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The “Pusher” syndrome. Special task-specific resistance treatment and explanation of this syndrome. Part 3

Authors: Jan van de Rakt¹, Steve McCarthy-Grunwald²

¹ *Physical Therapist NDT teacher IBITA, Course Leader and teacher on the Dutch Institute for Allied Health Sciences . Nursing Home “Waelwick” in Ewijk The Netherlands.*

² *MSc BSc RMN Lecturer in Mental Health Nursing with Dementia Specialty. University of Cumbria, Bowerham Road, Lancaster, LA1 3JD England.*



Abstract

An important part in the treatment of person after an stroke with an “pusher” syndrome is the task-specific resistance treatment. There is always discussion about strengthening by neurological patients but when the muscle react with more coordination and power in the muscle pattern can this be only very important. That restriction was for the strengthening for an isolated muscle and then pointed at an muscle strength increase. Often was the effect an tone increase and an stimulation of the pathological synergy, but with an task specific approach the must be an task specific movement and that asked for an almost normal tone to get the movement and you still have that movement but now with load. With this increase on power and coordination will motoric learning have more effect because there are more possibilities through the increase of coordination and power.

The stair in an training program is an example of the use of the stair to make an training with load that lead to increase of power and coordination and gives immediately an increase in learning. The stair is for patient with the pusher syndrome an perfect training and with load an very important part.

In the mid the hypothesis around the phenomena Pusher and that support the treatment-approach of Pat. Davies and there approach to work with the back - splint.

The last part is an closing part of the pusher article. There we lay the focus on the chronic stage that is often an very long period in which the level stay on the same height or makes an slow decrease. Here is for every patient possibilities to better the level but for the patient with the pusher-syndrome this chronic stage is often an delay of the subacute stage and maybe even the acute stage. And that asked for all possibilities to ensure that all is done to get the best level. That asked for variation and an treatment that never stop with assessment and searching for the best training possibility.

Keywords: *Stroke, diagonals, pusher, perception of the spine, midline- perception, chronic stage.*



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Correspondence for author: Jan van de Rakt email : jan@vanderakt.nl



Introduction

Task- specific resistance treatment to created better power and coordination in the affected side !

When the patient was brought in an very dangerous situation, so dangerous that the static reactions [1,2] occur, than there was an cross over from the diagonals from the not-affected side to the affected side but this was an reaction on that dangerous action. That means the patient provoked everything he had from his not-affected side to make an stop possible. The amount of information to the affected part of the brain isn't there because this information is blocked. But it give us the picture that the diagonal are still there and can cross over. In the 3 attitudes [3,4] this was possible when the information of the affected side was done on the right level, especially in the standing posture an cross over from the affected side was possible and that give an reaction in which it was obvious that the affected leg was the start of the diagonal. This reaction must be dynamic and that means that the patient must do something in this standing position or there is changing from this standing position to walking , because that is always dynamic. Mostly this patients has an low tone and feel their muscle soft. That means that the muscle are not strong enough to carry the weight and the body will bend to stretch the muscle and that gives an eccentric contraction. Eccentric contraction can be harmful for muscle especially old people[5]. Therefore it is good to try this eccentric contraction to change in an concentric contraction. There is no reason why muscle of stroke patient cannot go from an eccentric contraction to an concentric contraction especially the muscle of the spine and the big joint because there innervation is double[6]. Lieber[7] on the contrary has investigated that concentric likes higher in the brain than eccentric and it is known that eccentric can also an muscle-reaction that occur when the muscle get an stretch that can harm the muscle. This stretch is no eccentric contraction but an reaction in the spinal cord without interference from system above. Still there are also investigation that the eccentric contraction as control-instrument has an higher place in the central nerve system as concentric.[8] Is therefore important to obtain an true muscle contraction without an stretch. When an concentric reaction occur in the muscle than it is possible this muscle to train to get more strength [9,10,11]. Further is know that this occur in the beginning with an better coordination and later on with more power. And coordination is part of the central nerve system. By therapist there was always the fear to ask to much of the muscle and therefore the wait till the patient was so strong that it was possible without much support. On the other hand the approach from Pat. Davies [12,13,14]standing position with an back splint gave so often an amazing result that it must be possible, this movement make heavier by giving "over"-load. In the affected leg the extension synergy will appear and no part of this synergy is the muscle gluteus maximus.

Is this an concentric activity or is this an eccentric activity, how to feel the difference ?

Always that is the problem when there is an start of this exercise. To long eccentric will damaged the muscle fibers therefore the must be an concentric action. And surely in the beginning the muscle power is so less that an concentric contraction in this attitude isn't possible. Therefore use an chair as start of the diagonal [15-19] from the not-affected side, that will give the tone in the diagonal (especially the back diagonal) an higher tone and maybe this can help the tone in the remaining diagonal to increase. By lifting the leg the system get much information and that boost of information can awake the system (picture 2). But the arm support can give an wrong angle in the diagonal and then there is only activation of the adductor /semi muscle and the medial knee stretch muscles and no activation of the muscles gluteus medius and maximus. This can be done by an combination of support on the not-affected side through an chair and the "berengriff"(picture 1). Instead he makes an lower trunk sideways, he makes an upper trunk sideways, an Duchenne and an shortening of the spine on the affected side. That will all patient do when the power in the gluteus medius is to low but gives us the opportunity to find the right upper trunk sideways with an activity of the gluteal muscle and the first concentric contraction can occur. In this situation the therapist must always lift the not – affected leg and decrease the weight of the leg and make it easy to create an concentric contraction. The

concentric contraction will be an co-contraction at the end in which the lower trunk goes sideways but the pelvis lift also on the affected side up.

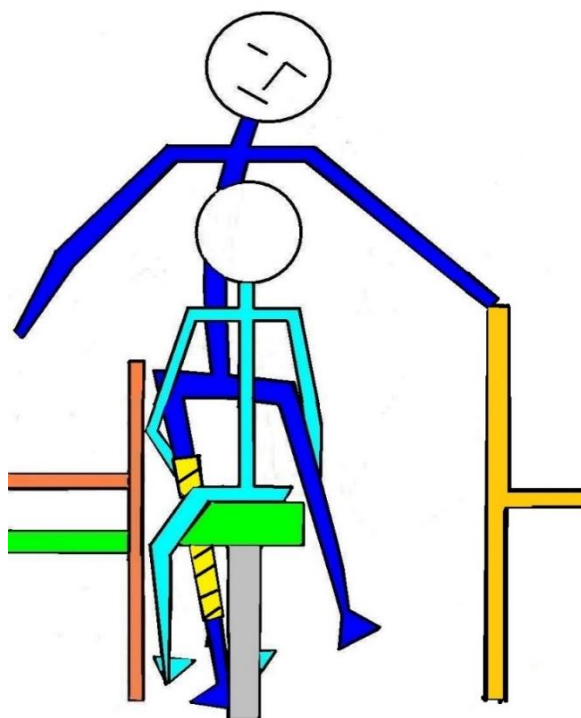


Picture 1.

Picture 1.

The “berengriff” often in the beginning the best approach to give the information on the affected side and make it possible to get an shortening of the spine on the affected side. So is the therapist in control of the spine but also through the arms on the back and front an control of the hip and especially the hip extension. And through the knees of the therapist is there an control and an dynamic stimulated possible of the knee of the patient and on the weight on the affected leg. Total control and training possibilities but this technique can be heavy when the therapist do this not on regular basis. Therefore start with patients that don’t need it directly but where an extra stimulus can give an boost on the performance.

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



Picture 2.

Picture 2.

One leg standing with an back splint on. The patient may hold on an chair of bench that means that the diagonals start on the not affected side and often on the other side an chair or even an bench to give him security. But also to control the elongation of the trunk and when necessary can this be change in an shortening. Through make the room between the affected lower trunk lesser. Important is that there activity in the trunk muscles on the affected side. This is also important to get the angle of the diagonals in the hip joint.

Start with help the patient to lift his not-affected leg and control the hip that will go in an retraction to the back. The activity of the muscle gluteus can be felt and can be stimulated. Try to avoid the trunk flexion because that can give an contraction though stretch. Picture 2 published with the responsibility and permission of the author by j.v.d.Rakt.

Start with an back-splint on.

Most “pusher-patients” have an low tone and the extension movement synergy [12,21] is present but not extreme. Standing performance will stimulated an grow of power and coordination that inhibit the further forming of the extension movement synergy.

Increase of the load is easy because lifting an leg will give an reaction and that will in the beginning be almost 100% . Rehearsal will be limited but when that is increasing than we can do two things :

1. Make the back-splint less important as support or
2. weight on the not-affected foot.

But be aware of the rules to get the right co-contraction in the lower trunk and leg.



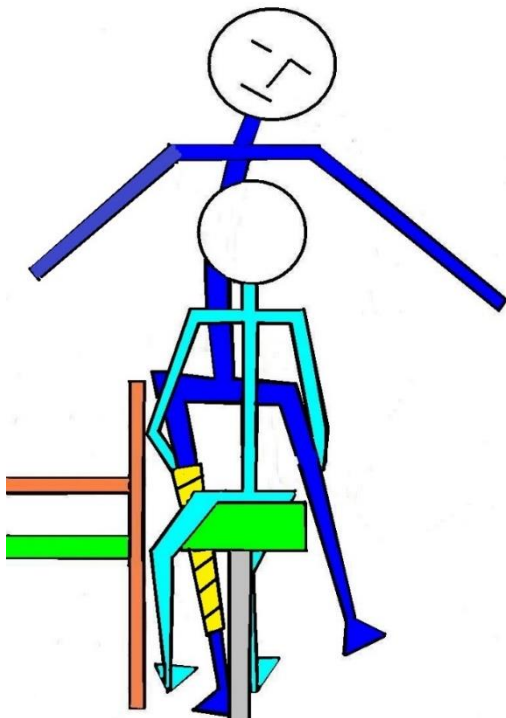
Photo 1.

Photo 1. Co-contraction.

Standing on his left leg he pushed with his right leg an weight of 75% R.M. to the front and that gives an concentric contraction in his left hip muscles.

But not only in his abductors of the hip but also in his extensor, adductors and flexor and that all together is an co-contraction and now the hip has full control over the situation. Co-contraction means here not that no movement is possible in the left hip. Movement can still occur because this is an cooperation between the agonist and antagonist muscle. The reaction that we must see, is that the right pelvis go up and that the right lower trunk is in align with the trunk. We see here no shortening of elongation on both sides of the trunk and that means that the diagonals on the front and back are working together and that the keypoint hip on the affected side and shoulder on the not-affected side are in good alignment. Photo 1 published with the responsibility and permission of the author by j.v.d.Rakt.

Only when with all this facilities there still no concentric contraction than this exercise isn't right and is it better to go to side lying position on the affected side and start with lifting the not-affected side in this position eventually with assistance [3,4].



Picture 3.

Picture 3. Without support of the chair.

That means that the diagonal must start in the affected leg. The therapist lift still the not-affected leg, there is no optimal co-contraction because the pelvis is dropping. Now the chair/bench can be placed closer to the affected hip but the therapist can also push this hip more to the affected side and together with the lift this is an facilitation of the affected hip to create an co-contraction.

Of course can this also be done by pushing the affected hip to the not-affected side. The affected knee is stabilized between two knees. Two reaction can occur; A) An pushing back with the lifted leg than there is fear and is this too difficult or B) An contraction of the hip often with an shortening of the trunk through an upper trunk sideways. The contraction of the hip muscle is the goal and of course the trunk movement isn't correct but will be changeable as there is an good hip stability. Picture 3 published with the responsibility and permission of the author by j.v.d.Rakt.

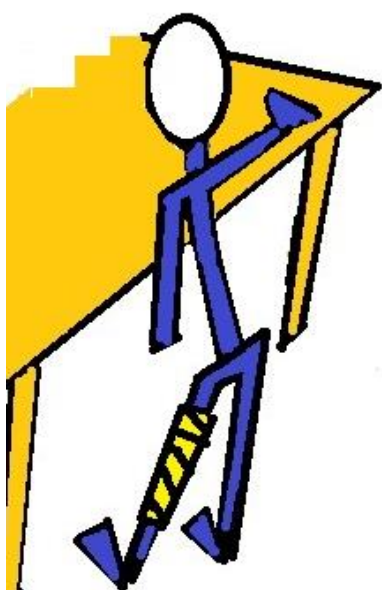
It is important to realize that lifting with support means that the Repetition Maximum [21,22,23] is more than 100%. That means that the rehearsal will be only an few times and then the muscle is tired.

That means also that there must be an period of rest otherwise the muscle cannot recover. But this is often only an few minutes, therefore for muscle strengthening and coordination increase don't stop the treatment. And this is also important, another reason that this exercise is done, is because it gives an very high information boost to the brains to react. And often this is the reaction that is needed to get that reaction. And when the muscles system is tired is that also an variation and give an boost on differential motor learning [24,25].

The next step will be without an back splint, first with the splint not so fast on the leg that gives an possibility to bend the knee and ask for an stretch of the knee and makes the whole movement difficult because now the patient must hold not only the hip but the hip and the knee. Often the foot is support with an bandage so that the foot stand firm [4]. Be aware that when the bandage isn't so firm anymore and the knee can bend that the end of the splint can hurt in the upper and under leg and that can hurt and pain can give an flexion movement synergy [1,2,12] and that will be give an extension reaction in the not-affected leg and that makes this approach impossible. When this is to difficult than take another road. Another way is to give weight on the not-affected leg to the front /sideways or backward. Again the not - affected leg is from the floor and the affected leg must work to start the diagonal. In the beginning with support on the not-affected hand to create tone in the diagonal, but the support of the arm will also alter the diagonal angle. In the case of the pusher patient there is also the possibility to put the hand against an wall. Not low but so high as possible.

This will ask for an elongation of the not-affected trunk and when the not-affected leg is now lift this must give in the affected leg an reaction and also in the trunk on that side. Of course this ask for more muscle pattern and is difficult as the support on the chair. But the hand high against the wall make pushing more difficult than the hand on the chair. And again do this with an back splint on, when it is going well walk with the patient along the wall with the hand high and start with walking backwards, than forward and then turn with the face to the wall and walk sideways.

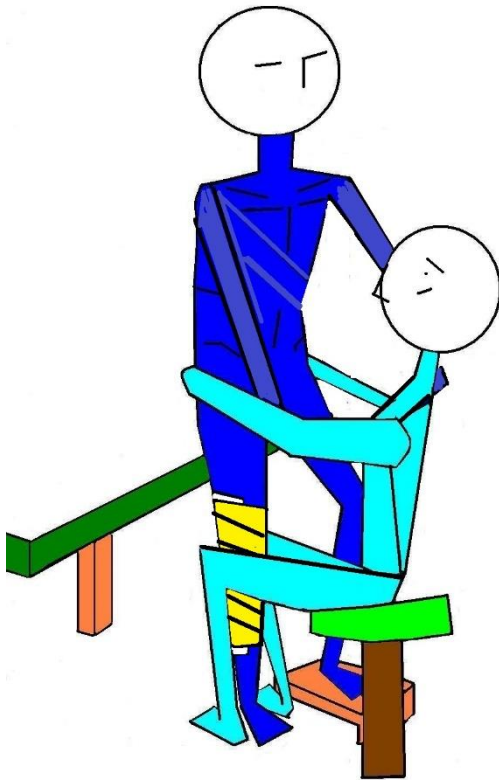
Walking with the hand high against the wall and then start with backwards walking seem an little contradictory, but often is the patient that able to walk on his own. For this form of walking he must have an upper trunk forwards because that we need to get the affected leg to the rear[26].We need no lift of the affected leg, Through the trunk movement the leg glide to the back and putting weight on it is than easier. And it can be done with the back-splint on. This can also be done along an high bench. By walking forward must make the patient, though the splint, an pelvis- lift and an circumduction movement to get the affected leg to the front.



Picture 4.

Picture 4.

Walking side way can be done with back-splint on and through the shortening of the opposite trunk goes the affected leg more sideway and again placing weight is simple. There are so many option to varied in walking sideway and it trained the stand-phase and the swing-phase. Of course the back splint asked for some adjustment but in this position is it possible to train on an combination of placing the affected leg to side or more to the front or the back. Standing on the affected leg we can started with balance training similar with one leg standing [27]but also task specific resistance treatment by placing load at the ankle of the not affected leg. And again the variation of the muscle pattern in the leg especially the lower trunk and hip are great. That is very important because the key point hip can so get back some of his coordination and power. Picture 4 published with the responsibility and permission of the author by j.v.d.Rakt.

**Picture 5.**

Starting with step up technique with an back splint. In this picture the patient hold the therapist on his shoulder instead of an chair or bench. The advantage when the patient hold the shoulder of the therapist is that he feel how much load he set on his not-affected arm and the diagonal started in the not-affected arm to the affected leg can have an better angle. When this angle goes near the 45° than the gluteaal musculature including the medius will more active. But of course the load can too much and the shift of the body too much than use an chair or an bench. This placing of the not-affected foot on the bench can from the back to the front but also sideways as an abduction movement but also as an adduction movement and of course can after setting the not-affected to the front on the floor, also stepping back. Picture 5 published with the responsibility and permission of the author by j.v.d.Rakt.

Picture 5.

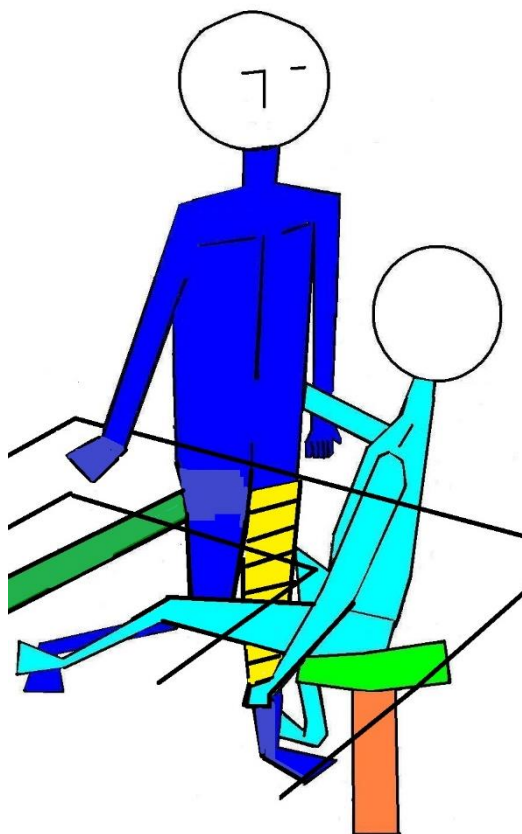
The greatest danger is the reaction of the patient.

When he lift his leg this will give the boost of information in the affected leg but when he placed his not-affected leg on the small bench, this can alter the information complete. The weight that he putt on the bench can be so high that he pushed and then the information to the affected side can so much decrease that he "panic" and evoke an cross extension –flexion reaction an collapse through his affected leg. That is with an back splint not possible, but he will push himself to the back and will landed on the bench behind him. Be careful and sometimes is better to only lift the not-affected leg with an facilitation through on the affected side together with the not-affected side the hands push the pelvis on the not-affected side up. The initiation must lie by the patient but through this help the concentric contraction can become an co-contraction. The load is again more than 100% thus the rehearsal will be small and rest period are needed. From lifting and hold for 4 second 100% R.M., the load can be higher and then we can move with the not-affected leg against resistance to the front, to the back and sideways. Now we have an task- specific resistance therapy that always has an load of 75% R.M. 3 sessions of 10 times must give muscle fatigue and that must the therapist feel of see. When this is done three times an week will this increased the muscle power of the hip but also the leg and the diagonal muscles and improve their coordination.

Lifting without an back-splint –sure- but moving that leg from far back to far to the front is also for the knee an different task, thus we aware that the knee cannot hold this movement especially far back and far to the front.

This task- specific resistance training must be an central part in the walking training !!

But this movement – far behind too far in the front is also the highest moment of action of all keypoint muscles around the hip. The swing phase asked for exorotation in the hip and that asked also for action of the small muscles in the hip. The stand-phase has at the end an endorotation component and in the mid-stance we asked the highest action of the m. gluteus medius muscle. That action start earlier and grow and will contributed not only the pelvis stability but also the rotation in the hip. Therefore is the task specific resistance therapy so important because that can stimulated an recovery of the stabilization and action of the lower trunk, hip and rest of the affected leg.

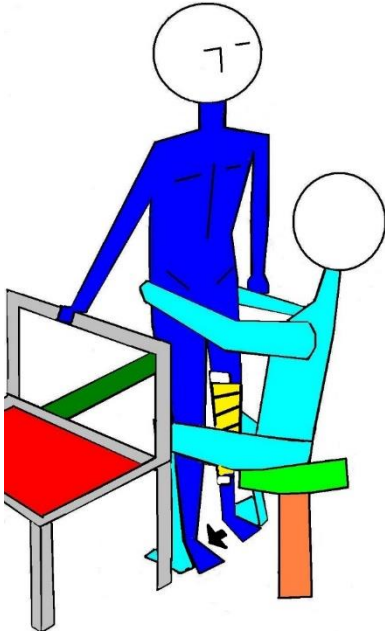


Picture 6.

Picture 6.

Standing with an back splint on the patient must try to get his not affected leg to the leg of the stool where the therapist is sitting. Now we have an distance that belong in the walking pattern and that ask from the affected leg to move to the front in the co-contraction. This can also be done with an sand-back but on this way there is very much variation possible and the therapist can feel what the reaction is of the hip and leg muscle. Is the reaction good, par example when an patient this can with an back splint from the rear to the front than he can also exercise with lifting the not-affected without the back splint. In between we can do this exercise also with an back-splint that isn't so robust, through let the bandage more free. But be aware that when the patient seeks for support the end of the back-splint can hurt and that will evoke an flexion movement synergy. Place an hand on the gluteal muscles to control or the muscle action is adequate and corresponding with the load that you asked and hold control on the pelvis lift on the affected side. Picture 6 published with the responsibility and permission of the author by j.v.d.Rakt.

An problem that can occur that the diagonal front and back don't have the right angle and therefore not all muscle of the gluteus are working properly. Or that the small muscles of the hip cannot react. Often only the part that is closed to the Sacro Iliacal joint are working but the muscle fiber that goes further to the side including the medius are not very active. This problem is that the connection of the back and front diagonal creating the homolateral structure is according Lieber[7] an higher brain function than the both diagonal sec. Therefore there must be an boost of information that push the brain to created there tone and an concentric activation , when that is possible.



Picture 7.

Picture 7.

With back splint on and with the support of an chair on the not-affected side, the therapist placed the patient in the right position, through putting his weight complete on his affected leg and placed his other foot against the not-affected foot of the patient. Placing the foot on such an way that the foot of the patient stand straight to the front and can go only in this position sideways. Thus the foot that stand near the chair must go straight sideways. Watch the hand position of the therapist again. By pushing on the affected side to the inside and down and on the other side also inside and up, he created an co-contraction facilitation.

We want there an pelvis lift of the affected side with an trunk shortening (not an upper trunk sideways). This shortening must be an part of the pelvis lift and must be done together and be an part of the pelvis lift.

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

This foot position is important because an activation of the gluteus medius muscle often only occur when this foot on the not- affected side makes this movement. An clear side way movement with no rotation. That is heavy but that comes because the affected hip has difficult to hold the stand. Only when the muscle gluteus medius on the affected side react, than there is an concentric contraction. When the load is too high against the not-affected leg, Than will this asked for an compensation. The not-affected leg will go in exorotation, that is an action from the gluteus maximus on that side and the affected hip change his position and the pelvis will drop down on the affected side. This means that the load is very important, is that load to high than the patient cannot perform the movement right . And from that load we need 75% R.M. to create an muscle strengthening task specific with an co-contraction with or without facilitation. An rotation of the not-affected leg with resistance will have an effect as the pelvis lift stay present and an rotation reaction in the affected hip is present as that hip makes on rotation.

Look to the form of the muscle around the hip.

Of course there are muscle deeper lying around the hip that has the rotation function but often after an stroke is that equilibrium gone by too much stretch in the beginning after the stroke. But there can also another reason, the small rotator muscles in the hip and also in the shoulder are often not active in the an synergy . That means not that they are not working, but they are not capable do there function as before. Thus often this muscle do with the flexion or extension synergy but are not capable to adjust and certainly not inhibit them. That muscles gives us the great selectivity!!

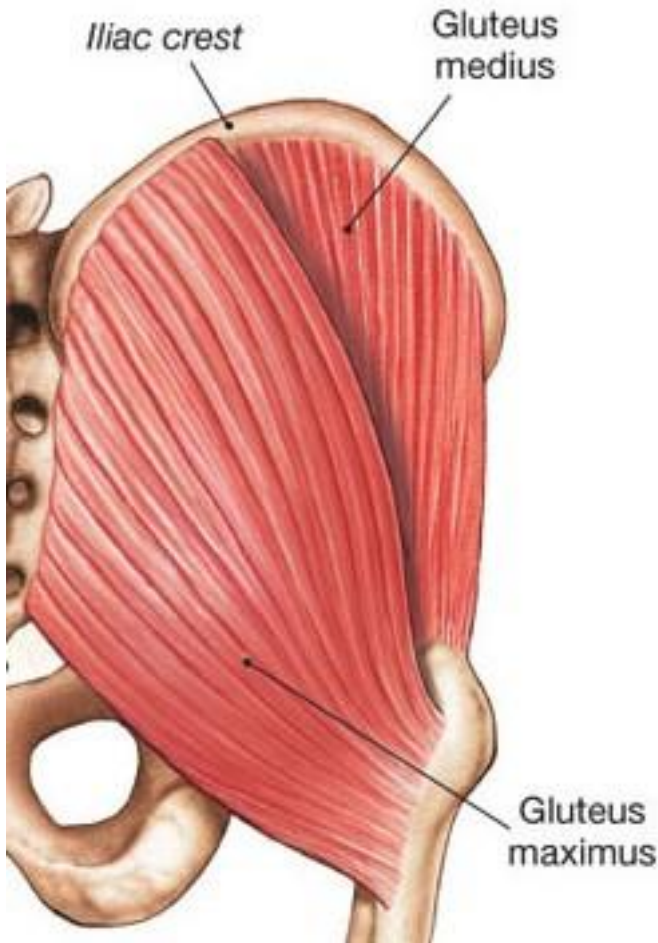


Figure 1 a.

Figure 1a , b and c.

M. gluteus maximus and medius. Look how the fibers are build. The fibers from the sacrum are more horizontal than the fibers from the iliacus crest. When the diagonal angle is more than 45° than will the diagonal enter in front of the hip and will this muscle has nearly an contribution. Only stretch will activated this muscles an often only the mid part. This muscle will be more active when the diagonal ended in the hip joint. In figure 1 b this part is given an special line. There will feel that this muscle part isn't there anymore and that the part under the line has an less contraction. The part of the medius on the front will active when there is an pelvis lift in the mid-stance. Figure 1c show the fascia and the location of the part of muscle distal that will react lesser and will fast have an lesser function. Mostly we feel an gap between the this two parts. Figure 1a,1b and 1c published with the responsibility and permission of the author by j.v.d.Rakt

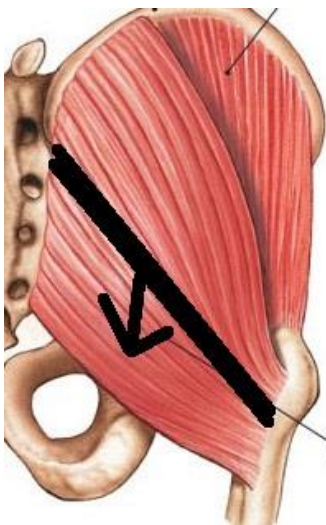


Figure 1b.

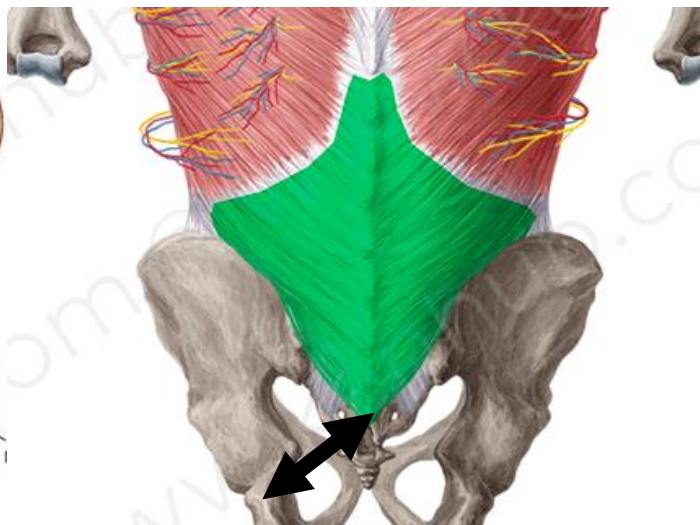
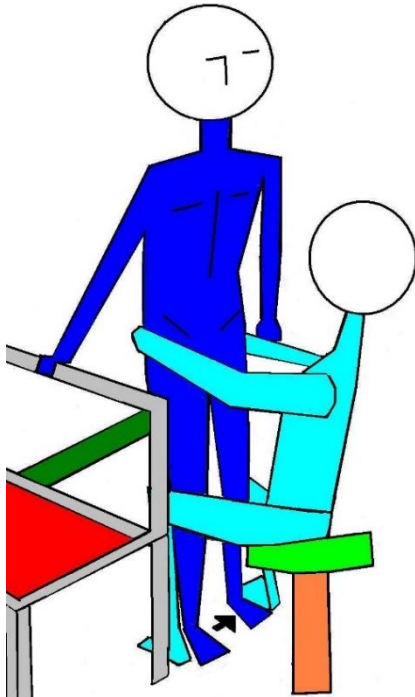


Figure 1c.

The upper part of the fascia is the starting point of the stomach muscle that walks oblique. Together with the origo of the maximus and medius they form the base that pull on the right way on the fascia and together they create the perfect keypoint from the front, back and homolateral structure with muscle fibers that goes in much more directions than only straight down and gives thus much more function than only extension and abduction. But in this case the abduction is essential to get an stable pelvis with an co-contraction on the moment of midstance in the walking pattern and that is an difficult posture that must be exercise but be aware of the difficulty to get this muscle again in the system. Other attempt to get abduction back in the affected hip.



Picture 8.

Picture 8.

This approach is for most stroke patient very difficult because they are not capable to take enough support with the affected arm on the chair. Another support possibility is on the elbow[28,29], than the support area is better an bench that stand high and make it able to support with the elbow on the bench. Support against the shoulder is also an option but then choose for an wall. Through the support on the affected side arm and leg the homolateral structure must do the job and must the abductor muscle be active. Again try with an active facilitation the muscle gluteus medius to active to create an co- contraction. The glide movement over the floor can be made easier by ab towel under the not-affected foot. Again the pelvis must be stable that means that we must see an lift of the pelvis The R.M. is now clear and the exercise will give an coordination and power increasing.

Figure 1a,1b and 1c published with the responsibility and permission of the author by j.v.d.Rakt

This exercise can also perform along an bench. Even with the hip against the bench and with little support of the affected arm/hand. But be aware that when the patient makes an upper trunk sideway he try to avoid an action of the hip abductor on the affected side. When an concentric contraction is possible, it can cost an long time of exercise before this muscle is an part of the walking pattern. Often the muscle is so weak that the power necessary to stable the pelvis cost months of exercises also because the walking pattern with an support on the not-affected side has an negative effect on the angle of the diagonals that the abductor isn't an part of the walking pattern through the day and that means that the patient must learn to active the muscle in the standing phase. And that means learning, thus much rehearsal with an lot of variation. Because the muscle is also needed with the movement in bed, the combination bed exercises and different walking pattern are good method to get the growing power in the walking pattern. Also walking with load is an possibility to v created more need for an stable pelvis by the abductor muscle. Bed exercises and the transfers out the bed/stool/ toilet etcetera and standing up are now possible and are and stay very important. This can be the difference between independent or not !! Still there is one more exercise that can be done before the transfers in and out bed are independent by the patient and when I say Pat.Davies than did she it before the patient was independent in coming in and out of the bed. She did this even before walking with the patient and that is stair going and first go stair up.

Stair.

In the articles about the treatment of stroke patients [17] the stair as part of the therapy is described but to use it by the pusher patient was for many of us total new. Even with an back splint was it possible and patient react very well on this exercise. That means that the information that reach the brain was so good that this created an whole new body scheme that change the pusher behavior complete. Two masters must have the credits for this approach . First Miss. Pat. Davies Senior Instructor Bobath course from Suisse and in the Netherlands was Jacques van der Meer the great instructor who try to get the Bobath –concept possible for all neurological patients.



Photo 2.



Photo 3.

Photo 2 and 3.

Photo 2: Pat. Davies from Suisse. She was the brain behind the approach of the treatment of the pusher with the back-splint.

Photo 3 : Jacques van der Meer from the Netherlands.

Bobath/ NDT teacher but also great practice therapist.

Photo 1 and 2 published with the responsibility and permission of the author by j.v.d.Rakt



Picture 9.

Picture 9.

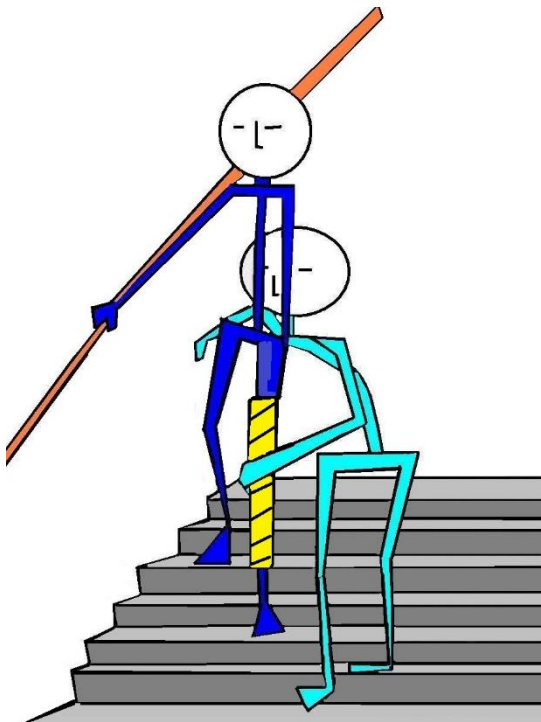
With an back splint isn't possible to walk an stair as we normal do but we must get the affected leg every time along the not affected leg. Only the not-affected leg can go up.

Why gives the stair this patient so much information.

The railing created for the patient an support that he will grasp high and that elongated his trunk on the not-affected side. The structure of the stair is very clear , patient recognized this immediately and give their confidence. There is immediately an great amount of information in the affected leg when the not-affected leg is lift to an higher level. The greatest problem is the movement and the placing of the foot on the next level of the not-affected leg because when fear is there, the placing is than not on the next level but against the edge and then will the pushing start with the weight on the affected leg. This will create an cross extension –flexion reaction (an static reaction). *Picture 9 published with the responsibility and permission of the author by j.v.d.Rakt*

Start always with the stair up. Down stair will become later because most patients are fear by seeing the gap. Therefore be sure that you can leave the stair when you are upstairs. It look wise to start on an little stair but put the stair against an wall because now the structure is very clear and the disadvantage of this exercise stair is that the railing is very fast not going up but horizontal and now the elongation is gone. Thus when it is possible go to an normal stair of minimal 10 steps, now the R.M. is often between 90 – 75% and there is an rehearsal of 10 times and then an short rest and again 2 stair we have reach the stimulus to created more coordination and power. When it is with an back splint lesser than 75% R.M. use load to increase the weight. Often is in an institution the possibility to

go up and then with the elevator back. Or placed an chair on the top of the stair because stair climbing is very heavy for the muscles but also cardio-pulmonic. Feel what the muscle are doing especially the hip muscles m. gluteus maximus and medius. They must work hard and when the use of the not-affected arm/hand is less this contraction will be great. Further it is necessary to create an co-contraction in the pelvis otherwise it is very difficult to place the not-affected leg to the next step and try from the beginning to walk through. Not standing still after each step, the rhythm of stair climbing is essential. Is down stair possible use the back-splint and do it.



Picture 10.

Picture 10.

Down the stair is difficult.

Most people are afraid looking down that they will fall and will start to bend the body in the hip. That means that the buttock goes too far to the back and walking down stairs isn't possible anymore. This will start with a great amount of support on the railing and that makes walking with hip extension not possible. The technique of facilitation is important. The affected leg will when placing down go in adduction because the patient must give an eccentric contraction in the not-affected leg to get the affected leg on a lower step. This is a moment without information on the affected side and can give panic. The "push" to the floor can deliver information but also a quick and good placement.). *Picture 10 published with the responsibility and permission of the author by j.v.d.Rakt*

The first time go always the stair up, patient cannot see how high they are and when for the first time going back, placed the not-affected good on the step and facilitated the affected foot one step lower and ask to set the not-affected leg along the affected leg. Another option is without changing the posture go back on the stair on the same way as going up. But normal we use another technique and when it is possible to this on the normal way so fast as possible with a back-splint. Is back still a great problem start to go up with the attitude to go back. Standing with the back to the stair, ask to set the not-affected leg on the first step and push with the not-affected arm and leg up and placed the affected leg with the back splint. Many patient can do this on the own but the not-affected side works the most and so further until he is standing on the third or fourth step. Now placed the affected leg to an step lower and ask to place the not-affected leg along that leg.

The technique with a splint must always be the same, up first the not-affected leg and down first the affected leg. Without a splint this can be very useful that this is an exercise because when the stroke patient goes up he can build up the tone in the affected leg by lifting first the not-affected leg and that makes it sometimes easy to lift the affected leg two stairs higher after that.

Downstairs he must with a splint set first his affected leg. That is a difficult moment because the affected leg gets no information but on the other hand he can control his attitude with his not-affected leg. When the affected leg is standing he can create more information with his not-affected leg and can still hold some control. With good facilitation technique it is possible to get the rhythm good and give the right velocity on the stair climbing exercises. And the possibilities to make it a task-specific resistance therapy is endless.



Photo 4.

Photo 5.

Picture 11.

Photo 4, 5 and picture 11.

Gives and picture how stair walking upstairs can be facilitated. Photo 4 gives the facilitation of the affected leg to make an good extension in the knee , but the arm behind the buttock show the push with arm up against the buttock. Together give this the patient the feeling to go up and can walk further. Very important for the patient with the pusher syndrome is to held the arm high on the stair railing. High to get an good elongation of the not-affected side. This elongation the push against the buttock –up and to the front- is essential to hold the right rhythmic. The push and the pressure on the leg is very important but asked that the facilitation skill are automatic. Because the patient will feel the difference of an facilitation on the right moment and pressure and an facilitation that isn't adequate. Therefore therapist train yourself. Photo 5 gives an impression how to lift the affected leg two steps up and then come the facilitation technique on the knee and the buttock. But look at the attitude of the therapist because the pelvis is between their hand an shoulder and she is able to place the body perfectly on the not-affected leg and inhibit an "pusher" movement.

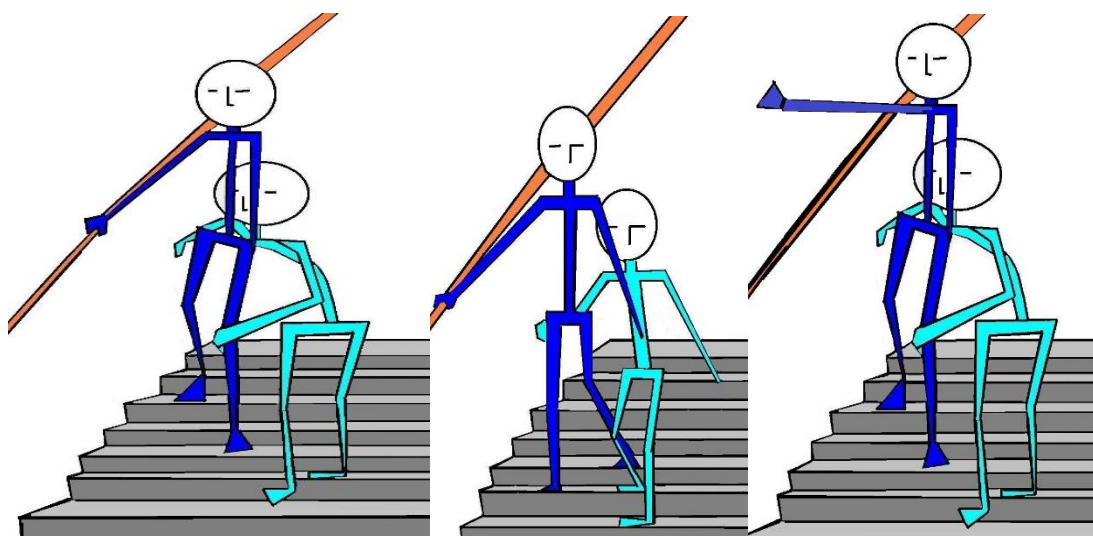
Picture 11.Gives an picture when the affected foot on the next level and now the facilitation is pointed to get the weight on that foot with an erect trunk. The push with the elbow against the buttock is therefore to the front and up

Photo 4 and 5 and picture 11 published with the responsibility and permission of the author by j.v.d.Rakt

This looks very difficult especially with patient that have the pusher syndrome but it is sometimes easier to do than walking. Therefore it is so important that the information to the affected brain is given by clear input of the affected side. That information makes it possible that the diagonals will find each other and makes the base of the body complete again. Therefore the essential therapy with the back-splint to make this shift of information possible. When the patient dare to lift his not-affected leg complete there is an great boost of information from the affected side and there is no way there is information from the affected side so that the pushing solution isn't an solution anymore. The diagonals are system low in the brain and double innervated[6] and that means that restoration must be possible but that ask for an boost of good information.

Ask the patient not to release the tone on the not-affected side because nothing is there to replaced that information. Only when there is an alternative will the tone of the not-affected side decrease and that can be only tone and thus information from the affected side. The high tone on the not-affected side and especially when he feel that he is out balance is his reaction with that what he have and what his damaged brain instructed.

The treatment is give the system extra information that this reaction isn't necessary and the stair gives with good facilitation also information out the environment that facilitated the movement also.



Picture 12.

Picture 13.

Picture 14.

Picture 12,13 and 14.

Down walking of an stair is often for patients fearful but when people hold the trunk erect than it is quite simple. The erect trunk will make the “fall” on the foot that goes down easier and with an correct facilitation we can place that foot firmly on the stair-step. The technique is an combination of extension with exorotation in the hip to inhibit the extensor synergy that can occur. The erect trunk is necessary because flexion in the hip gives an feeling of falling to front of the stair and that is prevent by the technique with the arm behind the trunk. By the “pusher” will the structure of the stair stimulated the walking performance and sometimes it is wise to place the not-affected hand high against the wall. This will give an elongation on the not-affected side and will brace the shortening of the not-affected side of the trunk.

The facilitation technique develop by Pat.Davies asked that the therapist has this on automatic level than the patient will benefit from this approach.

Picture 12,13,14 published with the responsibility and permission of the author by j.v.d.Rakt

“Reverse” Rehabilitation.

Walking and also walking on an stair will be possible but the transfers in and out bed are still very difficult. That means that this in latter phase of the rehabilitation will be have an greater priority to get this movement on an higher scale and useful for the ADL.

First the attitudes in bed.

Lying on the back, affected side and on affected side and later on the movements to come in this position. The movement to get on the edge of the bed and the transfer to the chair will be come after the attitude in bed but also after the attitude standing with or even without an back-splint. That means that standing up from the toilet and stand will be come later than walking and the balance to clean herself will be possible long after walking and other exercises.

Again the team that is treating must communicated what the goals are in the each period. Especially the activity that ask more than alone the control over the body, are very difficult because all this patient have much more disturbances in the cognition and neuropsychology. And that makes dressing , washing often very difficult and ask more from the patient than he can do. All neuropsychological disturbances can be present and the neuropsychologist must be an part of the team so that he can help to copy with this disturbances. But very important is that the attitude are under control of the patient before this part of the treatment is started. An patient who has difficulty with sitting on the edge of the bed isn't capable to dress himself. An patient that is not independent in sitting in an wheelchair will be incapable to cooperated with training to speak or eat better or to drive the wheelchair at its own. When he is capable to sit independent there is room in the brain to listen to instruction and try to follow that instruction to drive that wheelchair through the corridor. But now



the neuropsychological disturbances will make this very difficult because the patient is mostly not aware from his neuropsychological disturbances and that makes exercises very difficult. They are an lot of (EBRSR –guideline Chapter 13)[30] exercises to influences this disturbances and there are some result but the generalization is very pore. It is good to know which neuropsychological disturbances are present and often are that more than one . Therefore an summary from all the disturbances on that area that can be expected by the pusher patient .

Cognition and Neuropsychological disturbances (B. Rood) [31]

Domain;

- 1. Attention**, this is not only attention but in this domain belong also elements of attention as;
 - Arousal,
 - Concentration,
 - Attention that is focus on an task and isn't easy disturbed by other stimuli
 - Attention that makes it possible to do different task together.
 - Flexibility of the attention to other task and changes easy from one task to an other
 - Stay focus on one task during an certain time.
- 2. Neglect (Body/Space- Attention)**
 - Personal neglect , the patient isn't aware and give no attention to one side of his body.
 - Peri personal neglect, that patient isn't aware and give no attention of something on the border of his body on the affected side
 - Extra personal neglect, the patient isn't aware and give no attention to the space on the affected side of his body and see no person on that side.
 - Extinction, stimuli on and in the affected side extinguish.
- 3. Sense and recognition.**
 - Visual agnosia, not recognized objects, faces, clothing ect. But the eyes are not affected.
 - Acoustical agnosia, not recognized sounds.
 - Tactile agnosia, not recognized material by feeling.
 - Somatic agnosia, not recognized an part of his own body . even deny that this is their arm or leg.
 - Spatial agnosia , not recognized the distances or the construction of par example an trouser.
- 4. Acting. (Apraxia)**
 - Intentional apraxia, there is no capability to start and action.
 - Ideator apraxia, the incapability to do the correct sequence.
 - Ideomotor apraxia, not capable to hold par example on an right way an object to act with it. And often this will repeated endless.
- 5. Memory.**
 - Short memory
 - Long time memory.
- 6. Orientation**
 - Orientation in the time
 - Orientation in the place.
 - Orientation of an person
 - Orientation in the space.
- 7. Communication**
 - Verbal communication, not capable to speak or to understand the spoken language or both.
 - Nonverbal communication.
 - Written communication
 - Not capable to use of communication rules on the right way.
- 8. Executive functions.**
 - Disturbed insight of the illness.
 - Loss of initiative
 - Problems with the planning and organization.



- Problems with the flexibility
- Impulsiveness acting without thinking.
- Disturbed self-control and self-correction.

All patient with stroke have this problems and it is therefore very important that all members of the treatment team know this disturbances and are aware that this are problems where the patient is often not aware. When his memory or his attention is disturbed this will for the patient an motivation problem when therapist again and again repeat that they do it wrong and that he said and explain that: “ all so many times”. By the pusher there are often much more cognition and neuropsychological disturbances that makes an treatment very difficult.

Patient with the pusher syndrome have also difficulty to learn. Pat. Davies[12,13,14] was the first that discovered that this group was not allow to enter the rehabilitation centre because the patient were incapable to learn. But she discovered that this patient cannot learn as the other stroke patient and especially not on that way and not so fast. But when she start with here approach the result were sometimes even better than the other stroke patient without the pushing behaviour. But the start was slower and it cost more time. Not months but years and that give the therapist an task to search also in the chronic phase for solutions every time again to get the best results. And in the chronic phase often the therapy has an structure that can be over years the same and that this patient will only exercises that and never learn somethings else. The inability of the therapist can be never the reason that an patient cannot learn. And of course are we aware that patient loose the abilities but then there is an indication to learn something else and make the quality of live so high as possible. **Learning is always possible!!** : There isn't an patient that cannot learn but the team members must know what the level is the patient can learn. Too often the patient get the mark that they are incapable to learn and that is never right. Even the patient with an deep dementia can “learn” but the level on which he or she can learn is very low and often difficult to find. But as long there is an possibility to enter the brain there will also an reaction and that is react and when the patient react always on that stimulus he is “learning “. As patient in an vegetative status or unresponsive wakefulness syndrome(UWS)[32,33,34] can react on stimuli that enter the brain and give an reaction, than is that “learning” but an person with an pusher-syndrome cannot learn at the normal way as used by stroke patients but that means not that he cannot learn but we-therapist – **gave the wrong lesion.**

Par example , the neuropsychological and cognition problems of three patient which photo stand in this previous articles[3,4].

The smiling mister on photo 1. [3]

Problems in the domain 1,2,3,4,5 and 8. Furthermore there was an orthopaedic problem in both hip joint. This joints were so bad that an operation was necessary but not possible because he couldn't be operated anymore. The search to get an good attitude in the bed that result in an “push-away “orthoses is the best example which level of implicit learning was needed to reach in his affected brain and created an reaction that he can copy with. The physic condition that was poor when he started with the treatment , because through the apnoea he had no condition and was not capable to learn. The problems in the neuropsychological en cognition domain were not the greatest problem. The greatest problem was that the capacity of his body and thus also from his damaged brain was so poor that there was no space for recovery, compensation of learning. He sleep bad and was in the daytime so tired that his arousal was too low to create an situation that he could change something. The effects of the treatment were there because the arousal was possible because the fatigue was less and now there was capacity in the body and the brain to change something by doing exercises in bed to create an new attitude. After the training of the attitudes (lying in bed, sitting in an wheelchair and standing with back splint) was there more room for other things and was an examination of the cognition and neuropsychological disturbances possible. Therefore this was not really possible but an global view was given. Now with an more clear view about the disturbances in the domain , there was also an better approach possible. That means that sitting on the edge of the bed, there must be more capacity over and there is space for the brain to do something more than only sitting. Now the disturbances with the recognizing of the clothes and how to put the were very clear. But the approach when an

patient is not aware that the problem lies in his brain, must therefore be on that level. That means that explicit learning is impossible and another method must be found to start this process on an level of unawareness and see what the brain can learn from it . The method of Affolter[35](Guiding) and Fröhlich[36](Basic Stimulation) are the best to exercise this patient to an higher level. And this patient makes great progress but was never able to do this on his own. He will be dependent of assistance. On other items he progress especially in the attitude stand but when the walking part was started the pathology of the arthrosis of the hip make great progress impossible but the transfers in and out bed, on the toilet etc. were with facilitation easy to do and his family could do it in the weekend. Quality of life was the greatest progression.

The mister on photo 2.[3]

There is still some tone in the head more on the not-affected side than on the affected side that make lifting the head straight up very difficult. The back diagonal starting on the not affected side was in the head still very strong and that explains the deviation in the cervical spine. All domains were disturbed except the recognition of his loves one but it was obvious that when he was in an stable phase, there was an robust from of vascular dementia. That means that first the stability of his body must be achieved to get an clear picture what his neuropsychological and cognition functions were. The approach to create an good an stable attitude was extreme important to investigated what his possibilities were. The “push away” orthoses gave that stability and now the brain has possibilities to do more than only searching from stability. The stimulation of the input that restore the basic of the diagonals, first only the back diagonals but later on also parts of the front diagonals. The sitting attitude in an special wheelchair was also obtain but the head posture was the same as photo 11 show. Not more because that would be an sign that sitting was for him very difficult and has an impact on the capacity of the brain. An attitude had an good level when the patient is capable to more and that is learning possible. Exercise out this two attitude were thus very difficult and must be clear for him because people with dementia will not understand what to do or what others want as the surrounding area isn't what she recognized. Thus in the morning out of bed was for him obvious but the exercise was very difficult and ask everything from him and the therapist. Than it isn't wise to make that exercise an transfer that others use to get him in or out of the bed.

The third patient (Photo 6) [4]



Photo 6.

Photo 6.

The disturbances in the all domain were present except the domains 5 and 6. His start was very poor, with almost no recovery and no arousal because his condition was very low. By this patient was the apnoea also an very important factor. The first attitude, lying in bed on his back was achieved after 4 months than he was capable to turn his face to the affected side and was capable to recognized his love ones and could communicated with them on his restricted way on the affected side. But when this attitude was achieved, he was capable to rest at night better and his condition improved and that base is needed to be able to learn. The base was achieved now the approach to learn or to restore the possibilities there are still present in the affected brain. Therefore standing with an back splint was the next step. Before the sitting attitude because standing of walking with back splint had an very positive effect on his arousal and attention and give an much better sit attitude.

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



Transfers in and out bed are for more than one year an exercise that only the therapist and an number of nurses with an special education. When there was an attitude that he had under control than was the ADL – wash and dress not the goal but this was use to get an better attitude. The way this washing and dressing was Guiding[35]. That means together with almost no speech, create an situation in which the patient tries to wash and dress himself but the hands of the therapist/nurse are always there, to cooperated and make this not an struggle but an learning moment. It isn't errorless learning[37,38] but it helps the patient to overcome awareness problems by guiding the movement when this is necessary. This approach lead to an better trunk stability and had an positive effect on the domains 1,2,3, 4 and 7 and 8. There were sometimes also positive effects on his speech performance. The understanding was improve but only in this ADL environment, there was no generalization. The step from unawareness to awareness is by patient with neurological disturbances often the most difficult step. On the moment that they are aware of their problems and they have an good stability there is no real obstacle that makes learning on the trial and error way possible. The way to the awareness and the capacity of the brain makes this period so difficult and al explicit learning methods are often too difficult and de- motivated. An good example was an small accident on the toilet. He try to dress himself after and there was an nurse that has supervision. She should not help but only observed and of course give support when that was necessary. The problem was that he couldn't get his trouser up because an small part was under his affected foot. The patient but also the nurse were not aware that this was the obstacle he couldn't copy and he stay to long on his affected leg and get an extinction. He was not capable to move to his not- affected leg and then back and create an new input. Instead he started to push with his not-affected leg and evoke an cross extension-flexion reaction and the affected leg collapsed. Of course nothing happen because the nurse get him and facilitated him to sit on the toilet and relax. But it give an picture how fast the capacity of the brain by this patient can reach his borders and then will occur what always occur the pushing action with all the reaction that were there in the whole rehabilitation process.

All this three patients are died in the Nursing Home, only the third patient stay for limit time at his home but after an period his hart was ill and he couldn't stay there. Than we see the opposite from the recovery time and often very fast. The condition is lesser and that means that the capacity of the brain and the body is decreasing. First the elements that were under control at the end of the rehabilitation will be go lesser and need assistance and that is the neuropsychological disturbances and the transfers.

Why patient with an stroke push ?

There are on this moment three explanation what is happen in the brain that causes this reaction. And this three are not total different but have great resemblance.

1. Prof. Karnath[39,40,41,42]has investigated severe stroke patient and conclude that in the brain the system is disturb that us give the right stand on earth using the laws of gravity.
2. Prof . Prosiegel[43] believe that the projection deep in the brain that control our middle line is disturb and that this line has an different stand comparison with not stroke patient or stroke patient with no pushing signs. Well is obvious that in the hospital almost every patient show signs of pushing but mostly only an few minutes or hours. Only an 12% find no solution on his own and that group goes to nursing homes, an very little number goes to rehabilitation center and from that group goes an few to their home , mostly is way to home through an nursing home.
3. Prof L.Fasotti. [44,45,46] He believe that this is an personal neglect that decrease the awareness on axial level in the brain. This loss on awareness in the brain for the basis – the axial system- makes that the patient is totally fixated on the not-affected side. The possibility is present that the cortical- spinal tracts are not so damaged and still functioning but the awareness for this isn't present.

Prof. Karnath [39,40,41,42] By placing 25 CT-scan of Pusher-patients syndrome on each other and that compared with CT –scan od 25 stroke controls. This CT-scan were colored to see were the greatest

resemblance was. The greatest difference is the damage in the area of the ventricles, deep in the brain. This area are almost clear by the controls and is the damage heavy by the pusher patients. NASA has investigated this area is responsible difficulties with their equilibrium of astronauts. This area is known to calibrate the body balance with the gravity force to get the body in the best position on our planet. An experiment he did with stroke patient with the pusher syndrome in an laboratory in comparison with control patients give him more prove that the problem lies in that area that control the body orientation using the gravity forces.

Test in laboratorium.

This were patients from an rehabilitation center, that means that the very severe patient were not included. Still this patients can do this for maximal 20 minutes. No “support” on the feet and that makes pushing with the not-affected leg or arm impossible. On this way Prof. Karnath try to investigated when this patient had the feeling that they are sitting in the best upright position and thus in good balance. Because he taught that pushing is an reaction of the patient to create with the gravity the best position. The control scored with the eyes open an deviation of 0.3° and with the eyes closed but with all other signals active was the deviation 0.4° . The patient with an pusher syndrome had an deviation in their feeling of the right position of 0.9° with the eyes open but this is still two times more than the “normal” patient had with their eyes closed. But when the eyes were closed their deviation was far greater an reach an central tendency of 17.9° . That gives an important sign that eyes are very important for this patient to correct the deviation and gives us an reason why at night often the greatest disturbances take place. To get this correction with the eyes as part of the therapy there must be an anchor for this patient on the wall or sealing when they are lying in bed, see article [3]. The basic stimulation works sometimes with an pair of blankets to decrease the space around the head and let one side free to stimulate the patient to look to that side . Eventually with an light point to give more stimulation

Prof.Prosiegel [43].

He discovered that this patient has another middle line.

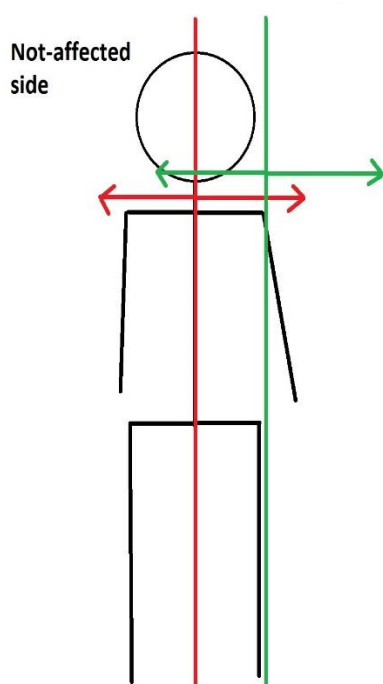


Figure 2.

Figure 2.

The red line is the normal centerline. This line cover an area from 360 degrees but give the possibility to go from that centerline always an restrict amount of degrees. Otherwise the person get out of balance. An centerline that this “pusher patient” had, had move some degree or as in this figure till the shoulder (green line) and that means that the possibilities to move from that centerline are changes and are not equal with the reality. When he goes to the affected side he think that he can much further than the reality the difference between the red arrow and the green arrow and he will fall without he has the feeling that he had it wrong because he is not aware of this. When he goes to the not-affected side the opposite happen and the stop the movement (Pushing) to early, but he is aware that when he goes further he will fall!! Prof. Prosiegel called that : “Störung der subjektiven visuellen vertikalen. Figure 2 published with the responsibility and permission of the author by j.v.d.Rakt.



Both investigators give a problem in the possibility to sense the vertical line – the center line – and both see that patients are better do correct somewhat with the eyes but never complete. When the eyes were excluded than was the deviation extreme. That means that the other senses are not capable to correct the attitude and that give an picture that the other senses are so damaged that the recorded an attitude as good and that attitude is very wrong. What we see, the deviation by this two investigators is always an deviation in sit with patient from an rehabilitation center but when the attitude is more difficult – standing position will this increase and in lying position should this decrease or the damage is more severe. That the senses give an “wrong “picture must be come through the damage in the brain and that will give input in that damage brain that this brain must concluded that this position in correct. That means that the awareness is also severe disturb and that the patient isn't aware from this wrong position, only with the eyes is an correction possible but also not complete correct.

Prof. Fasotti [44]

His investigation about neglect/awareness and then especially the personal neglect convict him that the reason patient let see an pusher syndrome come because an part of the axial control is disappears. This axial control lies low in the brain and through the damage the input and thus also the output is sever decreased. Especially the low tone of this musculature is an sign that this center don't works and that the awareness of this side is complete gone and that the patient must depend on his not-affected side. The trunk muscle –the axial as lies depth in the brain and there lies the damage also according Karnath and also Fasotti and colleagues.[45,46,47,48]

Prof. Fasotti give the control system through the damage an loss of awareness/attention and create an neglect for the affected side that isn't to correct through the other higher systems. An personal neglect is an arousal or attention deficit but in this case this attention must be found in that deep structure that controls the axial system of the trunk on the back and the front. There is an tract that not stay on the same site of the brain but cross totally and that are the cortico-spinal tracts. But there are other tracts that not complete cross on cortex level is that 90 -10 % and that 10 % stay on the same side and is involved in the control of the trunk and the large joint on that side. In deeper layers of the brain that crossing is often more than the 90-10 % difference, there are investigators[6] that call 70-30% as an real picture. Therefore it is strange that an system that lies deep in the brain isn't active from the other side. Therefore it seems that this is not an problem with not functioning of the crossing system but an lack on arousal and attention in the system itself. And when this awareness isn't there, the solution of the brain system is to active the remaining system. The severe pusher patient will give the picture to increase awareness and activity of the not-affected side and will therefore build up an kind of reciprocal inhibition for the affected side. Still see that system and see what an system of little muscles and their input system are there active to get the optimal control on the basis movements of the trunk (diagonals) and the great joint. That system is unbelievable as you analyzed in his building.

Look to the deep muscle system of the trunk on the back side that is not crossing over the midline. The crossing is higher and there is the cooperation between the two body side and there lies the damage and the lack of arousal and attention according Fasotti.

Robertson and North developed from this insight this approach to have an influence on the neglect: the Limb Activation Therapy (L.A.T.)[49]. Limb activation is based on the idea that any movement of the contra-lesional side may function as a motor stimulus activating the right hemisphere and improving neglect as described above. She demonstrated, via a series of single patient experiments, that left hand finger movements made in left hemi-space were associated with a decrease in neglect as assessed by letter cancellation tests. This decrease was independent of visual scanning in that the subject did not need to see the left limb for the effect on neglect to occur. Verbal cueing to anchor visual perception, passive visual cueing, movement of the right hand in the left hemi-space, and movement of the left hand in right hemi-space had no significant effect on neglect. The authors



proposed that neither cueing nor personal spatial system theories when considered independently offer adequate explanations of the effect of contra-lesional limb movement on neglect.

EBSR [30] concluded; Conclusion; Regarding Limb Activation Treatment for Neglect. Based on the results of 4 RCTs (3 good quality and 1 fair), there is strong (Level 1a) evidence that limb activation therapies improve neglect. However, little information is available with regard to duration of effect or the effect of treatment on functional ability.

That means that activation of the affected side seem necessary to active the affected side but also give an inhibition on the not-affected side that overrules the affected site.

Therefore taught Prof. Fasotti that the personal neglect axial was the reason for the pusher syndrome and was activation of the affected side important with scanning technique to get an better and higher awareness of the affected side. There is always an ...but... and that has to do with the level that patient have reach. There must be an attitude that he can manage and on an good level than will there be space in the brain to do more and then are scanning, L.A.T. , TENS stimulation technique or prism spectacles possible and will this have an good result. Is the patient not capable to manage an attitude than is this patient not capable to do two things at the same time but that means not that he or she cannot learn, but that the level of the exercise/ treatment is too high. Now it is on the therapist and the investigator to seek for an lower level and the patient can learn. One of the investigation of Prof. L.Fasotti[51] was the fatigue among stroke patient and he concluded that sequence of activity and rest was not at the right level and that an recovering brain need more energy and that ask for another approach of activity and rest. This is confirmed by the AVERT [52] investigators that say an faster recovery with acute stroke patient when the frequency of treatment through the day was increased with an good intensity but with little time per treatment. Now there were 6 of more activity on an high intensity in the day but the intensity was so high that this could only be done in par example 10 minutes that was rest necessary.

This three investigators have all three an slight different angle of explaining the pusher behavior but there is also an great resemblance amongst the three.

- Visual control is important.
- Patient are on-aware of their problem
- The problem has to do with our basic balance feeling and lies deep in the brain
- The brain (conscious part) has no or less control over that system, thus explicit learning has no effect. On the contrary it will not work and will decrease the motivation of the patient and often therapist think that the patient cannot learn.
- There is working one side and the other side on his axial level isn't functioning. And total different from other stroke patient.
- To restore the center line of the balance system , we need input of the affected side.

Chronic phase

Certainly the moderate or severe stroke patient with the pusher syndrome will always need an good treatment. Here their control is so small, that independent control the consequences of this disease isn't possible. Through the disturbances in the body perception will there often be an situation that ended in an accident. And often after that accident is there an greater loss than by others with an equal stroke but without the pusher element. Treatment in the chronic phase must be done on regular base and with an great amount of variation but always pointed on holding of the good coordination and power of the basic system- the diagonals. The greatest mistake that we –therapist – can make, is to give an treatment that is every time the same. Not only will the patient learned nothing and is the stimulus under the level of holding or improvement of the power and the coordination, it will also give no stimulation to the brain. This will lead to lack of motivation and decrease of adherence. The treatment must be full variation and pointed on the that what will come;

The adaptation of the body and mind when people go older!

By the pusher patient isn't in the beginning no cooperation and we see that the diagonal starting in the not-affected leg stopped at the spine in the back/ front diagonal and that the diagonal that start



from the not-affected shoulder stopped also at the spine. There is on no level an crossing. When this patient moves he will activated this both part and the result is an shortening of that side and an passive

elongation of the affected side. Passive will give no information thus will the search for information be continued on the not-affected side and that means that the most distal parts of the diagonal give their contribution and that will lead to an pusher behavior. Through the investigation of the scientist there is also an deviation of the body in the brain that give the patient the feeling that he is out of balance and that pushing to the affected side gives an better attitude. Pat. Davies was unaware of this result of the investigator but has found the right solution. By giving the affected side an large amount of input the system inhibits or awake and the crossover of the diagonal occur.

There must be, therefore not an motor problem but an perception problem in the brain are present, because al high amount of input gives an motor reaction and that motor reaction is an very great input stimulus. Her approach to search for good attitude with an high amount of input that was very variable awake the system in the brain and give an motor answer. Lifting the not-affected leg when an patient stand on his affected leg with an back-splint is an stimulus that always evoke an reaction in that leg and give the damaged system an boost that lead to an restoration.

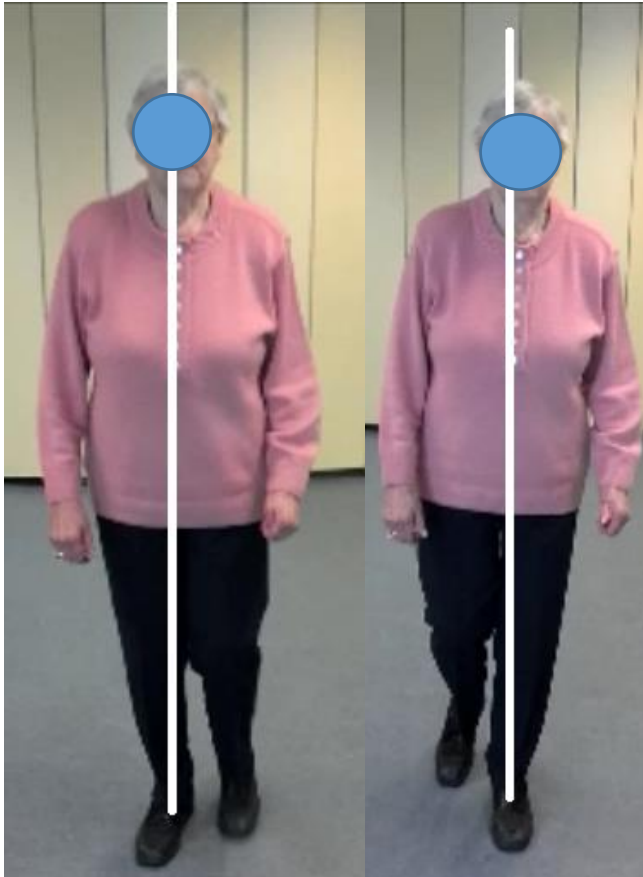
That means not that this restoration is complete but the possibilities are not poor but very good. Listen to Pat.Davies[12,13,14];

- This patient have often an problematic start. Now we know that this is true and that the condition is one of the factor we must investigated.
- They are not aware from there problem and that make therefore an great problem but there are enough possibilities to learn.
- They need more time for their rehabilitation, think not in months but in years .
- There selectivity is often higher than the other stroke patients especially in the hand and feet but central in the trunk the selectivity and the tone are poor.
- But at the end they will created often an better walking pattern than the other stroke patient because they must move to the not-affected side and the other stroke patient must learn to move more to the affected side.
- Start with standing on the affected leg with back-splint before do transfers and ADL exercises. Give this patient an attitude they can manage and ask than for more.

Specific motoric problems at the end of the rehabilitation by the pusher patient is when he is walking that he has difficulty with the swing phase of the affected foot. Often is this an point that is be noticed after an accident. The movement of the foot is often present, he can lift his foot from the floor but the swing phase keeps an problem. There are patient that receive than all kinds of splints that assisted the foot in the swing phase but the swing phase still is problematic. The problem isn't often present in the foot but in the trunk because the awareness of the center line isn't optimal.

To get the affected foot to the front all the body weight must be on the other side and that side must have an optimal elongation that ask an perfect cooperation between the diagonals and the front and back diagonal especially on hip level, one of the two key - points on that side. When that movement isn't optimal than there will be weight on the affected foot or the balance is still too much to the affected side and now it is problematic to get the affected foot to the front. That center line problem will stay the problem to walk without an great amount of brain capacity , because when they try to walk without this great amount of attention , the change that they will fall, is present. At home they walk with an stick and often they have an affected hand that is so good that they may be capable to carried something in it, but they cannot do two things at the same time (Attention). The treatment must be directed on an improvement of the center line and therefore is Task specific resistance treatment essential and exercise that learn her to go so far as possible to the not-affected side with an elongation and cross the affected foot for or behind the not-affected leg. This task-specific resistance can be start with standing on the not-affected leg and the resistance against the affected leg/foot. Of

course start with an support but choose the wall with an position of that not-affected hand so high as possible. Than the resistance against the affected foot will asked for an active elongation and an active shortening of the trunk and we can calculated the amount of resistance to get an optimal result of power- and coordination increase. After this start with crossing exercising- affected leg over the not-affected leg and that can later on also with resistance. This is the balance reaction to the not-affected side and that is for patient with an pusher syndrome very difficult. Than with hand-on facilitation introduce this swing phase with an greater elongation on the not-affected side in the walking pattern but with more speed and also the crossing activity.

**Photo 7.****Photo 8.****Photo 7 and 8.**

Stroke patient with an hemiparesis on the left side. Look for the difference when an line from the foot where she is standing up is draw. Than is on 13 an picture that it looks that there is more movement in the lower trunk to the right but is the amount of body that stays on the left side of the line greater. And the left hand is dropped. That means that there is some weight on the forefoot of the left foot. Standing on the left –affected leg- is an upper trunk sideways but is there also an co-contraction in the hip/lower trunk and is more weight on the left leg and is the swing phase without an problem. This problem came back after an influenza illness some 5 years behind an rehabilitation of two year intern when she suffer from an severe stroke with an pusher –syndrome *Photo 7 and 8 published with the responsibility and permission of the author by j.v.d.Rakt.*

This example give ab picture what chronic phase need. Adaptation is necessary but with policy. Is the treatment -safe walking- with an rollator frame than will the technique that this people will embraced an upper trunk sideway over the stand leg. That will weaken the hip-muscles that are without this rollator frame still are active but weaken. Therefore in the chronic phase must be room to strengthening in an task specific resistance approach and that asked an minimum of 2 times an week with the right amount of progressive resistance. This will not mean that walking with an rollator frame isn't important to get this person his independency back but that is only an part of the treatment. Independency in house means more than walking with an rollator, movements in and out bed , standing up etc. are more important and need our attention and to get that better we will exercise that element also and with an task-specific element.

There are so many element that will decrease that in the chronic phase every time the focus must lie on the elements that are getting worse and how to improve them instead to find an aid. That means again not that aid aren't good but that is often an temporary solution and when that works good is more possible. Patients with an stroke and an pusher syndrome are often in the chronic phase when



the recovery start through all others reason that are written in part 1 and 2[3,4], therefore it is often room for real recovery in the chronic phase.[53] This is an opportunity that isn't often possible but by

this group of patient essential. Through the combination of task-specific resistance treatment and training to increase the independency is treatment in the chronic phase very important and that need an minimum on treatment on the right level to make it possible. Of course it perfect to leave it sometime but we wise an make an good report/assessment by good measurements of that moment. And when there is an restart make the good measurement / assessment [54,55] and compared this two. This makes treatment is the chronic phase so important and able us to go with the patient in his adaptation and handling his disease. This casus tell us such an story: An year after his stroke, he was according the rehabilitation- team "ready" with his rehabilitation but he couldn't do the transfer on his own and standing up and walking wasn't possible without assistance. ADL was also dependent of assistance.

This make it impossible to go home and he came in an nursing home. His condition was poor and he had after an night inspection apnea. He sleep this whole year bad and that was the first where our team was focus on.

After an year was there an progression but still the apnea was present and his performance through the day was minimal. It was an great performance of the rehabilitation team to try so long so hard but the progression after an year was too little, that they say : "he isn't able to learn!"

His tone of his affected leg was low. Only with an higher speed of movement as is done in the MAS-scale was there an resistance[56,57]. There was no random activity in the arm and in the leg only in the hip but then there was an extension and flexion movement synergy. The movement of the head to the affected side was restricted and the trunk had an high tone on the not-affected side. His speech was good , he understand all things well but was depressed. Out the letter of the rehabilitation center was there in one year little progression and according to their observation was the basic condition too little. We started with our program with an orthosis in bed and placing of the bed against the wall and when he was not to tired we start on the ward with standing with an back-splint [3,4]. What there was different as in the rehabilitation center isn't clear but after an month he sleep much better and eat better and his condition but also his mood get much better. He enjoy the exercises and after 3 months he was able to start with the transfer training , standing up and walking without the back-splint. This recovery of condition let us see how important that is to get the Recovery and rehabilitation started. When in the acute phase this isn't there than will this brace the spontaneous recovery and investigators [54] think that the spontaneous recovery that has his greatest moment after 3 months and go than 3 months further, start by patients with an "pusher"- syndrome thus spontaneous recovery when their condition is almost normal and that can therefore the reason that this gentlemen after an year started with recovery.

After 6 months he goes to his own home and started with an program of exercising 3 times an week.



Photo 9.

Photo 10.

Photo 9 and 10.

Two pictures of the patient mentioned above. Photo 9 gives an impression of sideway crossing training with the affected foot over the not-affected side. This requires an elongation of the not-affected trunk but more important an active shortening of the affected side and that together means that the two parts must cooperate and that the diagonals have a “cross” in the center of the trunk –lumbal- fascia thoraco-lumbalis. Photo 10 gives a picture of his capacity when he walks without an aid: he is instructed by a student how he must be facilitated to allow him to go faster. *Photo 9-10 published with the responsibility and permission of the author by j.v.d.Rakt.*

The most important items that need treatment in the chronic phase are:

1. The stability of the hip and lower trunk on the affected and not-affected side and that will be seen in a lesser stand-phase or less swing phase and of course had an effect on the balance.
2. The balance second and then especially the sideway component but also the backward and push-off element.
3. The transfers element especially the transfers in bed because often this will be done at home or on the ward and assistance is given very fast when caregivers or nurses find that the speed is very low but this will cost often his independency and often is that “solved” with an aid.
3. The alignment of the joint and the nerves is very important because the start is often very slow and long and that gives alternation of joint plane and problems with the mobility of the nerves. In this article we will focus on the plexus brachialis because a great number of the “pusher” patients have a restriction in the mobility of the neck. Mostly is this the tone on the not-affected side but this can have consequences for the stand and mobility of the cervical vertebrae and the tone of the scapula – shoulder on the affected side.

Example of item 1: The stability of the hip and lower trunk on the affected and not-affected side.

**Photo 11.****Photo 12.****Photo 11 and 12.**

Photo 11 the stand phase let us see that the keypoint on the affected side has to little power and coordination to hold the correct stand. She try to give the back diagonal more power through the bended elbow and closed hand. Photo 12 give an picture of the swing phase of the affected side and there is the movement over the affected leg to little and his the weight still present on the front of the forefoot, again look what the reaction is of the not-affected hand.

Photo 11-12 published with the responsibility and permission of the author by j.v.d.Rakt.

An example of an lower trunk and hip muscles that are not capable to give the right amount of stability. Of course there is also an great deficit of proprioception but we know that the coordination increase through task-specific resistance treatment also give an improvement of proprioception through the muscle spindles system.[58,59] This item must have the attention because the patient will walk at home always with an form of support and will decrease the power and also the coordination of the hips and lower trunk.

An example of item 2: The balance sec and then especial...

**Photo 13.****Photo 14.****Photo 13 and 14.**

Balance training through facilitation: Photo 13 not-affected leg over the affected and opposite on photo 14. The facilitation-technique that here is applied is on stomach and lower-upper trunk border and so the connection of the front- and back diagonals as point of handling using. So can also the elongation and shortening of the trunk be facilitated on the back and front side and stimulated the muscles pattern.

Photo 13-14 published with the responsibility and permission of the

This technique is the motor-learning stimulation and is very useful when there is also an task-specific resistance treatment because the translation to this balance movement has needed of this approach.

The coordination that is growing in the task specific resistance exercise is always a little different with the movement that is required and when that movement is learned, than can we working on the increasing of the speed. Speed is the base of an good balance system. This approach can also be used by retraining of the push-off in the walking pattern when the strength and coordination has return by task-specific resistance treatment.



Photo 15.

Photo 15.

Push-off is when we normal tempo walk not essential for the propulsion. Most of this energy will be delivered through the lower trunk and the buttock muscles. That start on the moment of the heel strike when the muscle is at his largest and full of energy. This together with concentric contraction is more than enough to pull the body over the stand-leg. Still we see at the end of the stand-phase that the heel is free of the floor but the forefoot is still there and we see contraction in the calf muscles. Still and especially feel the different of this contraction when we walk with a slow speed or when he go faster. Than the contribution is an really push-off and is the contraction earlier and greater. By slow speed the contraction is an contribution for the knee flexion that must occur after the stand-phase.

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

The facilitation-technique is again an learning hand-on facilitation to get the power in the leg to push with the forefoot the body up and to the front and learn to use the possibilities that there now after the training by task-specific resistance training.

An example of item 3: The transfers element especially the transfers in bed

Movements in bed as turning etc. need power of the legs. And that leg is almost straight but when the people get older the legs are more flexed. In all transfers-books [60,61] we use flexion in the knees because the buttock muscle isn't capable to give the power anymore. But normally is the leg that support in extension and allow that the other can move and lift of the support-area.

**Photo 16.****Photo 17.****Photo 16 and 17.**

Turn to the right side start often in the upper trunk but then there is in the legs assistance through an push with the leg (photo 16) left heel in the bench.

Photo 16 and 17 published with the responsibility and permission of the author by j.v.d.Rakt.

Photo 16 turn start in the upper trunk through the left arm and head (front diagonal) and we see that the right leg is lift of the bench (front diagonal) and that need the support of the back diagonal and that we see in the heel of the right foot. Photo 17 we are now fast in side lying and now the right foot must lift and that asked for an support of the other leg. Normal will there be no foot movement but often will the foot in an neutral position because the extension is done through the buttock muscle with an leg in almost full extension. When that isn't enough than will there an reaction in the foot and/or by more flexion in knee and hip.

**Photo 18.****Photo 18.**

On this photo we see that the reaction of the support-leg that makes turning to right very difficult. We see an endorotation in the right hip and plantair flexion. That are sign of an extension movement synergy and that means that the adduction, endorotation will be more and that makes it very difficult for the person to place the other leg to the other side.

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



Photo 19.

Photo 19.

Here an extreme reaction of the paretic leg when there is weight on and against the foot is given. No support of this leg is possible.

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

Turning without an support of one leg is difficult and means that simple movements in bed are struggles to get to another attitude. [63] That means often that other attitude is hold long other the patient must be awake to get the job done. Therefore make this an treatment goal and that can be achieve by task-specific resistance training and facilitation to create an optimal use of the possibilities that this training has given. Flexion in hip and knee makes the support easier but the turning will be difficult, therefore when this is necessary make this flexion so little as possible.

An example of the 4 item: The alignment of the joint and the nerves

As example we choose the assessment of the cervical spine to search of the attitude of the head often in the beginning has influence on the mobility of the cervical vertebrae or influence on the nerves that go to the arm. Central the plexus brachialis because when there is tension on than will this affect the non-affected side but also the affected side and that will often be seen as an increase of the tone and an increase of the flexion (movement or attitude) synergy.

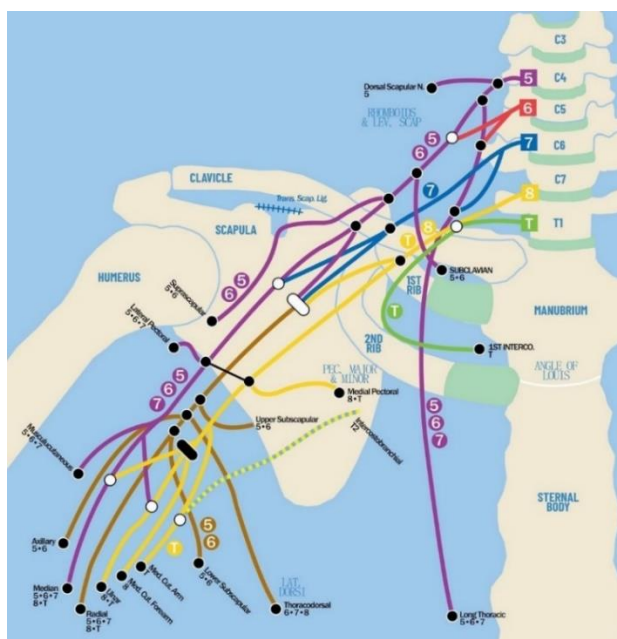
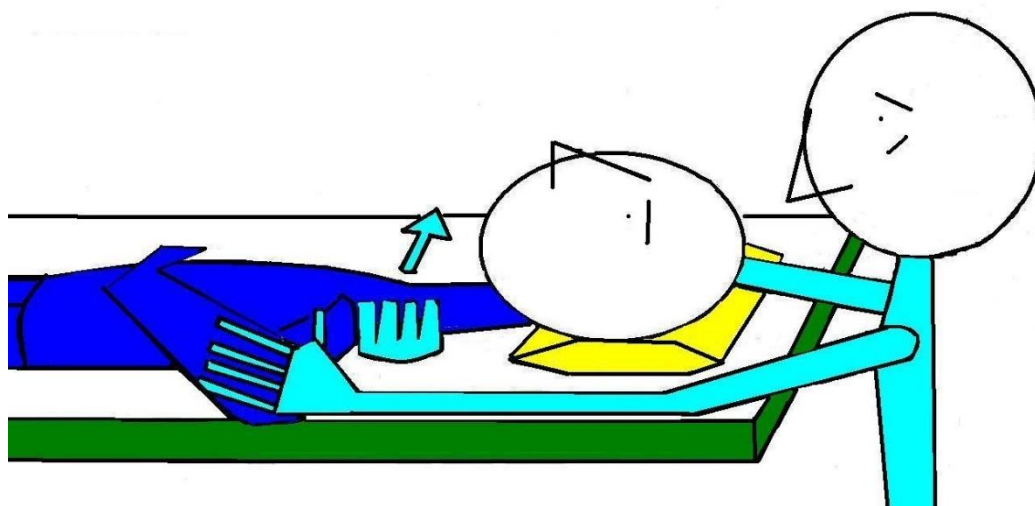


Figure 3.

Figure 3.

The plexus brachialis [64] is an complex system of nerves[64,65,66] that start in the low cervical spine and goes as an bundle that goes under the clavicle between arteria and muscle to the arm/shoulder. Problems in the cervical spine even only small changes can give tension on the nerves-tissues. But the tone of the muscles around the neck and from the neck to the shoulder and around the shoulder blade. This together makes this system vulnerable. *Figure 3 published with the responsibility and permission of the author by j.v.d.Rakt.*

Every patient with an stroke will can have problems with the cervical spine and that can be an brake on the rehabilitation because an head, that cannot move proper all directions gives the whole input system an great problem on all senses. The “pusher”- patient and certainly the severe patient has for the beginning an deviation in the neck through the high tone on the not-affected side and mostly is the back diagonal starting in the not-affected leg so long superior that the shoulder on the affected side stand in retraction with elevation. That combination will give tension on the nerves-systems and the muscles but will also change the joint position and all together will this in the chronic phase have often great problems an need treatment. But first the assessment to assess or the tension in the muscles is caused by the plexus brachialis.



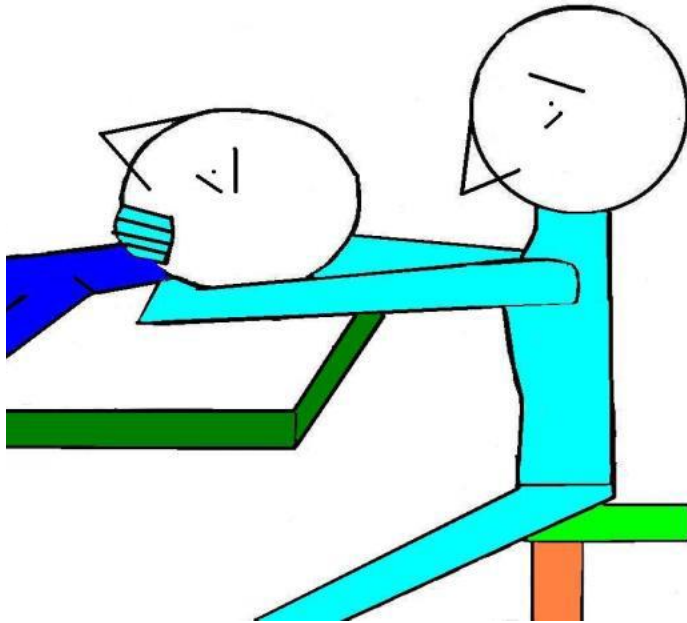
Picture 15.

Picture 15. Assessment technique by Butler[64,65,66].

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

This technique makes an lateral deviation of the cervical vertebrae and after than they tested the tension on the shoulder girdle to feel what this deviation create in the plexus brachialis. And when this is positive, give an treatment that will decrease the tension on the nerve system and often also on the tone.

When this assessment gives no solution and the tone is quite normal than the can be an disturbances in the vertebrae and their movement between each other. There are an lot of approach that can be used to assess this and to treat it [67,68,69,70,71].



Picture 16.

Picture 16.

Technique to give an longitudinal traction on the cervical spine to investigate where there were disturbances in this part of the spine. And of course as an treatment after an assessment. This technique get the whole cervical spine but of course there are other techniques that are more specific for problems at vertebrae or clavicular /shoulder level.

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

Often is there an hesitation to integrated this mobilization techniques by patients with an neurological disease and that is understandable, because often the tone makes this immobility.[72]

But when someone is capable to lower the tone and find the cause of the immobility than will this makes more possibilities and often the tone will stay on lower level.

What in this article has mentioned, the problems of the mobility of the neck count for all joints and asked therefore for knowledge and skills to integrated this and make the quality of the treatment better with an better quality of life for the patients.

Conclusion.

This patient deserve an change for an good rehabilitation and time must be no factor for an inadequate rehabilitation. Often the condition is poor and that ask from the whole team to search why. Often there is an reason as the struggle people have with their body especially at night and cost that so much that there is no power through the day but there are indication that also apneas can be the cause or both. The next step is to work for stabilization in the attitudes. There must be stability and the possibility to do more in this attitude. That means that the accent in the beginning not must lie on movement and ADL but on restoration of the attitude with little movement to get an good and stable input to the damaged brain. The problem with the center line is so dominant that all other problems are lesser because when this center line is not change no normal movement can be achieved. Here start an good team with the right approach and will this team see how fast this patient can learn on his level, now the patient get the change to exercise on his level and learn to cope with disturbances. An be aware that the patient isn't "aware" that his center line isn't right and that he will push when therapist push him in the therapist right position. Don't push give input on the affected side and stay alert that the level of exercises is right. The patient will, when the condition is there, make great progress equal with other stroke patient and sometimes more because the cortico-spinal tract is often not so bad damages.

Therefore give this patient an chance !!



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