

Jan van de Rakt, Steve McCarthy-Grunwald

**Diagonals Part Five – Pathology**

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

746

# Ita. J. Sports Reh. Po.

Italian Journal of  
Sports Rehabilitation and Posturology

## Diagonals Part Five – Pathology

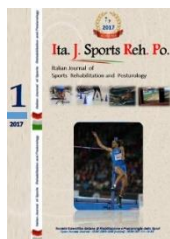
**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

**Authors: Jan van de Rakt<sup>1</sup> , Steve McCarthy-Grunwald <sup>2</sup> .**

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

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

*Correspondence for author.:* Jan van de Rakt e mail : [jan@vanderakt.nl](mailto:jan@vanderakt.nl)



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online] ISBN 007-111-19-55

## Transferring in and out of bed, including synergy.

### Abstract

*In part four we discussed the difficulties some individuals experience when moving independently whilst in bed following a stroke. We identified the benefits of exercise in promoting recovery, and provide greater opportunity improve movement which receive the most attention within rehabilitation for instance, standing up and walking. The article indicates the need for practitioners should consider the exercise program and specifically put it into context of their occupational performance such as getting in and out bed, on to the toilet or in and out the shower, which although traditionally is seen as a nursing task, in reality should not be ignored. Re-establishing skills therefore requires the need for rehearsing such activities providing variation of movement and exercise, with the best outcomes being achieved in the individuals home environment.*

*Primarily, practitioner's start working with individuals whilst they are still within the ward of the rehabilitation centre. Once they have reached the point of discharge, particular attention should be afforded to assisting with the transformation back to their home environments, to ensure the skills developed as identified above, remains appropriate in the new setting such as standing up and walking. Consequently, the exercise programs should be developed for use in all settings and with all healthcare professionals and not just for the clinic area. This provides both the consistency of approach to ensure the skills are practiced and developed over time, whilst providing the context for daily activities, and variation of performance with differing environmental constraints.*

*Using diagonals help to create task specific resistance therapy which provides the right 'Repeated Maximum' (RM) and the right intensity of exercise specific for each individuals need. This in turn helps practitioners calculate optimal time required for each individual to maximise their potential for recovery. Appendix gives an picture about the synergy. This is an part of the restoration of the brain after the stroke and makes movement with support possible but gives also restriction on selective movement and therefore problems with the balance. Therefore is every improvement of the synergy an reason for therapy and not only in the first 3-6 month after stroke but lifelong !*

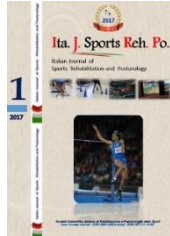
**KeyWords :** Stroke, Stroke Rehabilitation, Diagonals, Synergy.

### Introduction.

Part 4 ended by looking at transferring to a sitting position from lying on our side. Mornings provide the perfect opportunity training, providing authentic situations to practice with load and rehearsal ( variation ) in performing. Getting into bed is a transfer skill which is less practiced. This is because there are often only two moment that patient will practice this movement, in the beginning after lunch and late in the evening. Often down to the fact that individuals are so exhausted that more assistance is necessary to get into bed, consequently reducing the potential for and real skills development. Following rehabilitation you often hear from families that they have helped their relative into bed. Consequently, practitioners need to be aware that this happens and make appropriate adjustments with the exercise program to include also this part of the transfers and exercise to the highest level of independency.

### Moving to a lying position on the affected side.

When assistance is required, training can make it easier for the individual when everyone practices the same exercise techniques. When sitting on the edge of the bed, for the individual



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

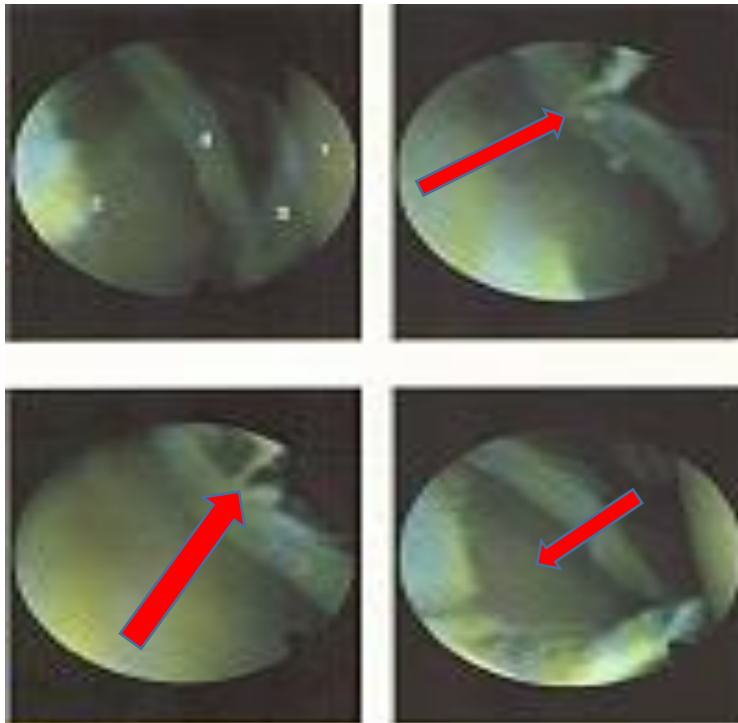
ISSN 2385-1988 [Online]IBSN 007-111-19-55

748

to move into a position so they can lay on their affected side, there must be an control present of the rotation (exo) of the hip and the legs need to move individually into the bed.

Remember, the level of assistance provided in the morning is always less than that which is required for individual in the evening. The impact on the individual's energy levels by simply sitting for half day much greater that most care providers consider.

When individuals move into lying position, this movement requiring an coordinated action in the lower trunk, with the affected hip becoming the fixed point for the diagonals. Often the tone is so low that the individual start more in the upper trunk. No tone/movement in the lower trunk/hip results in the active exorotation of the hip to be absent, producing a rigid position which prevents the individual from lying on their side. If this movement is forced in any way this can potentially rupture the ligament of the hip joint, complicating the process of recovery.



**Photo 1.**(a,b,c and d).

**Photo 1.**(a,b,c and d).

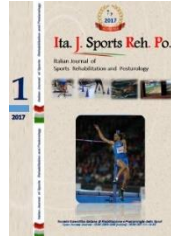
When the hip is rotated to the end with force the ligament and structure around the joint head can be ruptured.

Following a stroke this is unlikely to be repaired by surgery and will result in rehabilitation on a lower level.

Furthermore any changes we see on recurrences will be significantly increased.

A is a normal presentation whereas b, c and d have evidence where damage has occurred.

It is crucial therefore to ensure any movements whilst transferring into bed focus on preventing this type of damage to the hip joint. This requires practitioners to restrict the affected leg moving into the wrong position reducing both the speed and force of the movement. We must therefore stabilize the lower trunk and control the speed of the movement, whilst limiting the hip movement from the start until we can safely move the affected leg into the bed. To do this we placed a hand on the upper leg of the unaffected side, this creates a fixed point enabling the individual to start building up the tone in the diagonals and homolateral structure.



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55



**Photo 2.**

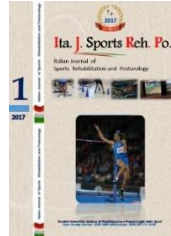
Placing a hand on the upper leg of the patient. We can now ask the patient to place their unaffected hand on the bed creating a further fixed point which helps to build tone in the diagonals and homolateral muscle structures.

**Photo 2.**

The affected leg provides no fixed point, this results in the remaining part of the diagonals being unable to create sufficient tone to produce stability. The movement therefore will come from the upper trunk as the patient “falls” towards the affected side. We need to ensure the fall is coordinated and performed at the right time, to prevent injury. Otherwise this can go very wrong. Nurses complain always that the individual pull them over the bed to the back and that hurt their back, but the reason is, that the patient has the feeling that he is falling and don't want to fall to the front and further one going to the back gives **no** pain in the hip. Therefore when we fix the unaffected hip and create another fixed point with the unaffected arm, the diagonals now have two fixed point (both on the unaffected side). Furthermore, with the hand on the unaffected leg, this can help to generate reaction in the affected arm while the hand on the bed can stimulate the tone in the affected leg. This may be enough to increase the tone and function and therefore create more control for the individual whilst moving.

When we support the lower trunk(photo 2) be aware that this is done to build up the tone. The support on the bed by the individual is only possible when a sideways movement of the lower trunk has occurred and this is only possible when the lower trunk controls the movement or the care provider take care of that. Through the support on the hand and the pressure on the upper leg the diagonals will go further towards the affected side. (From the lower trunk unaffected side to the upper trunk affected side). When the back diagonal dominates, the upper trunk will go in retraction when lying on the affected shoulder, which can be extremely painful for the individual. Even though care providers can restore the shoulders position after the individual has lay down on their side, it is always safer and more appropriate to prevent it from occurring in the first place. Placing one hand on the scapula, enables the care provider to hold the upper trunk more forwards.

Ensure in this position you don't take too much of the persons weight because the tone will decrease rapidly and you end up supporting the individuals full body weight. Support on the unaffected arm will stimulate the lower part of the diagonals on the opposite side resulting in limited movement with exorotation. It's worth noting here that with too much extension in the affected leg this results in the individual moving backwards, whilst with too much flexion the individual moves forwards therefore it is imperative that the correct position is identified to prevent both of these from occurring.



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55



Photo 3.

#### Photo 3.

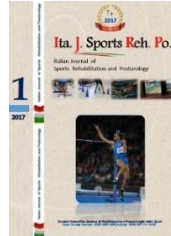
Here the Individual's right side is affected, and they are practicing movement whilst lying against the physical therapist.

This individual is capable of walking with a 4 leg cane but when he tries to lean against the therapist, there is only movement in the upper trunk. (Movement in the lower trunk appears absent). It is crucial that there is control over the affected hips exorotation and that there is more fixed points for the diagonals. He try to create one by flexing his unaffected leg on the bench. Fixation is extremely important to increase tone and reduce the speed of movement. His foot is positioned on the floor which inhibits exorotation in the hip creating an increased risk of injury.

#### Difference between ADL and training.

When considering the importance of ADLs alongside training you need to continue to remember how fatigue can affect performance and make adjustments to allow for this. For instance preparing for bed itself, (changing clothes for pyjama's) and the simple act of pulling the bed clothes back and turning to sit on the bed are made all the more difficult when the individual is tired. Training in the evening therefore is not always possible, therefore care providers should make these tasks of the everyday training looking towards developing a RM of 75% when practicing exercises.

Also wherever possible it is important to try and to train the develop these movements using the individuals own bed during the day to make it as authentic as possible. Par example start with training in the midday after lunch. As the individuals skills develop, the next step is to apply pressure only on the leg. In the beginning this will require more time when placing the unaffected arm and enabling the individual to move further when unassisted. This training can be achieved by decreasing the pressure on the unaffected leg, whilst the individual places their arm as before



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55



Photo 4



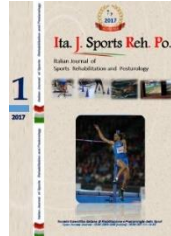
Photo 5.

#### Photo 4 and 5

Control of the affected leg is very important. In photo 4, it is possible to hold the affected leg with the hand in exorotation which is often necessary when the affected leg has little tone.

Photo 5, here support is provided by the leg of the care provider, and when the individual lays down on the bed, it may be necessary to lift your leg up to maintain the correct exorotation of the affected leg whilst positioning the unaffected leg first in the bed, then the affected one afterwards. Following a stroke Individual's tend to experience a significant change in perception, therefore now they can sense clearly both legs as they move **independently**. All movements should look at preventing any stretching movement with the paretic muscle and ligaments of the hip joint. Any stretching in this area increases pain, and results in the automatic movement backwards to prevent injury.

Once the position is stable they can then push backwards on the bed. Often is a fixation of the individual with his unaffected leg on the edge of the bed and nice solution. It's important to remain aware of the potential damage that can be done to the hip on the affected side (as discussed above). Physical therapist can also use RM training and task specific resistance treatment to help develop more tone, power and coordination in the affected hip and lower trunk.



Jan van de Rakt, Steve McCarthy-Grunwald

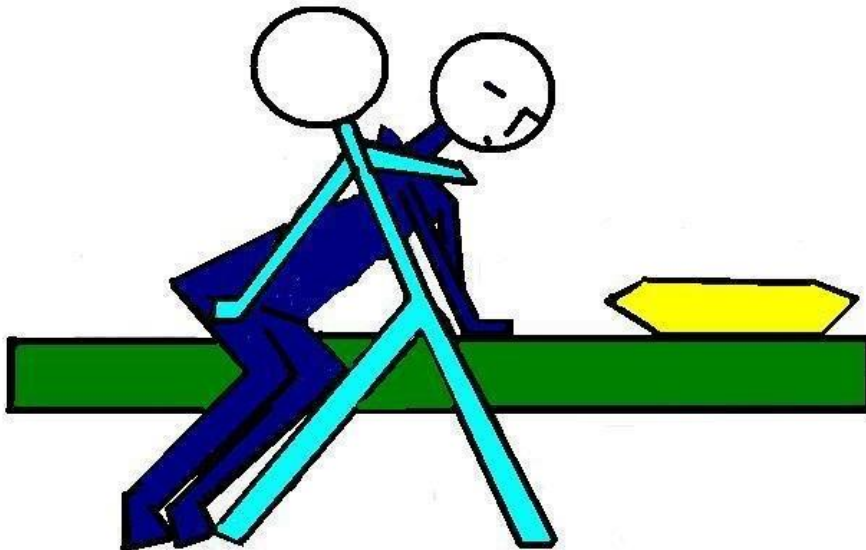
### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

752

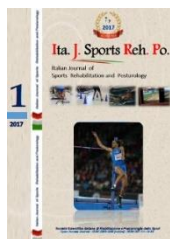


Picture 1.

#### Picture 1.

Here is the entire technique with special attention on how far the supporting leg of the care provider can control the exorotation of the affected leg.

Once the individual is on their side on the bed they can then look at turning onto their back. Often this movement will be done by the care provider by turning the legs towards the centre of the bed, which results in the individual having to do minimal movements. It's important to remember that there needs to be sufficient tone to do this and that tone will be created by the individual by simply keeping their **head up**. When individuals lay down, we automatically keep our head movements under control to prevent the head flopping and hitting the surface too hard, which may cause injury. Consequently, care providers must observe that the individual can hold their head and in turn, this requires the movement to be active and not passive. This can be achieved by simply pushing gently on the bended knee of the unaffected side, towards the mattress. This also enables the individual to have some control in the movement reducing the potential feeling of falling that can be experienced in a passive type movement, as the individual cannot see what is behind and may have reduced sensation of where the bed is behind them. Some individuals will first feel or there is a "bed" behind there back!! Individuals must also learn the same movement (getting back in bed) over the unaffected side to increase independence further. This movement has the distinct disadvantage of the diagonals on the affected side having reduced stimulation and limited fixation minimising the amount of support it can offer during the movement. Once the individuals recovery has reached a sufficient level these movements can be developed. Like before they have two elements which incorporate both exercise training and ADLs.



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

753

**The importance of the exorotation of the affected hip is crucial in the individual's recovery, therefore all transfers provide opportunities to exercise and develop this area. Care providers therefore must remain aware that there needs to be sufficient tone and sufficient conditioning for this to remain safe!**

### Coming to sit position over the unaffected side.

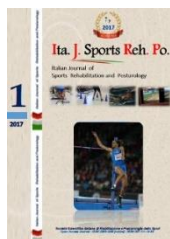
When the individual lies on their unaffected side they need to bring their legs individually out of the bed rather than both at the same time. One by one and try to avoid that the individual lifts his affected leg out of the bed with his not-affected leg. (It's worth noting this is exactly the same when moving the legs when the individual is lying on the affected side).

### Why is this important?

For successful rehabilitation it's important to maximise the opportunities for practicing movements which can stimulate the affected side and therefore ask the individual to move their affected leg separately every time to optimise the potential for overall recovery. Previously individuals were taught to push the affected leg out of the bed using the unaffected leg. What tended to happen is this movement became more entrenched, therefore when the individual's strength developed they still used this pushing movement limiting the development of the affected leg as a consequence. Especially as when the leg is allowed to extend this increases the overall tone (towards being able to stand up) but by simply pushing the leg out, this tone is not allowed to develop. Consider for a moment when the individual is lying on their side, there is only a tiny amount of knee extension required to enable the leg closest to the bed to move outwards. Care providers can assist with this movement initially (if required) but once the individual's strength develops you can then encourage them to do this independently from then onwards. Once the lower leg (closest to the bed) has been moved outwards, the individual now has two points that provide support. The upper trunk on the unaffected side which can assist in pushing up from the bed, and the lower trunk that can try to endorotate and flex the leg under the edge of the bed. Understandably, this last part can be difficult and is therefore easier to achieve by using the other leg. As we already know, the diagonals of the unaffected upper trunk link with the lower trunk of the affected leg. When the individual pushes up off the bed with their arm, a level of extension and control is required in this area to prevent the upper trunk moving too far forwards or backwards. Often the affected upper trunk moves backwards and that the affected arm goes in a flexorsynergy that may result in its position being behind the individual's back which can increase the risk of injury. **Be careful!!**

Without a fixation in the lower trunk this movement is impossible. Therefore care providers need to provide support for the lower trunk on the affected side which is applied on the upper leg. Now the individual can alter the placement of the arm and can move to a sitting position. This movement needs to be controlled as if it is too fast, there is no brace on the affected side and the individual will continue to fall sideways in the direction of movement. The best time to start developing this movement is when the individual is capable of creating a fixation point with his affected leg. Sometimes the individual will fix on the edge of the bed with their unaffected leg. To do they are required to reposition themselves further backwards back which increases the





Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

overall energy required to perform the movements because the front diagonals are required to work. This in turn creates an extension on especially on the affected side. The unaffected leg is able to create more selectivity and he can make flexion the knee and pull himself to an sitting position. This ask for great power and often this may result in the individual falling backwards and ending up lying across the bed requiring assistance to then move forward into a seated position.

754

### Lying down over the unaffected side.

Lying down over the unaffected side starts quite easy. The unaffected hand can be placed on the bed because the lower trunk is able to provide an active exorotation and shifting the weight to the unaffected side. This enables the individual to place their hand beside the upper leg and so they can control the beginning of the movement when lying down. This movement will require two fixing points to be successful. One is created in the diagonals that start in the unaffected hand(upper trunk) but requires the paretic leg to create a second point which may be beyond its capabilities initially. Therefore depending on the individual's current level of functioning, two options are available to try:

1. They can let their body fall on the bed. This requires a degree of skill as due to the potential of falling forwards with no control, the individual is more likely to push backwards (as it feels safer) but could potentially end up lying on the affected arm increasing the risk of injury.
2. The individual creates a fixed point with his lower unaffected leg. His required them to position themselves further backwards on the bed so they can flex their knee on the edge of the bed (Photo 6 provides an impression of this). As you can see, this movement over the affected side has resulted in them trying to create a fixed point with the unaffected leg in addition when trying to into a sitting position.

The risk of injury from the rotation of the hip is now reduced when the individual is lying on their side reducing the ability to lift the affected leg in the bed. Although the risk of injury still remains, significantly less when the individual lays down on the affected side.

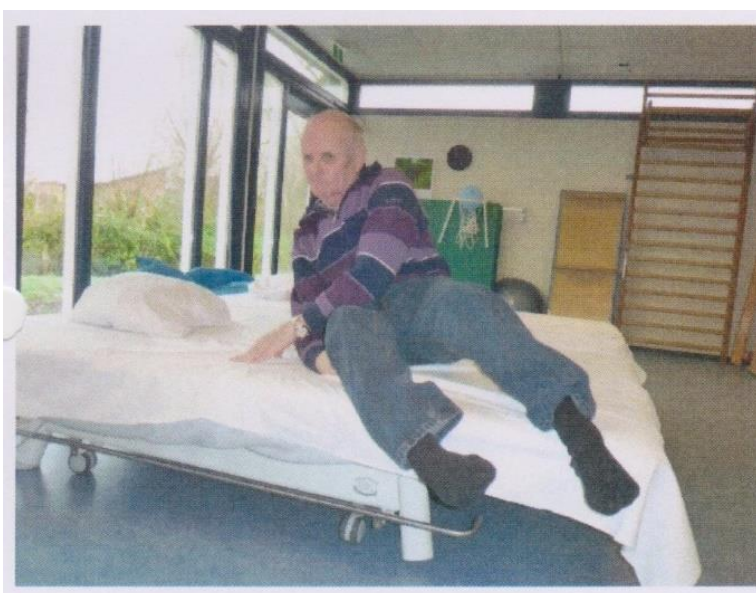
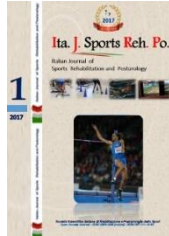


Photo 6.

### Photo 6.

The fixed point on the unaffected side is not enough therefore the individual tries to make another with his affected leg. This results in them needing to go further back on the bed to make this movement possible.

Observe the affected arm and hand. It is extremely likely that the affected hip will end up lying on top of it.



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

755

Once the individual is lay on his side, they still need to lift the affected leg into the bed whilst moving the affected arm in a position where it is not at risk of injury.

Lifting the affected leg is difficult with such limited power and often requires assistance. Even pushing it with the unaffected leg as identified previously, is difficult with no assistance. So even if the individual turns on to their back, the affected leg will follow, but there is always an increased possibility that the affected arm may become partially trapped under the body, whilst the affected leg ends up laying across the unaffected leg. Therefore this level of movement training is better left till later on in the rehabilitation.

Once the individual is more adept in performing these movements, (both in and out of the bed over both the affected and unaffected sides), but still has limited function in the affected arm, they are required to develop more speed and perform the same movement into a sitting up from a supine position with rotation of the side. This results in a rotation of the lower trunk as the individual sits up on the edge of the bed. It worth noting that an sitting positions with flexion of the hip and extension in the knee can irritated the muscle and nerves tissues, and should be avoided wherever possible.



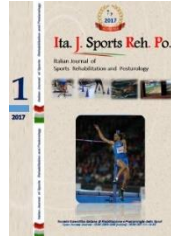
Photo 7.

**Photo 7.**

Additional speed provides the front diagonals with more power and momentum, and by lifting the legs it is now easier to sit up by pushing with just the one arm.

### **Sitting position.**

Sitting on the edge of the bed initially is also an exercise with an RM (Repeated Maximum) of more than 100%. Sit for even a few seconds is a big achievement for some individuals following a stroke and must be recognised as so. Therefore at the start no ADL training is possible, and just allowing the individual (with assistance as required) to lay back into the bed is enough before allowing for a rest period before making further attempts. Often this only requires eccentric contraction of the front diagonals, in the unaffected side with one or two fixed point (for example, the foot on the ground and the hand around the edge of the bed).



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55



Photo 8.

#### Photo 8.

The eccentric contraction of the back diagonals. The individual tries to sit with a concentric contraction starting in their head and not in the lower trunk, whilst using his arm and leg on the unaffected side.

The individual is focused and appear to be actively involved this is crucial to have sufficient motivation to reestablishing previous skills. (look to his face ) It's important therefore to consider body language in developing the training for the individual, allowing them to set the pace initially.

**Note: this movement is far more than 100% RM!**

**Consider which type of wheelchair will help build from the lower trunk upwards?**



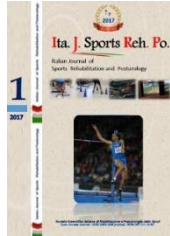
Photo 9

#### Photo 9

Here are my grandchildren. The youngest tries to build up a sitting posture but he have only control over their head. And he must have control over the lower trunk too for it to be successful!

His brother is reading him somethings about Knights!

Photo 8 provides an impression of how difficult it can be to build up a sitting posture following a stroke. We therefore rely on wheelchairs to provide some support but this reduces the overall strength development of the trunk over time. When the right wheelchair is identified for each individual this reduces the potential for restricted movements and loss of strength in a sitting position which can make this position an hell for individuals. We must also consider that the wrong posture in a wheelchair makes it more difficult to speak and swallow. One reason is that the stretch on the muscle on the front of the neck is so great, that the function of that muscle



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

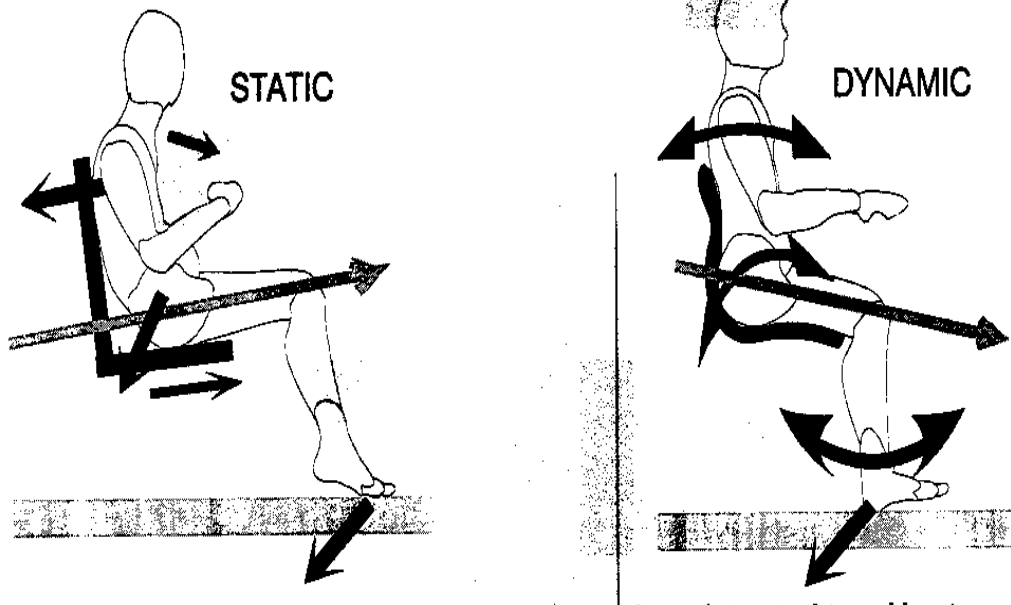
ISSN 2385-1988 [Online]IBSN 007-111-19-55

will obstruct the potential to speak/swallow. There can also be a disturbance between the muscles of the affected and unaffected sides coinciding most likely with particular damage in the brain that coordinates the swallow reflex (swallow and posture will be considered in a further editions of this series of articles).

Practitioners develop the individuals balance whilst in a seated position using a wheelchair which helps the individual to stabilize the lower trunk. Primarily sitting in this position for prolong periods is difficult, therefore time restrictions are imposed to prevent fatigue.

757

## Hemiplegia

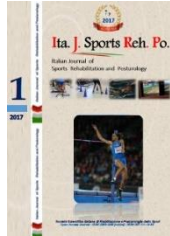


Picture 2

### Picture 2.

The dynamic solution involves stabilizing the pelvis in the correct position. Now the thorax will be more erect so no reaction in the cervical spine is necessary.

In the static situation the thorax collapses and the cervical spine needs to be extended to maintain this posture.



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

758

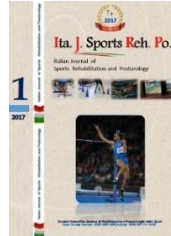
#### Photo 10.

The sit-orthoses is designed specifically at the back of the sitting part to provide a “fixation” of the pelvis.

This example is not as extreme as picture 2, but the outcome is the same. No collapse of the thorax spine which leads to an excessive extension of the cervical spine to correct posture which creates a stretch in the muscle at the front of the neck. Additionally, the sit-pillow allows the person more room when standing as the front is placed lower than the back, supporting the movement when transferring to a standing position, whilst making it easier to move forwards in the wheelchair with the trunk of the body, before placing their feet securely on the floor for support.



Photo 10.



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online] ISBN 007-111-19-55



Photo 11



Photo 12.

#### Photo 11 and 12.

Photo 11.

This Individual is sitting in the wheelchair. Observe the position of the thoracic and cervical spine. Their functional capacity is similar with the individual seen in photo 8 although that wheelchair had no sit-orthoses.

Photo 12.

We see the pelvis is tilted backwards, the thorax has collapsed and the cervical spine is extended. Note, (although rare) the affected arm often fell backwards, due to having a retraction in his scapula (part of an flexion synergy)

His neck becomes extended to counteract the thoracic collapse which inhibits his capacity to swallow.

**What movement does his neck make?**

**ADLs**– Additionally training for ADLs performance levels is conducted daily when sitting on the edge of the bed. Similarly this is time restricted to prevent the individual becoming too tired prior to sitting in the wheelchair.

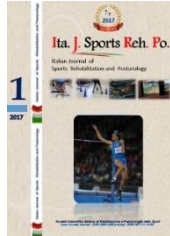
**Training**–Practitioners can exercise the sitting posture by providing resistance to hold whilst in a seated position (see below).

#### 1. Wheelchair

Bengt Engstrom's development of this theory is well recognised. He developed stability using a lower trunk sit pillow which "fixes" the pelvis in the correct position.

#### 2. ADL exercise

When power increases, training can develop looking at personal care needs such as washing and dressing. This can help to improve balance in the trunk itself. Daily practice is required to improve overall recovery, with the amount of assistance reducing as the movements develop towards independent activity. Initially work with the individual to put on the last item of clothing in the sequence of dressing (for instance a shirt or jumper) working backwards from there as the skills develop. At the most optimal point include the activities of washing and drying. You should note over time how the trunk becomes more stable, developing independence in ADLs, whilst the feet are placed on the floor. The unaffected leg provides support unlike the affected leg. This is due to



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

having no closed chain on the affected side. Consequently forward or sideways movements on this side are not always well controlled. When the individual sits on his unaffected leg, the beginning of the diagonals which cross over to the affected side (both front and back), can help to provide some support but moving the unaffected hand forwards or sideways towards the affected side requires more fixation in the affected side itself.

760

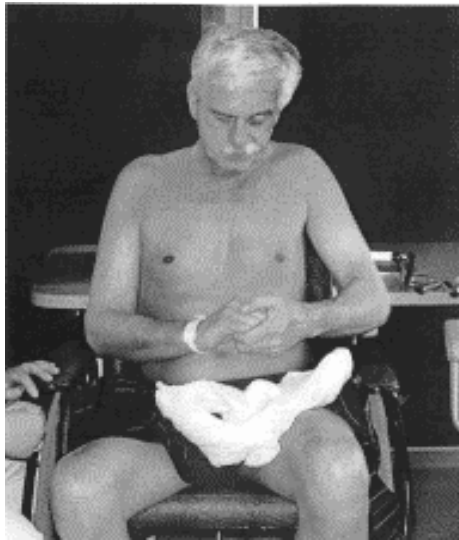


Photo 13

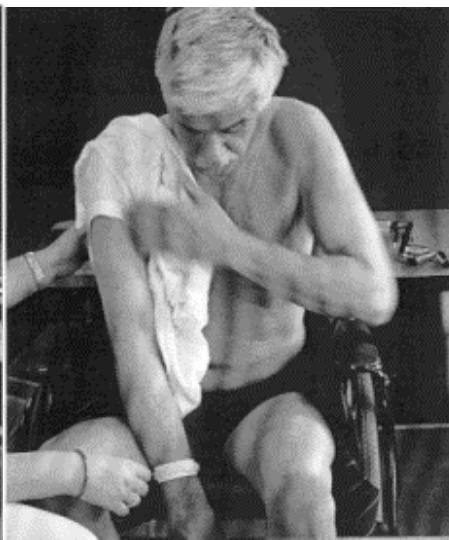


Photo 14

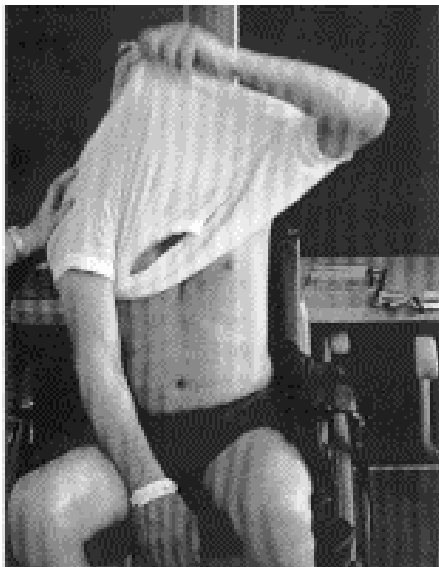


Photo 15

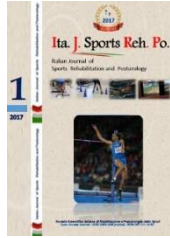
#### Photo 13,14 and 15.

This procedure is well known. Firstly, make a “hole” and place the paretic arm in the sleeve (trunk inclination moves forwards increasing control on both sides at the back).

Observe the support point of the unaffected elbow (14), when the sleeve is brought up over the shoulder. Also observe the reaction of the muscles in the unaffected leg. Next a concentric contraction is required in the back diagonals, which is initiated in the lower trunk requiring cooperation between the front and back diagonal. Observe the stomach. On the unaffected side the stomach is “smaller”- more tone and the tone in the affected hip and leg is reduced with limited change in the contour of the leg.

Also notice the decreasing waist line in comparison the unaffected side.

The most involved level of training with the ADLs is putting socks, shoes and trouser on. This not only requires ADL skills, occupational performance, it also requires a level of physical



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

761

therapy to develop the base movements.

To be able to cross your legs over and requires coordinated movements of the trunk forwards. One leg provides for a firm stable position on the floor. Here start the diagonals(in this case the back diagonals) and this diagonal must be capable control posture. The movement required an reach movement to the foot and that is eccentric. But this can never be an only eccentric movement at all because the necessity is always there to adapt , stop or change the trunk movement to give the arm and hand ( unaffected side) the opportunity to change and make the job easier. That ask for an firm and stable base that must be the affected of the unaffected leg. The unaffected leg must exercise and learn to do this and that ask for an task specific resistance training .

#### Photo 16 and 17.

Photo 16. Here the affected side crosses over the unaffected side. The unaffected side controls the movement which starts in the back diagonals. The affected arm is has reduced tone but we can see how the shoulder on the affected side is positioned higher and that the contour of the shoulder are poor. It appears to be subluxated.

Photo 17. Now the affected foot need to provide a fixation point for the body, which is difficult to achieve with the unaffected hand, resulting in an overall body position which requires the individual to rotate further. This is an exercise that enables individuals to be more independent but is more difficult to perform and is only usually possible at the end of sitting training. Doing this type of exercise regularly will provide more power and coordination in the lower trunk.

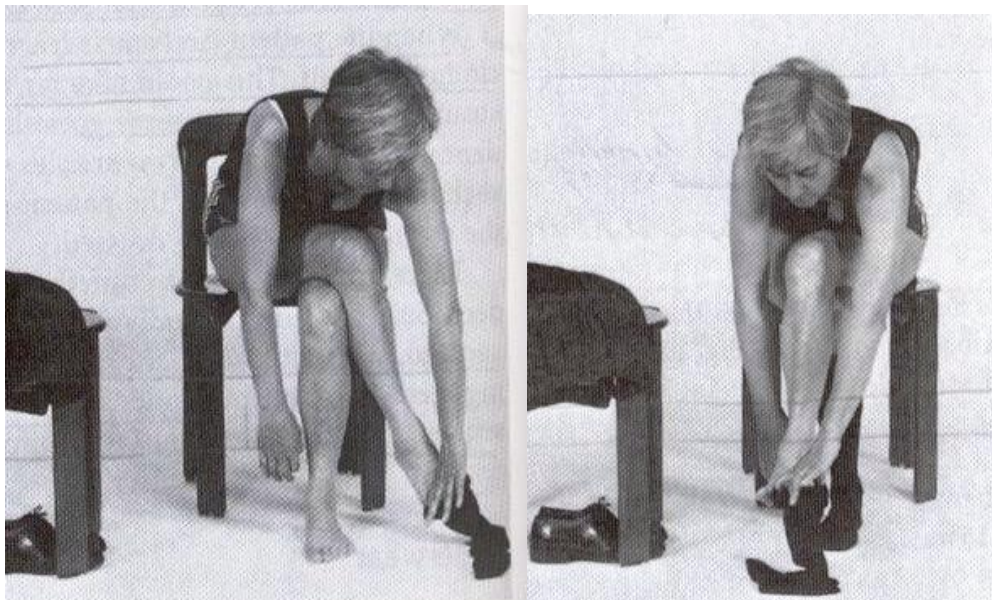


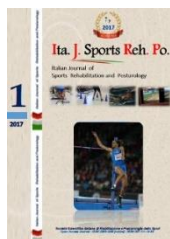
Photo 16 and 17.

#### Training of the sitting posture.

There are two approach:

- A. To train directly on the balance performance when sitting.
- B. Use of resistance to hold the sitting posture.





Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

762

A combination of these two is usually best, together with identifying a good sitting posture in the wheelchair. Also considering developing ADL performance as a functional goal is useful too.

Some circumstances prohibit the use of resistance for instance exercises with limited time periods which also have a RM of more than 100% (see photo 8). Performing this kind of sitting posture training has little value because the lower trunk is not stable. Therefore practitioner need to develop lower trunk action before we can train any upper trunk reactions.

#### Photo 18

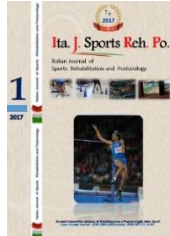
Here the individual is sitting while trying to lift his unaffected arm with no assistance from the practitioner. The movement proves difficult because the control required to maintain balance starts in the diagonals on that side. The other part of the diagonal appears to be active also because we can see a retraction with a flexor synergy in the affected arm.

This indicates that the individual is pushing down with his unaffected leg activating the back diagonal. His pelvis is also rotated backwards. When the other diagonal becomes fixed (starting in the unaffected arm), activity in the affected leg will be required. In the photo, we can see that this legs appears to be 'hypotonic' resting against the bench in an exorotation posture.

In this position is balance training hardly possible and he will learn nothing or maybe that this is very dangerous!!



Photo 18



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

Instead of developing exercises which are likely to demoralise clients such as the one above, practitioners should consider what the individual is more likely to be able to achieve which potentially has more fixation in the lower trunk.

763



**Photo 19.**

Building up the sitting posture with support from the trunk starting in the lower trunk area. There is still a rotation of the lower trunk backwards, but the individual is able to reduce the level of support using their hands/arms with a more positive outcome.

This can create a feeling of sitting independently. We can use this fixation to build upon, creating a more stable lower trunk and increased cooperation between the front and back diagonals, developing in turn the homolateral structure.

And the next step is make it something heavier!

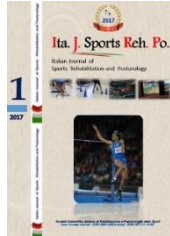
**Photo 19**



**Photo 20**



**Photo 21**



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

764

#### Photo 20 and 21.

Photo 20. Reaching with the affected hand as far as possible sideways. What can we see? No elongation on the affected side. No reaction in the affected leg due to holding the position with unaffected side. One sign is the unaffected hand on the unaffected leg. Often the knee bends on the unaffected leg, therefore placing the hand creates an anchor position with which to hold the movement. Now what we would hope to see is an action in the affected leg, but sometimes this is too difficult to achieve initially!

Photo 21. Here no elongation is evident, and the unaffected leg is bent to provide fixation. Now we can see an action in the lower trunk because there is extension with slight exorotation. At this point we can progress further looking to create more power and coordination in the lower trunk.

#### Which diagonals are working hardest?

The front and back diagonals on the unaffected side start in the bent knee. Observe how the upper trunk on the affected side rotates backwards. This is due to the upper portion of the diagonals on the affected side having more power in the back diagonal compared with the front diagonal and more activity in the unaffected leg which stimulated the back diagonal. We can see a retraction with flexor synergy (see attachment in this Part).

In the next photo we see both the activity in the unaffected side and we can also see the synergy in the affected side. This is because the unaffected leg is working harder, and is now dependent on the selectivity of the affected side. The individual with reduced selectivity in their arm (photo 21) will automatically create a flexor synergy.

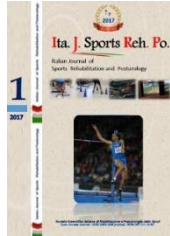
**When an individual following a stroke is able to effectively use unaffected leg, then this will have an effect on the rest of the diagonals and we are likely to see more reaction on the affected side. This can result in higher tone in the arm with reduction or loss of selectivity.**

**Therefore always treat the affected arm after any treatment!**



Photo 22  
Photo 23.





Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

765

#### Photo 22 and 23.

Photo 22. The same movement is performed but now on the unaffected side. We can see elongation, and the unaffected arm can go higher. There is exorotation in the unaffected leg, and there is a fixation on which the diagonals can perform, with overall a good reaction in the remaining parts of the diagonals. The affected leg moves in endorotation and the affected arm moves in abduction. There is also evidence of an attempt to bend the affected leg. Now we can see action on both sides resulting in exercise which is less than 100% RM.

Photo 23. There is an elongation of the unaffected side and the base on the unaffected hip makes an active exorotation, with a little reaction in the affected leg. This means there is a reaction all the way across the diagonal from the upper unaffected side to the lower affected side. Note how the reaction in the arm is a flexion synergy, which will affect the potential of the affected arm. The control is reduced compared with the individual in photo 22, because the individual requires a fixation on his “finger” and overall the height achieved by the unaffected arm is less too. The reaction in the unaffected leg ( photo 22) exorotation is limited because of the “fixation” with the affected leg around the edge of the bench.

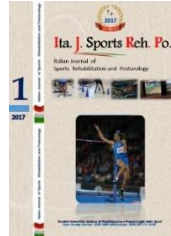
When the unaffected leg is very dominant we will see a reaction in the remaining part of the diagonal.

When the affected shoulder/arm has less selectivity then the flexor synergy will increase often in tone but also in further reduction of selectivity.

So although this exercise needs to be completed to develop better posture and balance when sitting. It's Important therefore that once the exercise has ended, we must still look at treating the individual's shoulder and arm.

Often this balance exercise in a sitting position is almost always 100% R.M. or more. This is a level which is very difficult for clients to reach, hold and repeat. Reaching out is difficult and can often be demoralising for individuals. Therefore a more appropriate approach is to create together situations that they can hold for short periods of time whilst bringing in resistance training. Now we can identify the individual's level of RM and use task-specific training to improve muscle power.

From this position we ask the individual to try to sit on his own in the same spot. Now we observe the reaction in the hip on the side next to where the practitioner is sitting. Here the risk is reduced again, and the possibility to repeat still remains.



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55



Photo 24

#### Photo 24

Sitting on one side, with one leg behind the back of the individual, the weight of their body moves to one side as they lean against the practitioner. This is the base, where the knee (of the therapist) provides support to correct the trunk. Ensure that any movement comes from the lower trunk. There is reduced risk of falling and the movement sideways is enough to produce a reaction.



Photo 25

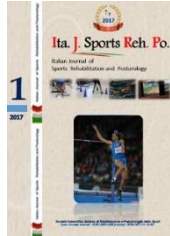


Photo 26.

Photo 25 and 26.

Photo 25. A variation here where we see that there is additional activity. The practitioner asks the individual to lift the other leg and cross it over. This movement reduces balance and in turn increases the difficulty. With the support removed we see exorotation resulting in a fixation with the diagonals.

Photo 26 Another variation now balance has shifted to the opposite side from where the individual is sitting. The practitioner provides some control while the individual crosses their legs. Once this exercise is achieved we can consider additional repetitions.



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

767

#### **In both situation we can provide resistance!**

Photo 25: Resistance against the leg which is being lifted to cross over the other. This will activate the diagonals (both front and back) all the way to the opposite shoulders. What is more important this exercise requires a better fixation of the diagonals which must be performed in the affected leg. Here we see an increase of exorotation, and we can observe which diagonal is more dominant. (extension leg = back diagonal and flexion leg = front diagonal). We can sense what a RM 100% would be, therefore we can develop a more individualised task-specific strengthening program for each individual which will hopefully lead to more power and coordination!

Photo 26: There are two possibilities to provide resistance. The hand at the back of the spine can provide resistance along with the hand on the shoulder. It's worth noting the training rules, where there must be sufficient load and rehearsal to produce muscle fatigue and provide sufficient stimulus to develop more power and coordination.

**Resistance – load on a task specific exercise must be the base of all therapy.** Always remember that resistance has no value when the individual cannot do the task. Therefore practitioners need to create situations which enable the individual to achieve the task whilst providing load and resistance!



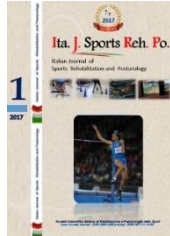
Photo 27

#### **Photo 27**

Testing the 100% RM on the affected shoulder. We can see that the individual lacks full control of the lower trunk but consequently has to work harder at such a higher level. When resistance at 75 % is possible we can look at completing task-specific training.

#### **Low Transfer**

The most difficult movement with weight on the affected leg is getting in and out of bed, alongside moving in an chair or wheelchair and for posture correction. It is also possible when on a toilet but not always advisable as individual may have reduced power therefore a better choice might be to transfer on a commode- chair. Often the individual can perform a transfer



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

out of bed easily, but due to significantly reduced strength it is more difficult when planning to get back into bed. Individuals following a stroke require support when using the toilet. The act alone can be draining on energy due to the need to support the client whilst providing personal care when cleaning and adjusting clothing. Therefore to reduce any risk of injury for either the individual or care provider, it is more advisable to use a commode- chair, and transferring the individual onto the bed before providing for ADLs after the toileting. **This difference is always there in the rehabilitation, the difference between ADL (training) and training of skills.**

Training: we try to develop new skills with the individual, which again involves a higher level of learning, but for ADLs to be successful this really needs to be less than the previous skills level. Because the individual will do this transfer many times through the day, it is unrealistic to expect every time to be performed successfully and at the same level of involvement due to natural fatigue over the day. **That can nobody !!**

Training for low transfers will be completed first. Then when the individual is successful in performing these the training can progress towards considering ADLs. That requires the practitioner to go to where the individual is (for instance a rehabilitation ward or home) to assist them up from where they usually sleep. No matter how many times this is possible the practitioner needs to ensure they are always working towards every contact being part of the training program.

What therefore is it useful for the individual to be able to do before we can consider making use of the low level transfers in place of fully assisting the individual. ( by elevator)

1. They must be able to sit on the edge of the bed with minimal support and provision of the right equipment suitable to the individual's needs. For instance, a wheelchair and a chair for support. Note for the wheelchair to be adequate there should be no foot rests and one arm rest is removed.

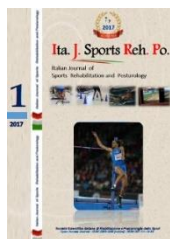
2. Pivoting round from the edge of the bed to the wheelchair is usually a 90° turn which is never possible to achieve in one smooth movement. Especially because of restrictions in the affected leg preventing the foot to change position therefore increasing the risk of damage to the meniscus of the affected leg. Conversely, a three-point movement allowing for correction of the foot position is necessary to maximise safety.

3. It is important that the individual has shoes on which provide support.

4. The individual must be capable of leaning on their **unaffected elbow** on the seat area of the chair. Now distribution of weight is ideal ensure the transfer does not place unnecessary strain so the individual has more control allowing for some freedom of movement in the legs to lift just enough to place in the required position, than stretching with the back to reposition the feet before continuing the move again through to completion.

### **Training of the movement to lean on the sit-part of the chair ( Vorlage )**

When an individual following a stroke leans forwards with their unaffected foot on the floor, they can control this movement by using an eccentric contraction of a part of the back diagonals. This part that start in the foot and goes through the unaffected hip but without some assistance of the other leg is this almost impossible. Often the unaffected foot push away and create an extension in the unaffected leg ( back diagonal). Control in the upper trunk on the unaffected side is usually possible but we need to remain aware of what is happening in the paretic side. The upper part of the affected side will move in retraction and flexor synergy because the



Jan van de Rakt, Steve McCarthy-Grunwald

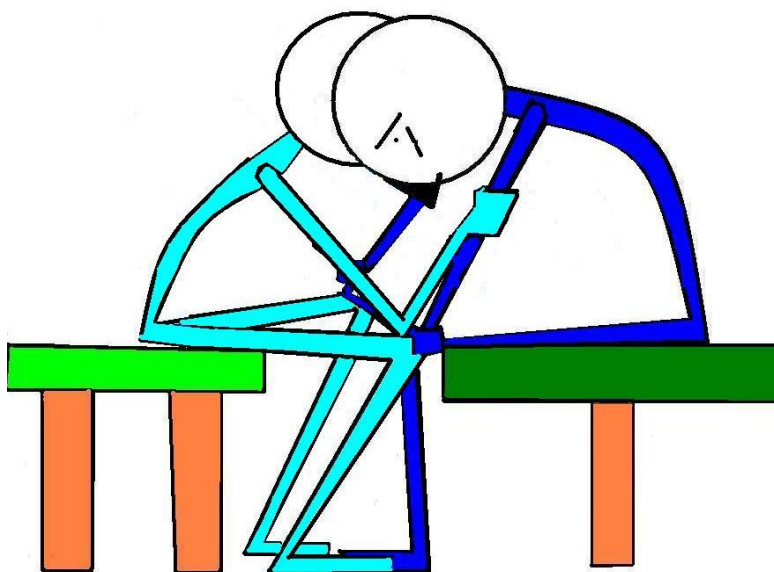
### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

unaffected leg is working so hard resulting in much activity in the back diagonal starting in the unaffected leg. And that extension will give an flexion in the affected leg ( static reaction–cross flex-extend reaction part 6 ) Decreasing the individuals stable position potentially increasing the risk of falling. Practitioners therefore need to predict such problems that the individual may face and select more appropriate training with required minimal exertion from the individual as at this point in recovery. We create situations in which the individual can start to move the upper trunk forwards, whilst the lower trunk is stabilised with assistance from the therapist.



**Picture 3**

The individual sits as far back on the bench/bed whilst their feet remain on the floor and the body weight is in the center. Forwards movement needs to emanate in the upper trunk as far as possible without the individual feeling they are falling. Movement starts with the head flexing and being held stable whilst the trunk curves forward.

**Picture 3**

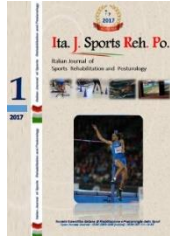
Before movement takes place the practitioner/therapist sits in front of the individual and places their legs either side of the individuals on the outside, providing minimal pressure against their knees. Now the individual is required to bend their head and place the unaffected elbow on the practitioner's leg followed by the affected elbow. The spine is shortening on the affected side, and the scapula moves into retraction. In response the unaffected elbow on the practitioner's leg can provide some downwards pressure creating a closed chain on the unaffected side, resulting in the front diagonals having some fixed points. The spine will then shorten on the unaffected side too. Having a fixed point in one front diagonal upper trunk and another in the lower trunk( affected side) with homolateral structure movement on the unaffected side creates a closed chain which is often enough to decrease the tone on the affected side and works to provide support with pressure from the affected side. With this increased pressure from the affected side, there are now 6 chains on the front side which allows us to;

1. Learn to move from the upper trunk forwards to gain support similarly as to the description above with further repetition and variation of movements.

2. **Task specific resistance therapy** to strengthen the muscle and improve coordination. Practitioners need to know one RM to be able to make a training program that will help improve coordination and power.

A few options are available to the practitioner.





Jan van de Rakt, Steve McCarthy-Grunwald

### **Diagonals Part Five – Pathology**

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

770

1. The practitioner pulls on the upper arms resulting in a reaction in the shoulder backwards with the agonist produced more in the front diagonals starting in the upper trunk. When there is an support on the knee of the therapist.

2. The practitioner pushes against the upper arm of the individual. The front diagonal needs to be active lower down in the trunk. This is often the first time any action in the scapula occurs due to the stomach and the serratus anterior being active. This becomes more apparent when the knees and feet move up off the floor which allows for the complete diagonal to become active.

3. More difficult but still possible, the practitioner pushes the elbow on the upper arm into each other (although having an atonal arm restricts this from happening) you will notice that the homolateral structure will be active within the m. gluteus. This muscle is mostly inactive when puled as the diagonal traverses via the inside muscle structures (adduction), when this action is performed it can help the individual start making movements similar to standing up. This training will hopefully assist in building more confidence for the individual when sitting forward by training the muscle patterns whilst providing support.

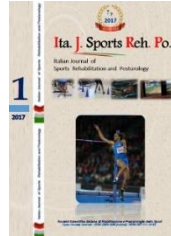
4. Push against the upper keypoint ( shoulder ) sideways will evoke an reaction in the lower trunk. When the shoulder makes an upper trunk sideways , we see an adduction action in the leg on that side with force on the ground for the stabilisation.

Now the individual is ready to start learning the whole movement of the low level transfer and train task specific at a higher level.

This requires:

1. Less support
2. Support on one elbow( unaffected side) by an atonal arm
3. Support of the affected leg and relay on the support of the practitioners knees. Lifting the buttocks whilst the practitioner assists in rotating in three phases into a chair or wheelchair
5. Can do the same low level transfer with other care providers (ADLs)
6. Strengthening of the affected side to make low level transfer easier
7. Strengthening of the muscle that are required when the individual stands

To increase the possibilities for the individual it is important that these exercises have lots of variation. You can also use these exercises as part of a training program for the paretic arm which is not only vitally important, it also increases the possibilities for recover further. Recovery of support possibilities on the affected side will increase the possibilities to do something with support , par example , think on standing position and you must reach for you trouser and you can do this with support of the affected arm, but we van also use it to make standing up easier!



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online] ISBN 007-111-19-55



Photo 28

#### Photo 28

Support on the leg of the practitioner. This has its advantages simply because the typical leg shape offers a good support area, as well as allowing the practitioner to be able to feel the amount of pressure the individual can exert.

In this case they are training the individual to control movements in his scapula. This can also be used for more support when standing.



Photo 29

#### Photo 29

Support using a stool with the hand curved on each side provides this individual with the right support area for his wrists. They can now exercise standing up and sitting down with the upper trunk in flexion.

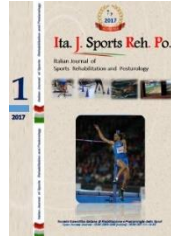
(Notice how the wheelchair is positioned higher towards the back so that the individual's knees end up lower than the hips).

We also train for extension of the elbow on the affected side.

We can also take the training further getting the individual to lift the stool and hold it before placing it down again.

Note all three exercises can be repeated one after each other.

**Variation!!**



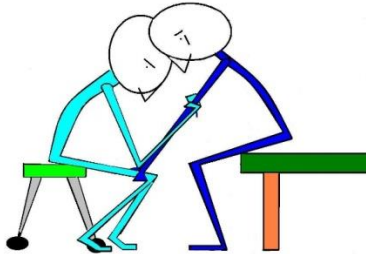
Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

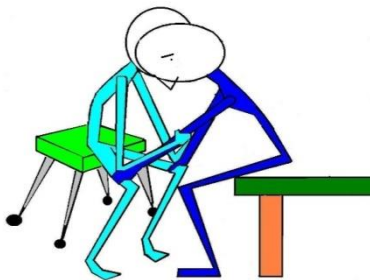
How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online] ISBN 007-111-19-55



Picture 4

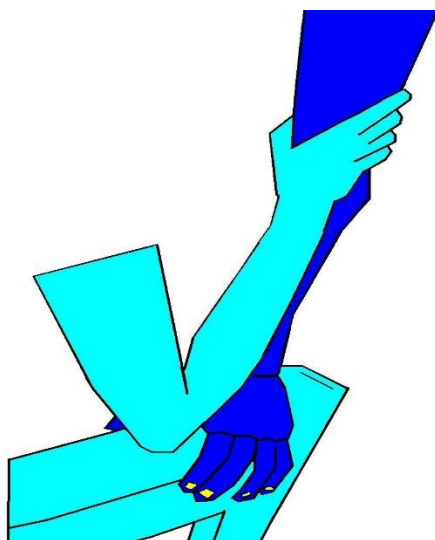


Picture 5.

#### Picture 4 and 5.

**Picture 4.** The pushing movement the individuals make will shove the therapist away because he sits on a stool with wheels. That will help stimulate a standing-up movement. Notice how the individual's knees are lower than the hips.

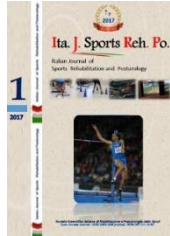
**Picture 5.** Now the practitioner changes the direction of resistance towards either side which evokes increased activity on one of the sides. By supporting the arm the practitioner is able to regulate movement of the hand and elbow therefore they can shift the weight more towards the affected side or not as required.



#### Picture 6.

By placing the elbow between the thumb and the fingers in the “thumb-web”, you can control the individual's hand and wrist. The hand can hold the elbow and move the weight more left or right as required.

**Technique of Joan Mohr.**



Jan van de Rakt, Steve McCarthy-Grunwald

**Diagonals Part Five – Pathology**

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

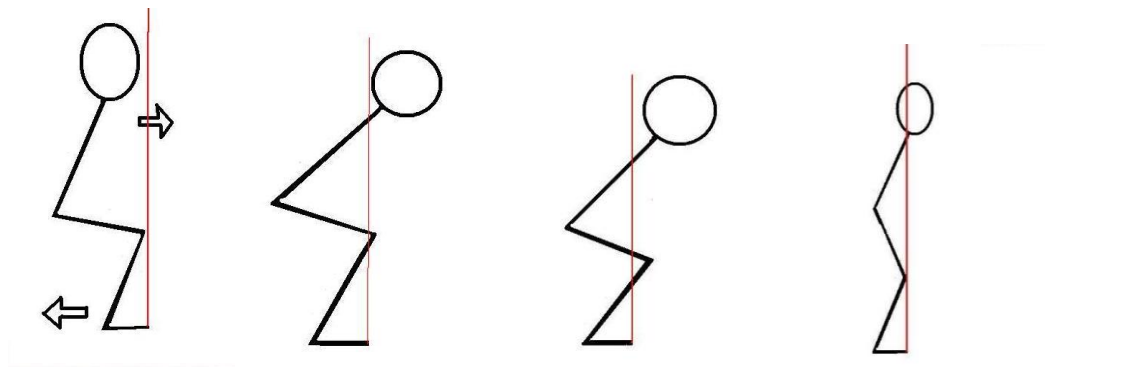
Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

**Why does the bench or wheelchair/chair have to be the correct height (with the individuals knees lower than the hips) when we start to train on “vorlage” position and after the buttocks have lifted when standing up?**

Plus, why do we require the individual to make this movement with the upper trunk positioned forwards.

Imagine when we stand up normally. We see movement of the lower trunk forwards with extension of the lumbar spine. This movement will provide the right position for the feet to move as the trunk passed over the hip and the feet will be set back both below and behind the knees. The feet remain stable and provide support as the trunk passed the hip and in turn the buttocks begin to lift up. Before we can stand up straight, there needs to be movement in the ankle allowing the knees to move forwards, so the weight on the feet is perfectly distributed enabling us to stand tall.



Picture 7A

Picture 7B,

Picture 7C

Picture 7D.

**Picture 7 A, B, C and D.**

A. When standing up the movement starts when the trunk passes the hips and the feet move backwards.

B. Now the position is correct with the nose past the front of the knees and the feet stand slightly apart for a stable base. We still have too much weight behind the feet

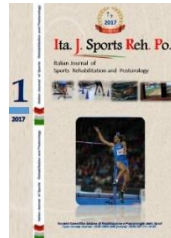
C. Now the ankle joint moves to allow the knees to move forwards

D. We are now able to standing up maintain balance.

This movement is also required when we look at training movements for individuals who have had a stroke in low level transfer. It ultimately requires the knees to move which can be difficult and places high demands on selectivity for the affected side.

**This movement of the knee can be prevented by correction with the sitting high and the trunk movement !**

When the hip joints sit higher than the knees, movement is easier, and no adjustments in the ankles are required. So when we position ourselves with the upper trunk forward, this position does not require ankle adjustments and the knees can immediately start to straighten out and with an adequate support to allow the affected knee can to straighten also. We must always provide firm support to the front of the knees otherwise the individual may resist the movement by repositioning the upper trunk backwards, which is an inadequate position vorlage with which to stand.



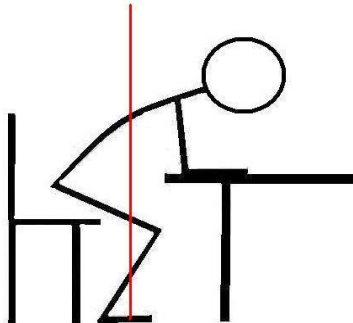
Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55



**Picture 8.**

Now with support from a table, the forward position “Vorlage” is more than enough and because the chair is at a suitable height, there is no need to correct the movement in the ankle. This individual can stand up with support at the front and can immediately straighten their knees. This principle is very important for the low level transfer to be successful.

**Picture 8.**

#### Low level transfer.

The technique for this transfer is to use support at the front and assist the extension of the affected knee. This provides a moment where the buttock has lifted up from the bed/bench which makes it possible for the individual to move sideways. Before starting place the bed in a position which allows for the individuals hips to be higher than their knees.

A. Prepare the wheelchair, by removing the armrest the same side as the bed and remove both foot plates, be sure that the brakes are applied and that the front wheels are in the right position(facing forwards). Finally,there must be a stable stool or chair for the individual to support themselves on with an support on the elbow.

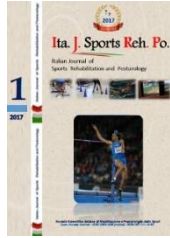
B. The care provider stands with both knees against the individual’s knee on the affected side so that movement start over the affected side.

C. Now we can assure better control in movement of the trunk with the stool placed at an oblique angle over the other side of the wheelchair. The practitioner guides the individuals arms to the stool so the individual can support themselves on it on his elbow.. The best support through the elbow of the unaffected arm, whilst the affected arm can be held next to the individual’s stomach.

D. The care provider leans across the individual and places their elbow over the spine on the unaffected side whilst bending their knees.

E. The practitioner simulates a “sitting” movement and ask the individual to lift their buttocks off the bed. They then pull with their elbow and push with the opposite hand that rests on the bed surface while pushing with their knees so that the individuals knee goes into extension. When the buttocks have lifted slightly,they support the individual to rotate slightly towards the wheelchair

F. This movement needs to be done in stages and can never be completed in one turn due to the affected knee having limited movements therefore too much rotation can damage the menisci of the affected knee. Realistically the movement has three stages to end up perching on the chair/wheelchair and then one further movement to sit back on the seat. Therefore, between each movement stage make sure the individual moves back slightly with their trunk to relieve any pressure on the feet, while ensuring they are facing in the right direction, before moving again.



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

775



Photo 30 and 31

#### Photo 30 and 31

Low level transfer may be different each time they are performed but the principle is the same.

Photo 30, Shows support on the seat area of a chair. Observe how the elbow of the practitioner is positioned next to the side of the individual.

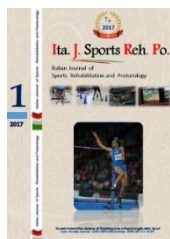
Photo 31, Here we can see the support from one (or two) hands on the seat area of the chair but which is enough in the situation, due to the amount of forward movement.



Photo 32.

#### Photo 32.

A practitioner training on the basic movements of low level transfer (a wheelchair is not necessary at this time). Greater support on the seat area of the chair is more important when the practitioner is smaller in size compared to the individual. Additionally, the practitioner can use a pillow to protect the individuals affected knee especially as sometimes the practitioner's patella may risk hurting the individuals knee due to the position it is in and the pressure applied when pushing. The practitioner is training for movements which are almost 100% R M level. This is not only over the affected side but backwards. They are trying to increase the weight on the affected leg as much as possible.



Jan van de Rakt, Steve McCarthy-Grunwald

### **Diagonals Part Five – Pathology**

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

776

Support from the unaffected arm is extremely important because it enables the practitioner to lean over the individual who has had a stroke, making it possible to perform the “sitting” movement of the therapist/care provider possible as they rock backwards. Here from the start the diagonals in the unaffected arm are complete all the way to the affected leg. In the affected leg the inner part of the muscle structure will work because the diagonals angle is larger than 45°degrees.

Little adjustment is required by the practitioners arm and elbow placed by the individuals side, to generate more weight through the paretic leg.

### **How do we make this movement into task specific resistance training?**

Photo 32 provides the first method.

By generating more weight on the paretic leg, practitioners can feel the individual is unable/able to make the extension required in the knee without assistance. As a result, our assistance alters the level of R.M. from over 100% to under 100%, we must continue to practice this movement until there is evidence of muscle fatigue linked to a slowing of the individual’s performance. For instance, repeat the lifting of the individual’s buttocks off the bed up to 10 times with some variation. This muscle fatigue tends to occur in the muscle structure, often the extensor of the knee and hip(buttock)- muscles themselves may be the first to show signs of fatigue. Practice with variation may involve, changing the direction of movement (photo 32) or a movement which has more backwards or forwards positioning, or increased range of movement looking to end at the furthest extremes of knee movements, (although it’s important to ensure the speed is reduced to prevent risk of injury). The fatigue tends to dissipate quite quickly, so allow for a short break before attempting further practice attempts. Three practice cycles a day should be sufficient to produce a stimulus that promotes better coordination in muscle structure and power.

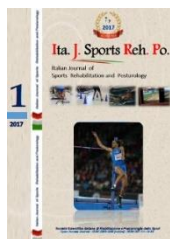
### **The second method involves resistance instead of assistance.**

Some practitioners opt for an alternative low level transfer method (the high-low level transfer), Although this has an element of learning action involvement where the movement itself stimulate the brain to search for a solution.

Task specific training requires an increase in the overall impact whilst performing a set task. Therefore, when practitioners move past the need for assistance when the individual can support their weight on the affected leg whilst performing the task, practitioners can move to applying resistance with your arm over the individuals back with the elbow next to their side. The training now moves towards having a load dimension. Coordination and power increases which provides the brain with more powerful stimulus with which to problem solve toward a workable solution.

- The rules:**
1. Practice with variation average 10 times till muscle structure fatigue
  2. 75 % of the RM
  3. Look to having a ratio of training opportunities for each set of exercises.
  4. Minimal 3 times a week. Often at this stage of rehabilitation the frequency may well be higher through the week better and then not 10 times but 7-8 and 2 rehearsal behind each other.

**A.D.L.**



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

777

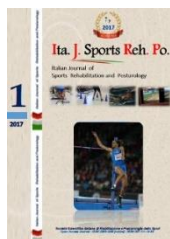
Introducing ADLs into the training program, helps to increase the potential for individuals to develop skills towards independence. Such low level transfers are crucial in ward based settings to help compliment those carried out as part of clinical treatment. Therefore the same transfers will be performed every time the individual moves in and out of the bed. Initially there needs to be a period of observation to ascertain if the equipment is conducive for training E.g. if the bed is higher than the wheelchair, or how much fatigue the individual experiences over the day to ensure that training does not compromise the potential benefits. It's important therefore to ensure if the individual is unable to move into forward position or be able to support their weight on a stool as previously identified then using low level transfer presents a risk and therefore staff should revert back to moving and handling procedures until such time as they are possible. Then use the elevator!

**Reaction following sitting:** Fatigue following a long period of sitting can be common and results in the individual having a *higher muscular tone in the spine* along with a decrease in power and tone in the buttock muscles. Changes in tone on the affected side can occur after short period of time (on average 30 minutes), which can *decrease to the point* that the individual will look to repositioning themselves more towards the unaffected side with often support from the unaffected arm. Therefore prolonged periods of time spent sit up, may reduce the individual's energy reserves to the point where they are incapable of performing any transfer due to limited ability to move the upper transfer forwards (Vorlage). Further consideration needs to be on how we support individuals when using the toilet. Transferring with a low transfer on the toilet is far too heavy and must not be done. With a low transfer to a commode- toilet chair is a better option and because standing for even short periods isn't possible, is the best option to transfer back onto the bed whilst personal hygiene needs are attended to. Such simple activities may be so draining for some individual's energy levels that following using the toilet-chair they may need to rest on the bed for a while to replenish some of the lost energy. This should not in any way detract away from the importance of developing the low level transfers as soon as possible and incorporating the ADLs as this is what the individual will expect to do once they have recovered sufficiently to be more independent.

Therapist keep doing the transfer on the ward in and out bed, toilet and shower chair. Makes it easy to find the weak spots and the nurses on the ward have the feeling that they have support from others. Make this an important point in the "working together in the right context rehabilitation multidisciplinary approach !"

We will discuss this element of care provision more in part 6.





Jan van de Rakt, Steve McCarthy-Grunwald

**Diagonals Part Five – Pathology**

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55



**Photo 33.**  
 Individual following a stroke where the left side has been affected. Notice when sitting in the wheelchair how they have rotated the unaffected leg (exorotation) and placed it on top of the paretic foot. Although this may be due to comfort for the individual it is likely to create more tension and exorotation in the unaffected hip as he repositions himself on the unaffected side.  
 As a result the pressure on the affected buttock has reduced along with any potential discomfort.  
 One problem is now the support area is reduced therefore they requires support from the unaffected elbow making it difficult to undertake other activities of daily living, for instance taking a drink. The affected shoulder's position is in elevation and retraction because the lower part of the diagonals are working harder due how they are sat. Consequently the whole dorsal diagonal (unaffected leg to affected arm) begin to develop higher muscular tone in the upper trunk following a prolonged period of sitting.

**Photo 33.**

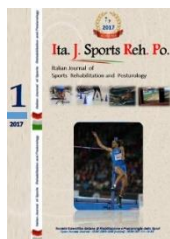
By combining low level transfers repeated several times a day in different ADL situations with consideration of task specific resistance therapy will enable the individual's progress to be easier. We need to consider here that once the power in the lower trunk begins to increase, the likelihood of the individual experiencing more discomfort in the buttocks also increases. This in turn will increase the need to find more comfortable positions (as identified above) by repositioning themselves.

**Consequently we can use further strategy to assist with this.**

1. Training with more trunk extension
2. Use the upper trunk in a forward position to perform a standing posture.
3. A mixture of both.

**Training with more trunk extension.**

The biggest disadvantage of the low level transfer is that focus relies on the front and back diagonals equally. Individual can potentially develop six chain, because all four point of the body are fixed. Therefore the agonists can be the muscle structures at the front whilst the back diagonal can be the antagonists. When the chair moves, more dynamic processes are evident and the back diagonals becomes the agonist. Greater trunk extension (the trunk and buttock muscle) with limited to no support from the chair makes the back diagonals the agonist.



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online] ISBN 007-111-19-55

779

Furthermore, it's important to look at developing the normal reactions when the individual stands up, with lower trunk extension and training for adjustment movement required in the ankles.

Now facilitation needs to be delivered differently, because the knee is required to move forwards. Therefore instead of the care provider placing their knees in front of the individuals affected knee, they are now placed either side just behind the knee joint. Now forward movement is possible with the knee, so both the practitioner and individual can move into a forward position at the same time, ensuring any changes in ankle position still occurs in both legs.

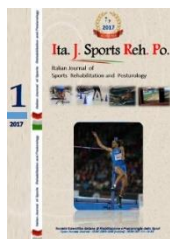


Photo 34.

**Photo 34.** The classic N.D.T. – Bobath transfer; here the unaffected hand helps support the affected hand during movement. Notice the position of the practitioners knees either side of the individuals affected knee.

This type of transfer can be very heavy and often requests a lot of involvement from the individual. There is also a risk of placing the paretic shoulder at risk of injury. Due to the upper trunk being more in a backward curved position, the upper extent of the back diagonal are working harder. This results in the shoulder blade position being in retraction. Consequently any movements being performed are likely to require at least a 90 ° anteflexion in the shoulder joint which is often not possible and increases the risk of damaging the shoulder. Consequently this type of transfer (extension lower trunk) is best served as a variation for training of the task-specific resistance therapy. On the ward there is no benefit for patient and nurses to do it on this way, even with only the not-affected hand on the chair because the patient cannot stand properly. That gives no advantage in the ADL but the capacity to stand with the upper trunk forward (flexion) gives that advantage well. It's more useful to start training by looking for greater capacity for extension of the knee and movements crucial to standing up which requires more from the front diagonals improving the overall standing posture which is beneficial when starting to incorporate the ADL.

**Part 6** goes further with the training which considers standing up and sitting down along with the first considerations for walking training. With similar approaches as identified in this



Jan van de Rakt, Steve McCarthy-Grunwald

### **Diagonals Part Five – Pathology**

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

article. Again first learn, than task-specific exercise against resistance and make the transfer to the ward for the improvement in the ADL.

## **Appendix**

### **Synergy**

The Bobath's and Brunstrom were one of the first to discuss synergy. Individuals have two types of synergy (movement synergy and attitude synergy). Individuals with any residual brain damage following a stroke will use the movement synergy to perform movement, but if this is not possible, due to the affected arm or leg becoming fixed, they will then revert to using attitude synergy. In the arm primary movements will present with a flexion synergy.

The attitude synergy is often seen in later stages or when the individual has so much perception loss, that just lying in bed requires significant energy to maintain position, and therefore the attitude synergy is present as a consequence of this. Often the attitude synergy is evoked through the movements that the individual makes with the unaffected leg, by pushing the unaffected leg into the mattress which increases the tone in the whole dorsal diagonal resulting in the attitude synergy in the arm.

Usually attitude synergy presents in a later stage of movement often at the point where balance is required, and the unaffected leg evokes a flexion attitude synergy through the diagonals. But when there is no balance in bed then will this attitude synergy appear immediately. The flexion attitude of movement synergy is then to present simply because restoration of movement following a stroke tends to present in the back close to the spine (by not crossing nerve pathways in the brain). Extension of the trunk on the unaffected side together with the affected side produces initial stability, usually with elongation on the unaffected side and a shortening on the affected side. That results in the upper trunk on the affected side moving in an extension –rotation turning backwards.

This is not always that obvious as the tone is low with the muscles in the front diagonals having lesser tone than the back diagonal, especially along the spine which tends to dominate the movement. Individuals may sit with the spine in a curved position. Although the back tends to work mostly with eccentric movement which is the beginning of the flexion synergy.

### **Flexion attitude Synergy of the arm.**

No movement with the high tone in the upper portion of the back diagonals from the affected arm over to the unaffected leg. There is muscular tone in the spine and across to the shoulder blade which results in;

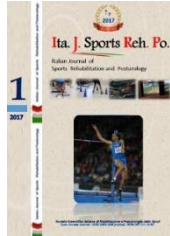
Retraction (adduction, medial rotation and depression or elevation. (This depends on the function of the front diagonal on the affected side). – A retroflexion, endorotation and adduction in the glenohumeral joint

-- A flexion and pronation in the elbow.

-- Palmar flexion with ulnar deviation in the wrist. The fingers are in flexion and the thumb adduction and flexion. Often the fingers move over the thumb.

Variations are possible, but often any joint restrictions or neural pathway issues restrict the range available.

The highest tone that I have ever felt was with an individual in the foetal position who was experiencing increased tone in the neck that was so fixed it was impossible to manipulate



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

passively. To search for the best possible level of stabilisation I needed to search for ways of decreasing tone.

### Movement Synergy of the arm.

Our attention now turns to the movement synergy. We have two of them (flexion synergy and extension synergy). Remember these can only be detected when the individual can **move** their arm. Movement of the arm is also possible through a balance reaction which is still a recognised movement synergy. Thus not only movement that can be evoke thought the individual with a stroke arbitrary, that is the old rule but movement by balance reactions are still movement and can be used to create an arbitrary movement. This is an area that has an greater difference than in the old definition.

781

### Flexion movement synergy.



Photo 35

#### Photo 35

Flexion movement synergy.

The individual tries to lift their arm. Movement start either in the upper trunk or the unaffected leg.

The trunk doesn't often shorten on the affected side but will on the unaffected side. Notice how the stomach lifts, the arm creating a stretch over the stomach muscles.

The activity of the stomach muscle on the affected side is significantly reduced compared with the unaffected side.

The individual is trying to lift their arm;

-- Observe extension and rotation in the upper trunk.

-- A retraction(adduction, mediorotation and elevation) of shoulder blade. The elevation is dependent on the tone of the abdominal muscle that is evoked often passive. -

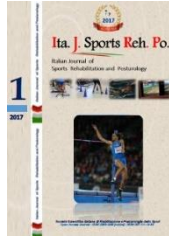
- Abduction retroflexion and exorotation in the shoulder joint. Exorotation seems a rare occurrence but it is still an active exo- rotation action.

-- Flexion with supination in the elbow. The elbow goes to supination from pronation.

-- Dorsal flexion is often seen in the wrist.

-- The fingers and thumb are flexed.

Different variations of presentation do exist but this is dependent on the extent and nature of the brain damage, along with the resulting mobility of the arm and amount of muscular tone.



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

How can we develop the diagonals so each individual achieves optimal recovery following a stroke?

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

782

### Extension movement synergy.



Photo 36

#### Photo 36

Extension movement synergy.

Movement starts in the upper trunk with an active flexion movement.

Activation of the front diagonal are required for this, which goes from his affected arm to his unaffected leg.

This requirement for muscle power at the front, builds up in the stomach muscles on the unaffected side, and when the muscles on the affected side have enough tone the shoulder blade starts to react.

Observe the stomach muscle, there is now more action evident.

There are also differences between the flexion – and extension synergy.

*The reason for this is in the trunk capacity.*

When only the back muscles are active only a flexion synergy is possible.

When there is also activity of the stomach muscles then a protraction movement is possible allowing for an extension synergy.

#### **When extension synergy is possible there is greater selectivity!**

Extension movement synergy has the following components:

- The trunk will be flex. With active tone in the front diagonals.
- Protraction (laterorotation, abduction and depression) in the shoulder blades.
- anteflexion, adduction and endorotation in the shoulder joint.
- Extension with pronation in the elbow.
- Dorsal flexion and adduction in the wrist.
- The fingers are in flexion and the thumb in adduction and flexion.

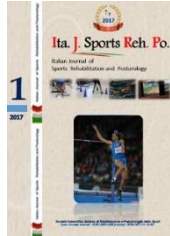
#### **The synergy of the leg.**

The trunk plays an important role in the creation of synergy. The upper trunk for the arms and the lower trunk with the hip joints for the legs. Both the upper trunk and the lower trunk work together by means of diagonals. Therefore poorly functioning diagonals influence the formation of synergy.

**Extension attitude of the leg.** – The trunk is shortening on the affected side at the lumbar spine level.

- Extension, adduction and endorotation in the hip.
- The knee is extended.
- Plantar flexion with inversion in the feet.

Inversion results in movement commencing in the calcaneus. Therefore the calcaneus is inverted with the rest of the feet in supination.



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

783

The joints are locked within this synergy, no movement is possible and many people think that this is the purpose of synergy itself. ( Bernstein – freedom degrees).In the foetal position we see the legs pushing towards each other and often we see that the knee are bent excessively. Therefore many practitioner's see this as a flexion attitude synergy but it is more likely an extension synergy. But because mobility is lost, the knee are bent and therefore there are more adductor muscle working in the hip which results in this extensor attitude synergy which is more in flexion instead of in extension. We see this type of extension in this synergy,especially in conditions such as stroke Parkinson's and M.S, plus other conditions affecting the brain.

This extension itself is an action between the adductor and the semi muscle, but not from the hip extensor m. gluteus maximus. When there is more flexion in the hip joint, there are more adductor muscles at the front of the hip joint allowing the hip and knee to flex. This is still regarded as an extension attitude synergy, because there is a change in the flexion, the other movement remain the same. Movement synergy suggests that the individual brain has experienced less damage compared with the presence of an attitude synergy. Either that or there must be a particular reason why the attitude synergy is necessary to help maintain this position, as without it the whole position is extremely vulnerable.

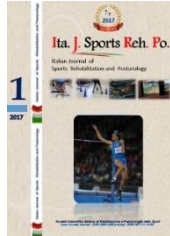
### Flexion Movement Synergy

The individual tries to bend their leg.

- Observe how the lower trunk moves backwards.
- Flexion, exorotation and abduction in the hip joints.
- Flexion in the knee.
- A dorsal flexion with supination in the foot.
- Often we also observe Babinski signs, (flexion of the hallux with a dispersion of the toes).



Photo 37



Jan van de Rakt, Steve McCarthy-Grunwald

### Diagonals Part Five – Pathology

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

784

#### Photo 37

Flexion movement synergy.

This individual attempts to lift their affected leg starting with the unaffected leg.

His unaffected leg will be pressed in the bed to emphasize a fixed point so that the lumbar spine is stabilised and the hip flexor can function. Pressing the unaffected heel into the bed stimulates an m. gluteus maximus action on that side, and together with the abdominal muscle stabilizes the pelvis. This enables the pelvis and lumbar spine to remain in a position that is in flexion (with the lower trunk moving backwards).

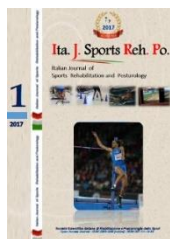


#### Photo 38

#### Photo 38

Extension movement synergy.

In this picture we see an extension movement synergy, although it is not completely correct. The spine has an evident kyphosis and the toe creates dorsal flexion. This photo was taken prior to the action seen in photo 37. The individual attempted to bend the affected leg and he must trough his extension movement synergy. Observe how the unaffected heel is pressing hard into the bench.



Jan van de Rakt, Steve McCarthy-Grunwald

**Diagonals Part Five – Pathology**

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online]IBSN 007-111-19-55

**Extension movement synergy.**

Here the photo is taken in a supine position and the individual is trying to stretch/lift his leg. When the individual is walking this action appears sometimes before the foot has touched the ground, but mostly when the forefoot is just touching.

- There will be a lumbar lordosis in the spine with the pelvis rotated backwards.
- Extension with adduction and endorotation in the hip.
- Extension in the knee.
- Plantar flexion with inversion in the ankle. Resulting in an rotation by the m.tibialis posterior in the calcaneus.
- Extension of the toe is likely, or a claw standis observed along with the potential of a Babinski sign at times.



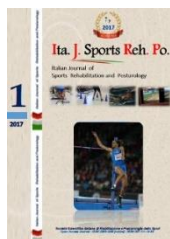
**Photo 39**



**Photo 40**

**Photo 39 and 40** Extension movement synergy. Photo 39: This individual tries to stand up and evokes an extension movement synergy with a particular low tone. Notice how as a result the position of the foot makes it impossible to stand up. Photo 40. Walking with a Nordic walking cane the foot has a brace on both side of the shoe (preventing inversion) notice how the plantar flexion and extension is already there. The support phase is still developing but the synergy is already there. Observe the affected arms on both photos. Starting with the shoulder girdle you can see both have a flexion synergy. The reason for this is that the majority of the standing procedure will be achieved by the unaffected leg resulting in that diagonal being dominant. Both have limited selectivity in the stomach therefore the upper portion of the back diagonals on the affected side becomes dominant.





Jan van de Rakt, Steve McCarthy-Grunwald

### **Diagonals Part Five – Pathology**

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online] IBSN 007-111-19-55

786

Is there a difference between the flexion and extension synergy in the arm? The spine's functional capacity has an effect on the synergy. With the leg, gravity often has more influence with individuals following a stroke when they try to stand up. Here the extension movement synergy is required and therefore prevents earlier than the flexion synergy.

Individuals with low tone differences can present, but overall this is rare.

Most individuals try moving in bed, which is performed by the unaffected leg which evokes an extension movement synergy with a plantar flexion/inversion posture in the foot.

In cases where there is pain in the affected leg, we tend to see flexion movement synergy.

Practitioners need to be careful here because flexion with exorotation can injure the hip structures leading to movement restriction in the knee (does not fully extend) or create an amount of great mobility in hip (exorotation). Both of these situations will lead to problems with standing and walking.

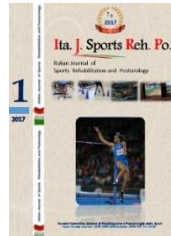
The extension movement synergy may have clear extension but there may be limited to no activity in the buttock - muscle *m. gluteus maximus* - . Most extension will be achieved by the adductor muscle which is the reason why individuals following a stroke walk with a flexed trunk, this posture evokes either an eccentric or a reflex reaction in the buttock muscle because the muscle is elongated and will be stimulated when lifting the unaffected leg. This results in the muscle only being able to participate (support) but not propel the body forwards over the hip joint when the individual is walking.

Synergy itself produces poor movement but it is the basis on which movement can occur. And when muscles are able to react, it is then possible to train them with Task-Specific Resistance Therapy and change from an eccentric contraction to a concentric contraction.

**End of Part 5, Part 6 will start looking at individuals standing up and walking.**



**Reference for part 5 see Part 4 and 6.**



Jan van de Rakt, Steve McCarthy-Grunwald

**Diagonals Part Five – Pathology**

**How can we develop the diagonals so each individual achieves optimal recovery following a stroke?**

Ita. J. Sports Reh. Po. 2017,4,1 ; 746 -788

ISSN 2385-1988 [Online] IBSN 007-111-19-55

787

