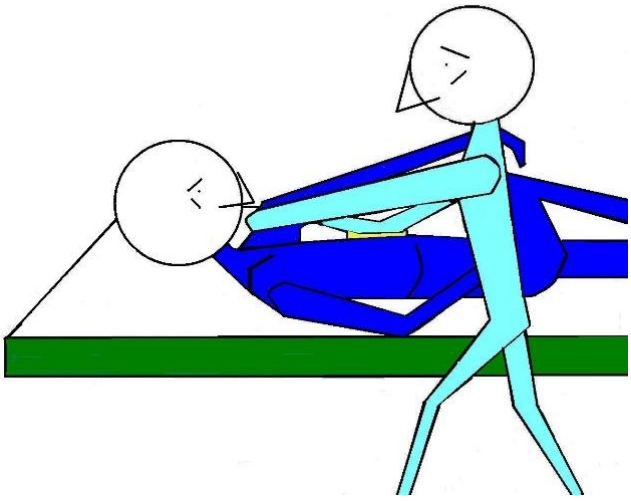


Picture 13.
An technique to lower the tone of the muscle between the spine and the scapula. The individual must lift his head with an little assistance an rotated to the affected side (right) . The scapula is fixated by the weight and the muscle will be elongated. *Picture 13 published with the responsibility and permission of the author by j.v.d.Rakt.*

Picture 13

Photo 13.
This technique is passive. The therapist has the whole top of the shoulder and by standing on the unaffected side, she pull this in the front diagonal direction and in the direction of the unaffected leg and pull it down .
To ensure that the rotation isn't too much she had placed her elbow on the ribcage and now it is important that there is mobility otherwise this will hurt. An towel; between the elbow and the ribcage can prevent somewhat. This elongation of the muscle ask some time , the most restriction is almost every time tone and that take time. *Photo 13 published with the responsibility and permission of the author by j.v.d.Rakt.*

Photo 13



Picture 14.
This is the active approach by activated the front diagonal from the affected side to the unaffected leg. Now the elongation on the backside will be stimulated by an shortening of the front side. And again use overload by resistance when this is possible. Lifting the head even lift the unaffected leg to the affected shoulder. Resistance against the head but better against the unaffected leg.
Picture 14 published with the responsibility and permission of the author by j.v.d.Rakt.

Picture 14

The arm/hand of this individual with an severe stroke that gives an flexion attitude synergy, the inhibition cannot always can be follow by an active training. Certainly resistance will be very heavy but when this is possible will it have an great impact on the holding of the mobility of the shoulder, upper trunk etc. Never I have seen an individual after an stroke with an attitude flexion synergy that has no

mobility limits. Within several days after the stroke there were limits in the movement of the elbow especially the supination and that will continued. The whole mobility holding is almost impossible but that must stimulated us , therapist together will all members of the team to get the best result. Photo 13 gives an picture of the most strong inhibition technique and that means that this position with adjustment when the tone an little bit decrease must be hold and adapt. That is an heavy job that can go to 5 minutes, thus prepare yourself that you can give this pull on the right way so long.

The gleno humeral joint.

For the gleno humeral joint it is important that the head stand optimal in the cavity and when that is the case the kop will move smoothly[46]because often there is no tone in the muscles of that joint. The restriction lies mostly in an wrong movement of the cavity, but be aware that the head stand good in the cavity and that there is no subluxation.

There are three forms of subluxation: inferior (the head goes down) anterior (the head goes to the front partial out of the cavity) or superior (now the head of the humerus goes up and to the front partial out of the cavity)[47]. The last two are often painful and ask for special treatment. The inferior isn't painful when we are careful and when the cavity stand good than create an optimal position for the head and make the movement till the end and feel it and observe the individual.

Be aware that other structures as the tone of the m. pectoralis or the nerve[48] can give the problem and that ask than for an proper treatment before make the movements in the gleno humeral joint.

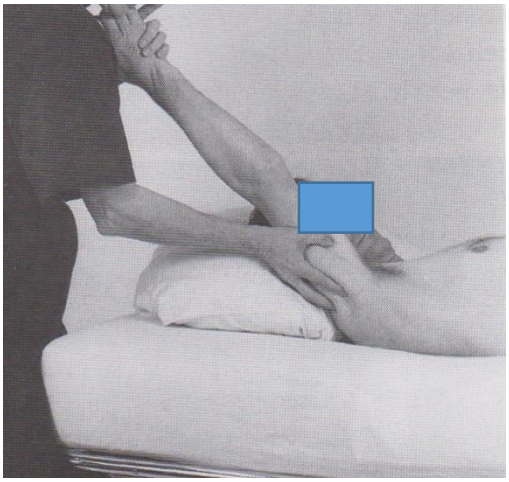


Photo 14

Photo 14.
Placing and holding the head in the optimal place and make an movement in this case anteflexion with exorotation.
Exorotation is very important because than there is the most space in the gleno humeral joint and will the movement be come to the end and when there is not enough exorotation than this can be damaged the structures of the shoulder joint.
With the fingers feel the head of the humerus and hold him in place. In this case she apply some traction in the arm at the wrist.
Photo 14 published with the responsibility and permission of the author by j.v.d.Rakt.

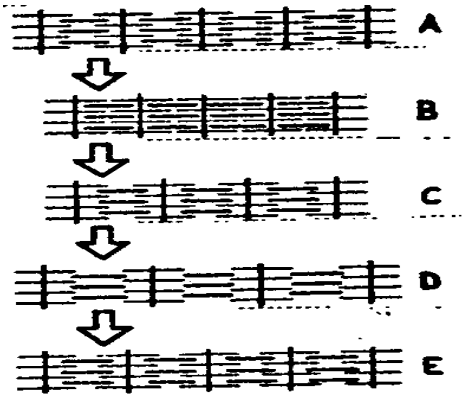


Figure 4

Figure 4.
Sarcomeres adjustment. Still today we don't know which time this occur. We still hold 12 hours after the experiment of Tardieu[49]. A = is an picture of an muscle that has an normal sarcomeres stand. B = An muscle with an high tone and the sarcomeres are close together. C= the reaction after "12 hours" of the muscle , normal stand but one sarcomere less. D = elongation of the muscle and the sarcomeres and E= the adaptation of the sarcomeres on that elongation.
One more sarcomere !
Figure 4 published with the responsibility and permission of the author by j.v.d.Rakt.

Of course there can be obstruction in the shoulder that ask for an manipulation technique but that is an specialization and by individuals with an stroke it is very important that the obstruction isn't tone or loss of sarcomeres[49], because than can manipulation give an negative effect.
An loss of sarcomeres than the only option is casting for more than 12 hours in an elongation position[50],but for the shoulder girdle is this almost impossible. But don't manipulated when there is an shortening through loss of sarcomeres because the muscle will not react but the ligament will react and there is no muscle to control that.
An exception is the manipulation by Mulligan [46]because there is an search for an optimal placement of the joint and this is an active method .
That means that the joint is positioned in "good" fashion but the individual moves and when that movement goes better than will this be rehearsed and give an great result often.

The individual with an stroke cannot make the movement thus must the therapist make an passive movement and that movement must go easy and without pain otherwise adapt the positioning and the pressure on the joint and create an new "displacement".

Perception.

In the past has two investigators[51] try to hold the exorotation of the shoulder on his best by create an posture of 90° abduction with flexion elbow and in the shoulder optimal exorotation. This posture was restricted with weight and hold in this position for an half hour. This was done without stretch , this position was possible for this individuals after an stroke.
But individuals with only an flexion attitude synergy has so little perception in their affected arm that this position of the arm will be fast out of their movement "memory" and they will not feel anymore their affected arm(extinction).
That is and will be the great problem, why this individuals cannot control their own affected arm because the damage in the brain is so great that the perception is gone but also the awareness is gone and this arm with be fast out of "sight".
Lying in that position will give this effect and this person will move and damaged his affected arm. That signal (pain) will enter the brain but often is the problem location of the pain so big that they look to the unaffected arm.
Therefore teach this individual that they must grasp their affected arm and put him in front on their legs. And never lay this group of severe damaged brain patients in an end position.

Elbow.

Remarkable fast is the loss of movement in this joint. And that is almost every time the end of the extension that is loss. That is an combination of extension and supination and the supination is often the very first obstruction of mobility that occur. That has to do with the radius head and his joint with the ulna and the humerus (olecranon), here is often an displacement of the radius head that give an restriction of full supination with extension. And just the extension is very important because support exercise are possible when there is extension in the elbow and that is often an of the first goals for an good treatment of the flexion attitude synergy.
Through the extension support training is it possible to get an better inhibition of the attitude synergy and prevent great loss of mobility and problems with caring of the affected arm/hand. We can than create an closed chain and exercise with the diagonals to an inhibition of the excessive tone and stimulated activity against the flexion attitude synergy. Support on the arms activated the front diagonals that are very weak in an flexion attitude synergy.
The method Mulligan[46] is by the elbow the best method to get the mobility back and often will then also the tone fast decrease and is support-exercises possible. Be aware that when there is no reaction in the muscles that supporting on the paretic hand /wrist /elbow and shoulder can be very heaven and be therefore careful that this give no damage. But on the other side don't hesitate to do it, because the results are perfect.

Photo 15

Photo 15.
Gives an impression of the Mulligan[46] approach. In this case by using an band to lift the under arm and fixate the upper arm with the hand and the individual turn his hand from full pronation to supination. Meanwhile the direction of the traction or the fixation or both can be change to get an better movement with no pain and restriction.
This approach ask an active movement of the patient but in this case the therapist perform this movement passive.
Photo 15 published with the responsibility and permission of the author by j.v.d.Rakt.

Wrist and hand /fingers.
Often in the beginning there is little tone in the wrist /hand and fingers, but when the flexion attitude synergy develop this tone will often increase in the hand and fingers and often is than there the first restriction in the dorsal flexion of the wrist. Furthermore this hand with so little perception is very vulnerable for damage and edema developmental by cutting the vein transport possibility. Problems with this transport can have an lot of reactions but one of them is pain and that can increase the tone in the hand and can give restriction in the wrist/hand and fingers.
And there is maybe an very little change, that this individual after an stroke can use his hand, it is still very important that this hand will not have an negative influence on the quality of life.
When the hand has an low tone than be careful with support training but do it, but set never the joint in the end position.
Support on the edge of an crunch gives the wrist, hand and fingers enough space and still give an good stimulus to decrease the tone and hold the mobility.
There must be than first an tone-decrease before the treatment “support activity” and then in sitting position we can tone decrease and go to support without too much load. We can go over to the support activity.

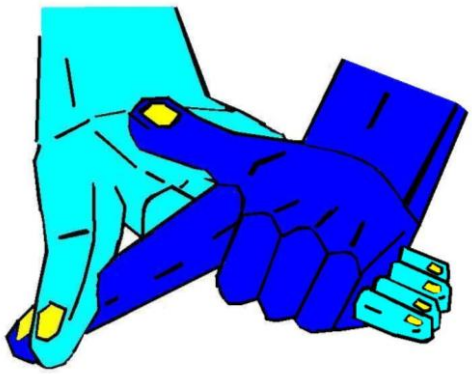
Photo 16

Photo 16.
This photo shows this movement on an chair but much better is this to do on an bench or bed. Here the therapist sitting along the individual but in front for the individual is even better.
Moving from the upper trunk in flexion will give an protraction in the scapula and between the legs with the hand in each other is holding the hand in exorotation.
Photo 16 published with the responsibility and permission of the author by j.v.d.Rakt.

Now we can control the tone of scapula and bring this with the head of the gleno-humeral joint in the right position[38]. Between the leg is one technique, there are more but the grip of the hand (see next pages) as praying gives an great result to hold the mobility.

Picture 15

Picture 15.
This technique asked for great hand of the therapist because to control both the scapula and the gleno- humeral joint is difficult with small hands.
The thumb goes around the humerus , the first two fingers are in extension and placed against the scapula directly under the spina scapula and the two other fingers are bend around the humerus on the inside of the axilla.
By pushing with the fingers in extension the scapula will go in protraction and we feel it with the bended fingers on the inside of the axilla because we feel the edge of the scapula. The other fingers around the humerus place the head in the right position in the cavity. The other hand can get the wrist and the hand/fingers.
Picture 15 published with the responsibility and permission of the author by j.v.d.Rakt.

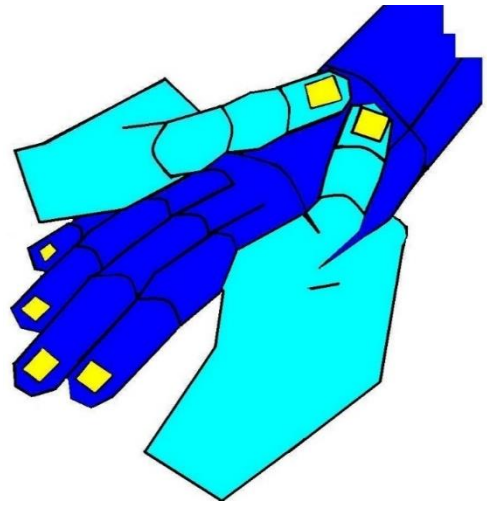


Picture 16

Picture 16.
With one hand control the wrist, thumb and the fingers. With the index finger we hold the thumb in the right position, our thumb stand on the distal base of the lower metacarpalia for the ulna and the radius and push this base down. With other fingers hold the fingers in optimal extension and now we can placed the whole arm on an edge to create an support exercise or the therapist upper leg.
Picture 16 published with the responsibility and permission of the author by j.v.d.Rakt.

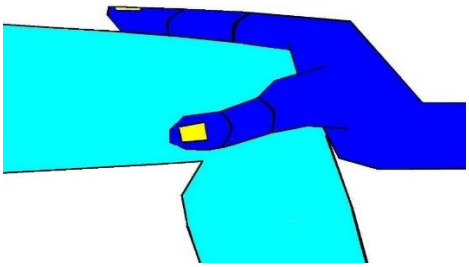
Problem when the arm has too little or when the exorotation is too difficult than placed first the hand and then correct the gleno- humeral joint and the scapula in the right position. Is that too painful than ask for help and let one do the scapula and the shoulder joint and the other the wrist and the hand.
There are two problems that makes this approach difficult;

A. The tone of the hand can be so high and difficult to decrease, that the technique show in picture 16 isn't possible and that there must be an inhibition that stay on with no very much change of posture, see E.
B. The technique is too difficult for therapist with little hand or difficult to hold the wrist and hand and on the same time take care for the shoulder joint and scapula stand.
C. And the edge of an chair, crunch or bench is too risky than it is better to go to an forward support with the hand of the individual on your knee/upper leg.
D. Recently there is evidence that Shock-Wave can have an inhibition on the tone[52]. The investigators has make an trial between Botox and Shock-wave and the result were almost equal.
E. Try to activated the muscle by stimulation even FES [37](Functional Electro Stimulation) can be used.



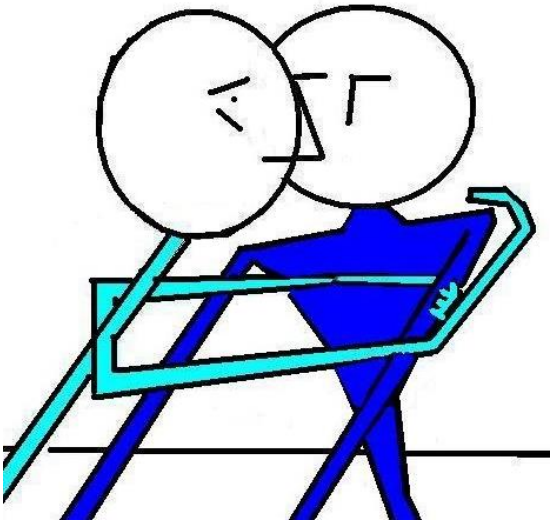
Picture 17

Picture 17
This technique from Joan Mohr[53] Senior Bobath Instructor IBITA focus the pressure by the two thumbs of the therapist against the ulna and radius. She push this two bones "away, hold this for minimal one minute and you feel the tone decrease and can make the dorsal flexion of the wrist. This technique is an combination of Mulligan[46] , tone inhibition and technique of mister Warmerdam[54]. This technique makes it for the therapist possible to create from the start an good position of the wrist with an good alignment of the hand.
Picture 17 published with the responsibility and permission of the author by j.v.d.Rakt.



Picture 18.

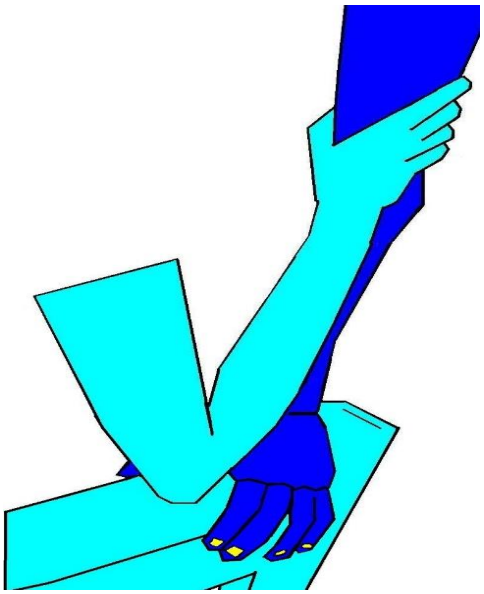
Picture 18.
Before she (Joan Mohr) placed the hand on the edge of an chair or on here upper leg, she placed the hand against her patella and give pressure on the under arm of the individual. That often created an better tone in the whole underarm and give the hand /fingers and the thumb an excellent alignment.
Picture 18 published with the responsibility and permission of the author by j.v.d.Rakt.



Picture 19

Picture 19.
When the control of the shoulder isn't possible as showed in picture 16 than we can use this approach . First placed the hand on the edge and fixated that hand . Now placed one hand on the shoulder girdle and be sure that the scapula goes in protraction. Now with the other hand in front of the breast take the upper arm far out and rotated the arm more in exorotation and the wrist stand firm against the breast and the shoulder stand in the right position and alignment. Now you create an point in the upper trunk that can serve as an" push "point and create an upper trunk forward.
Picture 19 published with the responsibility and permission of the author by j.v.d.Rakt.

All this technique can be done by an arm with low tone or an arm that develop an flexion attitude synergy. Because when the mobility in the joint is good and the tone is to decrease till an degree that support with an open hand is possible. Open isn't total extension but the possibility to "grasp "an edge an take support on the affected arm.
After that always feel of the whole mobility is still there or try to go to the border without pain. Still search from day one for an translation in the ADL. Than this will be done often and have we the opportunity that it is an automatic" action and that will help the arm/hand the most !!

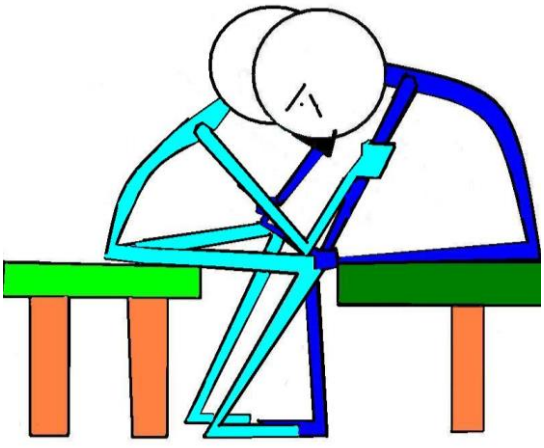


Picture 20

Picture 20 .
Problems with the placing of the hand after the 'Joan Mohr" technique has done(picture 17) ?
Than no edge of the chair or elsewhere but on your own upper leg. The great advantage of this is, that the therapist can feel how much the individual support on their leg. Disadvantage can be that much support gives an flexion in the fingers and that can hurt but you will be aware of that on time. When the hand of the individual with an stroke stand, placed you elbow in the place between thumb and fingers and with your hand bring the upper arm in exorotation and extension of the elbow. With the other hand you can control the shoulder girdle. *Picture 20 published with the responsibility and permission of the author by j.v.d.Rakt.*

Photo 17

Photo 17.
Here is on both faces readable that the individual with an stroke knows that he is squeeze and by the therapist is visible that the control over the hand isn't well enough and that the increase flexion of the fingers isn't pleasant.
But look to the alignment of the arm , the elbow isn't in extension and the humerus (gleno- humeral joint has not enough exorotation. When that was manage the flexion reaction of the fingers disappear.
Photo 17 published with the responsibility and permission of the author by j.v.d.Rakt.



Picture 21

Picture 21.
Still it can be possible that it isn't possible anymore to get the hand and the wrist in the right position to support. Certainly by individuals after an stroke that had not the therapist who knows that it is his responsibility to get the hand and wrist in the best alignment . When that is the case, start with support exercise on the knee with the elbow and increase this training to an resistance task specific treatment to improve the coordination of the affected shoulder girdle and the upper trunk.
Picture 21 published with the responsibility and permission of the author by j.v.d.Rakt.

Increasing the resistance can be done by the hand of the therapist on the upper arm by pushing and pulling and asking for an reaction that the arm of the patient isn't move away. This is an Task specific

resistance treatment with an R.M[55] of 75 % and with the right amount on rehearsal and frequency, this will have an effect on coordination and power.

Photo 18

Photo 18 .
Learning to push with the elbow from the upper trunk down.
This push will stimulated the front diagonal and now it is important to try so soon as possible, introduction of resistance task-specific treatment by ask resistance from the upper arm to hold that elbow in that place . Here the therapist pull the upper arm to the front but also push back will stimulated the front diagonal and create an good upper trunk forward that able this individual to lift his buttock easier when he has placed his feet well, when he use the support on his legs. *Photo 18 published with the responsibility and permission of the author by j.v.d.Rakt.*

Photo 19

Photo 19.
An variation on the support program with more joint to control and try to move the head freely in the space.
She hold very well there affected hand on the chair but the head movement were still difficult. By holding pressure on the back of both shoulder girdles, there was enough stability and the head movement were better. The next step is this closed chain replace for an dynamics form and place the chair on the two front legs and move than freely with the head. Hand training with FES.
Photo 19 published with the responsibility and permission of the author by j.v.d.Rakt.

It will always be an discussion when the cervical spine must be treated. The mobility must always be controlled but it is difficult to hold the cervical spine free and support on an edge of the chair. Certainly by person after an stroke with only an flexion attitude synergy, it can be important to create first movement and then go working on an free cervical spine. But every time - the cooling down of the treatment- ask for an treatment to restore the tone and maybe also mobility, don't forget than the mobility of the cervical spine.
Others will reply that an extension of the head gives an extension in the cervical spine (see photo 19) and will say that this extension gives an retraction of the shoulder girdles and stimulated the back diagonals. In photo 19 it looks like an extension in the neck but here head is coming out an flexion position, looking at their feet, to an position of looking to the gay that takes the photos and try to smile.
When the head and the cervical spine hold the extension also in an supine position, than never will decrease the tone of the scapulae and stay the back diagonal very active and is an treatment to reach an better activity in the front diagonals impossible.

Search for an possibility that after the upper trunk forward with neck flexion can be further develop with an upper trunk forward and support possibility but also with an free head. Than some extension is necessary otherwise isn't rotation and lateroflexion almost impossible.

Head /cervical spine.

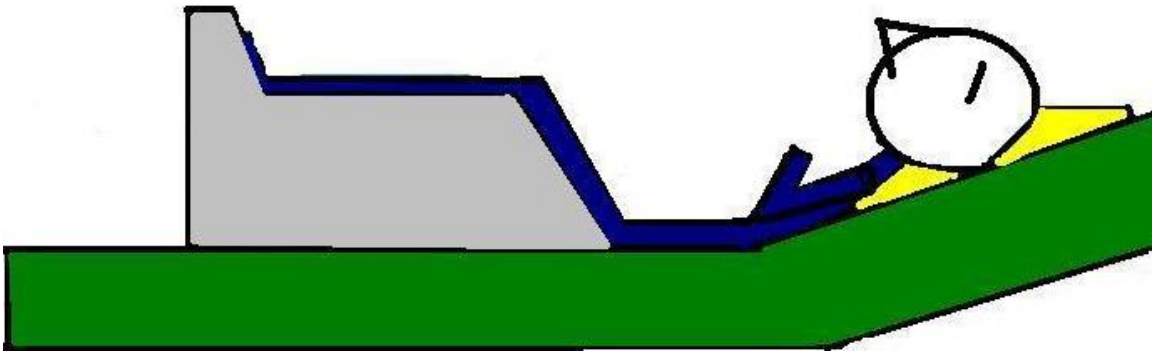
For an person after an severe stroke is stabilization essential. The relaxation of the head/neck will only occur as that stabilization is enter the brain. That isn't the same as lying in the mid and straight because we know that people with cognitive impairment [56] or who has suffer from the "Pusher Syndrome[57] have an change in the brain what their body perception concerned. Therefore it is possible that the person leis oblique but with an relaxation of the head and neck.

There are two important measures to do and when that isn't enough, we can give another with static of even dynamic information[59] to create an stabilization and an relaxation of the head/neck and therefore an relaxation of the upper trunk backward (back diagonals) . This last part is only needed by severe stroke patients.

The first two :

1. An stable and an hard matrass.
2. An secure environment visual and tactile, meaning that the individual can easy contact the wall on the unaffected side.

Extra an orthosis static or even an dynamic one ,an "pushing away" orthosis.



Picture 22

Picture 22.
The orthosis that gives an greater stability of the legs and can give an contribution to an release of the head/neck extension. This extension activated the back diagonal from the upper trunk. Through the support and stability of the legs the lower trunk gives an decrease of tone of the back diagonal from the lower trunk. The high tension of the upper trunk trough the extension in the head/neck will also create the high tone in the flexion attitude synergy in the arm.
Picture 22 published with the responsibility and permission of the author by j.v.d.Rakt.

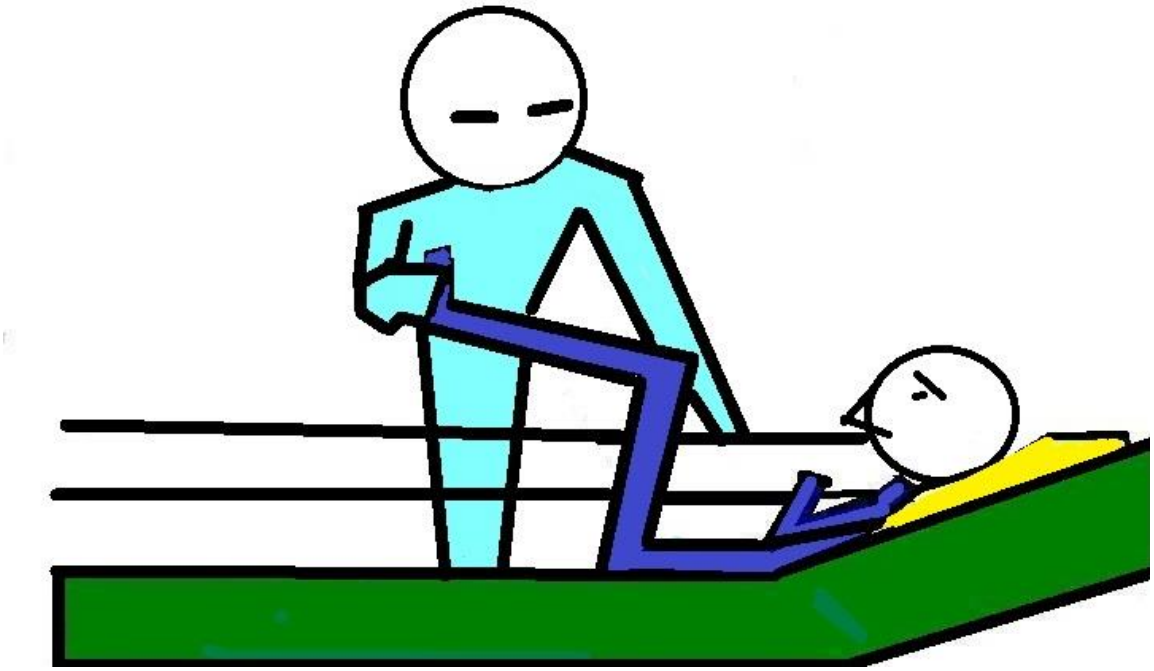
Sometimes this isn't enough. Certainly by severe stroke patient will this stabilization not enter the damaged brain and see we static reaction[60]. An sign that the brain has not the right information and still "think" that the must be an high tone to stabilize the attitude.

That can have an great impact on the swallowing[61], ADL and therefore the quality of live.

Than we must create another input to informed the brain that there is more and that this tone isn't necessary[57,58]

We search than to the point that the person withstand the pressure that we give against the feet/legs and react with an pushing away movement.

This movement decrease the tone not only in the legs but in the whole body and gives often an perfect reaction of the head/neck and the upper trunk. When that tone is less we are capable to treat the neck area and stimulated head movement.

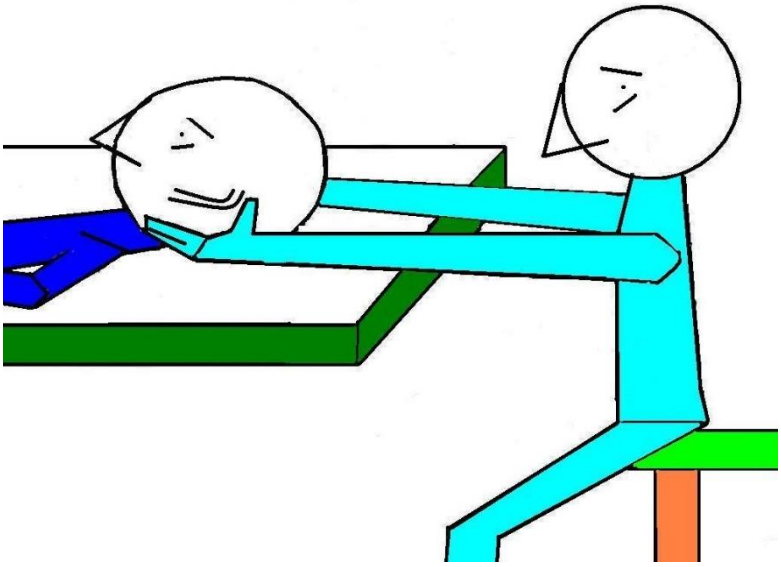


Picture 23

Picture 23.
Search for the limit. When the legs are moving toward the chest the reaction will we extension in the legs and will decrease the tone in the back diagonals all away to the head/neck. On this picture the test but with the orthosis (see picture 22) can this also by placing the orthosis further in the direction of the head. Picture 23 is only an test when the "pushing away" reaction occur, because the orthosis must be built to do that also. When this orthosis is doing his job than after 10-20 minutes the tone decreased and is an treatment possible. Of course it is important that the recovery goes on otherwise this treatment will be necessary to hold that level.
Picture 23 published with the responsibility and permission of the author by j.v.d.Rakt.

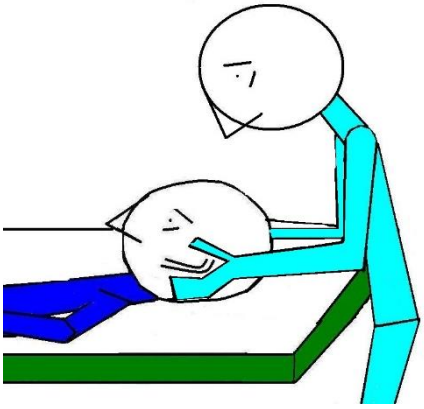
Now the extreme tone is decrease, we can work on movement and restoring the mobility of this region. That can be done by further inhibition of the tone but the greatest value we will reach when we can create an active head movement. Starting with an flexion to the chest and built this further to an increase in power of the front diagonal, because that is the best answer against the dominancy of the back diagonals.
Always will the inhibition give the best effect when we create also an active movement that can control this tone of the antagonist.
But the tone can also have reaction in muscles, joints and nerve tissue and vice versa.
Therefore an good assessment of the mobility of all structures is necessary and when there is an mobility- loss is that an part of the treatment.
Pain will always have an negative impact on the tone and that is always the tone that we want to normalized.
When the muscles change in length not much can be done because casting[8,17,50] is only possible by arm and leg problems, but often it is the tone and we can increase the effect of the stabilization by giving pressure on the head and also on the tone by lengthening the muscle.
Mobility of the joint asked for mobilization technique that not evoke pain but place the joint is his right alignment[46].

Nerve tissue[48] will asked for slide movement and especially in the area of the trunci it is important to assess and treat this, because there will through the extension of head/neck often we not enough space to move normally.



Picture 24.
Both hands of the therapist are on the side of the head with exception of the ears and the therapist now try to evoke an pressure with the hands pressing to each other[38]. That pressure may change(dynamic) but hold this pressure for minimal of 1 minute and wait till the tone is decreasing.
Picture 24 published with the responsibility and permission of the author by j.v.d.Rakt.

Picture 24



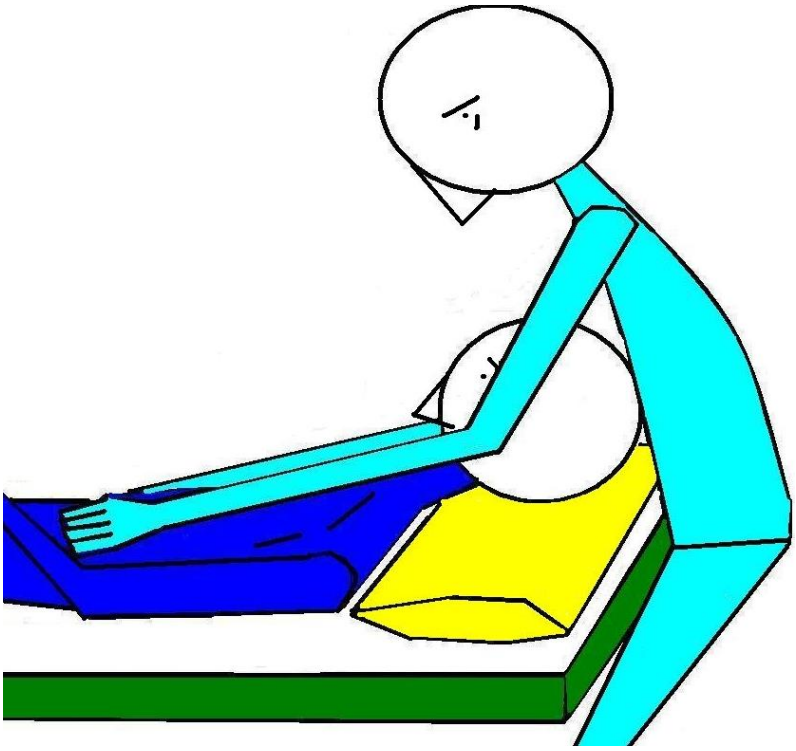
Picture 25.
The same principle; give pressure between the two hands on the head and change the intensity of that pressure but wait till the tone will decrease than we can move and alter the head attitude and maybe facilitated head movement. Furthermore we are able to give an stretch on the neck muscle to get an greater inhibition.
The pressure must enter the brain and give the brain the perception that the extreme tone isn't necessary.
Picture 25 published with the responsibility and permission of the author by j.v.d.Rakt.

Picture 25

Pressure on the head in an stable bed with correct environment that is small and safe eventually place the patient in an "pushing away "orthoses must give an tone reduction after 1-5 minutes. When that not occur or partial occur than there are two possibilities;

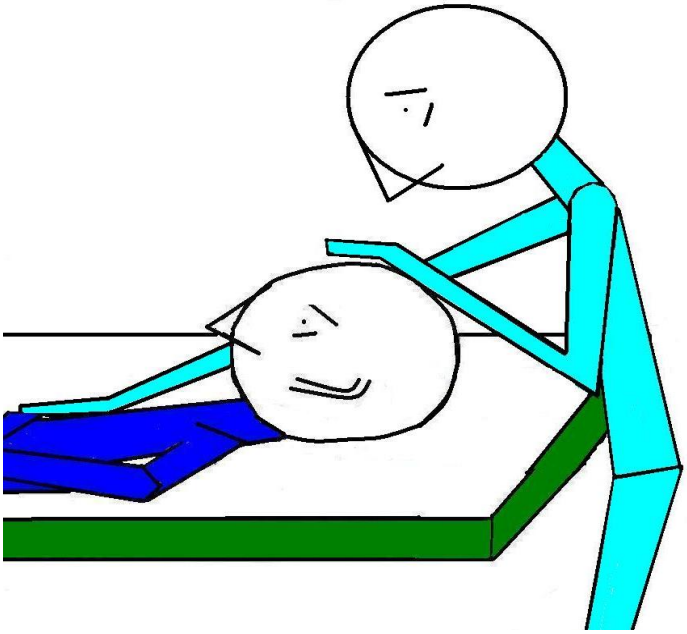
1. There is an restriction in other structures as the extreme tone or…..
2. The stability feeling isn't enter the brain and/or the perception of the brain cannot feel it. Try again and make the stability more intense.

When the tone decrease, than is this moment to try and move the head and facilitated to an own movement of the head by the individual with an stroke.
Combination of pressure an lengthening of the muscle on the backside of the neck is also possible but be aware that the pressure must enter the brain to get an result.
Only an stretch will never give an decrease of the tone as the situation isn't stable and pressure can give the damaged brain that last part of stability.



Picture 26

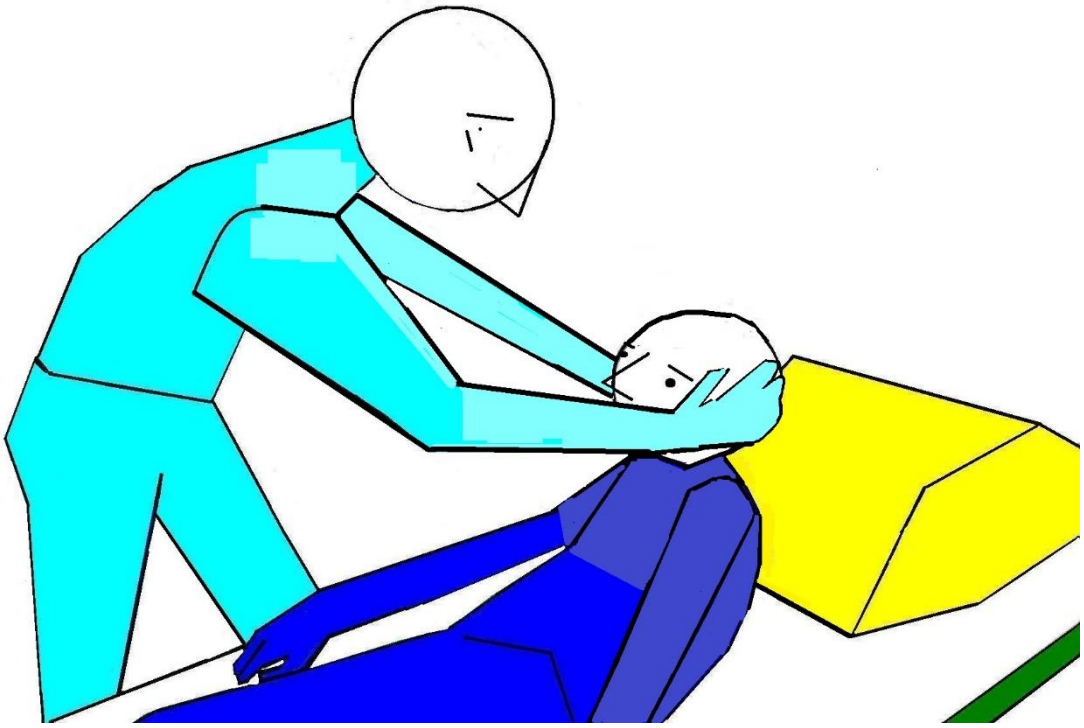
Picture 26.
An difficult combination certainly in an hospital bed but in this picture the stomach of the therapist hold pressure on the head to inform the damaged brain and by stretching his legs he can move the head to more flexion. With his hand on the ribcage – stomach - the therapist can stimulated the front diagonal to fixated the ribcage and allow to lift the head in flexion. Also an mobilization of the ribcage. First start with active movement. *Picture 26 published with the responsibility and permission of the author by j.v.d.Rakt.*



Picture 27

Picture 27.
This is another approach to stimulated and facilitated the active flexion of the head of the individual with an stroke. Now is one hand placed on the top of the head and help the individual to lift his head and the other hand stimulated the ribcage – stomach to become active and make it possible to hold the head in an flexion position. *Picture 27 published with the responsibility and permission of the author by j.v.d.Rakt.*

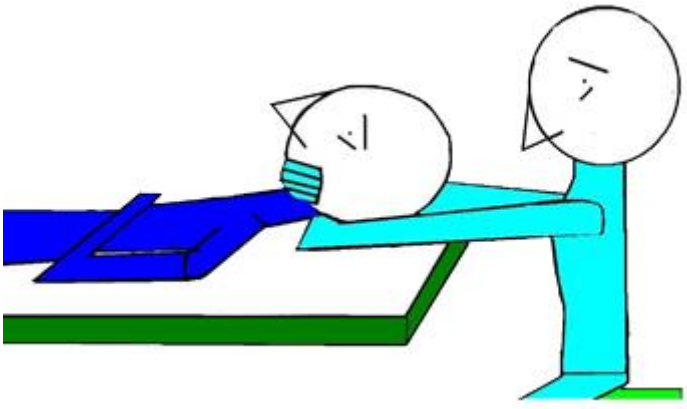
When this treatment is necessary than it is good to realize that the front diagonal are very weak or that the back diagonal are extreme dominant. And that it is important that other measures will be taken to prevent this attitude or treat this attitude during the day and night. Because when this isn't taken in the "whole day"-protocol the tone will remain in the remaining time extreme high , only when there is an treatment there is an decrease and that will never give an good base.[6.9, 38,43,57,58,59]



Picture 28

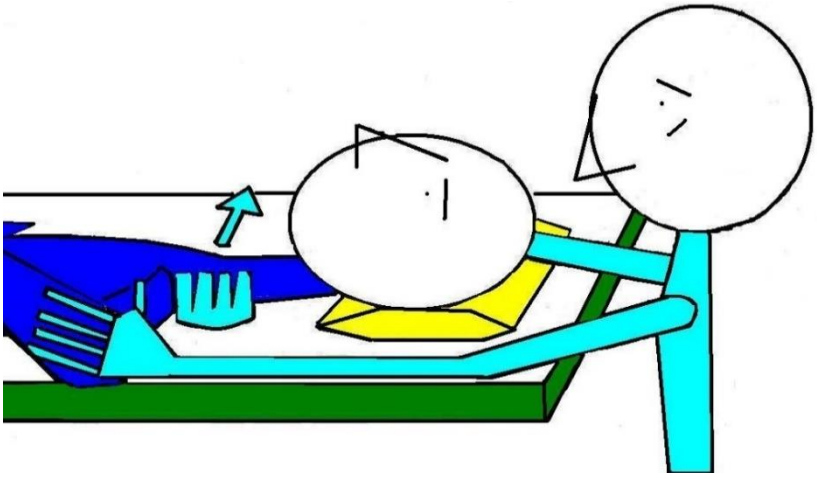
Picture 28.
It is not comment that the treatment will be start as is show from picture 22 , mostly there is an higher extension tone but with pressure on the both sides of the head often the tone decrease and can we start with facilitating the flexion movement. Do it on both side because the unaffected side will have an greater perception and the movement of the head after decreasing of the tone will be accurate. And that is important because an movement that has an deviation to the unaffected side can also give an unilateral stretch on the tongue bone and therefore make the swallowing[61] process difficult.
Picture 28 published with the responsibility and permission of the author by j.v.d.Rakt.

When movement is possible, assess the mobility of the cervical spine because the tone difference can change joint position and then will lateroflexion and rotation be restricted and must other technique be used to decreased that restriction.



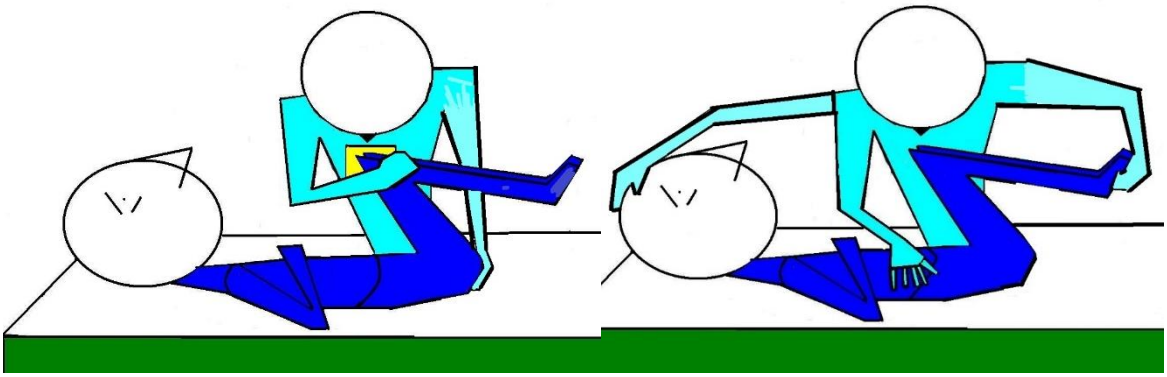
Picture 29.
Traction of the cervical spine according Mulligan and after this traction an pain free movement active when it is possible to flexion. Mulligan has other technique to remove restriction in the cervical spine[46].
Picture 29 published with the responsibility and permission of the author by j.v.d.Rakt.

Picture 29



Picture 30.
An technique out the Butler school. To assess and treat the truncus of the arm nerves . Again other technique for the cervical spine and the arm nerves.[48]
Picture 28 published with the responsibility and permission of the author by j.v.d.Rakt.

Picture 30.
There are always exceptions and one is worth mentioning. And it is rare but by some individual is inhibition of the tone of the back diagonal in the back and in the legs very important to get the extension in the head and shoulder girdle on an lower level and make movement of the head possible. All other technique didn't work and the flexion attitude synergy was developing very fast with an subluxation of the glenohumeral joint to an superior status. That is very painful and movement in threat shoulder and head isn't possible by treating the head or upper trunk. Only an treatment of the legs and the upper trunk has influence and make it possible to inhibit the extreme tone of the cervical spine and had an positive influence on the pain.



Picture 31 **Picture 32**

Picture 31 and 32.
Bend both legs and turn the knee an little to you and fixated the knee with our chest (eventually put an towel between the knee and chest) . When the tone is high on the affected side turn to the unaffected side and is the unaffected side high of tone turn to the affected side. The pressure give with your chest on the knee to the hip-joint before you do an muscle –stretch. The turning of the knee isn't great and after the pressure an tone decrease, place one hand sacral so high as possible and the other hand on the ribcage – stomach. The hand on the sacral area gives an traction and hold that traction till you feel that the tone is further decrease.
Now hold this position and make the hand on the ribcage free and facilitated the head to an active flexion position.
Picture 31 and 32 published with the responsibility and permission of the author by j.v.d.Rakt.

Why this works , isn't clear. It works by individuals with an stroke that have an different attitude of the legs. Normally is one leg(not-affected) straight and the other in an flexion , exorotation and abduction, this attitude associated with the cross extension –flexion reaction[60] and we know that this is an very

dangerous attitude[62] because it can hurt the hip or make the exorotation of the hip hypermobile, therefore prevention is necessary .
But by this individuals there is an flexion, endorotation with adduction, more components of the extension synergy that the flexion synergy and often both legs are press together, another attitude is also possible than is the unaffected leg in flexion adduction endorotation and has the affected leg more extension but also with endorotation and adduction and again press together.
An “pushing away” orthosis is very useful but very dangerous because this evokes movement often in the unaffected leg and can create an pressure score when this is to long applied.
The best orthosis is always that orthosis that allow that the legs touch each other than the damage of the skin isn’t present.

This individuals after an stroke were always coming out other long care facilities, therefore it isn’t realistic to search for the reason . One possibility is that the affected leg is from the start in the wrong attitude and that pain in the hip has create this attitude, but some believe that the instability of the matrass is the reason and of course an complex of reason can be the answer.
By the most of this individuals was the tone of the head high and the attitude flexion synergy extreme and was there an superior subluxation with no movement possibilities because of the pain and great difficulty to dress, wash and care this individuals.
But the reaction on the pushing away orthoses was the start to treat, starting on the lumbar spine instead of the upper trunk and head and when there was an positive reaction , first often in the head and upper trunk and after that also in the shoulder girdle

Photo 20.
In this photo only one element is disappear , the extension of the head. The wheelchair was construct on an way that upper trunk flexion was stimulated and after the treatment of the legs and lower trunk the upper trunk react first with the head. No longer the extreme extension of the head to the back of the wheelchair support, but an free head. Still there is some stretch on the front of the neck but this has no influence any more on the swallowing capacity. The flexion attitude synergy in the arm is still very strong but in this position there is no pain.
By washing and dressing it was still very difficult to do that without pain.
Photo 20 published with the responsibility and permission of the author by j.v.d.Rakt.

Photo 20

The hand is not total closed but that come by the extreme palmair flexion of the wrist. The muscle that placed the wrist in that position were so strong that closing the fingers wasn’t possible because the muscle that stretch the fingers were at their end of their length.
An further high component was the activity of the biceps on the elbow and pectoralis together with the latissimus and that placed the head of the humerus up against the roof of the cavity of the gleno-humeral joint [47]. Not only up against the roof but also somewhat out of the cavity and that is an superior subluxation.
Inhibition technique starting from the legs and lower trunk had success but together with BOTOX this was faster obtained and the subluxation was decreased and now was exercising better possible and was there movement passive after inhibition possible that can be used when this patient was wash and dressed.

In the beginning after the BOTOX injection the exercises were done on the ward to create an decrease tone and more passive mobility and after that there washing and dressing was done. That was done every time there was an need for to prevent that the pain was returning and the tone increased.
After three mounts every one of the team was able to inhibit and wash and dress without tone increase and pain and that means that here quality of live was very strong improved. Still the restriction are still great but movement for the ADL in the shoulder ,elbow and wrist and hand was possible and the was little pain. But every morning asked this for an extra treatment before the ADL could start.
Important that this must be prevented and that must start as soon as possible because the combination of high tone, changing van muscle structure (cross-links, advanced glycation end products (AGEs)[63,64], sarcomere , joint position altering and too much stretch on the nerve tissue can give an stand of the arm that isn't correct totally.

Summary treatment mobility ;

Reason for so fast loss of mobility

- No good treatment and often to short and with an wrong frequency..
- To early give the responsibility to the individual with an stroke and his love ones.
- But also the increase of tone give changes in the muscles (sarcomeres)
- The interaction between the contractile and not-contractile element of the muscle will be inhibit the movement possibilities.
- The elastic and not elastic component in the joint will restricted often the end of the movement. The movement of the joint will be on the last part have an harder "end feeling"
- There can be displacement of the joint part. An few millimeter is enough to give an restriction of an joint , but now the movement end is very hard. Treatment with manipulation is in order , Methods likes Warmerdam of Mulligan are the best way to do it but by this group of individuals with an stroke this must be passive instead of active.

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