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What is Task Specific Resistance therapy and what is the Positive effect by people after an Stroke!!

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Abstract

Introduction

Training of people that have suffer from an stroke asked for an multidisciplinary approach, because by an damage of the brain are so many systems damaged that every disturbances asks for an purposeful to get an optimal That count also for the senso- motoric disturbances and this area are the approach still today so divers and often without the optimal evident base because often the experimental treatment is compare with usual care. This usual care is so divers that nobody know what is compared with what and the nomenclature is always changing without clear definitions. One of them is the training of muscle that is found to be possible and has an positive effect on the recovery of people after an stroke. But always are there borders why this isn't possible with the distal part of the body when the projection /pathway are disturbed.

Method

This article focusses on the best practice and evidence, that is done with people after an stroke on the area of regaining an optimal walking performance and that is an area where the projection in the brain and also on lower level is almost always present and the distal loss could be control with an orthosis.

Then is there an great assemble of approaches that all start with the word -task- but the performance is always different. Because this work has an great resemblance with sport training, we introduce in the practice their evidence and that was an eye opener.

Goal

Two elements was the goal to invest, what is the best task related training for people after an stroke to activated the muscle pattern and has an clear influence on the re-learning.

Second element was to invest what the best training to get an better power and coordination in the muscles to improve the walking performance. Isolated or task – specific!

Conclusion.

Train and use that improvement asked for an task specific resistance treatment, that will improve the muscle pattern that are needed to improve the walking performance. Clear is that task specific resistance therapy lie so close by the implicit (Differential) learning that this combination is the best. Of course Isolated muscle strengthening will increase the force of that muscle(s) but the integrating in the walking performance is much more difficult because it works not in the muscle pattern that are needed to increase the walking performance.

Kew Words: isolated muscle training; task specific resistance training; implicit (re)-learning; stroke treatment and effects on walking performance

Introduction

Reading the literature about training of especially people with an neurological disorder, than is one technique always the first that is mentioned and that is task-specific exercising. All guidelines [1,2] are full of it, but there is clear evident that this isn't always the same approach what is investigated and that makes the outcome of much investigation not so clear as it should be. There also different word formulae to give this approach an certain dignity. Task specific, but also task orientated but also in the treatment of people with dementia is often the term "Functional Training or exercising". Thus we have an lot of terms for – maybe- the same, but no reader will understand that and the most disturbing item is the word training or exercising. Often is no explanation, what the difference is between the task specific treatment and the task specific training or between the task orientated treatment or an task orientated training that means that the training stimulus isn't clear and then is comparison (certainly random) impossible. This is one part of the problem with many investigations by persons with neurological disorder, the other is that the comparison often is done with an control group that receive "usual" care. This comparison group with the term -usual care – is in the year 2016-2017 through the Stroke Recovery Rehabilitation Roundtable (S.R.R.R.) [3,4,5,6,6,7,8] as not desirable and this excellent group scientists has than decided to make an template where this control group have to fit [9]. This Tidier (The Template for Intervention Description and Replication) should now be standard by all investigation that were done by neurological disorders, only then will the difference between the new approach and existing treatment be clear. This base will benefit from an good "definition" what an task specific treatment, exercise, training is and in this article we will do an attempt to give an better description what it should be. The terminology, where the word task is incorporated, are always an indication that the task stands central. But that task will by people with neurological disorder often have an direct relation with movements that they make in the All Day Living (A.D.L.) or Instrumental Activities in Daily Life (I.A.D.L.) but this is often not an treatment or an training but an training in adaptation to deal with the remaining possibilities and the ADL/IADL. This

is also an treatment and training to learn this problems to solve, but this can we divide in smaller elements and that treat as task specific and so try an better result obtain in the total training. Of course, it is an treatment that is more pointed on the motoric recovery or adaptation and not directly on the neuropsychology problems and it is clear that in the ADL and IADL that play an very important part, still it is dependent of the possibilities of the senso-motoric system and that must be treat in relation of the task. Walking on an treadmill is an task, that is limit but still an task- specific treatment or better that could be an possibility. Is it an treatment than we want that there are borders be passed and that there is an stimulus for the body to improve and that can be on the aerobe and anaerobe level but for both are demands to get the this treatment the predicate training. But is this walking on an treadmill equal with walking though the corridor, at home, in the garden or outside in the shopping district? Beside the cognitive elements are now more adequate senso motoric elements necessary to deal with it and that isn't trainable on an treadmill, therefore we must deal with this situations and deal with it will be in the beginning an training but for how long and how we can this training give the progression that they need.

Task Specific Training.

The term -Task Specific Training is originating out the training of sport peoples. There was al for many years an insight that training of muscles "sec" was not enough and that the transferring to an improvement of the skills was not fast and often not complete [13,10,11,12,46].

Training of muscles to increase the power was often done in the period that was far of the moments that people must perform on the highest level and only the strengthening- room was no guarantee that the skill – coordination – improve on equal scale.

This was investigated by Buchner [13] in 1996 and he and his colleagues found that only strengthening was enough to get an progression that continued.

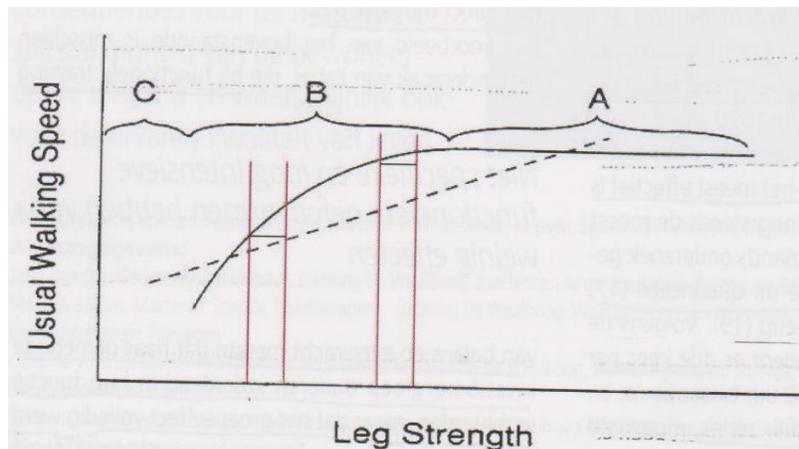


Figure 1

Three moments in the treatment to progress the ability to walk and that will an progression of greater independency and more speed.

C = is the group that wasn't able to walk only with great amount of assistance and aid.

B = is the group that can walk with assistance and aids, but the progression is fast increase through the strength training program, see the progression between the red lines.

A = is the group that is able to walk but now is the item to increase to an usual walking speed.

The dotted line was the line that the investigators has drawn as an hypothesis;

What will happen with the walking speed when the muscles are train and increase in strength.

The hypothesis that this progression was almost constant positive.

But the reality was the black line, were there was certainly progression in the C and B area, but at the end of the B area this progression flatten out and it seem that the "isolated" muscle training had no influence anymore on the progression of the walking speed.

The term isolated muscle training is confusing because this training from only one group of muscles is almost not possible but it is more an pure exercising that hasn't an connection directly with the performance.

Training on the leg press is absolute not comparable with walking.



Figure 2: “Isolated” but still an exercise with more action than only in the upper leg extension muscles.

To push the weight away is not only a power in the extensors of the knee necessary but also the extensors in the hip and that asked for an action in the whole trunk (front and back) to give the muscles of the hip/leg an good anchor.[14]

To get an strengthening in the muscle groups is an program to create muscle fatigue necessary and that asked for an calculation what the strength in the muscle group is (1.R.M. or 10 R.M.) and then can we set up an program where this stimulus to strength grow will be happen

This training is also possible by people with an neurological disorder when they have the coordination to perform this movement and then will there be an good possibility that the power in the legs will increase, but will they walking be going easier or better with an increasing of speed and step length.

Figure 2 let see the limits and also is the time, that this transfer in the movement is often too long, certainly at the right side of figure 1.

Still it is clear that this kind of isolated training has also positive effects when the task is almost not possible, but with the weight reducing apparatus [17] or hydrotherapy [18,19] can this be transferred to an task specific training that will give faster results and in figure 1 the dotted line reaction.

But when we look at the C group (figure 2) than is an investigation[20] that the movement (standing up) was not possible independent and an isolated program was capable this problem to solve with only the isolated strengthening on the leg press within 3-4 months .

Thus never forgot this part of training but it is good to see that in that article [20] , the selectivity/dexterity and the standing up strategy was intact and not decrease though pathological tone and/or synergies.

“Isolated” will have an strengthening effect also by neurological disorders but the person must be capable to executed the movement and with the progression that create more muscle strength but the missing link, is the movement. The coordinative part that is train, has no resemblance with the task, that we want to improve.

When is Task- specific training an real Task Specific training?

Back to the sport, because there is much more investigation done [10,11,12] and the structure, in which they see, what is task- specific and that makes an treatment or training possible.

This in contrary often with the rehabilitation where the clear elements are not visible or present, still is this called task-specific treatment.

What are the elements:

1. Intern movement structure: meaning that the muscle pattern that are necessary for that task were use on the same way.
2. Extern movement structure: meaning that the movement must be almost equal with the movement that we want to train.
3. Energy delivery; meaning that the amount of energy must be minimal equal to get likeness and that for a training there must be an higher energy delivery.
4. Sensory components; meaning the information from the alle tissues, muscles, joint etc. to the spine /brain and back must be have enough resemblance with the task.
5. Intension of the movement: meaning that the purpose of the movement, the goal must be clear and comparable with the task.

Important reason for this element are, that the muscles in this situation will be in the best optimal length to perform and that elements isn't never present by form of isolated training.

When we do an training than will this only succeed when there is muscle fatigue and that can be reach when we know what the 1 R.M. is of the movement and the muscles pattern.

An example out the work from Frans Bosch[10] of his work with the rugby team out Wales.

Problem of this athlete is that his speed and agility is too poor. Let's focus on the speed and then is the speed partly dependent how fast the swing leg is get too to front and the ground.



Figure 3



Figure 4

Figure 3 and 4.

Running and the task specific training with the purpose to increase the speed. Photo 3 give an picture of an person that run with great steps, but his swing leg stay long behind and it cost time to get this leg again to the front and on the ground. This swing behind isn't stopped and one of the reasons is that the swing of the leg isn't stopped., is through an unstable pelvis. This pelvis is tilt to the back and let the swing go further.

Photo 4 let see what is happen when the tilt of the pelvis is stopped and the swing is shorter and the leg faster to front. And his speed is clear increase but how is that training possible, task specific and thus fast transferred on the Rugby field.

We need a certain intensity to get the muscle fatigue that stimulated the increase of strength but by task -specific is this an increase of power. Power means: strength \times speed and that means that often first the coordination improve and that the muscle power increase will be seen later. In the example of photo 3 and 4 is therefore through the task-specific resistance, first an coordination improvement that will create an better core stability and that will brace the swing movement to the back faster and therefore goes the leg faster to the front and will this increase the speed of this person.

Task-Specific in parts, Motoric learning and task-specific neurological disorders.

Task-specific can therefore be an training that look like the task that we want to improve but we can also concentrated on an part of the task but never losing the whole task out our sight. We must also know how we can best train and learn the motoric skills to improve but also get the possibility to do that in different situations and moments. This must thus an combination of exercises with an great task specific element but also stimulated the brain to search for solutions.

These two elements are the base for an treatment for all people who has injuries and want to recover but this two elements are or should be the base for people that has suffer from brain damage all kind. Therapeutic approaches all kind must be have these two base elements (training and learning) to get an change in the possibilities and when that change isn't there than is this program not optimal for this person. To get a training and learning on the level of the person asked thus for an individual assessment to get an idea what the level is and what the training must give. That can be an improvement but also bracing of the decline, certainly by degenerative neurological asked this for an assessment every time to get a training and learning (motoric) on the right level. Often are training and learning by people with a chronic disease of every kind, always the same and that is the first great mistake that we can made, because than is motoric training and learning not possible!! Thus every day the same exercise is no training and learning and also demotivating.

The brain that isn't stimulated to search for possible solution, will never learn or develop. [21,22,23,24] The term task-specific and the explanation that is connected with the training demands are clear but especially in the training of people with neurological disorders is there an waterfall of task-training.[25]

Examples: task-related training, task -orientated training, task-oriented training, task-oriented approach etc., it looks often that the word task must be part of it than will the training be on the right level. That with often an comparison with usual care [9] and never, almost never, an complete explanation what this task was and how the intensity and learning possibilities are built up for the group person with an neurological disorder.

Important part is that there must be an coordination improvement possible that in combination with an learning situation. Improvement of the coordination is most difficult part and asked thus for an task specific training customization. *The elements;* Intern movement structure, extern movement structure, energy delivery, sensory components and the intension of the movement must be present to get the effect what we want and can also the learning elements be used.

We must thus assess what the intensity must be, or by neurological disorders can be, to create a task specific resistance training that will lead to an muscle fatigue in the muscle pattern and an coordination improvement. Again, is this through an assessment of the 1.RM. possibility but now not of one muscle but from the muscles pattern that play an important part in that task-specific movement that we want to improve. [10,11,15,16].

An example of the assessment and the training of a part task-specific resistance task:

Walking asked for an movement over the hip that on that moment do two functions. The weight bearing but also the propulsion. Normal walking asked for an concentric action of the hip extensor from the moment that the heel strike is active [26].

This concentric action is essential to get the movement of the body over that leg and give enough power to get through with walking. It is therefore important to training this muscle pattern in an walk-like movement but without all walking- and the balance demands. The base is thus an task-specific resistance treatment where the 1.R.M. of the extension of the hip is assessed. Than can there be program established what will lead to an improvement of the coordination and the power (strength × speed). That program must be lead to an muscle fatigue that lead to that improvement but asked for an action with resistance (par example 50-75% of 1.R.M.) with

rehearsals from 15-10 times dependent of the resistance and must lead that by the last action the delivered power is lesser. An sign of muscle fatigue and when after an short brace the next series can be done. After 3 series do this one's more that day and that 2-3 times an week.

First the coordination will increase after that the power and this must lead to an better walking pattern with more step length and speed.



Figure 5: *The assessment of 1 R.M. of hip extension of the left leg of this gentleman after an stroke about 1 year ago. His problem was that he wasn't capable to walk through and place his not-affected foot for his affected foot and that his speed was too slow. Of course, first the assessment or there were no mobility shortages in all joint, muscles and nerve tissues and that wasn't the case. There was in the affected leg an clear extension synergy but with dissociation but the tone in the muscle that are dominant is ±MAS (Modified Asworth Scale 1-2 [27] en MI (Motricity Index leg) 48/99.[28,29] The assessment of the power of the extension contraction in the hip is done by an resistance against the feet of not-affected led and it is important to get the right direction.*



Figure 6



Figure 7

Figure 6 and 7: *After the assessment is the 1.R.M. noted and can we set up a treatment for the hip extension in the task specific movement over the hip. An variation of the movement is possible as the step length to the front but also the start with the swing leg so far as possible to the back.*



Figure 8

The step – length is significant greater after an the training in which this task-specific treatment on photo 6 and 7 after 6 months.

Of course was this an part because the others items as balance are also important but the amount of coordination and power (strength × speed) was for the step length also the missing link.

The amount of resistance after the assessment of 1. R.M. , was dependent of the reaction in the rest of his body and especially of the affected side.

The tone in his whole affected side must not increase above the level that there is no movement, in this situation, in his affected arm.

*On the photo we see the **swing** of the arm in symmetry with the other (not/affected) arm, too much resistance will increase the tone and decrease the movement – spontaneous- in the arm, but also in the leg and trunk. To avoid that, an training-program must be adapt.*

Training program [31]:

1. The resistance was about 65 % of 1.R.M. so that the whole body move as ot should when someone is walking or swing his leg to the front.
2. The number of rehearsals is that within 15-17 and at the end must there be an sign of muscle fatigue.
3. This 3 times behind each other with an small brace, that is best sign that the muscle fatigue can be achieve and that is the best stimulus to increase first the coordination and after that the power.
4. This 2-3 times a week.

Of course, is always the question or the damage in the brain makes this training possible and the answer is simple:

When the buttock muscle (hip extension) contracted and resistance can be given is this connection with part of the central nerve system intact. Realize that also in lower parts of the brain are projections and that there also pathways are present out the not damaged part of the brain that not crossed.[32]

Second example of – part- task specific resistance treatment

This example is an part of an treatment for an gentlemen with dementia that have difficulties to stand up without the use of his hands. Problem is the lowering of his power in his legs and the “fear” to move far to the front to get the trunk far for to make standing up possible.



Figure 9

Figure 10

Figure 9 and 10.

An activity of an gentlemen with dementia against an resistance as an action to blow up an balloon. He doing it very serious and give his power to get the balloon full.

The therapist was searching for an exercise to get more power in his trunk movement to the front, because his standing up performance decrease. Is this an good part task-specific resistance exercise for that purpose?

Standing up asked for an amount of power but also for an coordination. The movement start with an movement in the lower trunk/hip. Still sitting, go the trunk to the front and the feet to the back. At the moment that people stand up, the feet stand often perfect behind the knee and the chin is over the knee. The movement to the front is by elderly often too short because they use the arm rest and make the movement not complete and so stand the feet not correct and is the trunk not far enough to the front. The power that is necessary for this coordination; The extensors of hip and knee and trunk without hand support and then is power an core stability and that means that front and back muscles must work together [14] With hand support is the amount of power of the hip and knee lesser, but also the trunk muscles with often an fast decrease of the trunk care stability and certainly on the front.

Photo 9 and 10 asked now an push movement with trunk attitude to the front without an support but with extra resistance to push the handle of bicycle pump and that stimulated the front trunk muscles but also the leg muscles and train the movement. Brilliant detail, this gentlemen knows how to handle an bicycle pump and place his feet on the foot plates and makes the whole exercise more difficult, but coordinated is this more difficult. It asked for an foot placement that isn't normal and asked for more control.

But is this an part task specific resistance treatment that will transfer to the standing up movement and how I calculated the 1 R.M.

1. The sensory tract isn't the same as standing up but an very important item ; the movement of the trunk to the front (Vorlage) is done with the hand to the front and active. Often elderly have so much problems with this "Vorlage"[33,34] that this part isn't properly done and then is standing up an push up with the arms.
2. The amount of force that is need for the forward movement is done by the back side of the trunk but an very important part is

the core stability that place the trunk/pelvis and the hip in the optimal position. By elderly is the fear great to go to the front and the power of the abdominal muscles often low to get an good core stability. Training elderly to stand up with an table in front is next step in the program to increase the power for standing up.

3. Thus 1.R.M. may thus the maximal power necessary to get the handle total down and air in the balloon, but 70% of that 1.R.M. should give so much rehearsal that this lead to muscle fatigue and an full balloon, this must be done by three balloons and important at the end the handle must go slower trough muscle fatigue.

Thus an perfect part to increase the standing up capacity but asked for an extra training form standing up behind an table. [33,34] When we going back to the muscle training through an leg press (Photo 1) and determinate or here is still also an part of an task-specific treatment as we say by photo 9 and 10. Because the strengthening of the upper legs is there present and perfect possible with an 1.R.M. calculation and performance. What an important aspect is that there this combination of the aspect that are needed by that task, that makes the task specific, thus 1. intern movement structure muscle pattern 2. extern movement the task (standing up) 3. energy- cost 4. sensory track and 5. the intention.

Look of that is present:

Of course, will some element especially with part task specific treatment be lesser but most elements are present.

That means that the part is could be give an better total picture, because of the resemblance with the ultima task but what is that lesser on the action on Figure 1.



The elements:

1. intern movement structure muscle pattern
2. extern movement the task (standing up)
3. energy- cost
4. sensoric track and
5. the intention.

Only energy cost; is the only element that will activated by this exercises and that are muscles that were use by this push away task because there will be fatigue

But will she better perform outside this apparatus in par example standing up and the number of rehearsal of this standing up? There is an increase of energy cost that is done by her upper legs push and this will follow with an muscle fatigue and thus an increase in muscle strength.

But is this the power we need for the standing up? This is the power for pushing an weight away and the coordination that there is needed. Leg extension with an good foot placement and an upper trunk fixation with the emphasis on the backside. Thus, from the 5 elements that are needed is only one present with an different coordination.

That thus is clear that an transfer from the increase power through the leg-press strengthening [36] will be slow and need thus always the movement where they were needed. That makes task specific resistance treatment more efficient than “isolated muscle strengthening “ or better not task bounded strengthening.

Task specific resistance treatment with lower gravity.

Two possibilities:

- I. Apparatus [37] that reduce the weight a let people walk with less weight on their feet and perform so the task with the

more speed. Very positive when the performance isn't possible through the gravity as by people after a spinal cord trauma or all neurological diseases where the change is that gravity asked for an pathological high tone that makes movement hard or almost impossible

- II. Or treatment in the water [38,39,40,41]

And the possibilities are much larger than only walking and balance training, but of course is kneeling down, stair climbing and in water exercises in sit and supine position that have an relation with movements as in bed or coming to sit on the edge of the bed. Balance training asked for disbalance situation and the possibility to react and in the beginning is that often too slow thus must the situation be safe. Both situations have an lesser degree of the gravity but that makes exercising with load or resistance still possible. The gravity decrease is especially that the movements can be executed and the most common reason is that the pathological tone is through gravity too high to move with some selectivity.



Figure 11: An person with an partial spinal cord paresis is walking with two elbow crutches. This support is necessary to control his balance and weight and make the variation in walking very poor. The power of the arms are now complete necessary to fill the gaps that are created through the spinal cord problem and now with the complete gravity on his body is walking pattern poor and balance is determinate through his crutches. Walking exercises on this way is an task specific resistance treatment for the arms and the upper trunk, or the legs have an benefit is an great question.



Figure 12: The same person is in an apparatus that decrease the weight and of course determinate the fear of falling. That is visible because he feel the possibilities and he use this immediately. In his whole body are more degrees of freedom in the joint visible and also in the joint of the legs. Compare the knee joint, now is there flexion in both and previous say we only the knee in extension. He use also the arm swing for an better swing -and stand phase and he had an much higher speed. This effect of this decrease of gravity let see that the possibilities are much greater. For people with an spinal cord are the result promising.[43]

This searching for better solutions to move freer and faster, are signs that the environment is an positive element in this task specific situation but this is de base, now be sure that muscle pattern are increasing in power and coordination, there where you want and that asked an treatment according the training rules.

Photo 11 will give an increase in power and coordination of the upper trunk and arms to lift the body and control the balance and increase the leg movements and the walking speed.

Water as environment enrichment [44]:

What should be the best environment for an task specific treatment, in which this gentlemen can work on an increase of power and coordination to restore

his balance and with that his walking capacity after an severe stroke. And where are the greatest possibilities to create resistance but also great amount of variation to search for an solution – differential learning.

Photo 13 an facilitation technique at height of the lower trunk.

Figure 14 with the assistance of gangway.

Figure 15 walking in the swimming pool.



Figure 13



Figure 14

Figure 13:

Facilitation technique to facilitated an optimal weight bearing and create an optimal balance so that walking with different speed and direction is possible.

The facilitation can also functioning as an resistance of almost 75% of 1 R.M.

Important detail the position of the arms an optimal position to control the balance without an fast point.

Figure 14:

Hands-off facilitation but with an fast point of his hand on the walkway.

How he proceeds? The fixation and control with come from his hand and arm, there will the diagonal start when he his walking, that will less when he stands on his left leg but very decisive, when he stands and swing his right leg and it will teach him to control his balance from this fixation and thus never asked the top level of his legs.

Task specific is now the primer control in his upper trunk and never in his lower trunk, thus that is where the coordination and power will increase and he learn to control his balance inhis upper trunk/arm.

He could walk in his home with an rollator frame and he exercise now to increase that! Is that what he and we want because the increase of coordination and power and the learning aspect as in photo 13 isn't there and will be never there as long as he uses his upper trunk /arm.



Figure 15.

Training in the swimming pool. In one session task specific resistance training with the emphasis on increase of the power and coordination of the standing leg and learning him to walk through the pool on an lot different ways, with different speed and direction and at some moment walk with no facilitation.

On his own crossing the pool and keep his balance. This with different water levels with create an new balance system that he will use on land and make walking without aids possible because the two element come together;

- Increase of the muscle pattern in coordination and power
- Learning to use that in all kinds of situations in the water first but later on also on land.[45]

Summary

Task specific training has rules that must be obeyed to get the results that we want. This training form has only success when there is an muscle fatigue because that is the stimulus for the system to increase the power and the coordination. The coordination is mostly the first. Often it is taught that this training form isn't possible by people with a neurological disease but that isn't true. When we are capable to create an environment in which this person can do this task, is it also possible to calculate what the 1 R.M. is for the muscle pattern and the task specific resistance training is created and make the learning aspect possible to the creation of much variation – implicit. The task specific resistance therapy makes an transfer in the A.D.L. simple because people will feel that the increase power and coordination are fast useable in the A.D.L. situation and the combination will create an perfect climate in which the progression can go on, also in the chronic stage. But be honest that movement is needed in the task specific therapy and that is only possible when the tone isn't too high and that means searching for environments in which the gravity is lesser and the movements are trainable. Isolated muscle training will always be a training that can be necessary because movement are too poor or not possible in that environment but keep in your head that the transfer - the use of that amount of increase strength- is difficult because now must the person feel what he can do with that strength and he has no recognition in his brain with that movement. Task specific feel that gap and make the learning in the A.D.L. must be faster possible, because the usability is much greater. Thus make the environment so that task specific is possible and it is almost all a learning moment for this person!!

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