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Treatment possibilities of "contractures" by neurological diseases.

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Abstract

This is an contracture !! We have heard this "Often and almost every time too fast", That " An restriction in movement is called an contracture". This give the physical therapist and others an tool to say: " That this isn't treatable". But is every contractures an irreversible situation and therefore not treatable ?
Working in an nursing home, there were so many situations in which there was an "contracture" and always was the reaction, that this wasn't treatable. Of course, there were joint deformation, that makes an movement not possible and the only cure was and is an joint replacement.
But in the nursing home, the most people suffer often from an neurological disease and one of the most remarkable symptoms is the increased tone, together with the loss of selectivity, gives attitudes that had an great "resemblance" with the joint destruction symptoms.
That has lead, that this attitude with high tone was called an contracture and regrettable give that almost always the same reaction : "Irreversible and not treatable ". People with an neurological disease with great loss of control (selectivity) can suffer from loss of mobility, but often it was possible to find, what this loss of mobility caused. Par example an restriction in the extension of knee was caused by the high tone in the

hamstrings muscle. Try of change this with stretch exercise, that will give no or almost no reaction, but the reason was and is high tone, that don't react on stretch alone.
That means only, that this therapy isn't correct or incomplete. And there must be an good assessment, WHY the tone of the hamstrings is so high and not react ? Observe an Individual with an neurological disease and an high tone in his hamstrings and this person has an epileptic insult. He lost his conscious and the tone decrease fast and the restriction ("the contracture") is gone. After that, when he is coming back, the tone will come back. (Jan van de Rakt, Steve McCarthy-Grunwald Treatment possibilities of "contractures " by neurological diseases**.** Ita. J. Sports Reh. Po.; 2020 ; 7 ; 1 ; 1450 -1478 ; ISSN 2385-1988 [online] IBSN 007-111-19 - 55 CGI J OAJI :0,101)

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Treatment possibilities of "contractures " by neurological diseases.

Introduction.

When I must believe the review of Katalinic out 2011, than an treatment of contractures is not possible, but his differentiation was poor and no special attention was spend on neurological elements and our practice cannot agree with him and his colleagues. Their program "stretch" will never will be affective, because when the spasticity remain the rest of the day, you will never "win" and you must also create an antagonist that is capable to hold the tone of agonist under control. That means not that the tone is normal but the stretch stimulated the possibilities of the antagonist and this is use by the person in the ADL. Even Botox will be only have success, when the antagonist active helps to move otherwise the agonist will always win.

But first it is important to have clear, what an irreversible contracture is !

Irreversible is an joint, that is so bad that the body itself decided to eliminate movement – ankylose. The joint build bone structures that makes every movement impossible (exofyt- grow)

That is an real contracture and total irreversible We see this by diseases of the joint, like: rheumatism, arthrosis and with other diseases that destroy the joint.

But when the joint isn't affected, which structures can created an restriction in the movement of an joint. Ligament or joint capsule can be affected and created an decrease of movement but often will this happen by diseases in the joint or traumatic event of the joint. But when the joint/ tissue around joint structures are not – affected, the system is dependent of the action of the muscle that help to create the fixed position that is required at that moment . Thus when the joint is not involve in an great amount of restriction, than are the activity of the muscle around the joint and their influence on the joint capsule, ligament and joint position an option. An example: the ankle sprain isn't an bad ligament, but an muscle that is too late to help the ligament to catch the load on the ankle on time.

That means, that coordination is the problem and coordination can only be done through muscles. When the muscle is change (tone or length), than we see "contractures" and that are "contractures" that are reversible. We must now search why the muscle react so.

The most “contractures” are muscle related and are treatable but we must search !! Almost never, we see muscle related - contractures by individuals with no neurological disease. Dystrophy gives brain transformation, critical illness has much impact on the brain, nerve tissue has an direct effect on the tone of the muscle – Defensé muscular and therefore there is by this diseases also an clear neurological component present.

That means that we must search: “Why the brain makes this decision”. And of course how we can influence that decision with information that so much tone isn’t necessary ? An exception but also an example is the manipulation- theory according Mulligan, that search for an deficit between the two part of an joint. By giving pressure on the two part in different direction and then move the joint active (but it can also done passive) they find that the tone decreased when the right joint movement is restored and this can be the case by every illness, therefore this is an exception and also example. Individuals that have had an stroke, have often an high tone and less selectivity and that together created an different movement in comparison with normal joint- movement. That can give an reaction of pain and joint problems and both can increase the tone. The result can be an restriction in mobility that feels as irreversible but that isn’t true.

Photo.1
Mulligan technique for restoration of the mobility in the ankle. With the band, he pull the furca malleoli to the front and with hand, he push the talus to the back and now must the individual makes an dorsal flexion and when this movement is better, we do this 10 times to hold this restoration.

Photo 1 .

But in most of the cases the contracture is created through an tone that is too high and stay high, because we are not able to find the reason of that tone-increase and cannot therefore properlytreat.
We have seen that instable bed attitude can give high tone totally (Foetal attitude) from head all away to the hip /knee and foot.

Individuals that have an great balance deficit, created an high tone in the arm and that the elbow and hand/fingers can stand in an massive flexion synergy posture.

Still when this individual is at rest or extreme cases is unconscious or very ill with very high fever the tone will decreased and sometimes the tone decreased from MAS 4-5 to zero !! That means that the brain than have no influence on the body and the tone decreased, thus there must be an way to inform the brain, that such an high tone isn’t necessary !!

By high tone the danger can exist, that the muscle change !(Tardieu)

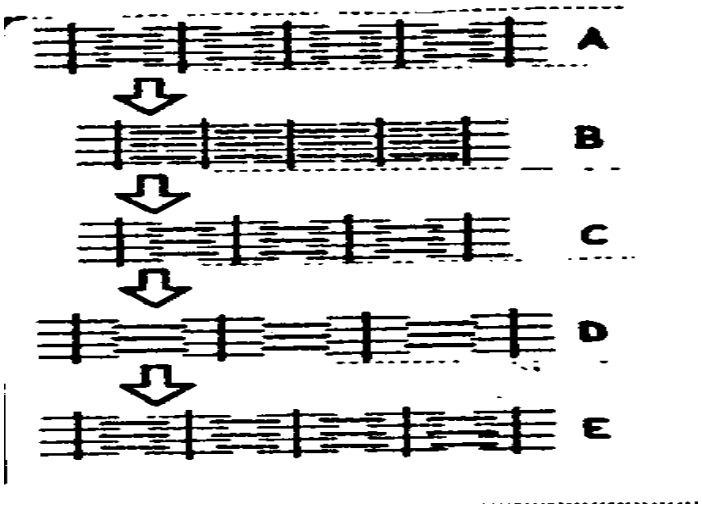

Figure 1 Sarcomeres
A = normal
B = contraction
C = restoration of the normal distance but with lesser sarcomeres D = elongation
E = restoration of the normal distance but now with an sarcomere more .

It is like A but this muscle had lost 25% of is power!

Figure 1

When an muscle stay in an continue contraction (B) for about 12 hours they muscle will adapt. This adaptation is an disappearing of one sarcomeres and the normal stand of the muscle is restore but the muscle will be shorter (figure 1)

When an muscle will elongated for more than 12 hours, we see the opposite reaction, there will be an sarcomeres extra in the muscle and the muscle is now longer. By both changes the muscle can lose his power, Vattangly has calculated that this is about 25 %.

Why 12 hours?

By our knowledge is the experiment of Tardieu and others not rehearse and they see that change after 12 hours in an laboratory situation.

By people suffering from an neurological disease the tone change through the day and night, but by someone very little, thus it can be possible that the adaptation through sarcomeres occur. When the muscle changes in his length, than will all not- contract -tissue (cross- links) adapt and that can give an mobility problem, but is this an irreversible situation?

Two component high tone and change of the muscle/not-contract tissue are the most likely reason for an mobility restriction, but is that an contracture?
No, because there are possibilities to change that !!

Photo 2

Magareth Johnstone used splint that can be fill with air and created an pressure on, in this case, the upper arm /elbow and under arm to decreased the tone of elbow. There are air-splint (Jobst) for the underarm, wirst, hand and fingers. For the leg with and without the foot . And this will give an decreased of tone or when patient are walking and the increase in the arm occur, than this can slowdown the increase.
The best effect will be obtain when the pressure is changing !! With this splint treatment, it is possible to control the tone better and obtain an better result, but not by all situation with high tone.

Photo 2

Walking is for stroke patient an difficult task because an great part of his balance and much of the movement must be done by the not-affected leg. (Buurke)

That will give an increase of the back diagonal from the not-affected leg to the affected arm and we see there the flexor synergy. (Trunk extension rotation backward on the affected side) That will created an upper trunk backwards on the affected side and this will stay there also when the not-affected leg makes an swing to the front. The high tone and the flexor synergy position will be the equal, the whole time that this person is walking. When that increase of tone isn't gone after walking, there will be restriction arise, first often in the wrist and elbow and fingers and shoulder /shoulder blade. That can also cause pain and the tone will react with an increase of the tone and will give changes in muscle and other tissue and the "wing-arm" is there and will be an obstacle for independent A.D.L.

Now this can also lead to loss of sarcomeres.
Therefore we can train the walking exercises with an splint, that decreased the tone and makes it easy to restore the movement and decreasing the tone after the exercise. Of course without is all right but that must there an treatment to inhibit the tone after the treatment – always.

Photo 3

Photo 3

In this case this is an splint belonging by the P.P.A.M. system, but can fill with air and created an high pressure on the arm /hand and hold the tone lower and the arm /hand out of the flexor synergy. Walking didn't much change by this person, but by someone this will alter also the tone and attitude of the upper trunk backward in an more upper trunk forward and can also decrease there the tone, because the retraction of the scapula is less and makes walking easier.

Another method is plaster .

Serial plaster can be used to give an permanent elongation of the sarcomere and created an situation that the sarcomere must adapt by creation of another sarcomere and so will be longer. That will reversed the restricted mobility but will also "damage" the muscle. The plaster can also be used to inhibited the tone and create an better movement. An better movement is the most important part, not the inhibition of the tone. Or with other words; "It is not an passive solution but when the plaster has effect, that must be use through exercise to get an higher level of movements.

Another indication can be pain /defense muscular, but only when we know what the cause of the pain is.

Plaster can be done on the hand, elbow, knee and foot.

In the case W.v.G (Part 9 Diagonal), an plaster was used to correct the foot in an good position because the shoe and splint was not capable to hold the foot. The plaster was able to do this job and now it was possible to improve his walking pattern.

Individuals after an tendon elongation have plaster for 6 weeks, weeks in which see often better walk than after the removal of the plaster. The reason is that through the plaster the foot stand fixed in the best position and that the perception of the foot was stimulated by walking in the plaster splint. The plaster technique was intense done in Suisse in the rehabilitation Center Bad Ragaz by young patient after brain damage and stroke patient and the result were more than obvious, but realize that it remain an difficult time for the individual to cope with the plaster. Still it is often the only way to treat "contractures " of people with an neurological disease and created an better movement in an leg or arm and the patient will not to have to undergo surgery.

We will show the following examples;

1. Making of an cock-up splint to restore the circulation in the paretic hand/wrist and to drain an "thick hand". This will only work by an thick hand, not by an shoulder-hand syndrome because that is something total different.

2.Serial plaster on the elbow to restore the extension /supination
3. Serial plaster for the hand/wrist and fingers

4. Serial plaster for the restoration of the extension in the knee
5. Serial plaster for correction of the foot .

The principles are equal but serial plaster or an splint is never **enough**, you must do much more to create an situation that the restoration of mobility can be used by the patient . **And when this is not always possible and then will always win the high tone and loss of selectivity.**

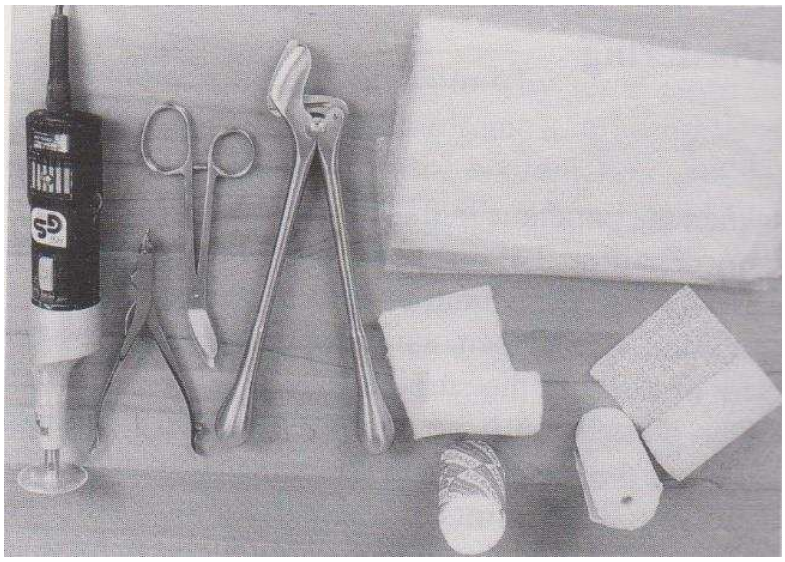

Photo.5
From left to the right; An oscillating saw that saw the plaster but stops when it feel no resistance. An plaster spreader. Two types of scissors that cut the soft bandage and plaster. Plaster material and bandage and soft material between the skin and the plaster.

Photo 5

What you need ;

We used also tubigrip (elasticated tubular bandage) that can be used by edema but in this case not too much pressure on the skin and the purpose is ;
1. That the people of the team can hold grip on the leg or arm of the person.
2. That the edge of the plaster can be cover with soft material that can fixed around the plaster.

Cock –up splint. Why?

The reason of an thick hand is an decrease or even an total stop of the carrying off of the blood and lymph-edema, that will caused through an extreme palmar flexion of the wrist. This is often discovered in the morning and therefore there is an possibility that this person has lie the whole night with the wrist in that extreme position. Often this individual with an stroke has lie on his not-affected side with his affected hand “under the ribcage”. This hurts very much, but the group – individuals with an stroke - with an low perception will not react and when this occur for few hours, the carrying off system can be blocked totally. There are two “types” of thick hand: The first signal is thickness in the **palm** of the hand. Now there must be action, as fast as possible, because now there is little opportunity to treat this without mobility loss. The second type that the first signal follow, is an thickness of the **back** of the hand and now it almost impossible to treat this without loss of mobility and maybe also function of the hand. No treatment or an bad treatment makes thinks worse and is no option. But the reaction on the first signal and prevention to avoid are very important. It is therefore so pity that often the reaction is too late.

Senior Teacher N.D.T.-Bobath Pat. Davies allow us to use there photo out there books and there the blocked of the carrying off system is visible and further one give it two photos about the symptoms of the two “types” of thick hand.

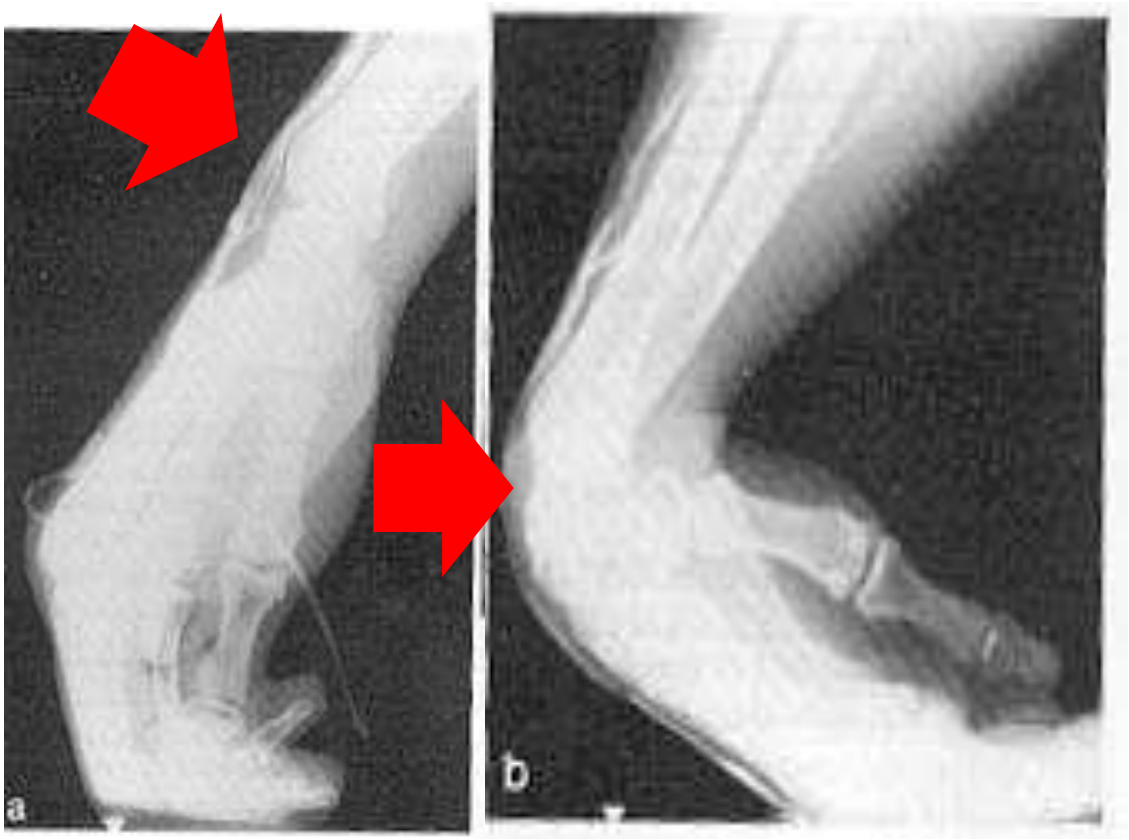

Photo 6 and 7.

Photo 6 . The red arrow show an open carrying off situation with the wrist in neutral position
Photo 7. Look at the red arrow, this on both photos the same spot but now is the blood vessel complete closed.

Photo 8 **Photo 9**

Photo 8. Edema in the palm of the hand , first signal – action
Photo 9. Edema on the back of the hand, later situation , still action.

The edema will be seen first in the palm and with no treatment the chance is very great that the edema goes further to the back of the hand and then in the muscle, ligament and the joint, that can restrict the mobility – all away to irreversible situation !

Therefore always treat and never let go, because no treatment can end so !

Photo 10.
An very painful hand/arm very difficult to live with , to care for and an disaster for the A.D.L. This start with an thick hand and no treatment. After that came an hand-shoulder syndrome.

Photo 10

How you make an cock splint !

Look to the underarm of the individual with an stroke and take plaster that makes an gutter around the under arm (plaster is present in different sizes). Make 8 layers and put they in water that is “hand-warm “ and hold this in the water for about 7-10 second. Longer is not bad, but you must work longer before the plaster is dry and the shape is fixed. That means that this is an team effort. That team must take care of the position of the individual

with an stroke and his arm. Often the tone must be inhibited to hold the position of the wrist so far as possible against the end of the dorsal flexion.

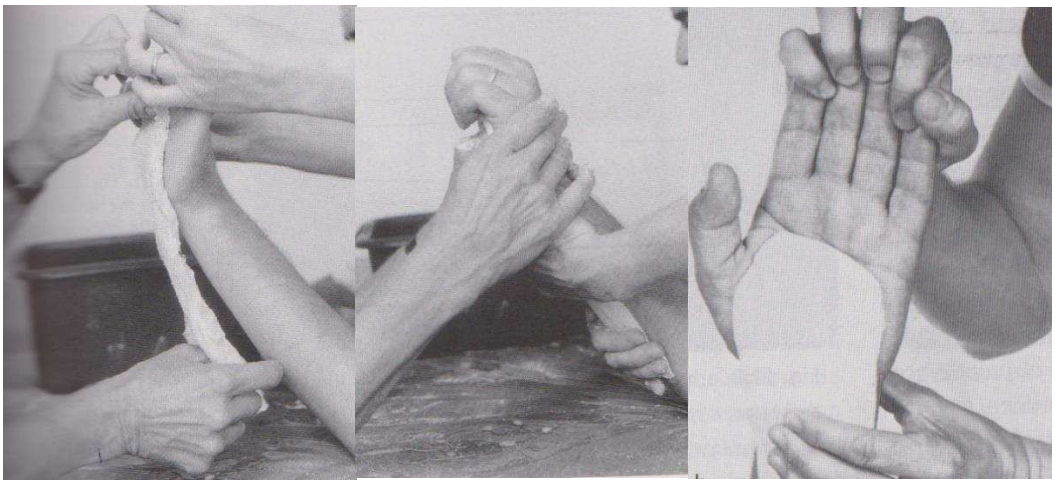

Photo 11 **Photo 12** **Photo 13**

Photo 11. Position of the wrist and elbow , dorsal flexion with flexion and pronation of the elbow **Photo 12 and 13** The splint stop under the meta carpal joint . It is important that the fingers can flex. Never want an total extension. Every splint that set the fingers in extension will **give away** the grip function of the hand.

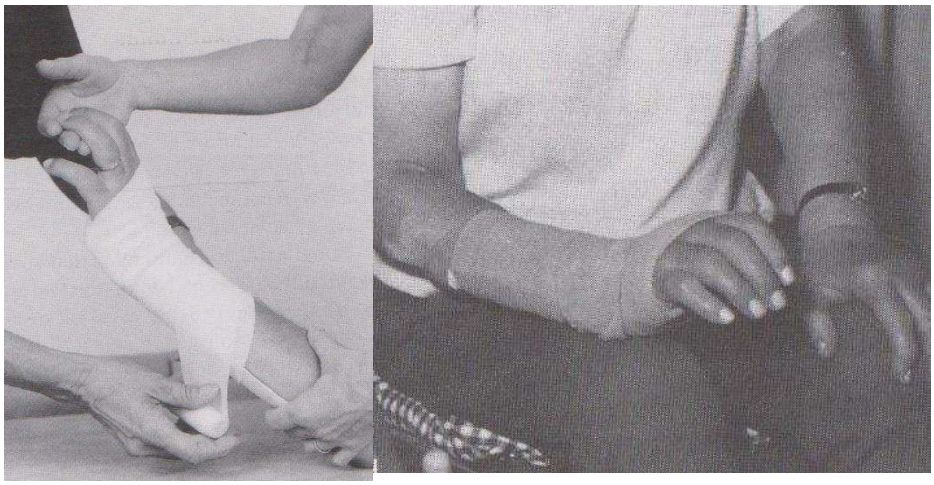

Photo 14 **Photo 15**

Photo 14 and 15. When the plaster is dry, we can use it and bring it on with an bandage. And start with an exercise program in which the affected arm is involved, also with the splint on!

This must be warn for 3 weeks, the whole day but of course this is not the only treatment. Every edema therapy is good, even wrapping can be done, exercises in ice water also, but be careful in the beginning, because often is the vegetative system involved and that will need an period of rest to restore.

After that you must exercise so much as possible with the hand - with and without the splint. But regrettably often is the splint removed, before that all the edema is gone and now it there an great change that it will be come back and that the vegetative system cannot cope with it and then this can develop in an shoulder –hand syndrome.

And very important :
Be sure that the splint is wear in the night and so long it is necessary , too often we see recurrence with all negative results!!

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Serial plaster – Knee .

Start with the treatment to restore the mobility of the knee. Here lies in our department the greatest experience, because often through wrong bed attitude can this flexion tone fast increased. The wrong attitude is : The affected leg turn in exorotation with flexion and that give an lot of pain. That pain will increase the tone in the hamstrings especially in the semi muscle and stimulated this attitude often through huge extension with the affected side (Cross Flexion-extension reaction)

For this treatment make an team and rehearsal before the plaster is placed. 1. One person give all his attention to the patient and inform him, what there is happening with his leg. Of course is in the preparation all with him spoken, but when it is real is that an total different world. Also by the removal of the plaster the same face, when it is possible. 2. One or sometimes two persons must hold the end position of the knee and that is an heavy job 3. One person is fry to help all others and know were stuff lies when there is suddenly to little. 4. One that bring on the plaster.

Make an plan and that is dependent from which knee extension can be achieved. Never will you can hold the frontier the whole time but know what the border is and try out how long the individual can hold that discomfort/ pain. Realize that too much pain will increased the tone and that will never work because the reaction on the tone will be only occur, when the plaster is getting hard.

Photo 16
The first two layers.
First the “tubigrip”(skin colour) and then soft tissue to protect the skin for the plaster and will have an braking effect on the saw. So will be the skin be safe.
One of members of the team is holding an traction on the ankle to hold the extension in the knee as far as possible.

Photo 16

On this photo it isn't quit visual but with an high tone of the hamstrings the under leg will not total translated and that means that the distal part of the knee joint not exactly fit with the proximal part of the knee joint. That means that is can be necessary at the end to lower the traction to get the knee joint the optimal position.

Often you see, that the patient relax and that is the sign that the plaster is getting hard and give an signal to the brain that there is an very good stability and that the high tone is not "necessary" anymore.

Therefore try at the end when the plaster is still soft to fix the best knee joint position otherwise it will be hurt when he stand on that leg. And that will make an good load on this leg impossible and will never lead to an reduction of the tone and an restoration of the knee extension.

Photo 17 **Photo 18**

Photo 17 The soft tissue is on the leg and the distal part of the knee (tibia plateau) stand still too far to the back.
Photo 18 . The plaster is still soft and now we placed the knee joint in the right position. That can be achieve through an combination of lowering the traction and also pull the tibia to the front.

The right position will be obtained by the traction trough the person on the foot , the push on the upper leg / pull on the tibia to the front and through the modeling of the plaster in the distal part under the patella. Now keep moving with your hands to get the plaster so god as possible and to dry the plaster sooner, than the team can lose the traction and must we feel an clear relaxation of the hamstrings.

The next morning start the treatment, because the plaster decreased the tone and will stimulated the sarcomeres to adapt but the antagonist has also adapt and there the sarcomeres are longer. Start with high R.M. when it is possible more than 75% and almost 100% is the best, because that gives hypertrophic. Muscle strengthen exercise task-specific to create more power in the antagonist in this case the knee extensors.

That must be concentric and the only way is to stand and walk with this patient till fatigue and that so often when possible through the day.

In the first days this will be possible for 5 minutes and then the muscle is fatigue but with an frequency of 10 times 5 minutes. When there is an increase of the start (5 minutes), there is an reaction in the knee extensors. This isn't never complete true because the weight of his body will be hold by the plaster. Therefore be sure that the muscle works and be fast with increasing the load or distance and frequency. Be sure through palpation that the knee extensor react so complete as possible. Regrettable the result is often not obtained because therapist train too little and with too little progressive intensity and the muscle has to little stimulation to increase in power.

Seek for every possibility that the extensor of the knee must work hard.

Photo 20

Bad Ragaz. Rehabilitation Centre Swiss.
Exercise with an patient after an brain damage. Both knee were in flex- position (contracture of almost 90°) with plaster technique in an period of two year to now almost full extension.
But every time the plaster was used, there was an great exercise program through the day to ensure that the extensors were getting stronger and were capable to bear the weight of the body also without the plaster splint .
Here the situation that after months of increasing extension in the knee the final approach start with both knee in an good extension position but the strength of the extensor must now adapt on this increased possibility .

And the therapist want to achieve not only stand position but also walk. And that means that the whole treatment will be done by the two therapist .

And after 5 !!! years, he walk will an walker !!!

Photo 20

Removing the plaster and the danger after removal.

After an week the plaster can be removed but there is an change that this give an reaction in the joint – an arthritis- and that will give pain and stimulated the tone. Therefore it is wise to make from the plaster an splint, that the person can use for the exercise and make an orthosis in bed, that will support the leg from his foot all to the buttock and prevent flexion of the knee.

When the individual has more power in the extension of the knee, the danger by an stroke patient that his leg turns in exorotation is still present. When this person lies on his back, be sure that there is an support that prevent the leg to move in exorotation and therefore prevent pain and an increasing of the tone. But the most important factor is that the treatment must go on with such intensity, that first the time walking with an splint increased further and there is an start without the support through an splint. Measure the time the person can walk and that must progressive increase. Therefore the R.M. (Repetition Maximum)is set on more than 75%.

Now we need first muscle strength to counter the tone of the flexor of the knee and create an agonist-antagonist system.

Removing the plaster

Photo 21

Photo 22

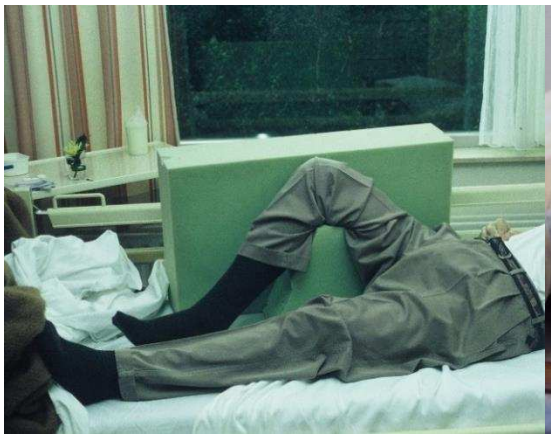


Photo 23

Photo 24

Photo 21 and 22
Removal of the plaster. We cut with saw on the side because we have than two splint that can be used with an bandage as an splint.
Now the team is necessary to hold the leg in the right position.
The splint can be used to further exercise and the orthosis for the rest moment in bed.
The orthosis must have an end point that is palpable for the person that lies in this orthosis. This must stimulated him to push against the orthosis and exercises his extensor possibilities.
An orthosis that has no end point (in this case the foot) can have an effect that the leg is "searching "and that can increase the tone of the flexor.
An increase of the tone of the flexor (hamstrings) will also change the position of the tibia and the femur and can create an wrong position and that can cause the pain in the knee joint.
Pain in the leg will by stroke patients always give an flexor synergy.
Therefore be sure that there is an end point that the person feels because now he can act when he feel something strange and he act with an extension of the knee and increase the restoration of the reciprocal innervation.
Photo 23 and 24 are two orthosis in which in both there is an endpoint for the foot and an prevention of the leg to go to exorotation. Because this exorotation is often the pain stimulus that increase the tone of the hamstrings especially the semi-muscles.

Serial plaster Foot.

In Diagonal part 8 this approach was mentioned use of plaster to create an better walking pattern. The tone of the calf muscle was too high, this “striker foot “ occur often in the beginning of the rehabilitation and start with the control of movement in bed. Prevention of this “striker“ foot is very difficult and asked for an attention from day one. Because the prevention is so difficult, it is an good option to start with plaster treatment when the person is able to start with the walking training.
The serial plaster technique is than used to inhibited the tone or/and get an elongation of the calf muscle by giving stretch on the muscle so that the muscle must adapt by making new sarcomeres. The difference with the knee is, that it is often not possible to stimulated the antagonist. Often the dorsal flexors are so weak or totally absent. There is an solution, activation of this the muscle- group by using electro power through the Ness L-300 that stimulated the m. tibialis anterior and mm. peronei at the moment that the heel is rising from the ground.

Another way to get this agonist-antagonist system work again isn’t possible without an active dorsal flexion and often the alternative is to make an good shoe with an good splint or start with an good shoe with an bandage and try to hold the adaptation of the muscle by giving stretch. You will observe that the patient walk on his best way and with the greatest speed when he had his plaster. Serial plaster gives an effect on tone that is absolute amazing. Still, it never succeed to copy that effect. Even with the two part of the serial plaster together with an bandage on the foot.
The plaster may have an load but the walking pattern start with an heel- strike.
Heel strike landing activated the back diagonal and especially the gluteal muscle and create an movement over the affected leg.
This asked for an good position of the foot and this position must be stable.
Every other adaptation with splint, shoes etc. give the foot still more instability and that we see back in the way the person walk and dare to walk.
When the person isn’t sure that his affected foot stand perfect on the floor, this will slower down his walking speed and asked for an visual control.
Both will inhibit the movement of the body over the affected leg and often the foot is placed flat and no activation of the gluteal muscle occur together with the whole back diagonal.
The plaster created the new position but to hold this position we need the other muscle around the foot and electric activation could be an solution.

Photo 25
Ness L-300.
In the bandage on the under leg under the knee joint there is an electric stimulation system that trigger the m.tibialis anterior and peronei muscle.
On the inside of the foot is the on/out system that works when the heel is of the ground and this can be ware in and on the edge of an normal shoe.

Photo 25

But first the mobility back and the lowering of the tone trough serial plaster.

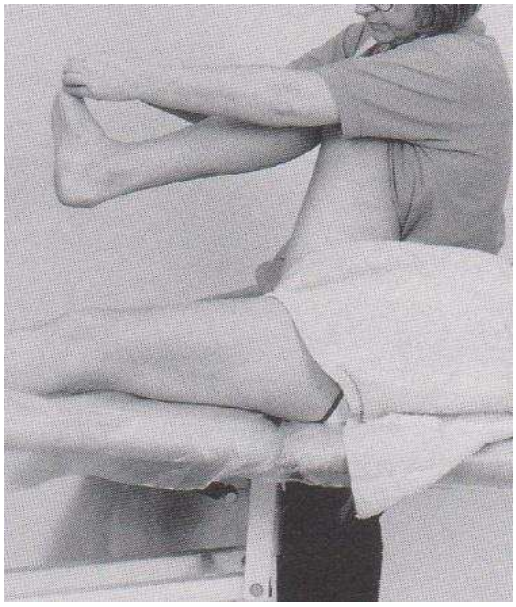


Photo 26
The team is working in preparation for an optimal plaster treatment of the ankle. On this photo the inhibition technique is show and through this technique is possible to hold the position and led the other team member do his job with the plaster. Make not the mistake to hold the knee in extension because than in the walking pattern the knee will be push in end extension. This because the person must bend his trunk and cannot create an active movement over the hip joint and will need an end extension in the knee. Very important is that the inversion is inhibited because that will stimulated an proper heel-strike.

Photo 26

Photo 27

Photo 28

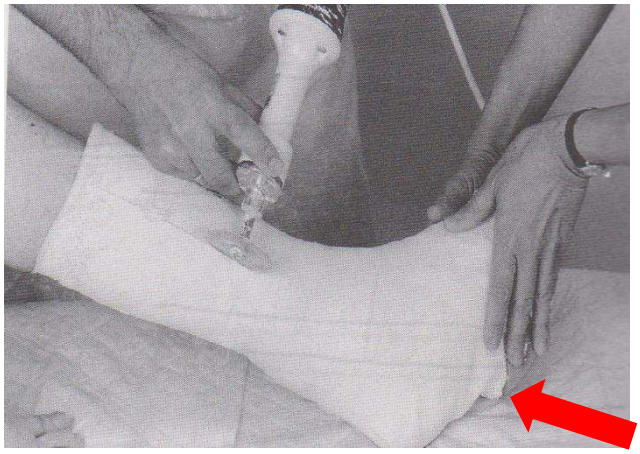


Photo 29

Photo 27
The under warp is placed. “Tubigrip” wasn’t use here.

Photo 28 Especially the toe are dangerous for pressure through the plaster and therefore “tubigrip” makes it easy because you can bend the end back around the plaster .

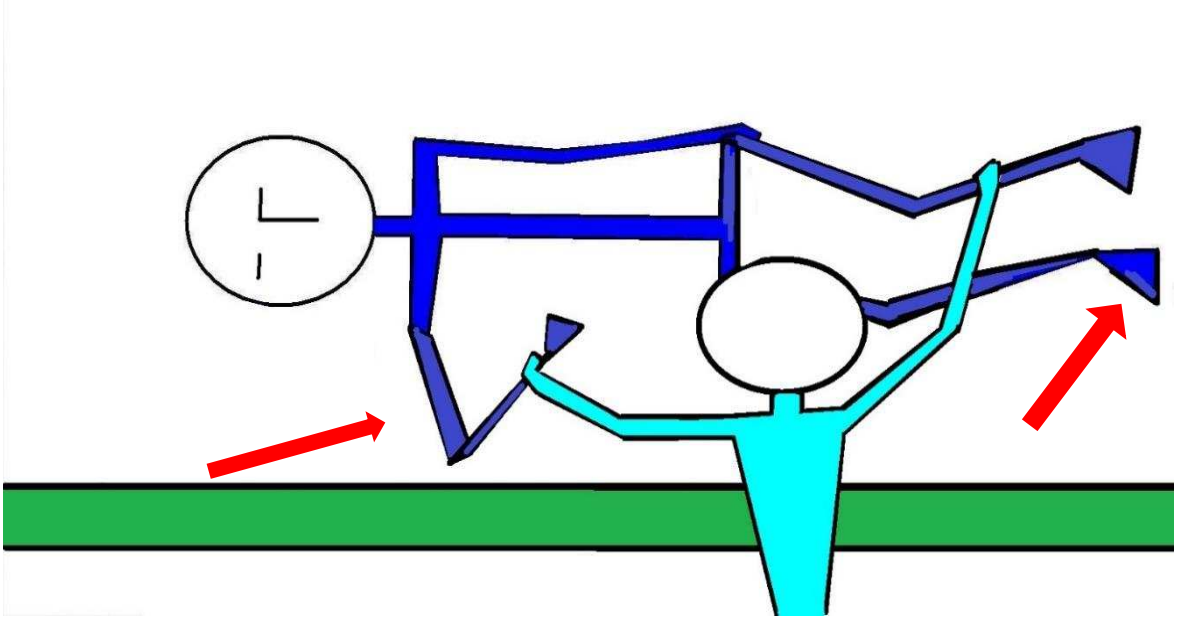
Photo 29 Removal of the plaster and create an splint.

Red arrow means: You can make in the plaster an support area or use an “shoe” that goes in the plaster and make the movement over the foot easy. But the most important issue is always , get when the plaster is dry, starting with good exercise that listen to the differential motor learning and to task specific resistance treatment . That is not always possible for the dorsal flexor of the foot but the movement over the hip can be restored and task specific be treated by resistance against the not affected leg . (Resistance against the not-affected foot in the swing phase ask for an optimal effort of the stand leg and create an task-specific movement over the affected hip – Part 6,7 and 8 Diagonals) The problem will be when the plaster is removed and the stability of the ankle is less. We have no activation of the dorsal flexor and we must create the best stability in the ankle. The stimulation of the dorsal flexor can be done with the electro- stimulation.

Stability through good shoe , splint or/and an bandage, to get the best stability but the most important issue that the tone decrease and the restoration of the mobility is used. That means that with an great intensity (heaviness) , task-specific with and without load or resistance must be exercised and that with an high frequency and in all possible situations. And be careful the first weeks that the result stay present and not disappear through pain or not enough stability in bed or chair. In bed an anti-striker foot orthosis can be necessary, but be sure that the person feel this orthosis and can react. This seem contradiction, but even an clonus will go away when there is resistance under the foot and we need that pressure that will decrease the tone of the calf muscle. In the wheelchair it is important that there is an good placement with an lot of pressure under the foot, especially under the heel. That will give more stability, perception but also pressure when this person try go sit different.

Serial plaster Elbow .

Mostly the serial plaster will be indicated when the flexion “contracture” has great impact in the possibilities of the patient when he want to be independent in washing and clothing, but before this treatment start, two important issues must be clear:
1. Is it an tone- and sarcomeres problem. Because very often is the “movement plane” of the elbow joint not right anymore. That we can assess through the Mulligan technique and when that is the case the tone will decrease and of course it can be an combination of tone/sarcomeres lost and wrong movement plane of the elbow joint. Serial plaster is still possible but place the elbow-joint proper before the plaster is dry.
2. When this patient has problems with the balance than will it difficult for him to walk with the plaster and the result of the plaster will be less after removing of the plaster. It is than wise to start the balance treatment with an inflated splint (see photo 2 and 3)
Most important : ” What can the antagonist”. An high flexor tone and missing sarcomeres, the antagonist will have more sarcomeres, therefore longer and that has an impact on the tone and the power of the muscle. Be sure that the extensor muscle of the elbow is to activated. Start therefore with task-specific resistance exercise to create some power. Exercise such as support technique are very good for this purpose.



Picture 1

Picture 1

In side lateral position on the affected side with the not-affected leg in the air and moving to the front. That ask for an support action of the arm to hold the body stable to prevent an fall to the front. In this picture the not-affected leg is support and there is one hand on the wrist of the affected arm, because we must search for the moment that the arm will extend. At that point resistance can be given against the arm till the moment that the border is reach that is often almost 100% . Start with this information with power exercise program, so many rehearsal till we feel that the power is less – Fatigue - and know that this we do 3 times 3 times an week. And make this program progressive!!

When he is capable to lift the leg, but the problem lies more in the affected leg, you can facilitated the movement through give the affected leg on the upper leg an endorotation, that will give him more support and often more possibilities to move his not- affected leg to the front . This exercise can also give an action of the peronei -muscle of the foot and can therefore use for strengthening from that muscle group. Every time almost 100% R.M. and this isn't an high cortical action but an balance reaction in an lower part in the brain. This will give an antagonist action but not always an action that the individual can make in other situations. This agonist-antagonist coordination is an lower brain function but can help to hold the effect after the plaster treatment.

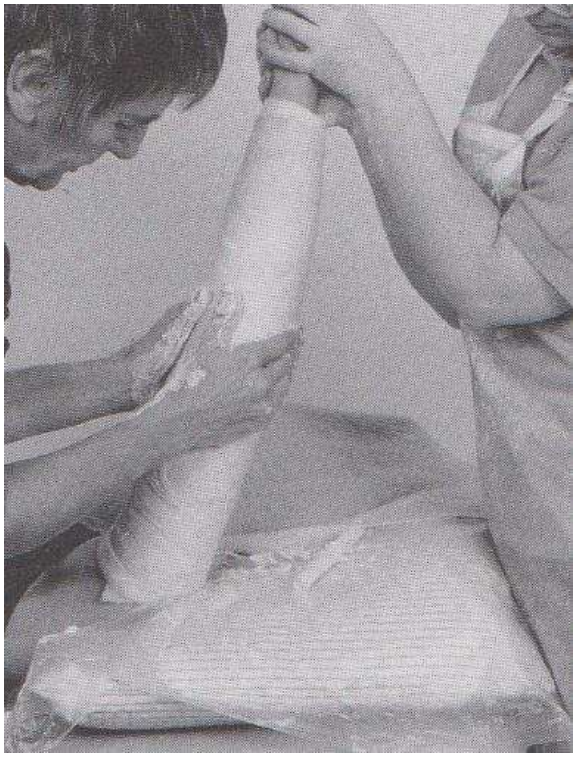


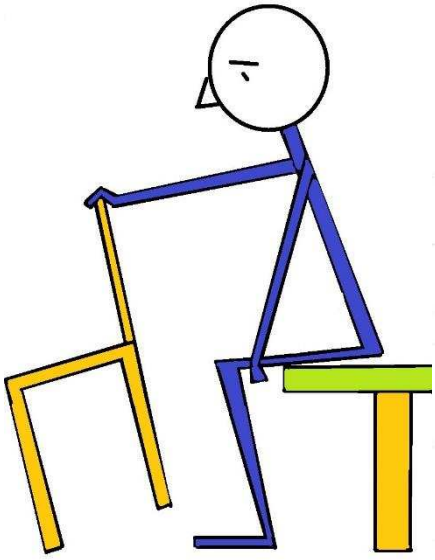
Photo 30

On this photo this is the result, achieved after the fifth serial plaster in one year.
Every time when the plaster was dry there was an intensive exercise program to strengthening the extensor of the elbow in the plaster (the plaster stay on an week) After removing the plaster, part of the plaster was used as an splint in the next exercise program and when that was going well there came an exercise program without an splint and when the m.triceps was capable to hold the length of the biceps than was the moment to go to the next serial plaster to created more mobility. In the week after the plaster removal the splint was also ware in bed, this for an longer period to hold the joint in the right place.

Photo 30

The combination of inhibition of the tone of the flexor (agonist) and the task-specific resistance exercising for the antagonist give an decrease in flexion of the elbow and enough own possibility

to extend the elbow. Still it was almost impossible to extend the elbow on their own in the beginning. They need to search for an close chain. Support exercises gave the person the possibility to extend their elbow but it wasn't enough to extend without that situation.



Picture 2

Picture 3

Picture 2 and 3

In the beginning only extension of the elbow was possible as in picture 1 , after that as in picture 2 and at the end an extension with an upper trunk forward to make dressing easier.

Especially attention after the plaster is removed must be for the movement of the joint. Be sure that this joint move on the right way and that this movement is supple. In the elbow is often the radio-ulnair joint not in the "right" place and is an manipulation of par example according Mulligan necessary to get that movement supple again.

Serial plaster wrist and fingers.

The most difficult of all, because the function of the antagonist is often not there from the wrist ,fingers and thumb. We can use electro therapy par example the Ness, but it is very difficult to build up power in the muscle and therefore the length of the sarcomeres will not decrease and we have no system that control the length of the agonist . The second problem is the application of serial plaster on the underarm , wrist and fingers. This very difficult an ask an lot of an good team. Last but not least the mobility of so many joint can be changed through other causes but also through tone increase. The thick hand problem has often give an lot of damage in the joint

It is important that the serial plaster has good result and that is only possible when the antagonist is capable to stretch the agonist and hold the agonist in shape.
Therefore be glade that you create more mobility but the program of exercise after the plaster is much more important. The next serial plaster always must wait, till there is an good result and steadiness of the created mobilitv.

and that can be very great. There are cases know that the joint are damaged through the edema. Still the indication to try to reverse will be often an situation that has in his history an thick hand period. Often with neglect and disuse symptoms that give in the beginning an flat and a-tone hand with no tone. But after an longer period the tone increase and then there occur some possibilities in the wrist , and fingers. But here isn't the tone alone often the cause for the contractures but also changes in the bones and joint and that can make this situation on some location irreversible. But still when the tone is the greatest problem and there is activity in the antagonist or there is an possibility to evoke this with par example electro therapie than it is an reason to take the plaster treatment. You will see that the tone decrease is often immense but the result is dependent of the action of the antagonist.

Photo 31,

Photo 32

Photo 33

Photo 31, 32 and 33 Photo 31 are changes visible in the bone density and that give us an sign that the vegetative system is assault. This is one way that this is visible, the other way is that the joint planes are not visible because the bone has grown over the joint and then the movement of the joint is almost irreversible.

Photo 32 and 33 When we this apparatus only let do his work the muscle will be stimulated but will the brain react ?

There are investigation par example from Alon that said that an combination of electro with exercise has more impact in the brain but then must there be an function in the hand.

No function, the electro will stimulated the antagonist but of that is good enough to resist the tone or give an adaptation of the sarcomere is still an great and difficult question. Our feeling is that this only occur when there is function. Holding an spoon in the hand and inhibit the extension stimulation of the apparatus can be an important change because this action must start somewhere in the brain and can have an possibility to bring an change in the brain .

Photo 34

Serial plaster for the hand/wrist. First the use of tubigrip (not on the photo) but that makes it for the team member that must hold an stretch on the finger and the thumb easy to get his hold and the person that lay the plaster has an little more place to work.

But you can never use the tubigrip for the finger and for the thumb. The solution is two tubigrip on the underarm, one you cut out the thumb and goes to the finger and the other you cut out the finger and goes to the thumb. The advantance of tubigrip is better grip, more place but also on the end an better protection against the edge of the plaster especially by the thumb and fingers.

Photo 34

The reaction in an hand with high tone on the moment that the plaster is dry, is sensational. This reaction must be there, because now you have the reaction(Jan Kool), that makes it possible to inhibit the tone and give an reaction of stretch on the sarcomeres. The pressure that by serial plaster is “felt” in the brain, is there the signal for release of tone. Jan Kool has tested this through E.M.G. and the signal decrease very quit after the plaster was dry. After an week plaster remove the plaster and the wrist /fingers will be total relax and when there is function in the hand, even with the Ness(Electro) than you be capable to hold an part of

the inhibition but the pressure is gone and the brain feel that and will react. Making an splint of the two part of the serial plaster with under wrap and with an firm bandage will never give the effect as the serial plaster, but is the best solution to hold some inhibition. An splint out of fractomed (what is hard material) and place that splint directly after their removal of the plaster has no advantage as there is no antagonist function or almost continue electro stimulation. Only an fractomed splint and no function in the antagonist or no stimulation will in an day set the tone on the level as before the plaster treatment.

Working in the hand with PVC tubes that fit easy in the hand is an possibility but again the reaction of the hand must be observe . When this PVC tube isn't fall out the hand , the tone will increase to the high tone as before. When the tube is falling out of the hand than there is an reaction of the antagonist and that is the moment to start the stimulation or learn the person to activated the electro stimulation with additional exercise for the hand.

Be aware that this fall out of the hand must be possible because that is an reaction of the antagonist or an tone decrease of the agonist and will also give an tone reduction in the whole synergy. But an tube that cannot fall out the hand, because the antagonist has not the power to open so far, has no value and will lead to more tone and often also to negative vegetative reactions. That means that the perception of the hand in the brain is changed and that an amount of pressure can give the brain the information that will be lower the tone. But only that pressure give that information in the brain another stimulus isn't good enough and give an high tone.

Serial plaster is one of the best way to decrease tone and/ or increase the length of the sarcomeres but be aware that the antagonist has an increase of length of the sarcomeres and that the success of the treatment is total dependent on the decrease of length of the antagonist and increase of power to hold the achieved mobility improvement.

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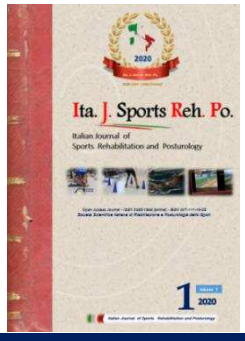

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The authors declare that they have no financial, consulting, and personal relationships with other people or organizations that could influence the author's work.

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All authors played a significant role in this project; All authors were involved in drafting the manuscript critically for important content, and all authors approved the final version.

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