

van de Rakt, Jan and Mccarthy-Grunwald, Steven ORCID: <https://orcid.org/0000-0003-4873-5068> (2016) Diagonals part three: Pathology. The stroke patient: how we can train the diagonals to create a better result. Italian Journal of Sports Rehabilitation and Posturology, 3 (1). pp. 576-615.

Downloaded from: <http://insight.cumbria.ac.uk/id/eprint/2667/>

Usage of any items from the University of Cumbria's institutional repository 'Insight' must conform to the following fair usage guidelines.

Any item and its associated metadata held in the University of Cumbria's institutional repository Insight (unless stated otherwise on the metadata record) may be copied, displayed or performed, and stored in line with the JISC fair dealing guidelines (available [here](#)) for educational and not-for-profit activities

provided that

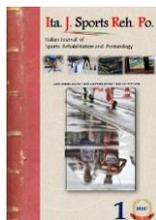
- the authors, title and full bibliographic details of the item are cited clearly when any part of the work is referred to verbally or in the written form
 - a hyperlink/URL to the original Insight record of that item is included in any citations of the work
- the content is not changed in any way
- all files required for usage of the item are kept together with the main item file.

You may not

- sell any part of an item
- refer to any part of an item without citation
- amend any item or contextualise it in a way that will impugn the creator's reputation
- remove or alter the copyright statement on an item.

The full policy can be found [here](#).

Alternatively contact the University of Cumbria Repository Editor by emailing insight@cumbria.ac.uk.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

576

Ita. J. Sports Reh. Po.

Italian Journal of
Sports Rehabilitation and Posturology

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Authors: Jan van de Rakt¹, Steve McCarthy-Grunwald².

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

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

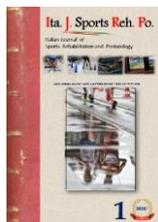
Abstract

Perception of the body is one way in which the brains makes direct contact with the outside world. This is essential information which following a stroke can present as a problem for individuals due to the differences in ability. It is important to identify what the brain “feels” and then interprets from the information which results in our external bodily responses. We are already aware that our vision and other senses can alter on two levels. These differences can be either in the sense itself or in the assimilation of the damage brain. This information assimilation provides the brain with the tools to react using the damage muscle system, especially damage in the selectivity process. Following a stroke there is always a degree of damage sustained in the diagonals, therefore it would be incorrect to differentiate by using of affect and unaffected side for identification purposes. However for the purpose of this article we do so to prevent the possible confusion this could pose to the reader. Damage to the diagonal makes lying and moving in bed more difficult. Within part 3 we will consider bed attitude which gives the individual a starting position to perform movements because now the brain can search for solutions. In severe cases it is often the lack of stability which results in the individual being unable to move sufficiently and therefore affects recovery. In this article we explain how to supporting the individual to start developing this stability and work towards building-up movement whilst in bed

Appendix :

The final part of this article will look at how important training regime is and that there are rules that need to be followed to get the best results. Research in this area of study has been found to be in direct contradiction of the thoughts and actions of individuals who have experienced a severe stroke. The research follows the principle that “more is better” which results in the need for more time to be given to promote a better recovery which is conducted at a greater “intensity”. Intensity concerns itself with the aspects of load and overload and therefore whether practitioners can calculated how much time is required to get the best result for the individual.

We don't yet know what the best “load” is for the damaged brain but we are aware that the brain is required to pushed to encourage it to search for solutions.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

Introduction

In the first two part of this series, we have explain the workings of the front and back diagonals and how together with the homolateral structures we are able to make the required muscle pattern, that are required for all our active movements. What we need to consider first is what will happen with such a system which requires active movement on both side of the body to function correctly following the individual receiving damage to the brain through neurodegeneration. We already know that the axial muscle of the spine have an innervation emanating in both sides of the brain and similarly, part of the trunk and the great joint have the same connection too, but when the brain receives damage and loss of function in one side, the distal parts of the muscle system become compromised and function is reduced because there is only one innervation taking place in the brain. In part one we identified what influence these distal parts have when normal function is observed in individuals performing at their optimal levels. Therefore the questions remain following damage of how will the remaining areas of the diagonal react, what function will be left in the homolateral structure and what consequences this change will on the individuals ability to move?

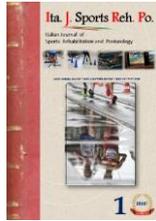
We will also look at exploring a further question which relates to understanding, how we can use the diagonals in rehabilitation and which motor learning process will be the best to maximize recovery for the individual.

Stroke

Stroke has such wide reaching affects for the individual and can be seen in so many different forms that we must first ignore certain aspects which present so we are left only with the sensorimotoric problems. Losses in the individual's perception are often the reason that tone recovery is extremely small which increases the difficulty with training regimes. This perception loss can result in altered brain perceptions in respect of the body positioning, therefore individuals who have had a stroke present with total different body perceptions and act in very strange way (Pusher syndrome). Therefore without perception training, being incorporated into the interventions then there will be a significant reduction in the potential for recovery.

Perception

Information that the brain receives from the body is in a continuous loop. A decrease of perception will cause a loss in the normal function, and consequently ways to stimulate this area in the brain is required. For instance following a period of long walking, you may experience feelings that yours hands are swollen. On a basic level this is correct, but there is more to consider, the projections from your brain have receive a reduced amount of information due to the impact of increased exercise and require more information so individuals generally start to rub their hands together to stimulate feeling. When observing individuals who sit on a high stool result in their feet being unable to touch the floor, what we tend to see is after a short time they will generally start to move their legs for instance swinging them forwards and backward. When we observe an individual who has experienced a stroke in the same position we tend not to see



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

that movement at all and this is not down to the fact that they cannot physically move the leg, it is more related to the brain not sending a signal to the legs in the first place. There is evidence to suggest this phenomenon occurs with all kinds of individuals. For instance soldiers who conduct extended periods of time marching experience positive Babinski sign which is a pathological indication. With rest this sign disappears, providing us with information that long marching have a blunting reaction within the brain. Surprisingly when the same soldiers have participated in an assault course then no Babinski signs have been observed.

We recognize that the quality of the information is important, and with perception this means not only the information, it also incorporates the processing of the information too. It is with this concept that the greatest problems exists, so when there is no reaction in the muscle patterns there is a loss of important information that would have been provided if this participation took place. Muscle spindles gives the most information about the stand of the joint etcetera.

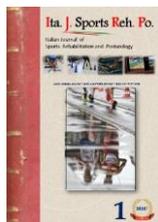
Input from the hand and the feet is more important which incorporates;

Gnostic sensibility:

The test involves using a tuning fork of 64 /128 hertz, as this helps to inform us about the capacity to recognize sensations in the hands and foot sole . With our hands this is extremely important because a loss of this ability to detect sensations results in poor recognition and requires a greater reliance on visual control. This is also as important for our feet as it provides the capability to identify changes and qualities in the floor. If this ability is absent just like the touch perception in the hands then there must be a visual control, but with visual control we are less capable of seeing for instance if the floor is slippery? You may think it is, but to know for sure, you really need to feel it. This information feedback therefore must be **continuous** to enable the individual to interpret how stable they will be by predicting the sensory information in the brain. The greater amount of information received enables for a more accurate projection in the brain, and then the amount of information needs to be maintained throughout providing more and more sensory feedback to remain stable, otherwise if information slows down or is lost, then our brains ability to maintain the projection will lessen, or decrease overall. Consequently following a stroke it is important that there is always sensory input being received, as no input results in a decrease of the damage projection in the brain. (photo 1 and 2)

Two point discrimination

Two point discrimination enables us to feel movement. For instance with our hands if whilst holding a cup it slips out of our grasp we can react immediately to try and catch it. When we do not feel it slipping we must control the grip visually by looking at the hand. This requires more cognitive capacity which for individuals who have had a stroke can present them with a problem.



Jan van de Rakt, Steve McCarthy-Grunwald
Diagonals Part three – Pathology
The Stroke patient: How we can train the diagonals to create a better result.
Ita J Sports Reh Po 2016; 3; 1 ; 576 – 615 ;
ISSN 2385-1988 [online] IBSN 007-111-19-55

579

Be aware when you test the sensory system, with individuals who have had a stroke we need to examine for the capacity to perceive movement within the brain and identify where the damage has altered this input. The input certainly in the beginning, is good. Research has suggested that when the input isn't "interpreted" by the brain then the input system begin to alter providing overall less information. The greatest problem remains how the brain is able to translate the information in the first place.

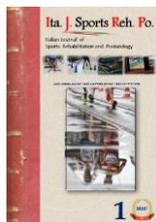
By recognizing this practitioners then require individuals to concentrate more on these sensations than we would normally do and that is on top of having some functional loss due to damage to the brain! When we look at perception from under our feet this presents also an great problem, as the quality of our touch receptors when in contact with the floor is lesser. Movement requires multiple reference points so you can feel where the border is. In normal function a movement of on average 35 mm will be felt clearly, but with individuals who have had a stroke this information cannot be absorb sufficiently by the brain and the movement therefore will be not recognized. By testing the foot we can develop an understanding of what the brain can do despite having a degree of damage. Often the patient have only two points of reference, one in the heel and one in the toes, therefore there is no movement possible between this two point that can be detected by the brain. We can observe this in individuals who have had a stroke where whilst in a standing position they stand behind the heel, so are not capable of activating the second point (in the toes).

This loss of perception results in the individual "Freezing" to the spot, because they don't know which way they are required to move to locate the second point of reference.

Another point is that the foot (medial to lateral), when one point is the heel and the other the toes (**that often claw, an active way to make a point, an border**) the distance between these two points is so great that in the medial –lateral area there are no two points (See photo 3). Thus every movement of the ankle in eversion or often inversion will not be felt beneath the foot and gives no contribution to maintaining stability.

Extinction

Here input tends to be lost within a short space of time. For instance when you feel the cup in your hand slipping this sensation only lasts for a brief moment before it will continue to fall. We can also observe this phenomena when an individual who has had a stroke is standing on the affected foot. Slow walking or standing on the affected leg and foot presents the patent with



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

580

the extinction phenomena so with this loss of sensation and information to the brain the individual usually panics and then due to the lack of information from the leg and most times they will “freeze”. The problem with freezing at this point is the individual will lose all input sensory information, instead the best solution is to continue moving so new input information is created.

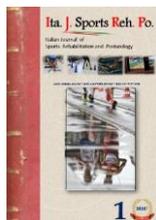
This requirement in itself can present with a problem for instance when healthcare practitioners are required to support an individual from the toilet and require them to stand for a period of time whilst they support them to rearrange their clothes.

Proprioceptive information

Practitioners only performed proprioceptive testing with the muscle spindles are not involve. So initially we need to test the muscle spindles influences. To do this test, we require a form of vibration apparatus. This test can aid practitioners to develop a good understanding of the muscle spindle influences by testing first without any muscle involvement and then when the muscle is active. Static input is the most difficult to assess by an damaged brain, whilst dynamic input will always a better enter an damaged brain. Therefore we test the proprioceptive feeling of the joint both static and dynamic but without the involvement of the muscles (muscle spindles)

We take care that the individual knows what they are expected to do and often boundaries are identified because this test required a degree of cognition from the individual. We perform this test with the individual in a lying position because we want to assess what they are capable of with all their attention focused on the task at hand. We take the affected arm or leg and move it, because we need to feel no resistance. Resistance itself informs the patient. Once we feel no resistance we place the arm (shoulder, elbow, wrist, fingers etc.) in a different position then ask the patient to adopt the same position with the unaffected arm, so we can compare their performance and identify if they are capable of performing this movement. A difference greater than 11° for the great joint or 4-5° in the finger joints is a positive sign that this position sense is not functioning correctly, and this degree of loss increases the more damage which occurs in the brain. (Photo 4 provides an extreme example of this). Now we encourage the individual to look and ask them to identify what differences can be seen. This helps the practitioner to assess if the individual can then correct the position of the not-affected arm to replicate the same position on the affected arm with visual stimulus. Often individual's with a degree of visual control are still incapable of doing this, this usually indicates a loss of cognition, although it can also be a loss in function for the entire perception system in the brain. Considering this final phrase it is clear how little difference there is between cognition and total perception.

The next step in our proprioceptive investigation is to identify if the individual is still capable of feeling movement without muscle spindles involvement. We explain to the individual what we going to do but don't allow them to have any visual control whilst moving the arm or the leg. The individual is required to indicate when the arm or leg has been moved and then copy the movement by placing the opposing arm or leg into that new position. As with the previous test



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

identified above the degree of error is exactly the same so the most important factor to consider is how the individual is able to recognize and indicate movement and positioning. So consequently the practitioner can assess how well the proprioceptive input in the brain is functioning. The practitioner needs to be mindful when undertaking this assessment with the legs, that when we have the affected leg in our hands and we ask the individual to move the other leg into the correct position that the tone of the affected leg muscles needs to increase because they will require the back diagonal to stabilize any movement with the front diagonal on the opposite side. Once the practitioner is aware of this then they can allow appropriate time and even change the position and repeat if required if the unaffected leg cannot be maintained in the raised position in the air. Repeating the assessment help to ensure an accuracy of assessment.

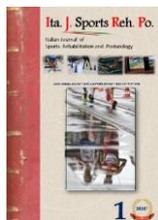
Exorotation

When there is an increase exorotation in the affected hip, the practitioner will need to feel that the end sign of the joint isn't present. If there is no increasing resistance at the joint end because the muscle tone is minimal then this suggests the muscle spindles of the endorotators are not active. This position can the patient with all his perception not find. This position of the leg comes not in the brain and will be not recognize.

Proprioceptive information & Muscle spindles

According to a lot of scientist this system provides the greatest input of our body and therefore plays an extremely important role. When testing this system we need to use a vibration apparatus because it is capable of decreasing the influences which allows the practitioner to observe for which changes are evident in posture and position. Practitioners may not have access to this apparatus, an alternative options would be to get the individual to do the test without movement now do with movement, than ask of they are capable to hold that position and show which position that is by placing the other leg or arm in the same position and measure the difference of degrees. That we compare with the result of the difference without an movement. Often there is an better result, that indicate, that with the muscle spindle the proprioception is better. Is this not the case, than is the influence of the muscle spindle poor and that picture occur when the selectivity is bad and tone is high or extreme low. We do this of course with no visual control.

Another method is, when possible, to ask the individual to complete the same movements with both arms and/or legs whilst sat on an open chain. The practitioner needs to ensure the hands or feet do not touch each other whilst asking the individual to hold the position they have adopted so they can observe what happens. Due to this exercise having a decrease in selectivity with an increase of the tone often we see the joint seeking out the end-position, usually because the burden is too heavy and therefore the synergy is required to become activated. After holding the position allow the individual to look and see if they can identify the differences and if so see if they are able to correct this with visual control.



Jan van de Rakt, Steve McCarthy-Grunwald
Diagonals Part three – Pathology
The Stroke patient: How we can train the diagonals to create a better result.
Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;
ISSN 2385-1988 [online] IBSN 007-111-19-55

Vibration

Investigations by Dr. Henri Kiers with individuals who have back problems, vibration of the calf muscle and spine muscle have been shown to provide the following result which indicated a balance is total body function.

582

1. Vibrations of the calf muscle whilst standing on a hard floor gave a greater sway of the posture than when the paravertebral muscle were vibrated.
2. In comparison when the individual stands on a foam pillow whilst we vibrate the calf muscle very little happens. Vibration on the paravertebral muscle of the back now gives a far greater postural sway.

This observation suggests the role of the posture stabilization is undertaken by the whole body working as a complete system. This of course is dependent of the surface and the forces being applied at the time. Balance reactions are therefore so important because we need to consider back problems as they will have an influence on that whole system making it vulnerable on unstable surfaces and when forces are applied to the body.

Individuals who have had a stroke tend to have problems with at least one calf muscle but also with the paravertebral system and that increases their vulnerability in being able to control and maintain their balance. They can also experience problems with their eyes or vision, within the labyrinth and vestibular system. A small group (12%) may also have problems holding the Center line of the body against the forces of gravity.

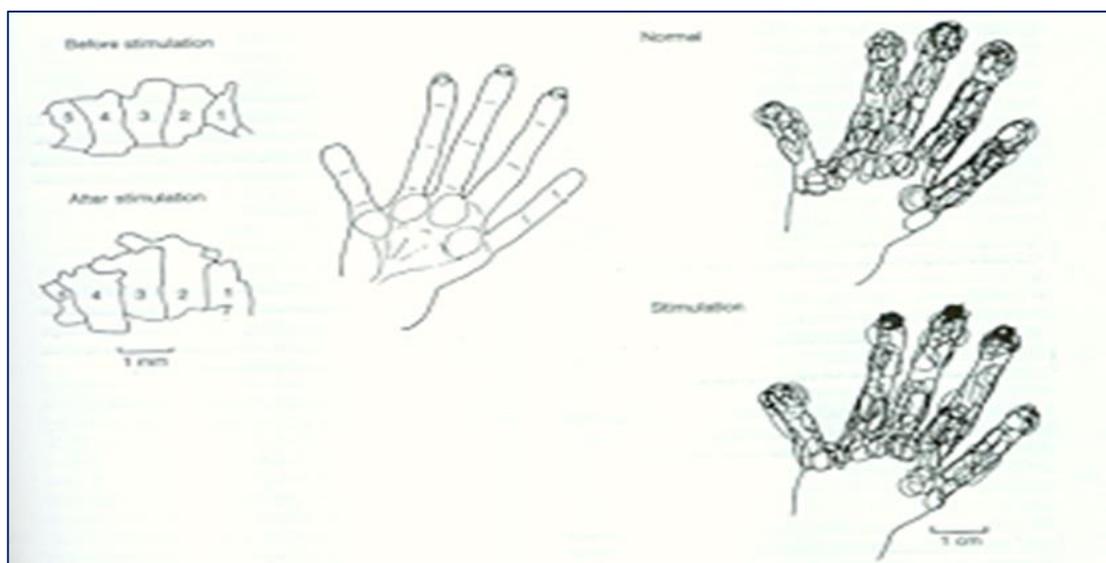


Photo 1 Three fingers on the hand of a monkey were stimulated (the black points of the fingers below). When we look at the projections of these three fingers, we see that they are bigger throughout the period of stimulation. Therefore greater input itself enables the brain projections to increase!

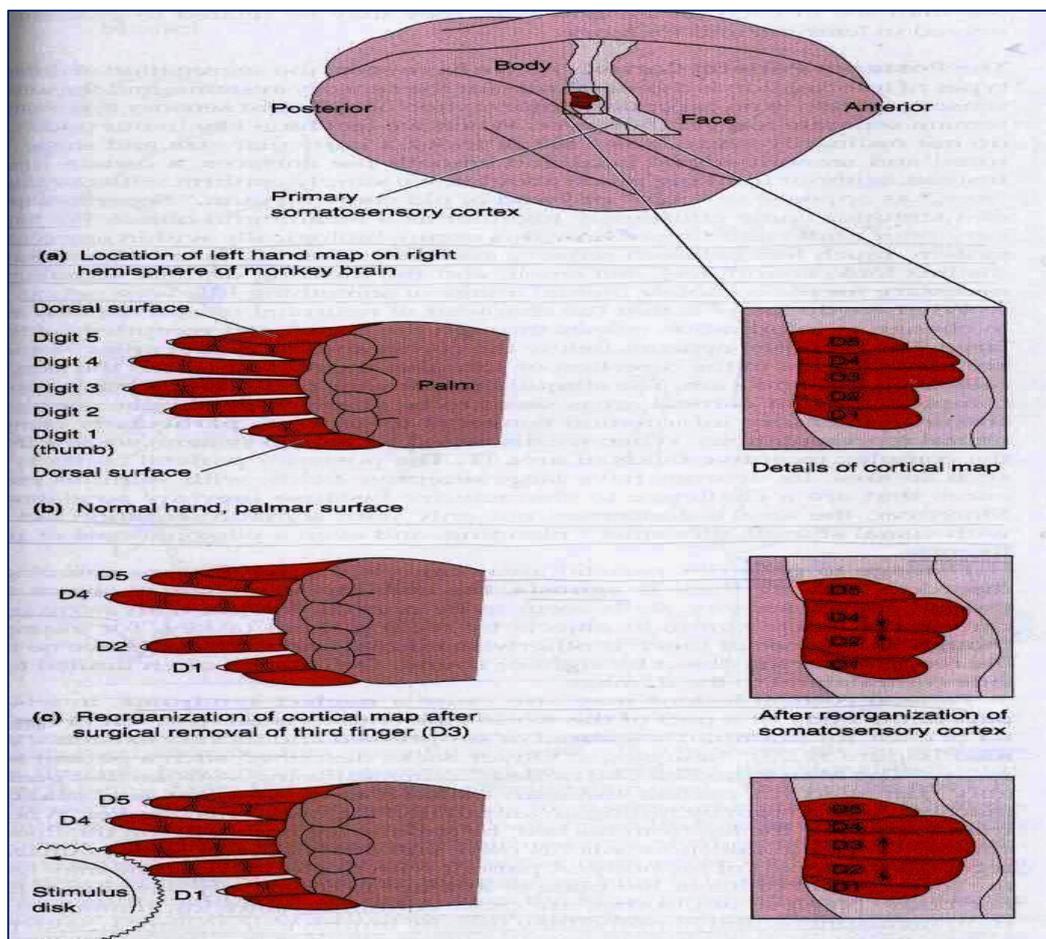
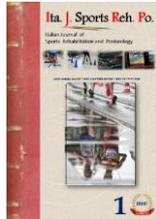


Photo 2

(a) This is a picture of the projection of the hand of a monkey in the primary somatosensory cortex.
 (b) This is a picture of the reorganization of the brain after a loss of one finger D3. We see that the area of D3 is now replaced by the fingers D2 and D4 which means that these two fingers have a greater projection in the brain improving their ability.
 (c) This is a picture that is the same as Photo 1. Only here the stimulation given on fingers 4 and 3 creates a larger projection. This stimulation needs to be almost **continue** for the projection to remain unchanged. Normally regular input to the somatosensory cortex needs to be maintained to hold the projection, within this experiment the input was increase. So therefore what tends to happen as the input decrease is other projections identified in the brain start to take over.



Jan van de Rakt, Steve McCarthy-Grunwald
Diagonals Part three – Pathology
The Stroke patient: How we can train the diagonals to create a better result.
 Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;
 ISSN 2385-1988 [online] IBSN 007-111-19-55

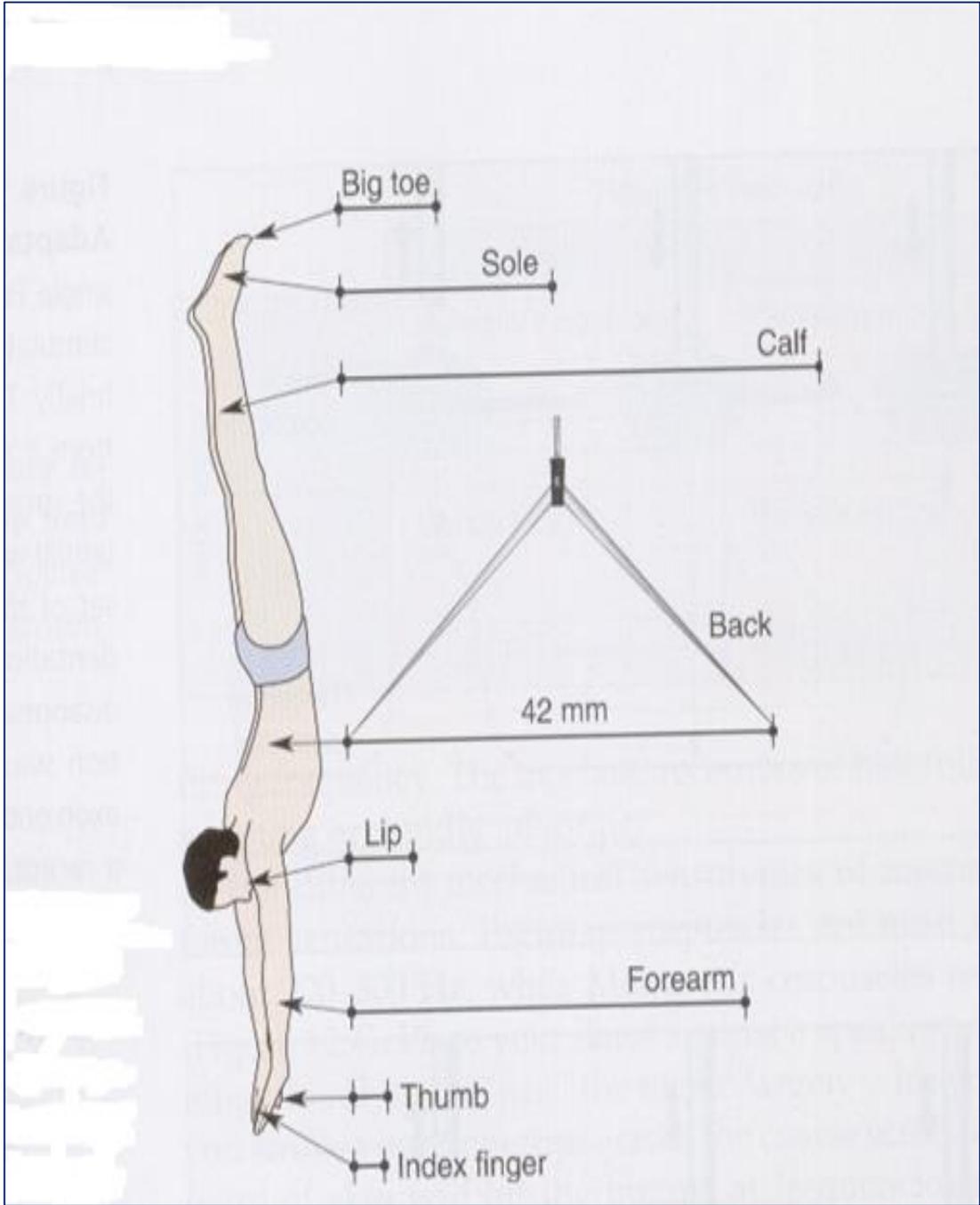
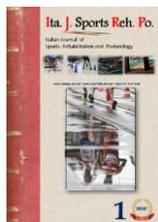


Photo 3 Discrimination sense.
 In this picture we can observe normal distances by testing the discrimination sense. Base is the distance of the back 42 mm and you can measure what the normal value is for the sole of the foot, the calf, the big toe but also the lip, forearm thumb and index finger.
 The lip, thumb and index finger have the most senses in our body and loss of these senses here make it very difficult to function without visual control. We use our lips to feel what we don't feel with our thumbs. Visual control of the lips isn't possible.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

585

Loss of perception makes it difficult for the brain to function once damaged, because individuals can lose the ability to copy using all the information available to them as the brain lacks the ability to visualize the image or position that is required. Another problem is that the muscle on the affected side have not got the right selectivity to provide the right information (muscle spindle) and therefore the tone of the muscle begins to alter.

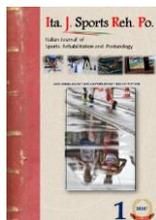
The degree of fluctuation can range from extremely high extremely low, resulting in the reaction of the muscle (spindle) being different and potentially delayed for each person.



Photo 4

Following severe stroke (low tone and very poor perception).

The individual's cognition was also a problematic factor: "Initially they were asked to find their affected arm". When we positioned the unaffected arm/hand on their stomach and ask them to search for the affected arm/hand this presented as extremely difficult to do. The picture shows the third attempt to try to locate the affected arm. Every attempt commenced by initiating movement in the unaffected arm towards the head and pillow and allowing them to locate my shoulder and then find the arm by following the movement.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

The spectrum of observed variation with the symptoms for individuals who have had a stroke so practitioners can assume that individuals with limited perception, low tone and little muscle movement is at the lowest level of performance.

Therefore individuals with severe stroke presentations have the following symptoms when we restrict to the senso-motoric level;

586

1. Very Severe

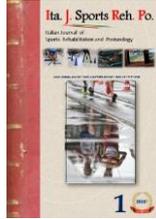
- A. Low tone
- B. Little arbitrary muscle control
- C. Very little perception.
- D. The diagonals of the back makes the cross over from the unaffected arm to the affected leg and the unaffected leg to the affected arm difficult, and this cross over tends to be incorrect, being unable to hold an angle of 45 ° at the height of the buttocks and pelvis.
- E. The front diagonal will experience greater difficulty in cross over because the selectivity of the stomach muscle will be too damaged resulting in the navel (umbilicus) moving more towards the unaffected side. This suggests that the front diagonal will have limited if any function.
- F. The homolateral structure is often completely unresponsive.

2. From very severe too severe.

- A. More tone often at an extreme high tone.
- B. More perception but still remains very poor (although tends to be more than when an individual has low tone).
- C. Little arbitrary muscle control but capable of move in synergy, often extension-synergy in the leg and a flexion-synergy in the arm.
- D. Back diagonal still cross over, but the angle tends not to be at the correct degree.
- E. The front diagonal tend to have the same problem although because there is a higher tone there tends to be more stabilization at the front.
- F. Homolateral remains unresponsive.

3. Severe to moderate

- A. The tone remains high although not as high when the presentation is severe. (comparing with Burnstrom-Fugl Meyer scale this will be between phase 4 and phase 3)
- B. The perception is improved.
- C. Arbitrary muscle control is better but often the individual can use all the synergy in arm (flexion and extension) and leg (flexion and extension) which results in more stability in the center of the diagonals especially towards the front diagonal.
- D. The back diagonal move further in the direction of the trochanter major but the angle is still higher than 45°.
- E. Greater possibility of the front diagonal to moving the arm and leg.
- F. First signs of the homolateral structure responding.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1 ; 576 – 615 ;

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

587

4. Moderate to minimum.

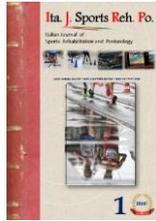
- A. The tone will always be slightly increased.
- B. This can result in a good level of perception but its influence on the muscle spindles is not as strong as should be.
- C. Arbitrary muscle control will be improved, although we can expect to see some reduced functioning in the hand, elbow and shoulder, foot, knee and hip.
- D. The back diagonal at hip height will be functioning, but small corrections remain difficult, this is the same in the shoulder. The keypoints are still not capable to get there high level.
- E. The front diagonal has problems with performing perfect function at the key points and both diagonals have uneven reactions in the hand and foot (see part one).
- F. When the key points are not functioning at their optimal ability this results in having an incomplete homolateral structures. All individuals have the potential to evoke reactions by muscle strengthening exercises.

This pad of restoration was first described by Twichell (1951), and is now incorporated into the klinimetric test. The Brunstrom –Fugl- Meyer test and provides a level of insight into the potential functional abilities of the stroke patient, but without including the diagonals.

Treatment

Treatment commences with the individual lying in bed and experiences difficulty moving. There are several question to explore including: Why is it impossible to turn over towards the affected side? Why is it dangerous to lift the unaffected leg? Why is the unaffected leg so heavy?

One of the most important aspect that an individual has, is moving on his own in bed. It is also important to be able to reposition on the bed so they can come to a sitting position on the edge of the bed. All individuals desire to recover to a point where they can walk which remains the ultimate goal, but primarily the inability to move whilst in bed results in an increased dependency on others. Being able to move in bed is important in preventing pressure area development. People can often walk with an aid once they are upright but still require support get out of bed. Therefore the primary focus will be exercises to aid movement in the bed and develop physical attitude that is necessary to prevent associated complications.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

588



Photo 5

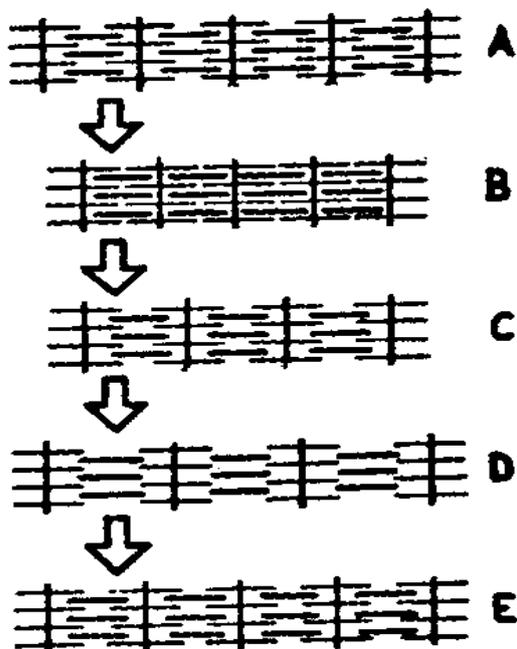
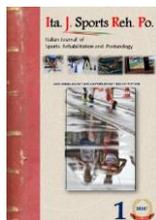
Often patient after a stroke lies with their leg in an exorotation position. Limited investigations have been recorded, but there are indications that in this position the endorotatore muscles will become damaged. Very often the mobility of the hip in exorotation is too far and without any resistance.

Photo 5

Photo 5 presents two distinct elements:

We see an individual following a severe stroke at the beginning with limited recovery of tone.

1. The extreme exorotation which results often after 24 hours laying in this position can become **permanent**. Due to the extended period of stretch, the muscle spindles have no function anymore and the muscle will develop an increase of the sarcomeres. The resulting impact of the muscle being in this position for so long and the tone so low that his contribution in stabilization of the hip is no longer possible.



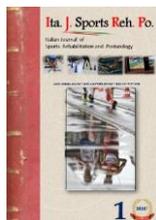
Picture 1.
 Shows us the sarcomeres.
 A = In a normal position.
 B = shows us what is happening when the tone is increased. When this situation remains for more than 12 hours, the muscle starts to adapt.
 C = The adaptation results in the reduction to 3 sarcomeres instead of 4.
 D = Indicates what happens when we stretch the muscle for more than 12 hours the muscle begins to adapt again

Picture 1.

When the leg lays in this extreme exorotation the muscle is significantly stretched and when this occur for more than 12 hours the muscle will start adapting by putting new sarcomeres in to the muscle structures. Now due to having no tone returned to the muscle, there is often no pain as a result, this frequently occurs with individuals who have experienced a severe stroke as early as day one. Tardieu investigated this phenomenon but unfortunately did not record the length of time required for this adaptation to present. He did however indicate a period of time in excess of 12 hours until the change occurs. To aim avoiding this development, practitioners need to observe good attitude positioning in bed from the start of the patients entering hospital until they are capable of controlling the leg once more.

2. The plantair extension/inversion attitude of the affected foot results in the foot adopting a position which produces an increased tone in the calf muscle. Why therefore do we observe this tone increase in the affected foot, knee and hip. Often with individuals who have had a severe stroke initially they have an extremely reduced tone.

Following a stroke individuals automatically try to move which although is a positive sign, tends to be initiated with the unaffected leg. Unfortunately due to not having fully capable in lifting that leg, when they try to move the body immediately rotates towards the unaffected side which culminates in a feeling that they are falling out of the bed. The resulting gliding move with the unaffected foot across the surface of the bed is difficult to achieve as the leg



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

feels very heavy when moving, and the resulting body rotation towards the unaffected side and the sensation of falling immediately increases.

Why is this the case?

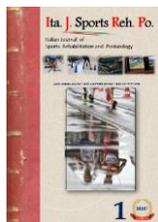
590

The back diagonal starts in the unaffected side (upper) and goes to the affected leg that has currently lost its function. Lifting the unaffected side requires the heel to be pushed into the bed to allow the leg to stabilize the body. Unfortunately this movement is not possible therefore the body starts to rotate resulting in the unaffected leg becoming heavier and difficult to move. One of the first compensations with the patient in photograph 5 is how they create a stabilization point by holding the unaffected hand on the bed rest. This reduces the fear of falling and the subsequent movement of the unaffected leg will now stimulate an increase in tone in the affected leg. An extension synergy forms which results in an extension in the hip but not from the m.gluteus maximus. Further we see adduction and endorotation whenever possible. Often in individuals who have had a severe stroke patients the endorotation muscles have no function anymore, due through the stretch in the beginning(as discussed previously). Furthermore the knee moves into an extension, and the foot into an inversion, plantair flexion which is the start of the plantair extension/inversion attitude of the foot. What we tend to observe is, when the possibility to move increases, the tone will increase and when the calf muscles becoming shortened, losing sarcomeres can occur and the plantair extension/inversion restriction of the foot occurs at this point through the tone or tone and losing sarcomeres. **Striker Foot**

To obtain a more secure position for the individual where they can consider moving without risk of falling and therefore makes the rehabilitation easier, we need to stabilize both the trunk and the four key points. We also need to create a stable point for the affected foot, so although we cannot remove fully the plantair extension/inversion attitude of the foot, the additional stability can help to decrease the tone development quicker. Practitioners also need to consider the surrounding bed area. Patient with stability problems tend to have increased difficulties with feeling safe in a strange hospital bed within a strange environment. Hospital wards tend to be set out with the bed standing in large empty space with no borders, usually to allow adequate room for medical equipment as required. Consequently many older individuals and patients with neurological conditions have an increased risk of falling out of the bed due to a lack of obvious borders. To reduce this concern one option is to place the bed with one side, preferably unaffected side next to the wall therefore reducing the risk of falling towards that side. Some situations however present with the individual only facing the wall with a lack of awareness of the affected side. In these situations it easier to turn the bed round.

But often this individuals with an stroke prefer sleeping with the unaffected side against the wall.

Another consideration is the quality of the bed and mattress. Our concerns automatically turn to reducing the risk of pressure areas and consequently we lay individuals low flow air mattresses. Unfortunately this makes the surface unstable and increases the possibility of extreme exorotation plantair extension/inversion attitude of the foot being created. It can also



Jan van de Rakt, Steve McCarthy-Grunwald
Diagonals Part three – Pathology
The Stroke patient: How we can train the diagonals to create a better result.
Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;
ISSN 2385-1988 [online] IBSN 007-111-19-55

increase the fear of falling and reduce the individual's motivation to want to try the move. Therefore this reduced movement increases the risk of pressure area development.

Bed Attitude

Supine position

591

We need to identify the best attitude that provides stability, and also increases the possibility of movement. Individuals who have had a severe stroke require support pillows on almost every key point. The hip on both the affected and unaffected sides along with additional support under the affected shoulder because when lifting the unaffected leg this tends to create a rotation of the body towards the unaffected side and the individual will try to brace this movement by moving the upper trunk backwards.

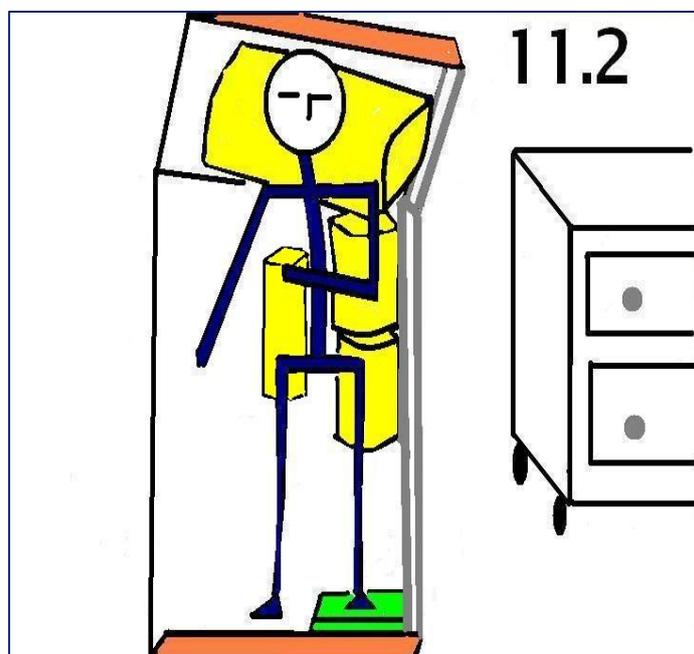
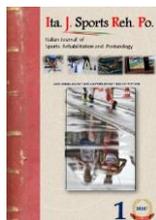


Figure 2.

Stabilization of the entire body using a pillow (yellow) under the affected and unaffected hip and part of the lower trunk. To prevent upper trunk moving backwards the head end of the bed is positioned higher and a part of the pillow is placed under the head and shoulder for support. Often a pillow under the arm is also required. The pillow under the affected hip is required to prevent the exorotation movement of the affected hip. Often this is enough to allow the rest of the pillow to take care of the exorotation brace. Under the foot a firm pillow (green) is placed not necessarily to prevent the plantair extension/inversion attitude of the foot but provides support when the foot moves into plantair flexion. When movement stops we generally observe the tone decrease rapidly and the position of the foot is good restore.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

592

The green pillow under the paretic foot does not always react in this way. A clonus can occur, when there is significant tension in the calf muscle which can be extremely high or opposed to this not high enough. If a clonus presents then adapting the green pillow is extremely important. Having nothing under the foot will only increase the tone of the calf muscle, due to movement of the not-paretic leg which creates a plantair extension/inversion attitude of the foot.

The extreme rotation of the hip can also occur in individuals who have had a severe stroke resulting in an increased tone in the leg.



Photo 6

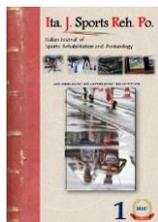
Individual after a severe stroke lies in bed and is experiencing a continuous feeling that he is falling out of bed. Therefore he grasps the edge of the bed with the unaffected arm and push his unaffected leg in to the bed. This evoke a cross extend-flex reaction. We see also that the affected arm lies more in a retraction position due to the actions of the unaffected leg. The back diagonal has an increased workload. The affected leg goes into flexion and falls in exorotation which creates a lot of pain. That makes lying and sleeping difficult and the affected leg will become fixed in this position which when combined with the pain increases the tone considerably.

Photo 6

When the individual tried to moves the unaffected leg in to flexion the other leg automatically moves into an extension, but due to the fear of falling, the individual almost always stretches the unaffected leg after only a little flexion, resulting in the affected leg moving into flexion and falls into exorotation. A few hours of lying in this position increases the tone from the adductor and semi muscle quite considerably. This increase in tone makes it impossible to fully extend the knee, therefore reducing later on the potential to walk.

This attitude must be prevent at all costs!

Therefore it is important for practitioners to create a stable base making it impossible for the affected leg to fall outwards.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

593



Photo.7

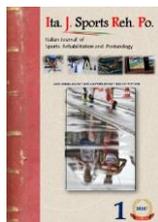
Here is a simple solution to prevent the affected leg falling outwards and help to decrease the tone in the adductor- and semi-muscle. Now there is considerably reduced risk of pain and with a stable bed and safe surroundings this individual is able to sleep again feeling safe.

Photo 7

Most individuals following a severe stroke tend to lie on their backs. This attitude provides the greatest surface area, although there is still an increased risk of pressure area development therefore alternative attitudes are required to provide a change in position to reduce the risk. We should increase the possibility for the individual to lie on either the affected or unaffected sides.

But this in itself is very difficult and in some event could be dangerous for the individual. Lying on the affected side provides almost no stability as this side is too weak or unable to do so. The surface area is very small although this can be correct somewhat using the unaffected side. Lying on the unaffected side provides a stable base but the surface area remains small and the affected side is unable to provide support and help correct the position. Tragically in the past individuals who have had severe strokes have ended up dying because the attitude change of lying on the unaffected side resulted in the individual not being able to correct the narrow surface area and consequently they have been unable to prevent their face moving in the pillow resulting in accidental suffocation as they were incapable of lifting their head or pushing away with their affected arm.

Individuals with severe stroke require exercises therefore to strengthen the side lying attitudes. During the daytime to allow for plenty of safe observations to be carried out, starting by assisting the individual into this position then return on average every 15 minutes (depending on the amount of initial control the individual has), offering praise and reassurance each time to help in supporting the patient to continue strengthening exercises in the side position. Then as confidence and ability increases so can the length in time between checks.



Jan van de Rakt, Steve McCarthy-Grunwald
Diagonals Part three – Pathology
The Stroke patient: How we can train the diagonals to create a better result.
Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;
ISSN 2385-1988 [online] IBSN 007-111-19-55

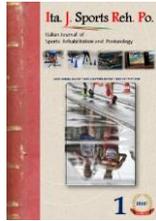
Sideways lying attitude on affected side

Again we commence with individuals who have had a severe stroke, by doing strengthening exercises observing for when they increase their confidence and abilities then decrease the amount of the support over time. Providing support also creates limitations, where more support results in less potential for movements, and pain will remain an issue because of the restrictions in movement. When we lie on our side the key points shoulder and hip, that are nearest to the bed surface and play an important role in stabilization of the attitude. Here the interactions of the diagonals start to make specific connection with the opposite side in this case the unaffected side.



Figure 3
The body attitude of an individual who had a severe stroke. The diagonals have no fixed point because the key point on the affected side are not functional. We must try supporting them to obtain good stabilization before it is possible to start the training in this position.

Figure 3



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

595

Test: Lie on your side and initially put your hand on that side under your head with your elbow bent. This is an impossible position for an individual to adopt after a stroke.

Next bend both legs, which is also very difficult for an individual who has had a stroke to perform. First stretch your underlying leg and make a complete right angle with the other hip and knee. Now lift your upper leg into the air, notice how the pressure under your elbow and the leg/foot increase on the bed.

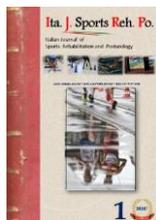
When you move the upper leg forwards, the other leg will start to work harder to compensate for the change in balance and prevent you falling forwards. At the same time the upper trunk moves backwards and your elbow begins to push into the surface of the bed.

Now move the upper leg backwards, notice how the other leg changes its action and now work hard to prevent you falling forwards. Also observe how your foot is trying to rotate towards the surface of the bed. Additionally the upper trunk moves forwards and your elbow continues to maintain the pressure it's applying to the bed.

Next ask someone to apply pressure on your upper leg and you should notice that the hip on the surface of the bed will work against the movement to try and absorb the pressure!

With respect to individuals who have had a stroke these movements and repositioning becomes markedly reduced or absent. Therefore practitioners are required to afford care by looking to provide a stable surrounding attitude even though this might still be difficult for the individual to achieve alone.

The movement of the trunk is a co-contraction of the back and front diagonals together, with a concentric contraction of the homolateral structure!!!



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

596

The support exist out:

1. A pillow under the head with the neck somewhat elongated. Therefore we can either give the patient a higher pillow, raise the head part of the bed a little or consider a combination of both.

2. Transfer the individual as far as possible towards the back of the bed, then raise the bed rack before putting a pillow between the back and the bed rack. This provides a firm stabilization point and prevents the individual rolling backwards.

3. Placing a pillow under the individuals stomach to stabilized/ fix the trunk and it help to support the paretic arm, although this is often not enough on its own.

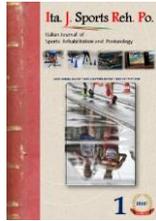
4. Placing a hard pillow underneath the unaffected leg provides a greater level of support (photo 7 provides a view of the position of this pillow). Additionally we need to ensure that this pillow is high enough, so that the unaffected leg is not lying down. No lower than the pelvis on the not-affected side and sometimes even a little bit higher to prevent the trunk rotating forwards which make it impossible for the individual resting against the back. To low can be observed because on the movement of the heel, an rotation from the bed. And here we required that the heel remain on the bed to aid stability.

5. Beneath the foot sole of the affected leg we can place a green pillow to provide support for the foot.

6. Finally we consider the affected arm. Many individuals who have had a stroke have a subluxation in the glenohumeral joint. One of the causes of this is the retraction of the scapula. Retraction is an initial indication that the back diagonal from the unaffected leg crosses the midline and causes the subluxation by pulling the scapula in retraction, which can be harmful to the joint over time.

We must ensure that the scapula is positioned correctly against the ribcage which we can check by pulling the scapula forwards. We should be able to feel it on the upper affected trunk, we are not being able to feel the edge of the scapula. This ensures the glenohumeral joint lies freely at the front and the scapula is fixed by the weight of the upper trunk. Attention is required to ensure the arm remains against the stomach and cannot fall, because when the wrist moves into palmar flexion, this can block the blood circulation and cause swelling to the affected hand.

When the patient is comfortably, you can start the training by positioning the patient on the affected side and from here start to exercises to improve movement in the bed, looking at both being able to turn and to move sideways whilst on the affected side.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

597

Sideways attitude on unaffected side

This is a totally different situation where the key points of the diagonals are on the surface of the bed which results in the diagonals (both back in front) having a fixed point. The diagonals do not enable movement all the way through to the opposite side which often makes it impossible to move the affected arm and leg. The back diagonals are more dominant in the unaffected leg over the affected arm therefore we can observe a retraction of the scapula. For a start, the front diagonal in the unaffected shoulder are used more to hold the position, whilst the back diagonal combines with the front diagonal to help move the affected leg forwards. We also observe the homolateral structure push the hip up from the bed when an individual tries to move. This occurs mostly if there is a backwards movement with the body, and involved the back diagonal more than the front. It is important in this position to create a stable position first then to build training exercises to move around in the bed, turning over onto the side from a supine position.

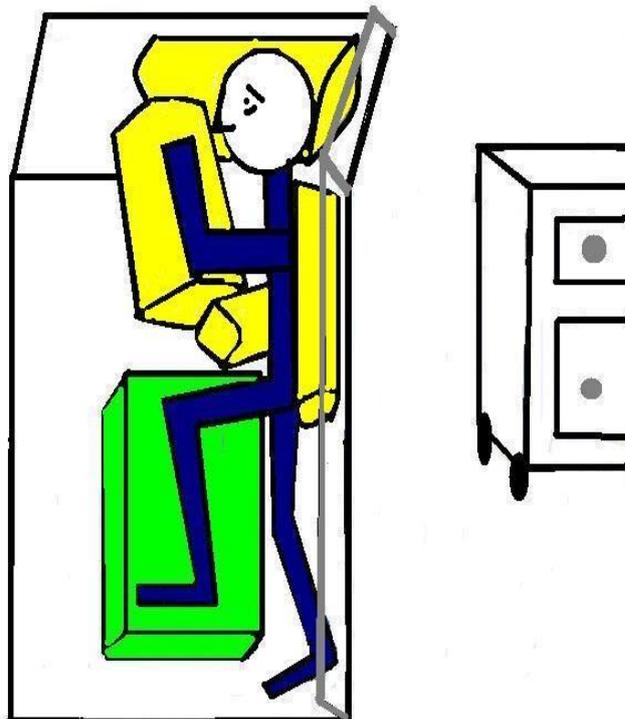


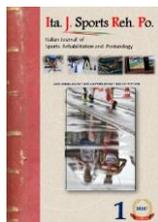
Figure 4

The attitude of an individual following a severe stroke. The diagonals have a fixed point against the surface of the bed. Although there is no real connection with the affected side which will instigate movement on that side. Practitioners should try to support the individuals to achieve a stable position, then and from there start training exercises.

Figure 4

Achieving a stable position with pillows includes the following:

1. Place a pillow under the head, taking care that the head remains in a neutral position, this prevents to unaffected side becoming somewhat elongated as a consequence. With individuals who have had a severe stroke we need to ensure that they can lift their head, and that they are also capable of pushing into the pillow to prevent the risk of roll forwards increasing the danger of the mouth and nose being obscured by the pillow leading to suffocation.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

598

2. The second pillow is positioned in the back, with the individual as far back as possible allowing more space in front of them whilst providing a firm support between the bed rack and the back.
3. A pillow goes under the stomach.
4. We must prevent the body rolling too far forwards by bending the affected leg to 90 degrees at the hip and knee and looking for more support with firm pillows.
5. The final pillow offers only light support for the a- tone arm, resulting in the pillow positioned next to the individuals face, so this allows access to the call button to summon assistance if required. This position for the arm is required as there is a lack of control in the shoulder which could result in the individual rolling forward onto the wrist area restricting circulation and risking damage as a result of swelling to the hand.



Photo 8

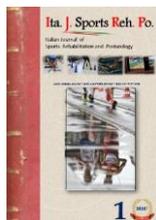
The stabilization of his body he must do with his not-affected side. That means with his head/shoulder/arm and his leg. When he turns to far back, his leg will come from the pillow and it is very difficult to come independent in the right position back, pulling with the hand has no function because the diagonal (not –affected arm to affected leg) is not functioning.

Therefore we tried to get the position so, that he is somewhat rolling to the front, but when the affected arm has no support, than can this happen !

The wrist is now in very dangerous position and this is often the reason an thick hand occur.

Photo 8

In photo 8 the individual does not have all the recommended pillows because the majority were not necessary anymore, but essentially the pillow under arm remains very important. Training is required for individuals following a severe stroke to be able to lay on their sides with the position rolled slightly forwards on the unaffected side consequently lying on the affected side more towards the back, decreasing the pressure on the trochanter.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

We now have three bed position which enables more ability to work on developing more movement in the bed. This area of exercises is often neglected which can create problems for recovery as they essentially work to restore the diagonals and the homolateral structures. This is easily achieved by staff supporting individuals to get out of the bed and return to the bed. Lying on the side requires more from the diagonals, and due to there being only a small surface area, this training has a greater effect on restoring the diagonals function and especially the homolateral structures in the key points. In our view the training should be conducted on a bed where the individual sleeps and (not on an examination bench within a training department as currently is the practice), a bed which closely resembles their bed at home. It is also important that this situation remains for the duration of the rehabilitation period. And of course will moving on the side one of the exercises that will be stay in the program for an long period of time even in the home situation , it is wise to train movement on their own bed.

Movements we should exercise whilst in bed include:

From lying on their back, the individual should be capable of moving sideways and up and down the bed. (Although up and down is more difficult than sideways, and may take more time to achieve).

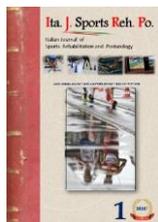
From lying on their affected side the individual should be capable of moving sideways towards the back and front of the bed. (Again this movement is quite difficult and takes time to develop). Similar to exercise 2 above although it is completed this time when lying on the unaffected side.

Last but not least, turning from a supine position onto a sideways position for both affected and unaffected sides.

Supine position and moving sideways.

A normal sideways movement for individuals unaffected by stroke is a series of moves completed in sequence. Initially we move the head and the upper trunk followed by the lower trunk. To reposition the upper trunk onto a sideways position, we must first move the upper trunk forwards which requires us to lift our head therefore shortening the upper trunk on the side we want to move (that requires the front diagonals to work by lift the head and together with the homolateral structure to create this shortening). When moving the lower trunk, we bend our legs a little bit and push the lower trunk slightly upwards before moving sideways. This requires the back diagonals and particularly the buttock muscle to lift and combining with the legs muscles and the homolateral structure of the trunk to physically move the lower trunk. The support area of the feet determines how far this movement can go, and how easy or difficult the control over the movement will be.

Individuals who have had a stroke experience difficulties in lifting their head especially within asymmetrical position. Following a stroke the diagonals on the front are unequal which creates an oblique angle of the head. There is also a retraction within the affected shoulder blade which provokes this oblique position. It is therefore important that we ensure the shoulder blade is free and that protraction is possible. Consequently we commence by examining the tone of the shoulder muscle before we look at moving the upper trunk.

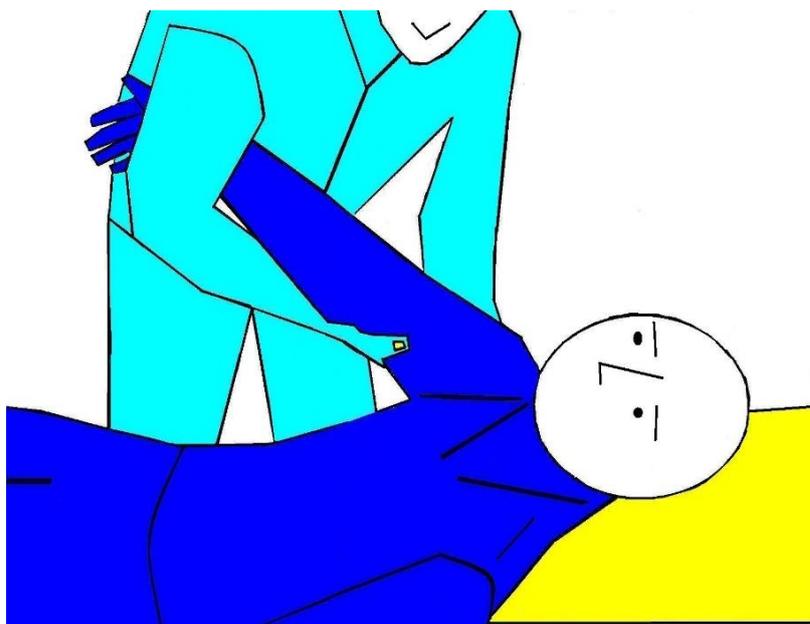


Jan van de Rakt, Steve McCarthy-Grunwald
Diagonals Part three – Pathology
The Stroke patient: How we can train the diagonals to create a better result.
Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;
ISSN 2385-1988 [online] IBSN 007-111-19-55

A retraction of the shoulder blade by a high tonus is often caused by an instable attitude in a lying position, resulting in the diagonal of the unaffected leg being dominant causing a retraction on the affected side. To get a good result we must improve the stability both in and out of the bed.

600

First we exam the tone of the shoulder blade:



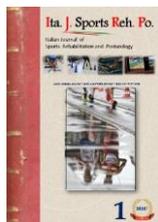
Picture 1

The affected arm is fixed between the practitioner's upper arm and chest whilst placing one hand on the upper arm for stability. The other hand is placed on the shoulder blade with the fingers directed towards the head. This hand makes a slight movement in the direction to the individual's nose, which needs to be easy and unrestricted. Repeat on the other side, for comparison.

Picture 1

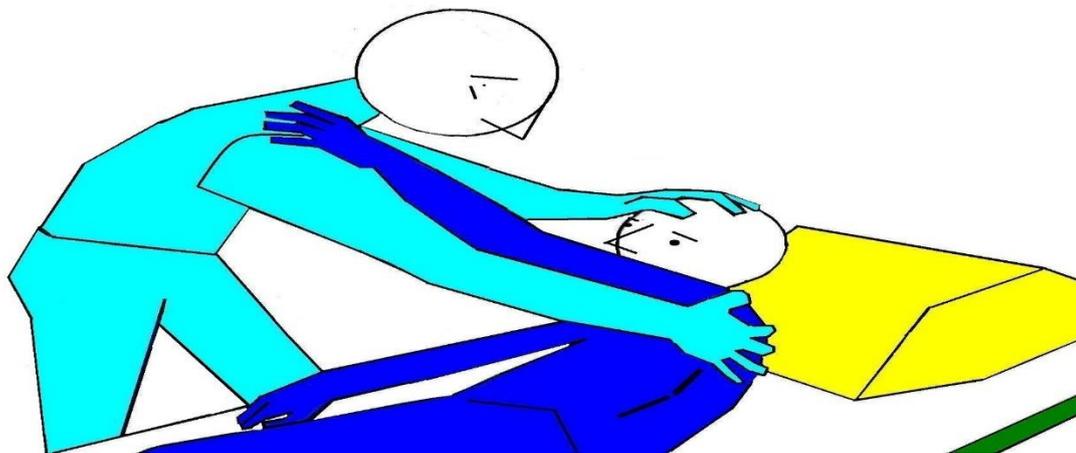
When there is a resistance identified, this is often due to the tone of the retraction muscles being increased. So therefore first we need to decrease the tone before we go to moving. The benefit of before we start any movements is the reduced risk of shoulder problems developing whilst enabling the shoulders head and socket joint to fit together correctly.

When the muscle tone is too high we look at decreasing the tone by performing an active movement across the shoulder blade. The shoulder blade stays fixed on the surface whilst the individual's upper body moves with the upper trunk repositioning forward over to the affected side. Now the trunk will move away from the shoulder blade inhibiting the tonus of the retraction muscles.



Jan van de Rakt, Steve McCarthy-Grunwald
Diagonals Part three – Pathology
The Stroke patient: How we can train the diagonals to create a better result.
Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;
ISSN 2385-1988 [online] IBSN 007-111-19-55

601



Picture 2

This is an **active** movement from the upper trunk. To help the individual you guide the unaffected shoulder and the head in movement. In the picture we see that hand is on top of the head, this provides a level of resistance whilst the individual tries to lift their head. When the hand is under the head the stimulus to lift the head is not present.

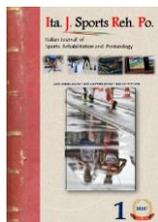
We can move so far until we see the affected arm making small movements, which is a positive sign that the inhibition works.

In the beginning this movement is difficult to achieve resulting in the individual searching for an easier way to complete the movement. Often this easier way involves bending the unaffected leg, using the foot on the bed to push the body over to the affected side. By doing this they activate the back diagonal towards the affected shoulder increasing the tone of the retractors of the shoulder blade.

When the practitioner feels that the tone has decreased, the individual can then reposition the affected arm using the unaffected arm. The individual places the unaffected arm over the affected arm and grasping the elbow (see picture 3), which enables them to now move sideways.

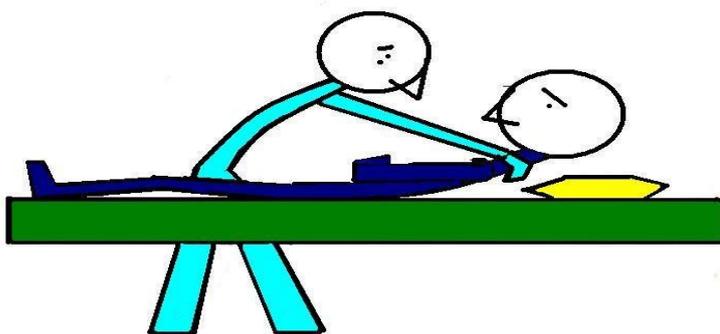
Initially this is a difficult heavy movement to initiate usually requiring increased assistance to achieve, but it remains important from the start make these adjustment in what the individual is doing to start the process of recovery. One question to consider at this point considers what we are doing to support the individual, and would it be termed as an Activity of Daily Living (A.D.L.) or an exercise? First considering the movement as an A.D.L., then we can consider moving sideways as a small part of a longer series of movements to achieve a better bed attitude for the individual for the purpose of assisting them to wash and change clothes etc. Whereas when we consider this an exercise, we must then be aware of and maintain rules of what needs to happen to achieve the movement (there is more on this subject further on in this article). When we exercise this movement we need to know what the Repetitive Maximum is (R.M.).

R.M. involves knowing what possibilities the individual has of performing the movement once when using the maximum amount of power available to them. Once we know this we then look



Jan van de Rakt, Steve McCarthy-Grunwald
Diagonals Part three – Pathology
The Stroke patient: How we can train the diagonals to create a better result.
Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;
ISSN 2385-1988 [online] IBSN 007-111-19-55

602



Picture 3

The practitioner stands of the patient at arm's length because when we stand above him, this does not stimulate them to lift their head. The hands of the practitioner helps to rotate them forward, activating the upper trunk to make more flexion.

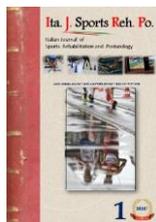
Picture 3

First the lift of the head must be active, when that is one R.M. there is no room for this movement in the A.D.L. and stay it an exercise. To lift the head the front diagonals must be active because than the front of the neck can be active. To facilitated that movement we grip the shoulders deep en rotated the upper trunk to the front because on this way the front of the neck muscles will be active.

At this point the practitioner needs to reduce this support and encourage the individual to makes the movement on their own, which moves more towards movements linked to A.D.L. with a less rigid structure, but still remains part of the treatment, involving not only the lifting the head independently, but also the moving to both the unaffected side and the affected side unaided. Often therapy stops at the point when the individual can lift their head independently and does not incorporate and sideways movement training. And that is wrong because this movement is essential for the movements in bed but also out of the bed.

Moving the lower trunk sideways

Moving the lower trunk sideways can be a difficult task but most healthy people are capable of doing this using one leg. The individual following a stroke will also perform that movement with one leg, and will that perform when he is on his one. Every movement stimulates the brain to restore function or to seek for a compensation to any lost abilities. But Wherever this movement occurs either during A.D.L.s or during practitioner led exercise it is important to maximize the use of the affected leg. Lower trunk sideways movement appears to be an action of the back diagonals but it's worth observing what happens when the buttock is lifted. The first action we see is in the abdomen which moves together with the buttock muscles to fix the pelvis in position. This enables easier movement of the legs. Even individuals who have had a severe



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

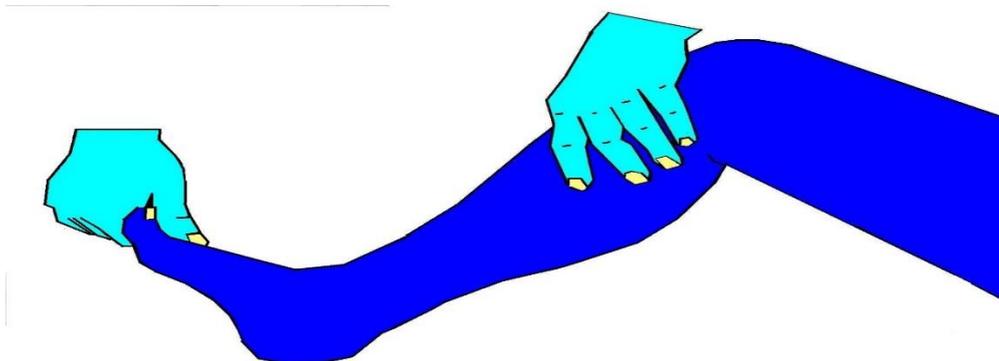
ISSN 2385-1988 [online] IBSN 007-111-19-55

603

stroke have this action but when they only move using the unaffected leg, the affected leg will go into extension and through lack of use becomes an increased burden, limiting the ability to fix the pelvis.

Therefore active involvement of the affected leg is very important and must be encouraged as part of the A.D.L.s and the exercise therapy. Commencing with both legs in a bent position, (bending both legs is best achieved by moving the affected leg first, then moving the other to the same position). For the individual this may feel strange because the unaffected leg movement is obvious but the flexion this creates, develops an extension movement in the affected leg making this rigid and difficult to flex. (This is a static reaction on segment level, a cross flex-stretch reaction, this reaction will be explained further on in the series in part 6). Further normally we move the lower trunk with our leg in much more extension because our hip extension is powerful and we need no elongation of the hip extensor muscle. By the individual with an stroke this elongation is necessary to create the possibility of an action of the hip extensor muscles.

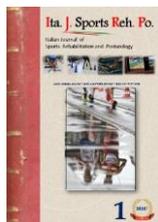
There is a technique which allows for more control with bending the affected leg and it also has a positive effect in the prevention of the plantair extension/inversion attitude of the foot.



Picture 4.

We call this the toe-grasp. The hands are placed in key positions which enables the index finger to lay under the toes for the ball of the forefoot. The other fingers lay parallel and support the index finger whilst the thumb is placed on the top of the foot. The movement involves pushing the heel into the bed and then turning the foot firmly to an eversion and dorsal flexion. That will stretch the Achilles tendon and in turn will flex the knee. Any further flexion of the knee can be achieved by using your other arm.

In the late 1980s a study identified that completing this action 4-6 times a day will help to prevent a plantair extension/inversion attitude of the foot becoming established. This study provided a limited solution due to the technique having to be completed over the whole day with staggered intervals which is very intrusive and labour intensive, and the must be no plantair extension/inversion attitude of the foot present in the first place for it to have a possible impact.

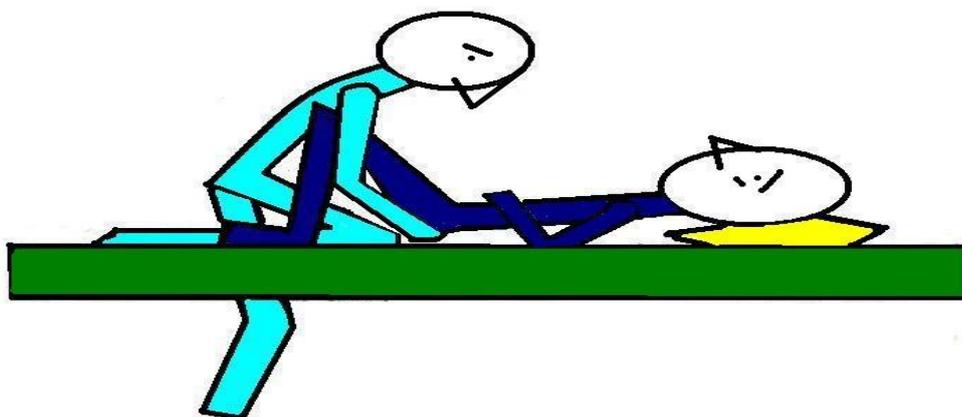


Jan van de Rakt, Steve McCarthy-Grunwald
Diagonals Part three – Pathology
The Stroke patient: How we can train the diagonals to create a better result.
Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;
ISSN 2385-1988 [online] IBSN 007-111-19-55

604

First place the affected foot so it is facing the direction where the sideways movement will go towards, then asked the individual to place the other leg alongside the affected leg, then bend the knee as far as possible m

Adopting this position creates only one possibility of direction to move enabling the individual to be part of the movement itself. Practitioners can help the movement by pushing the knees over the feet but only in **normal tone** will this achieve lifting the buttock off the bed. If normal tone isn't present this results in the unaffected leg becoming involved and the practitioner needs to support the affected buttock, when that is possible to effect the correct movement.

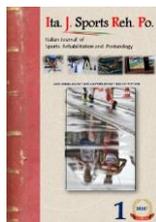


Picture 5

To get movement of the knee over the feet, we must bend the knee quite far which is not always possible. Practitioners can provide gentle pressure with their chest and the upper arm whilst leaning backwards. This pushes the feet into the bed and makes it easier for the individual to lift the buttock off the bed. But practitioner support of the buttock movement is almost always necessary!

The pushing movement with the affected leg provides a lot of information for the brain to identify what we asked. Therefore we need to consider "What does the brain do with this information?" Often practitioners observe reaction which provides positive evidence of brain activity and connectivity between the two sites. Consequently a positive reaction in the buttock muscle is important for the development of movement within bed, for standing up, walking and in maintaining balance. Therefore the affected leg can be involved in with many of the A.D.L type movements, alongside therapy exercises providing the right intensity, frequency and repetition. This level of input over time can help to regain the right accent with the affected leg.

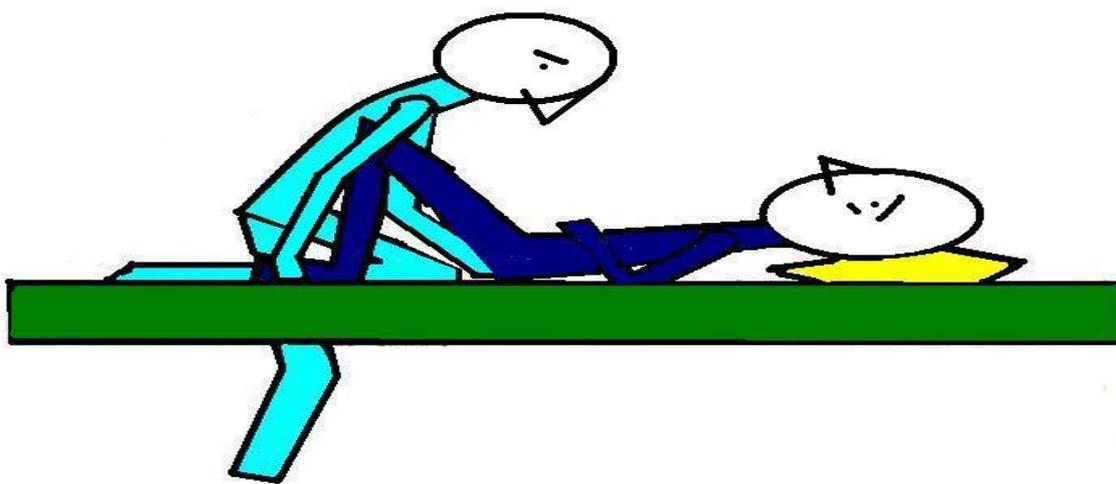
Poor stability of the hip can be an issue with hypermobility with exorotation or through the influence of the extension synergy, causing extension in the leg that the individual cannot control. Using this technique (picture 6) can help the individual to feels the changes within the



Jan van de Rakt, Steve McCarthy-Grunwald
Diagonals Part three – Pathology
The Stroke patient: How we can train the diagonals to create a better result.
Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;
ISSN 2385-1988 [online] IBSN 007-111-19-55

affected leg what the affected leg does and can the buttock muscle be active .
This provide important information about the functions of the back diagonal in the affected leg?

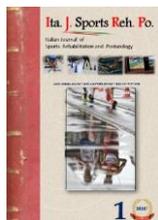
605



Picture 6

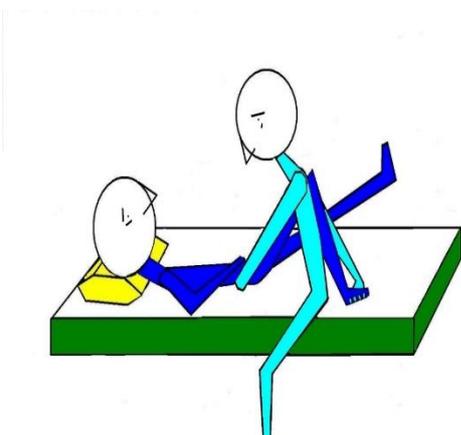
This technique differs from that in picture 5 as both knee are held together, now the practitioner holds the affected leg between his upper arm and chest. The knee must be in a bent position as far as possible and the hand is either placed on the individual's ankle or if possible it lifts the forefoot with the toehold grasp. Now the extension tone can be inhibited enabling pressure from the heel to the mattress and through moving onto the back, this should provide sufficient input to make the buttock to lift easily from the bed. The other hand helps to stimulate the movement activity in the buttock muscle. This technique can also be used to increase the potential of making a tentacle. A tentacle requires the affected side (especially the buttock muscle) to become active.

Tentacle is **an exercise**, and not an A.D.L type movement therefore we need to try and find ways to combine both here. When lifting the buttock and trying to change position of the lower trunk sideways the individual needs to move in the bed as part of everyday A.D.L.s so therefore we want this exercise to increase coordination and power of the lower trunk, making these movements easier over the recovery time.



Jan van de Rakt, Steve McCarthy-Grunwald
Diagonals Part three – Pathology
The Stroke patient: How we can train the diagonals to create a better result.
Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;
ISSN 2385-1988 [online] IBSN 007-111-19-55

606



Picture 7 Tentacle

Here is a combination of the technique of holding the affected leg and stimulating the affected buttock muscle to aid lifting the pelvis off the bed. In this picture the opposite leg is in extension which is not necessary and certainly in the beginning not beneficial because this extension makes it more difficult to hold the pelvis in the right position.

Start by lifting in flexion, when the power improves then we can consider more extension because the load will be greater and in turn places more demand on the back diagonal from the affected leg helping to improve function.

Picture 7 Tentacle

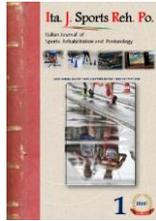


Photo 9

This individual can make a tentacle. Although when he tries to move his body to the affected side the amount of difficult increases . The reason for this is even though he has the strength to perform this movement the individual lacks the selectivity to move the lower trunk to the left side.

The individual may try and demonstrate that they can perform this move using both hands of the bed, but the unaffected arm and especially the elbow always “attempts” to provide support.

Photo 9



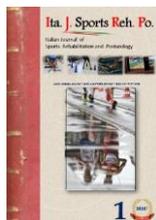
Jan van de Rakt, Steve McCarthy-Grunwald
Diagonals Part three – Pathology
The Stroke patient: How we can train the diagonals to create a better result.
Ita J Sports Reh Po 2016; 3; 1 ; 576 – 615 ;
ISSN 2385-1988 [online] IBSN 007-111-19-55

What are the reasons that a movement to the affected side is so difficult?

607



Photo 10



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

608



Photo 11

Photo 10 and 11.

Photo 10 the individual lifts the affected leg. We can observe the front diagonal being active towards the unaffected shoulder, but due to problems with perception he continues to look towards the affected leg so he can maintain control on the affected leg.

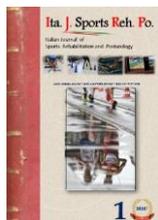
Even though the leg is raised there remains too much extension synergy. To lift this leg this individual has to work very hard with the opposite side, which cannot be seen on the leg, but the tone of the affected arm /hand is significantly increased.

Now look at photo 11. In the trunk area, starting on the affected side just above the pelvis, there is a small shift towards the unaffected side. Also observe how the affected arm develops the same tone and posture as the photo 10 previously, resulting in a retraction rather than a protraction of the shoulder. Unfortunately we cannot see what happens with the unaffected hand, but it seems that the hand inadvertently provides some support to the buttock muscle.

The affected leg has less exorotation in photo 11 compared with the unaffected leg in photo 10

This shift in the stomach muscles is caused due to the back diagonal from the affected leg to the unaffected shoulder not having the correct 45° angle, resulting in not enough muscle power in the buttock resulting in the adductor muscle in the affected leg compensating.

Unfortunately neither photo demonstrates the tone of the plantar flexors of the feet. Both feet are actually in plantar flexion but when you observe for the tone then a difference is observed with the affected side having a 4 on the (MASS –scale) compared with 0-1 for the unaffected foot. The muscle tone on the unaffected side is too high, although by being this high provides greater stability for the body whilst they control movement with the unaffected side. This shift makes it difficult for the individual to realize the tone of the adductors, so when they try to move sideways towards the affected side, they try to push with the unaffected side (See photo12).



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

609



Photo 12

Photo 12

The individual tries to place their lower trunk further towards the affected side, but initiates the movement with the unaffected leg. This creates a shortening in the trunk with no active elongation of the affected side.

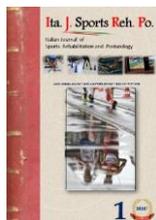
The back diagonal starting from the unaffected leg is so dominant and can independently lift the whole buttock but this will push the affected shoulder into retraction.

The individual also pushes with the unaffected arm but the buttock on the affected side is not a part of the same back diagonal as above, so consequently we see it falling down without completing a sideways movement on the affected side.

At this stage of rehabilitation support is required to develop sufficient power in the affected m.gluteus maximus and exercise to help place the lower trunk further towards the affected side (Picture 6 technique).

In part 4 of the diagonal series we will continue looking at the next 3 remaining descriptions of movement within bed.

- Considering how to move sideways to the back and the front of the bed whilst lying on the affected side which is difficult and not always possible in the beginning.
- Considering how to move sideways to the back and the front of the bed whilst lying on the unaffected side which is difficult and not always possible in the beginning.
- Then for an individual to turn from the supine to a sideways position for both affected and unaffected sides.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

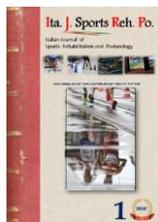
610

Summary

Sideways movements whilst lying on your back is difficult movement requiring involvement of the upper and lower trunk of the body. Lifting the head alone is not enough the individual is also required to make a shortening of one side to move in turn requires an action of the front and back diagonal together with homolateral muscle around the shoulder. The lower trunk can only move sideways at the front assisting in the shortening movement, whilst the back diagonal need to work in combination with the homolateral muscle of the hip and trunk to create an elongation of the opposite side. This requires a degree of selectivity which can be difficult for individuals following a stroke. Therefore it is important to ensure as part of the therapy there is a two part process involving Activities of daily living skills (A.D.L.) which is a part of everyday “exercises” at the right level for the individual.

The article refers to the fact that exercises are different to A.D.L. due to having rules to increase their effectiveness. This is also combined with the need for the individual to relearn previous movement and coordination skills which requires rules to ensure they can achieve this. Too often will the individual must act on exercise level in the A.D.L. and that is often too much.

The combination of exercises and learn to move and on a lower level using this capacity in the A.D.L. is the most learning environment that there can be created!



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

Appendix

Training rules

611

There are two very important rules (A and B). A) The intensity of the exercises must be right and give an change in the coordination and the power of the muscles. This is by individuals with an stroke not for all muscles possible, but when there is an connection with the brain is this the best way to improve. B) The individual with an stroke must learn to move and which learning model will be the best? There are many models but for brain damage individual must be search to an challenge that can be done by the brain and stimulated the brain to solve the problems. The first problem is the definition of intensity of the exercises. The research has intensity defined as the amount of time spent doing the exercises themselves. And not on what are the correct weight of the exercises. This gives an rear picture because an exercise that is under the level of the individual with stroke, is an exercise that is good when we do this exercise over an longer time. That means that every exercise is good when we do him over an long period. And then we can asked the question, will the damage brain this feel as an stimulation to try problems to solve and learn. An exercise that is under level is often not motivated and thus not stimulating the brain.

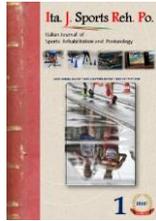
The right intensity on the other hand will evoke a reaction in the muscle patterns which over time the practitioner can train to try to get the greatest level of selectivity. Unfortunately recovery following a stroke for many individuals will never be as good as before it occurred, therefore the need to exercise at the highest level and stimulate the compensation mechanisms becomes more important in promoting the best level of function for the individual.

In the Dutch guidelines there are no specific investigations of individuals following a chronic or severe stroke and what there is, is only limited to a few topics. Balance, walking and then predominantly using advanced apparatus and standing up. Additionally arm training when is almost total restricted to Constraint Induced Movement therapy (CIMT).

Currently very little research has been published considering how individuals relearn to move in and out of bed including the importance of combining Activities of Daily Living etc. What research has been conducted, tends to involve only individuals who have been admitted to specific rehabilitation centers following having had a stroke, which equates to only 10- 15% of individuals, who have had a stroke in the Netherlands. The research assume that the result are comparable with all other individuals following a stroke who may have returned home following a period of time in the hospital or those who require further rehabilitation in a nursing home following a severe stroke, which on closer inspection is not necessarily the case.

Recognition must be made for the need for training rules which stimulate the muscle pattern on the right way. It is important to stimulate the muscle groups which have the greatest possibility for improvements in coordination whilst achieving the greatest selectivity.

Consequently it is important to ensure that these muscles produce a nerve impulse sufficient to reach the brain, so the brain can begin to “repair” by searching for a solution to reinstate control of movement, therefore practitioners play a large role in helping the individual to



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

undertake movements which stimulate the brain in the first place. This situation calls for a therapeutic approach with a great amount of **variation and repetition**.

Therefore our brains will more likely unstimulated and unmotivated to relearn skills if the learning process involved a rigid structure which is too specific and much too complex for the individual to actually follow. Or to low or always the same etc.

Walking; individuals learn this by walking not by hearing how he must walk

A) Task-Specific Strength Training

All task specific exercises create a positive effect that then transfers well into Activities of Daily Living. Strength training for one or more muscles on special apparatus provides an late transfers in possibilities for individuals following a stroke. For example; when looking to develop an individual abilities for an better standing position, we exercise the extensors of the knee in an sitting position in the leg press but this does not provide any better standing position. The transfer of the increased power in the extensor will need standing exercise to transfer in the standing position. Bücher has this investigated and when someone was not capable to stand up , the only way is strengthening of the muscle but when an patient can stand up with support and we stay exercises only the power of an few muscle (thus no task specific treatment) that stop the progression. When the treatment was an task – specific we say an further improvement.

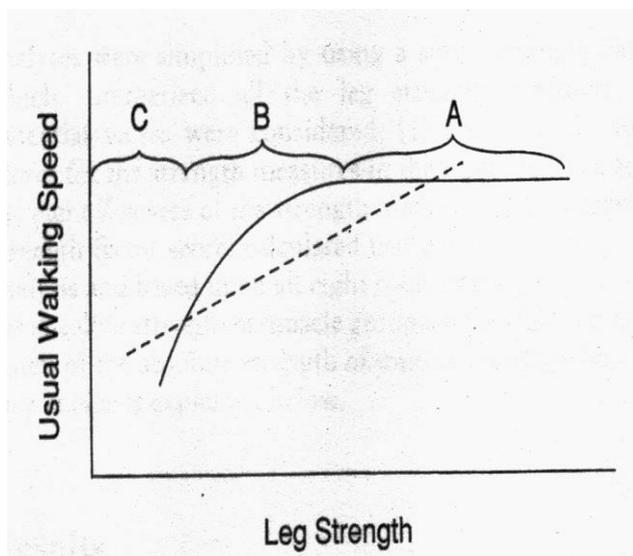


Figure 5

Figure 5

C is an individual who cannot walk.

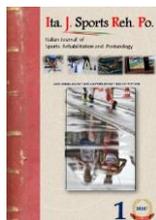
B is an individual which requires support to walk

A is an individual who can walk.

This dotted line suggest that by developing the muscle strength the capacity of walking and walking speed will increase too.

Whereas the complete line indicates the real picture.

That suggests that using strength exercises alone is not enough to develop higher walking speeds!



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

613

Task Specific resistance treatment

According to this principle any good treatment must satisfy 5 demands in providing the best results.

Rule 1: Muscle pattern required to undertake the task, must all be exercised. Therefore standing up provides limited effect on our abilities of sideways movement in bed.

Rule 2: The movement that we want to undertake should be completed with the same muscle patterns, we also need to look at the intensity being equal or more with the exercise. That suggests that standing up only can be exercises in developing a standing up movement.

Rule 3: The energy that is necessary for the movement must be at least equal to what is required and whenever possible more. That identifies with the need to know what the Repetitive maximum (R.M) of all the muscles which perform that task. Once we know this, we can exercise with 75% R.M. and complete a number of repetitions that results in mild muscle fatigue which provides a better stimulus, for an increase of the coordination and muscle power.

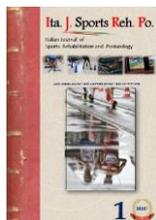
Considering figure 5, this seems impossible for group C simply because they cannot walk. We know that the R.M. is too high for this group, therefore the practitioner needs to be more creative in designing the treatments. Because when we are capable to make the movement, we are almost always close to the maximum R.M. and as such are on the correct of recovering the capacity to walk. So when we take 4 or more steps, this can produce a good amount of exercises and the transfer to walking is immediately present. And when we exercise in water the loss of gravity will create an environment in which walking is possible and all possibilities of give more resistance are present. Leg-press exercises will help strengthen the legs but will not have so fast quicken the ability when transferring to walking because all rules are not satisfied especially rule 4.

Rule 4: The sensomotoric track must be the same. That indicates that the perception of the movement must be the same. Standing up requires a different type of perception to conducting as an sideways movement within bed. Therefore it is essential for the brain to get the right perception input and come to the right solutions for each task.

Rule 5: The target of the exercises must be clear. This is important because knowledge of the result is more important than the knowledge of the performance. The individual must avoid focusing on how to walk and concentrate on where they are walking to.

Motor Learning!

This task-specific resistance treatment must be implanted in a motor learning program. That program must stimulate the brain to search for solution. This indicates that there should be a lot of repetition with greater amounts of variation.



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1; 576 – 615 ;

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

614

You will never stimulate the brain through repeating the same precise tasks every day. This creates a negative response stimulus to the brain creating a lack of motivation for the individual.

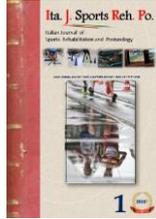
Create an **environment** which the individual is familiar with and similar to their daily residence. Once this is achieved look at performing all the exercises that they need to learn in this place, resemble with the environment that the patient know and exercises there what the patient must learn. If the individual has difficulties using the toilet because they lack the flexibility to reach down and pull their trousers up afterwards. Then the practitioner needs to consider the need to look at bending with higher difficulty that experienced in the toilet which are repeated to develop this skill. When the patient is tired, this suggests muscle fatigue, which in turn creates variations in movement training as being more tired and then bend down to pull up the trousers becomes even more difficult. But when he is capable to do it , he must do and rehears this on the different toilet and with different people to assess and at the end he must do it on his own.

But Prof. Wolfgang Schöllhorn suggests task-specific treatment alone is still not enough. The brain requires stimulation from different impulses whilst doing something completely different. That makes the brain more sensitive and receptive to other information stimulus keeping the brain alert.

In the Netherlands this motor learning system is called Differential Learning (Prof. Beek and Prof. Schöllhorn)

Summary Motoric Learning

1. Repetition through variation
2. Task-specific resistance treatment
3. Treatment in one context is an important for identifying an activity to be developed. Additionally identifying different contexts within this same activity can provide the much needed variations to aid development.
4. Do something different within the therapy to help stimulate the brain and keep it alert.
5. Work with target (K.R.) instead of (K.P.) especially in the beginning.
6. Assist movement with a hands-on approach because performing the movement is essential for the brain to relearn!
7. Don't talk too much, perform against the border of the individuals known competencies. We must create a mild level of fatigue which helps to develop better coordination and muscle



Jan van de Rakt, Steve McCarthy-Grunwald

Diagonals Part three – Pathology

The Stroke patient: How we can train the diagonals to create a better result.

Ita J Sports Reh Po 2016; 3; 1 ; 576 – 615 ;

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

615

power. The system tends to react initially to better coordination then with muscle power as it develops.

8. Current thinking revolves around how many times a week the therapy is performed. Task-specific resistance treatment suggests this is completed at 75% R.M. often times repetition 3 times and that 3 times' a week For individuals who have had a stroke in the first 6 months this should be every day, because exercises will stimulate the recovery of activity and participation (I.C.F.) and task-specific resistance treatment can be incorporated into the larger therapeutic regime. When an individual is in a chronic stage then a minimum of 2-3 day a week will be necessary to hold the level but will not be enough to improve the overall recovery so will need to be increased. Also In the chronic stage it is also crucial to identify that the activity that the individual performs is as essential to recovery as how often the patient must receive training. Observing how athletes develop their high level of functioning and maintain it is one way of identifying how individuals following a stroke need to approach the therapy to develop at their optimal level!

End of Part 3