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## Content

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# I. GENERAL REPORTS

## Undele de soc extracorporeale

**Gina Galbeaza, Delia Cinteza, Dana Poenaru, Victorita Marcu, Simona Popescu, Sebastian Diaconescu, Augustin Dima**

**INRMFB, Clinica IV**

**Rezumat:**

Prezentul articol urmareste o trecere in revista a studiilor existente in literatura de specialitate privitoare la undele de soc. De la descoperirea lor in urma cu cateva decenii si pana la utilizarea in afectiunile musculo-scheletale (1994) mecanismele intime de actiune ale undelor de soc la nivelul organismului uman si animal nu au fost studiate. Incepand cu anul 1994 exista un numar mare de lucrari in literatura de specialitate insa compararea acestora este extrem de dificila deoarece pe de o parte metodologia de lucru difera iar pe de alta parte efectele depind si de tipul de aparat utilizat.

**Cuvinte cheie:**

unde de soc extracorporeale, unde de soc radiale, tendinite, fasciita plantara, osteonecroza, ulcere cutanate

Undele de soc sunt unde acustice. Ele au fost initial utilizate in medicina in urma cu aproximativ 20 de ani in litiaza renala revolutionand tratamentul acesteia. In cursul tratamentului pentru dezintegrarea calculilor ureterali jos situati s-a observat ca au efecte si asupra osului. Studiile in vivo derulate ulterior au demonstrat ca acest tip de unde au efect de stimulare a osteoblastelor. La doze intre 10-20% din cele folosite in tratamentul litiazei renale aceasta forma de terapie este din 1994 utilizata si in tratamentul a numeroase afectiuni musculo-scheletale, in special in tendinite si entezopatii dar si in pseudartroze si necroze avasculare ale capului femural. Ulterior a aparut si unda de soc radiala (rESWT) care difera in parte de unda de soc clasica (ESWT). De asemeni terapia cu unde de soc este utilizata si in angina pectorala care nu raspunde la medicatie si care nu are indicatie chirurgicala (aparatul este in acest caz cuplat cu un EKG). In prezent se afla in derulare un studiu in Austria privitor la efectul benefic adjuvant al undelor de soc in interventiile chirurgicale de tip by-pass aorto-coronarian.

### Tipuri de aparate

Exista mai multe moduri de generare a undei de soc.

- electrohidraulic
- piezoelectric
- electromagnetic
- pneumatic

Toate sistemele cunoscute care genereaza unde de soc sunt prevazute cu unitati care permit energiei sa fie focusata intr-o arie precis delimitata.

Dispozitivele alectrohidraulice, electromagnetice si piezoelectric produc un puls care depaseste bariera sunetului si creeaza o unda de soc. Cel de-al patrulea genereaza mai degraba o unda de presiune care difera de unda de soc propriu-zisa.

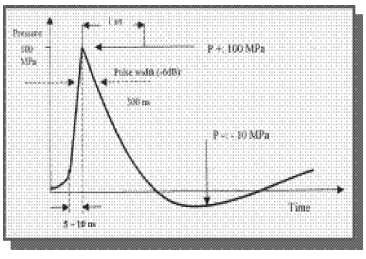
Sistemele electrohidraulice aplica tensiune inalta intre doi electrozi situati in apa, apa se evapora si genereaza astfel unda de presiune care este focusata cu ajutorul unui reflector elipsoid.

Dispozitivele electromagnetice utilizeaza o bobina careia i se aplica curent electric, generand astfel un camp magnetic care ulterior genereaza unda de soc iar pentru focusare utilizeaza un reflector parabolic.

Dispozitivele piezoelectrice utilizeaza un puls electric care se aplica unui element ceramic piezoelectric pentru generarea undei de soc iar focusarea se realizeaza prin intermediul a mii de cristale mici plasate in capul aplicator.

Unda de soc extracorporeala este o unda de energie inalta caracterizata de o presiune pozitiva de pana la 100 Mpa atinsa rapid (<10 ns) si de o presiune negativa de 5-10 Mpa, durata foarte scurta (10µs) iar viteza sa o depaseste pe cea a sunetului.

Spre deosebire de unda de soc clasica care depaseste bariera sunetului (1500m/s), unda de soc radiala are o viteza de aproximativ 10 m/s fiind mai lenta, mai putin intensa si mai elongata.



## Efectul undei de soc

Mecanismul exact de actiune al undelor de soc extracorporeale la nivelul tesutului moale nu este inca pe deplin elucidat. Se pare ca unda de soc actioneaza pe doua cai oarecum distincte:

1. Presiunea mecanica la nivelul tesutului tratat
2. Fenomenul de cavitatie. In spatele undei de soc apar bule de cavitatie care ulterior se sparg si apare o forta rezultanta. Aceasta forta este suficient de puternica pentru a dezintegra depozitele calcare din tesutul moale. De asemeni, in momentul spargerii bulelor de cavitatie apar unde de energie secundare. Acest efect nu apare in cazul undelor de soc radiale.

## Modalitate de aplicare

Parametrii utilizati variaza in functie de tesutul tinta si de tipul de aparat. Atingerea tesutului tinta se poate face ghidat (fluoroscopic, ultrasonic) sau clinic (zona de maxima durere). Intre capul de emisie si tegument se aplica gel pentru a asigura transmiterea undei de soc in interiorul organismului. Pentru undele de soc de energie inalta in functie de parametrii utilizati poate fi necesara utilizarea anesteziei locale. ESWT poate utiliza atat sedinte unice cat si repetate in functie de afectiune. RESWT utilizeaza sedinte repetate.

## Indicatii

1. Tendinite cronice. Unele trialuri dovedesc efectul favorabil al terapiei cu unde de soc in timp ce altele nu o gasesc superioara placebo. Variabilele multiple associate cum ar fi cantitatea de energie utilizata, tipul de unda de soc (focala sau radiala), frecventa aplicarii terapiei, utilizarea sau nu a anesteziei, fac compararea acestor trialuri extreme de dificila (12).

   Epicondilita laterala (tennis elbow) beneficiaza si ea de terapia cu unde de soc extracorporeale. O metaanaliza condusa de Rompe asupra a noua studii clinice a demonstrat de asemenea eficienta acestui tip de terapie in epicondilita laterala (16).

   In tendinita rotuliana – pare sa aiba rezultate bune dar o metaanaliza condusa de Zwerver demonstreaza ca studiile sunt deficitare pentru aceasta patologie. Pentru impingement subacromial exista un studiu simplu orb, randomizat (Vetrano) care demonstreaza o ameliorare mai buna pe termen mediu si lung cu ESWT decat cu tratament conservator clasic. Poate fi utilizata atat ESWT cat si rESWT. Pentru ESWT se folosesc 1500-2000 impulsuri, 0,1 mj/mm2, frcventa 10Hz. Pentru rESWT se folosesc 2000-3000 impulsuri, frecventa 10 Hz si 2-3 bari.

2. Tendinite calcare. O metaanaliza privind efectul terapiei cu unde de soc in tendinita calcara a fost condusa de Patrick Vavken. Aceasta a cuprins un numar de 14 studii ( Medline, Embase, Cochrane Controlled Trials Register) si a demonstrat eficienta acestei forme de tratament in reducerea durerii, recastigarea functiei si resorbtia depozitelor (8). Utilizarea ESWT la energii inalte – chiar 0,2-0,4 mj/mm2 (care necesita anestezie locala) pare sa fie superioara rESWT in dezintegrarea depozitelor calcare.

3. Fasciita plantara. In prezent se recomanda utilizarea tratamentului cu unde de soc in fasciita plantara care nu a raspuns la celelalte mijloace de tratament conservator (fizioterapie, kinetoterapie, eventual infiltratii). Aceasta terapie este deci in momentul de fata o alternativa la tratamentul chirurgical. In tratamentul fasciitei plantare se poate utiliza ESWT (aplicatie unica) sau rESWT (3-6 aplicatii la interval de cate o saptamana) la doze similare celor din tendinite. Rezultatele studiilor demonstreaza rezultate favorabile pentru ambele tipuri de unde dupa cum arata o metaanaliza condusa de Rompe et al (15). Efectul analgezic se mentine dupa unele studii si la 4 ani (Troncati, 2009). Nu in ultimul rand, Raykov (2009) a prezentat rezultate foarte bune dupa aplicarea rESWT in cazuri particulare de fasciita plantara (interventii chirurgicale, laceratii plantare), obtinand ameliorare semnificativa a durerii pe scala VAS. Sunt necesare studii suplimentare care sa demonstreze daca nu cumva aplicarea undelor de soc inaintea epuizarii celorlalte metode terapeutice ar avea rezultate superioare. Din 2000 FDA a aprobat acest tip de terapie in tratamentul fasciitei plantare.

4. Miozita osifianta. Messina si colab (2009) prezinta cazul unui sportiv de 15 ani cu miozita osifianta posttraumatica care nu a raspuns la tratamentul conservator. Supus ESWT – 1 sesiune acesta a prezentat ameliorare clinica si functionala dar nu si imagistica.

5. Osteonecroze aseptice. Wang si colaboratorii (18) au comparat efectul ESWT singur respectiv asociat cu alendronat asupra necrozei aseptice de cap femural. Rezultatele au fost similare in ambele loturi de pacienti demonstrand efectul benefic al ESWT in osteonecroza aseptica de cap femural. Nu exista studii randomizate, dublu orb, controlate privitor la actiunea ESWT asupra necrozei aseptice de cap femural. Studiile publicate pana in prezent sugereaza insa efectul benefic al ESWT demonstrand astfel necesitatea continuarii cercetarilor. Se pare ca doar ESWT ar avea efect in aceasta afectiune probabil datorita penetrarii mai profunde in tesuturi. Se utilizeaza energii inalte.

6. Pseudartroza. Pseudartroza este definita ca absenta procesului de vindecare dupa 6 luni. Primul care a utilizat ESWT in tratamentul pseudartrozei a fost Valchanov in 1986. Ulterior au aparut si alte studii clinice ca si studii experimentale care au demonstrat stimularea osteoblastelor (19,20). Moretti (21) a condus un studiu asupra a 204 pseudartroze si 16 fracturi acute. 85% din pseudartroze si 80% din fracturile recente s-au vindecat. Mentionam ca studiul nu a avut lot de control. De asemeni toate studiile prezentate pana acum in literatura au utilizat doar ESWT. Rata de succes variaza in diverse studii clinice intre 76-91%. Daca principala diferenta este puterea de penetrare in tesuturi, rESWT ar putea fi indicat pentru pseudartrozele oaselor superficiale (ex scafoid). Nivelul de energie utilizat este mai inalt decat cel utilizat pentru tesuturile moi.

7. Ulcere tegumentare diabetice si nondiabetice. Wang si colaboratorii au studiat efectul ESWT asupra ulcerelor diabetice (23). 72 de pacienti cu ulcere diabetice au fost supusi fie tratamentului cu ESWT fie celui cu oxigen hiperbar. ESWT a fost aplicat in trei sedinte la interval de cate 2 saptamani. Rezultatele au fost in favoarea grupului tratat cu ESWT. Se utilizeaza in general 100 impulsuri/cm2, 0,11 mj/mm2, 3 sedinte la interval de cate doua saptamani. Nu exista studii privitoare la rESWT. Mecanismele de actiune care stau la baza sunt multiple. Printre ele se numara stimularea neovascularizatiei, efectul bacteriostatic si regenerarea tisulara (celulele stem mezenchimale sunt influentate in ceea ce priveste migrarea si reorganizarea citoscheletului de catre undele de soc -Delhasse, Neuland, Bloch)

8. Spasticitate. Un studiu condus de Manganotti (17) asupra a 20 de pacienti cu spasticitate severa a membrului superior. ESWT a fost aplicat in sedinta unica asupra flexorilor degetelor si interososilor. Spasticitatea a scazut semnificativ la o saptamana si la 4 saptamani. La 12 saptamani 10 din cei 20 de pacienti au prezentat in continuare spasticitate scazuta. Exista cateva studii privitoare si la efectul rESWT asupra spasticitatii. Astfel Vidal a demonstrat actiunea benefica a acestui tip de terapie in spasticitatea din paralizia cerebrala. Dozele utilizate au fost de 2000 impulsuri si 2 bari, 3 sesiuni la interval de o saptamana. Un astfel de studiu se afla in prezent in derulare in clinica IV a INRMFB.

9. Trigger points. Punctele trigger sunt puncte dureroase la presiune situate in masa musculara. Ele apar ca urmare a unei crize energetice locale (Simmons 1996) determinata de o imbalanta intre necesarul si aportul energetic. Pentru tratamentul acestora pot fi utilizate atat ESWT cat si rESWT. Se incepe cu un nivel energetic mai jos care poate fi treptat crescut in functie de tolerabilitatea pacientului. In cazul in care punctele trigger apar secundar unei alte patologii aceasta trebuie tratata de asemenea. Tratamentul se aplica o data pe saptamana iar numarul sedintelor variaza de la 1 la 6 in functie de raspunsul individual. Numarul maxim citat in literatura de specialitate este de 10 sedinte.

10. Neurinom Morton. Exista date in literatura privitoare la efectul pozitiv al undelor da soc in neurinomul Morton. Specialistii de la Weil Foot & Ankle Institute au condus un studiu dublu orb, randomizat, placebo controlat asupra a 30 de pacienti cu neurinom Morton. Toti erau pacienti la care esuase tratamentul conservator si erau candidati pentru tratament chirurgical. 27 dintre acestia au avut evolutie favorabila, numai 3 din ei necesitand ulterior interventie chirurgicala.

11. Angina pectorala. De asemeni terapia cu unde de soc este utilizata si in angina pectorala care nu raspunde la medicatie si care nu are indicatie chirurgicala (aparatul este in acest caz cuplat cu un EKG). In prezent se afla in derulare un studiu in Austria privitor la efectul benefic adjuvant al undelor de soc in interventiile chirurgicale de tip by-pass aorto-coronarian (Dept of Cardiothoracic surgery, Medical University of Viena). Se utilizeaza ESWT.

## Mecanisme de actiune

Un numar limitat de studii in vivo recente au studiat mecanismele de actiune ale undelor de soc. Din cunostintele noastre nu exista nici un studiu care sa fi utilizat rESWT pentru a studia mecanismul de actiune. Studiile in vitro sunt si mai slab reprezentate.

1. Stimularea neovascularizatiei. Wang (22) a demonstrat intr-un studiu pe iepuri stimularea neovascularizatiei in fragmentele de biopsie de la jonctiunea muschi-tendon (supusa ESWT) examinate la microscop. Neovascularizatia a fost confirmata de markerii de angiogeneza (factorul de crestere endothelial vascular VEGF, expresia sintetazei endoteliale de oxid nitric eNOS, expresia antigenului de proliferare celulara nucleara PCNA). Majoritatea cercetatorilor sunt in prezent de acord ca la baza actiunii terapeutice a undelor de soc sta stimularea neovascularizatiei.
2. Efect bacteriostatic. Wang si colab (23) au efectuat culturi din plagile pacientilor tratati cu ESWT demonstrand efectul bacteriostatic al ESWT. Coombs si colaboratorii (2009) au raportat rezultate promitatoare in tratamentul infectiilor ortopedice.
3. Stimularea remodelarii si regenerarii osoase. ESWT creste nivelul seric de oxid nitric, TGF beta 1, VEGF si BMP-2. Consolidarea a fost obtinuta la 78,6 din pacienti intr-un studiu al lui Wang (24).
4. Stimularea chemoatractiei. ESWT stimuleaza expresia factorilor chemoatractanti (25). Astfel, expreia ARNm pentru SDF1 este semnificativ upregulata de aplicarea ESWT. SDF 1 este un ligand specific pentru CXCR4 care este puternic exprimat la nivelul celulelor progenitoare endoteliale.SDF1 (stromal cell - derived factor 1) joaca un rol cheie in atragerea celulelor progenitoare endoteliale circulante in jurul vaselor in crestere din tesuturi. Neuland a studiat capacitatea undelor de soc de a stimula migrarea si proliferarea celulelor mezenchimale. Conform acestuia rESWT au o capacitate mai mare promigratorie in timp ce ESWT au o capacitate mai mare pro-proliferativa.
5. Mecanotransductia reprezinta mecanismul prin care celulele convertesc semnalele mecanice in raspunsuri biochimice. Modul in care se realizeaza aceasta conversie este insa inca necunoscut. Undele de soc realizand o stimulare mecanica ar putea sa utilizeze acest tip de mecanism.
6. Diminuarea apoptozei. Majoritatea studiilor in vivo au studiat si fenomenul de apoptoza al celulelor supuse undelor de soc. Parerile converg spre faptul ca undele de soc diminua apoptoza celulara.
7. Diminuarea durerii. Scaderea durerii se pare ca este determinata pe de o parte de fenomenul de anestezie prin hiperstimulare iar pe de alta parte prin mecanism de tip gate-control. Se pare ca utilizarea undelor de soc cu anestezie ar avea efect mai slab decat utilizarea lor fara anestezie.

## Reactii adverse

1. hematom local (incidenta sub 1%)
2. accentuarea tranzitorie a durerii
3. ameteala, tinnitus si cefalee in cazul aplicarii cervicale

## Contraindicatii

1. Tumori
2. Aplicarea pe vase si/sau trunchiuri nervoase mari
3. Aplicarea pe tesut pulmonar
4. Sarcina
5. Aplicarea pe cartilajul de crestere

## Contraindicatii relative

1. Pacientii tratati cu anticoagulante
2. Tulburari ale echilibrului fluido-coagulant

# Extracorporeal shock waves

**Gina Galbeaza, Delia Cinteza, Dana Poenaru, Victorita Marcu, Simona Popescu, Sebastian Diaconescu, Augustin Dima**

**INRMFB, Clinica IV**

**Abstract:**

Thist article wishes to overlook the studies from medical literature regarding extracorporeal shock waves. Since they were discovered (few decades ago) till their utilization in musculo-skeletal disorders (1994) the mechanism of action in both human and animal organism weren't studied. From 1994 there are an increasing number of papers but their comparison is extremely difficult because of different working methodology and also different devices used.

**Key words:**

ESWT, rESWT, tendinitis, Plantar fasciitis, osteonecrosis, skin ulcers

Shock waves are acoustic waves. They were first used in medicine 20 years ago in urolithiasis, bringing major changes in its treatment. During the treatment for lower stones it were observed effects on pelvic bone. The in vivo subsequent studies demonstrated that these type of wave stimulated osteoblasts. At doses between 10 and 20% out of those used in urolithiasis treatment this kind of therapy is from 1994 used in the treatment of many muscular-skeletal disorders, especially tendonitis and enthesopathies but also for non-unions and avascular necrosis. Later was discovered radial shock wave (rESWT) which is somehow different from clasical shock wave (ESWT). Recently, ESWT is used in the treatment of CHD which can not be drug controlled and can not be surgically treated (the device is in this case coupled with an ECG device). Nowadays in Austria is developing a study regarding beneficial effect of ESWT in the aorto-coronarian by-pass.

## Devices

There are several kinds of shock wave generationL

- electrohydraulic
- piezoelectric
- electromagnetic
- pneumatic

All known systems which generates shock waves have units which permit focusing the enrgy in a well specified area.

The electrohidraulic, electromagnetic and piezoelectric devices produce a pulse which exceed sound barrier and creates shock wave. The fourth one generates a pressure wave different from shock wave.

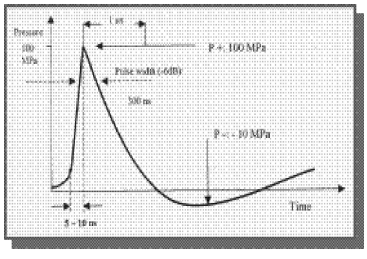
The electohidraulic systems apply high voltage between 2 electrodes in water, the water evaporates and the shock wave is generated, subsequently beeing focused by an elipsoid reflector.

The electromagnetic devices utilise an electric current which is applied to a coil, a magnetic field beeing generated. This magnetic field is the one which generates the shock wave. For focusing a parabolic reflector is used.

The piezoelectric devices use an electric pulse which is applied to a ceramic element. For focusing are used thousands of little cristals placed in the applicator head..

The extracorporeal shock wave is a high energy wave caracterized by a positive pressure up to 100 Mpa, quick raise (<10ns) and a negative pressure of 5-10 Mpa. The duration is very short (10μs) and its velocity is exceeding that of the sound (1500m/s).

In distinction, radial shock wave has a velocity about 10m/s beeing slower, less intense and more elongated.




## The effects of shock waves

The exact mecanism of action of extracorporeal shock waves is not completely elucidated. It seems that shock wave acts through 2 distinctive paths:

1. Mecanical pressure over the target tissue
2. The cavitation phenomenon. Behind the shock wave cavitation bubbles are borned. Thes subsequently breaks and a resulting force appears. This force is strong enough to break calcar deposits from the soft tissue. This effect didn't appear for rESWT.

## Application modalities

The used parameters depends on both the target tissue and type of device. Reaching the target tissue can be made guided (fluoroscopy, ultrasonograpy) or clinically (maximal pain zone). Between the transmitting head and skin a layer of gel must be applied for assuring the shock wave transmision into the body. For high energy shock waves depending on which parameters are used, local anestezy may be necessar. ESWT uses both unique and repeated session, depending on the diease beeing treated. RESWT uses repeated sessions.

## Indications

1. Cronic tendinitis. Some trials prooved convenient effects but others didn't find it superior to placebo. Multiple associated variables such are the quantity of used energy, the type of wave (ESWT or rESWT), the frequency of sessions, with or without anaesthesis, make the comparing of these trials extremely difficult (12). Lateral epicondilitis (tennis elbow) seems to beneffit from the therapy with extracorporeal shock waves. A metaanalysis runned by Rompe on 9 clinical studies demonstrated the efficiency of this kind of therapy in tennis elbow (16).

   For pattelar tendinopathy despite the fact that it seems to have good results a metaanalysis of Zwerver demonstrate that the studies are week for thia pathology.

   For subacromial impingement there is a study simple blind, randomized (Vetrano) which demonstrates better results with ESWT than with clasical conservatory treatment on medium and long term. Both ESWT and rESWT can be used. For ESWT 1500-2000 impulses, 0,1 mj/mm2, 10Hz frequency is used. For rESWT 2000-3000 impulses, 10 Hz frequency and 2-3 bars.

2. Calcar tendinitis. One metaanalysis regarding the effects of this therapy was conducted by Patrick Vavken. It comprises a number of 14 studies ( Medline, Embase, Cochrane Controlled Trials Register) and prooved the efficiency of this type of therapy in reducing pain, regaining function and resorbtion of deposits (8). Using ESWT at high energy (even 0,2-0,4 mJ/mm2) seems to be more efficient then rESWT.

3. Plantar fasciitis. This type of treatment is used for plantar fasciitis which has not responded at conservatory treatment (fisical therapy, injections), beeing an alternative to the surgical treatment. Both ESWT (unique application) and rESWT (3-6 applications, 1 per week) can be used. Rompe et al (15) demonstrated both waves having similar results. The analgezic effect is maintained even after 4 years (Troncati, 2009). Nevertheless, Raykov (2009) presented good results after rESWT in particular casis of plantar fasciitis (after surgical interventions, plantar laceration), obtaining significant aleviation of pain on VAS scale. Future studies are needed to demonstrate if this type of therapy can be used with superior results at the begining of treatment. From 2000 FDA approved this kind of therapy for plantar fasciitis.

4. Ossifiant miositis. Messina and colab (2009) presented a clinical case of a sportive of 15 years with posttraumatic ossifiant miositis who didn't respond to conservatory treatment. After ESWT - 1 session he showed clinical and functional good results but no imagistic improve.

5. Osteonecrosis. Wang and colab. (18) compared the effect of ESWT alone and in addition to alendronate on osteonecrosis of femoral head. The results were similar in both groups. There are not randomized, double blinded, controlled studies regarding the effect of ESWT in osteonecrosis. The studies published up to now suggest good results making research necessary. Just ESWT seems to determine good results, probable because of more deep penetration. The succes ratio varies in various clinical studies between 76 and 91%. If the main difference is the tissue penetration, rESWT could be indicated for nonunions of superficial bones (eg scafoid). High energy is required.

6. Nonunion and delayed union. Nonunion is defined as the missing of healing after 6 months. In 1986 Valchanov was the first who used ESWT for nonunions. Later other clinical and experimental studies appeared, demonstrating stimulation of osteoblasts (19,20). Moretti (21) conducted a study on 204 nonunions and 16 acute fractures. 85% nonunions and 80% recent fracture were cured. The study didn't have control group. All studies used high energy ESWT.

7. Diabetic and non diabetic skin ulcers. Wang and colab studied the effect of ESWT on diabetic ulcers (23). 72 patients with diabetic skin ulcers were treated with ESWT or hyperbar oxygen. ESWT was applied in three session at every two weeks. The results were in favour of ESWT. The parameters are 100 impulses/cm2, 0,11 mj/mm2, 3 sessions every two weeks. There are no studies regarding rESWT. The mechanism of action are multiple. Among them are neovascularization, the bacteriostatic effect, cell regeneratiin (stem mezenchimal cell are influenced for migration and citoskeleton reorganization by shock waves - Delhasse, Neuland, Bloch)

8. Spasticity. Spasticity is a frequent complication after stroke. Often it compromises ADL and its lowering is an important objectif of rehabilitation programm. A study conducted by Manganotti (17) on 20 patients with severe spasticity of upper limb demonstrated significant lowering of spasticity. ESWT was applied in unique session on finger's flexors. The spasticity decrease significantly both after 1 and 4 weeks. After 12 weeks 10 out of 20 patients continued to present decreased spasticity. There are also several studies regarding rESWT effect on spasticity. Vidal demonstrated benefficial effects of this kind of therapy in cerebral palsy spasticity. Parameters were 2000 impulses at 2 bars, 3 sessions every week. Such a study is beeing developed in 4th Department of INRMFB.

9. Trigger points. Trigger points are painful points at applied pressure, situated in muscles. They appear as a result of an energetic crisis (Simmons 1996) determined by a lack of balance between need and contribution. For treatment both ESWT and rESWT can be used. It begins with a lower energy which raise in relation with patient tolerability. If trigger points appear secondary to another pathology this must be also treated. The treatment is applied once a week and the number of sessions varies with individual response. The highest number quoted in literature is 10 sessions.

10. Morton's neuroma. There are some data in literature regarding positive effects of ESWT in Morton's neuroma. The specialists

from Weil Foot & Ankle Institute conducted a double blinded, randomized, placebo controlled, on 30 patients with Morton's neuroma. They were all patients who received conservatory treatment and failed to improve. 27 out of them had good results, only 3 needed surgical treatment.

11. Pectoral angina. The device is in this case coupled with an ECG device. In present there is a study on-going in Austria (Dept of Cardiothoracic surgery, Medical University of Viena) regarding the effects of ESWT used during aorto-coronarian by-pass surgery.

## Mechanisms of actions

1. There are several in vivo studies regarding mechanisms of actions for ESWT. As far as we know there are no studies regarding the mechanism of action for rESWT. In vitro studies are fewer.
2. Neovascularization stimulation. Wang (22) demonstrated in a study on rabbits neovascularization stimulation in bioptic fragments from muscle-tendon junction (treated with ESWT). Neovascularization was confirmed by angiogenesis markers (vascular endothelial growth factor VEGF, endothelial sinthetasis of NO eNOS, the expression of the proliferation nuclear cellular antigen PCNA). Up to the present most researchers believe that neovascularization determine the therapeutic effect of shock waves.
3. Bacteriostatic effect. Wang and colab (23) made cultures from lesions of the patients treated with ESWT and demonstrated the bacteriostatic effect.
4. Stimulation of bone remodelation and regeneration. Applicated on nonunions ESWT raises seric level of nitric oxide, TGF beta1, VEGF and BMP-2 (Bone morphogenetic protein 2) in patients who healed in comparison with those who maintain nonunions (24). Wang obtained consolidation at 78,6% out of treated patients
5. Stimulation of chemoatraction. ESWT stimulates the expresion of chemoatraction factors (25). The expresion of ARNm for SDF1 is significantly upregulated after ESWT. SDF1 is a specific ligand for CXCR4 which is strongly exprimated in endothelial progenitor cells. SDF1 (stromal cell - derived factor 1) plays a key role in attraction of endothelial progenitor cells from circulation around the ingrowth vessels. Neuland studied the capacity of shock waves to stimulate the migration and proliferation of mezenchimal cells. According to him, rESWT have a better promigratory capacity while ESWT had a better prproliferatory capacity.
6. Mecanotransduction represents the mechanism by which the cells transform macanical signals in biochemical responses. How this conversion is made is still unproven. Shock waves which determine a mechanical stimulation may use this type of mechanism.
7. Decrease of apoptosis. The shock waves diminish apoptosis, as the majority of studies demonstrates.
8. Diminish pain. Diminishing of pain seems to be determined by phenomenon of anaestesia through hyperstimulation but also through a gate control mechanism. It seems that using shock wave with anaesthesia the effect on pain is lower then their using without anaestesia.

## Adverse reaction

1. Local haematoma (< 1%)
2. Transitory accentuation of pain
3. Dizziness, tinnitus si head ache in case of cervical applications

## Contraindication

1. Tumors
2. The application on large vessels and nerves
3. The application on pulmonary tissue
4. Pregnancy
5. The application on growth cartilagepe cartilajul de crestere

## Relative contraindication

1. Patients on anticoagulants
2. Disorders of fibrinolysis/ coagulation balance

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# Evaluarea prin metode electrofiziologice a eficienței recuperării medicale la pacienții cu deficit motor cauzat de accidente vasculare cerebrale (AVC)

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## Rezumat

### Introducere
AVC sunt afecțiunile cu cea mai mare rată a morbidității şi mortalității în întreaga lume. Reabilitarea după un AVC este procesul prin care pacienții care prezintă modificări ale traseului muscular urmează un program medical pentru a-i ajuta să se întoarcă la o viață normală şi să se reintegreze în societate.

### Scopul studiului
Analiza modificărilor electrofiziologice de la nivelul fibrei musculare striate prin electromiogramă unitară (EMG) efectuată la pacienții cu hemipareză sau hemiplegie după AVC.

### Pacienți şi metodă
Am selectat un lot de studiu de 12 pacienți cu AVC ischemice şi deficit motor pe un hemicorp. S-a efectuat înregistrarea activității electrofiziologice la nivelul musculaturii lezate prin EMG unitară (sistem NEUROPAQ-MEB – 9100). Au fost analizate comparativ traseele înainte şi 12 săptămâni după începerea programului de recuperare medicală.

### Rezultate şi discuții
A fost constatată scăderea activității voluntare (ca frecvență şi amplitudine a traseelor EMG) precum şi potențiale anormale în contracție

## Introducere
Accidentele vasculare cerebrale (AVC) sunt afecțiunile cu cea mai mare rată a morbidității si mortalității în întreaga lume. În Statele Unite constituie a treia cauză de deces, după afecțiunile cardiovasculare şi cancer şi prima cauză de invaliditate dobândita. După ultimele date statistice, în SUA, din cele aproximativ 700.000 de cazuri de AVC înregistrate anual, circa 550.000 sunt reprezentate de evenimente primare. În Marea Britanie sunt înregistrate anual circa 110.000 de cazuri noi de AVC şi aproximativ 30.000 de cazuri recurente [1]. Numit şi atac cerebrovascular acut, el reprezintă o urgență medicală care poate determina o deteriorare neurologică permanentă, complicații şi frecvent decesul rapid. Factorii de risc pentru un accident vascular cerebral sunt reprezentați de: vârsta avansată, HTA, diabetul, un AVC sau AIT în antecedente, hipercolesterolemia şi tulburările paroxistice de ritm cardiac [1,2].

Electromiografia (EMG) reprezintă înregistrarea, cu ajutorul electromiografului, a potențialelor de acțiune generate în fibrele musculare, în stare de repaus, în contracția musculară voluntară şi după stimularea directă a muşchiului sau indirectă, a fibrelor nervoase ce inervează muşchiul în cauză.

Viteza de conducere în nervii periferici are valoare deosebită în diagnosticul bolilor neuro-musculare. Se determină pe fibrele motorii prin examenul EMG de stimulodetecție — respectiv excitarea proximală şi apoi distală a fibrelor motorii şi culegerea potențialelor de acțiune (prin mediere) ale nervilor senzitivi, în urma excitării dureroase repetate a pielii sau a nervului senzitiv respectiv [3].

În mod normal, viteza de conducere motorie este aproximativ 45 - 65 m/s, considerându-se patologice valori ale vitezei fibrelor motorii sub 45 m/s pentru membrul superior şi sub 40 m/s pentru membrul inferior. Viteza fibrelor motorii are valori scăzute, în medie sub 40 m/s în hemiplegii şi hemipareze, mult mai semnificativă fiind diferența vitezelor de conducere dintre cele două membre (membru neafectat-membru afectat); la subiecții sănătoşi această diferență este nesemnificativă [4].

## Pacienți şi metodă
Am inclus în studiu un lot de 12 pacienți (8 bărbați şi 4 femei), cu vârste cuprinse între 55 şi 60 de ani care aveau în antecedentele recente accidente vasculare cerebrale (AVC) ischemice însoțite de deficite motorii de tip hemipareză sau hemiplegie. Confirmarea diagnosticului a fost făcută prin examen neurologic de specialitate, iar etiologia hemoragică a leziunii cerebrale a fost exclusă prin examen CT craniu. La toți pacienții s-au efectuat înregistrări electrofiziologice în fibrele musculare prin EMG unitară care au permis culegerea pontențialelor de acțiune (cu ajutorul axelor coaxiale) de la nivelul unității motorii întregi.

Pentru acesta am utilizat un sistem de măsurare Neuropacq - MEB – 9100; acest dispozitiv complex este capabil să determine şi să prelucreze atât electromiograma cât şi potențialele evocate (somatosenzitive, vizuale şi auditive) dar şi viteza de conducere nervoasă.

Sistemul are în dotare un convertor analog/numeric de 16 bits, cu o viteză de conversie de 10 µsec/canal şi un timp de analiză a traseului de 0,1-0,2-0,5-1-2-3-5-10-20-30-50 ms/div.

Aparatul a avut de asemenea în dotare un electrod special bipolar folosit pentru electrostimulare şi electrozi izolați tip cupă, cu diametrul de 10 mm pentru cules răspunsul EMG de suprafață. Pentru EMG unitară am utilizat electrozi ac sterili de unică folosință cu diametrul şi grosimea adaptate zonelor de culegere.

Scopul studiului a fost cercetarea modificărilor traseelor EMG la pacienții cu deficit motor prin leziuni de neuron motor central înainte şi pe parcursul programului de recuperare medicală, încercând să stabilim în acest mod o corelație între activitatea motorie a fibrelor musculare sub acțiunea exercițiilor de recuperare şi modificările clinice ale sistemului neuromuscular în evoluția acestor bolnavi.

voluntară la toţi pacienţii incluşi în studiu. Evoluţia favorabilă clinic sub termoterapie, crioterapie, electroterapie şi masaj a fost întâlnită la 10 din cei 12 pacienţi incluşi în studiu şi s-a corelat cu creşterea activităţii voluntare ca frecvenţă şi amplitudine a undelor EMG la nivelul fibrelor musculare striate lezate. La 2 pacienţi, la care au fost înregistrate iniţial potenţiale polifazice de reinervare cu durată crescută (peste 35 ms) şi amplitudine mare (peste 150 μV), terapia de recuperare nu a dat rezultate, evoluţia acestora fiind către atrofie şi spasticitate musculară.

## Concluzii

Analiza traseelor electrofioziologice EMG la pacienţii cu deficit motor prin leziuni de neuron motor central poate oferi indicii referitoare la şansele de recuperare a acestora şi la eficienţa terapiei de recuperare medicală.


## Abstract

The electrophysiological evaluation of the medical recovery programme of patients with stroke related motor deficit

### Introduction

Strokes have the highest rate of morbidity and mortalily out of all diseases worldwide. The post-stroke recovery represents the treatment the patients with muscular tonus modifications undergo in order to return to a normal life and integrate again into society.

### The purpose of the study

The analysis of the electrophysiological modifications of the skeletal muscle fibers using the unitary electromiogram (EMG) at all patients with post-stroke hemiparesis and hemiplegia

### Patients and methods

We selected a group of 12 patients with ischemic stroke and hemibody motor deficit. Unitary electromiogram was used in order to analyse the electrophysiological activity of the deteriorated muscles (NEUROPAQ-MEB-9100 system). The initial results were compared to those which were noticed after 12 weeks of treatment.

### Results and discussions

A decrease of voluntary activity (regarding the frequency and the amplitude of EMG) was noticed and also abnormal potentials in voluntary contractions.
10 out of 12 patients included in the study favorably responded to thermotherapy, cryotherapy, electrotherapy and massage and the EMG voluntary activity increased.


Pentru comparaţie am utilizat un lot martor alcătuit din 10 pacienţi (5 bărbaţi şi 5 femei) cu acelaşi tip de afecţiune neurologică dar având etiologie hemoragică a AVC şi la care procedurile de recuperare medicală nu au putut fi începute după 48 de ore de la debutul leziunii.

## Rezultate şi discuţii

Accidentul vascular cerebral apare ca urmare a deteriorării vascularizaţiei cerebrale, fiind clasificat în două mari categorii: ischemic şi hemoragic. În cazul unui accident vascular ischemic, elementul fiziopatologic esenţial constă în reducerea sau oprirea fluxului sanguin bogat în oxigen şi glucoză într-un teritoriu cerebral (cel mai frecvent datorită trombozei sau emboliei) în timp ce accidentele vasculare hemoragice apar datorită rupturii unui vas sau unei structuri vasculare anormale. 80% din accidentele vasculare cerebrale sunt datorate ischemiei, celelalte fiind hemoragice. Unele accidente hemoragice apar în interiorul ariei ischemice (transformare hemoragică), necunoscându-se de fapt câte debutează ca accidente ischemice. Lipsa totală a oxigenului timp de circa 5 minute poate duce la leziuni neuronale ireversibile. Acest eveniment vascular, reprezentat de reducerea fluxului sanguin sau oprirea acestuia într-o zonă corticală, provoacă o cascadă de evenimente biochimice, fiziopatologice şi morfopatologice care conduc la necroza ţesutului nervos cu realizarea unei zone de infarct cerebral [5].

În mod normal, simptomatologia în AVC apare brusc, în secunde sau minute, iar în majoritatea cazurilor nu progresează, simptomele depinzând de aria cerebrală afectată. Reabilitarea după un accident vascular cerebral este procesul prin care pacienţii care prezintă modificări ale tonusului muscular urmează un tratament pentru a-i ajuta să se întoarcă la o viaţă normală prin reînvăţarea şi recâştigarea abilităţilor necesare în viaţa de zi cu zi. De asemenea, se urmăreşte a-i ajuta pe cei care au supravieţuit, să înţeleagă şi să se adapteze la diferitele dificultăţi, să prevină complicaţiile secundare şi o educare a membrilor familiei pentru susţinere permanentă. O echipă de reabilitare este, de obicei, multidisciplinară întrucât aceasta implică personal cu competenţe diferite care lucrează împreună pentru a-l ajuta pe pacient. Pentru cei mai mulţi pacienţi, terapia fizică şi cea ocupaţională sunt elementele de bază ale procesului de reabilitare, dar de asemenea în multe ţări se foloseşte şi reabilitarea neurocognitivă. Reabilitarea după AVC ar trebui sa înceapă cât mai curând posibil şi poate dura de la câteva zile până la peste un an. O recuperare completă este excepţională dar nu şi imposibilă.

Hemiplegia reprezintă o perturbare tonico-motorie consecutivă a unei leziuni unilaterale a căii piramidale la nivelul neuronului central [5,6].

Calea piramidală, formată din axonii celulelor giganto-piramidale ale lui Bentz din aria 4 corticală după Brodmann a circumvoluţiei frontale ascendente, parcurge un traseu care, în final, se articulează cu motoneuronii alfa din coarnele anterioare ale măduvei spinării, de partea opusă.

Deteriorarea acestei arii are influenţă asupra musculaturii striate determinând un deficit al contracţiei voluntare şi o creştere a tonusului muscular care în timp duce la apariţia spasticităţii [6].

Sistemul efector este format din neuronul motor periferic (sub control direct cortical şi reglare suprasegmentară) si din efectorul muscular (reprezentant de fibra musculară striată cu fibre roşii tonice [7], specializate în menţinerea tonusului cu minimim de consum energetic şi fibre albe de tip fazic ce intră în componenţa muşchilor de contracţie rapidă).

Controlul segmentar este realizat prin sistemul activator alfa [8] care acţionează asupra fusurilor neuromusculare.

De la nivelul cortexului frontal coboară informaţia de comandă spre formaţiunile efectoare. Corespondenţa celulară nu se realizează punct cu punct între un neuron şi o singură celulă musculară în acţiunea lor sinergică. Întinderea suprafeţei corticale nu este în raport cu volumul muscular ci cu complexitatea, fineţea şi precizia mişcărilor, teritoriile privilegiate fiind, cu precădere, membrul inferior şi faciesul, mai puţin membrul superior.

Spasticitatea este o condiţie comună care de obicei afectează muşchii persoanelor cu leziuni de neuron motor central (cum este şi cazul accidentelor vasculare cerebrale), sau o leziune palido-nigrică [7,8] datorită suprimării acţiunii moderatoare a acestor centrii asupra tonusului muscular. A fost estimat faptul că aproximativ 65% din persoanele care au suferit un accident vascular cerebral dezvoltă spasticitate iar studiile

2 of the patients initially had re-innervation poliphasic EMG potentials of high amplitude (more then 150 microV) and long period (more than 35 msec). The recovery regarding these patients was not efficient and the disease led to muscle atrophy and spasticity.

## Conclusions

EMG evaluation at patients with motor deficit caused by upper motor neuron lesisons can offer clues about the chances of recovery and the efficiency of the medical recovery programmes.

au arătat că aproximativ 40% din victimele accidentului vascular cerebral pot avea încă spasticitate la 12 luni post-accident. Odată instalată spasticitatea poate apare o scurtare a mușchiului ceea ce duce la modificări fizice și contribuie mai departe la rigiditatea musculară. Instalarea rigidității musculare poate face mișcările dificile și necontrolate în special la nivelul membrelor. Fiziopatologia spasticității este incomplet cunoscută. Aceste modificări ale tonusului muscular rezultă cel mai probabil din alterarea balanței dintre aferențele de la căile reticulospinale [9] și alte căi descendente către circuitele motorii și interneuronale ale măduvei spinării și absența unui sistem corticospinal intact. Cu alte cuvinte există o leziune în regiunea cerebrală sau la nivelul măduvei spinării care controlează mișcarea voluntară.

EMG de suprafață și unitară s-a efectuat la toți pacienții din lotul martor și la pacienții din lotul de studiu înainte de începerea procedurilor de recuperare medicală și la 12 săptămâni de la momentul inițierii recuperării.

În cadrul programului de recuperare medicală au fost utilizate tehnici de termoterapie, crioterapie, electroterapie și masaj [10].

Efectele terapeutice sunt obținute prin mobilizarea rezervelor funcționale ale organismului care la rândul lor vor modifica în sens favorabil reactivitatea organismului.

Termoterapia a fost folosită pentru efectul miorelaxant și pentru ameliorarea circulației periferice.

Crioterapia este utilă pentru combaterea contracturilor musculare.

Electroterapia – trecerea curentului electric prin corpul omenesc determină modificări la locul de contact al electrozilor cu suprafața tegumentară cunoscută sub denumirea de efecte polare, precum și la distanță în profunzime în zona cuprinsă între cei doi electrozi, efecte interpolare [11].

Efectele interpolare sunt importante prin aceea că acțiune lor determină în interiorul organismului efecte de bioelectroliză [11,12], ionoforeză modificări de potențial de membrană și excitabilitate neuromulsculară modificări în compoziția chimică a țesuturilor, efecte termice și de inducție electromagnetică.

Programul de recuperare medicală a inclus și masajul, datorită acțiunii mecanice locale și efectului reflex ca acțiune generală.

Acțiunea locală se exercită asupra pielii și țesutului celular subcutanat, circulației limfatice, circulației sanguine și activității cardiace [13], excitabilității neuromusculare precum și asupra pragului de sensibilitate dureroasă.

Acțiunea generală se sprijină pe mecanisme reflexe dirijate pe stimulii preluați de către aferențele și eferențele senzitivo-motorii [14], precum și vegetative.

Analiza traseelor EMG a evidențiat la lotul martor și la lotul de studiu înaintea începerii recuperărilor medicale trasee de tip neurogen caracterizate prin:

- activitate electrică spontană (în repaus)
- scăderea activității voluntare (ca frecvență, amplitudine), corelată cu severitatea simptomelor clinice de boală de neuron motor central.
- potențiale anormale, în contracție voluntară.

Prin lezarea multor motoneuroni, scade și numărul de unități motorii (UM) funcționale (unele fibre musculare nu vor mai fi inervate - vor fi din această cauză hiperexcitabile, în timp de câteva săptămâni, până când ele degenerează complet – dispar, de unde apariția în aceste săptămâni a potențialelor de fibrilație, spontane). La încercarea de contracție voluntară puternică, datorită faptului că nu se mai poate face o sumație spațială normală, fiind foarte puține UM rămase în funcțiune, se tinde la creșterea compensatorie a frecvenței potențialelor de acțiune de la motoneuronii și respectiv UM restante. Astfel apar, chiar la contracție maximală, trasee simple și mai ample.

În deficitele motorii severe s-au constatat potențiale anormale care sunt de două tipuri:

- potențiale polifazice de reinervare
  - durata crescută: 20 – 30 ms;
  - amplitudinea: 50 – 100 μV;
  - cu 10 –15 faze;
  - acestea arată un proces de reinervare a fibrelor musculare denervate, reinervare realizată de către puținii motoneuronii (respectiv axoni) restanți rămași activi, nedegenerați.
- potențiale gigante bifazice
  - amplitudinea: >1000μV;

- durata: 8 – 12 ms;
- sunt produse de UM foarte mult mărite (cu un număr foarte mare de fibre musculare). Mărirea este realizată prin reinervarea de către axonii motoneuronilor rămaşi indemni, care nasc ramificaţii axonale noi ce reinervează în final aproape toate fibrele musculare din jurul lor, fibre ce au pierdut inervaţia normală — prin distrugerea motoneuronilor ce le inervaseră.

După 12 săptămâni de la iniţierea programului de recuperare medicală la toţi pacienţii incluşi în lotul de studiu şi lotul martor s-au repetat înregistrările EMG.

La lotul martor nu au fost constatate modificări semnificative comparative cu momentul iniţial.

10 dintre pacienţii supuşi programului de recuperare medicală au prezentat o creştere a activităţii voluntare ca frecvenţă şi amplitudine a potenţialelor EMG culese la nivelul musculaturii afectate fapt ce s-a corelat cu un răspuns favorabil clinic cu regresia parţială a deficitul motor. Această modificare a traseelor EMG a avut şi valoare prognostică deoarece 8 dintre cei 10 pacienţi au recuperat la 12 luni aproape în totalitate deficitul motor fiind capabili să-şi desfăşoare activitatea zilnică fără însoţitor.

Doar doi dintre pacienţii incluşi în studiu nu au răspuns la terapia de recuperare medicală evoluţia fiind în timp către atrofie şi spasticitate musculară.

La aceşti pacienţi înregistrările EMG la 12 săptămâni de program de recuperare medicală au evidenţiat potenţiale polifazice de reinervare cu durata crescută (peste 35 msec) şi amplitudine de 150 μV.

## Concluzii:

Analiza traseelor electrofiziologice EMG la pacienţii cu deficit motor prin leziuni de neuron motor central poate oferii indici referitoare la şansele de recuperare a acestora şi la eficienţa terapiei de recuperare medicală.

Pacienţii cu AVC aflaţi în program de recuperare au prezentat o creştere a activităţii voluntare ca frecvenţă şi amplitudine a potenţialelor EMG culese la nivelul musculaturii afectate.

La doi pacienţi, EMG a evidenţiat modificări severe ale traseelor de tip potenţiale polifazice de reinervare cu durată crescută şi amplitudine mare. Aceştia nu au răspuns favorabil la programele de recuperare medicală şi au avut evoluţie către atrofie şi spasticitate musculară pe hemicorpul afectat.

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# II. CLINICAL STUDIES AND BASIC RESEARCH REPORTS

## Morphological and electrophoretic data about heterogeneous primary dermal cells cultures obtained from normal and Ovalbumin-Challenged Wistar rats treated by speleotherapy in the Cacica and Dej Romanian Salt Mines


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### Abstract

**Objective:**
To investigate the influence of salt mine medium from the Romanian Cacica and Dej Salt Mines upon the cell morphology and electrophoretic expression of heterogeneous dermal cultures obtained from Wistar rats' abdominal skin, on normal and Ovalbumin-sensitised animals.

**Materials and methods:**
Heterogeneous dermal cells cultures were prepared from Wistar abdominal skin. Cultures derived from skin rat develop with a monolayer of fibroblasts and epithelial cells attached to the culture dish. Before cultures initiation, Wistar rats of 75-100 g weight were divided in two lots: control and ovalbumin challenged animals. Ten


### Introduction

Asthma is a disorder characterized by chronic inflammation of the airways, airways hyperresponsiveness, and changes in airway architecture, sometime termed remodelling. The cells responsible for maintenance of lung structure are the parenchymal cells of the lung, including epithelial cells, mesenchymal cells, and endothelial cells. Recent studies have suggested that the function of epithelial cells, smooth muscle cells, and fibroblasts cultured from lungs of individuals with asthma differs from the function of cells similarly cultured from individuals without asthma. These functional differences, particularly as they relate to repair and remodelling, could contribute airway structural alterations (Sugiura et al., 2007).

The current study was designed to investigate the influence of salt mine medium from Cacica and Dej Salt Mines upon the cell morphology and electrophoretic expression of pulmonary fibroblasts in vitro obtained from Wistar rats' lung, in normal and Ovalbumin challenged "asthmatic" conditions.

Fibroblasts were cultured from lung parenchyma of control, ovalbumin-sensitised, and speleotherapy treated rats after ovalbumin-sensitisation.

Fibroblasts shape in culture can vary in accordance with the substrate, which on they is growing, and the space they have for movement.

Using pulmonary fibroblasts cultures to verify the therapeutic properties of saline mines medium, described as speleotherapy, represents an innovative and scientific new way to establish the medical methodology of preventing, treating and recovery of patients with various pulmonary problems.

### Materials and Methods

#### Materials

Phosphate Buffer Solution (PBS: NaCl 0,13M + KCl 2,6mM + Na2HPO4 x12 H2O 8mM + KH2PO4 1,4mM); HAM-F12 culture medium (Sigma); penicillin 100 U/ml, streptomycin 100mg/ml; neomycin 50mg/ml (Sigma); fetal bovine serum (Sigma).

#### Rat Wistar Model of Allergic Asthma

Wistar rats of 75-100g weights were sensitised to Ovalbumin by i.m. injections.

#### Primary fibroblasts culture

After anaesthesia with chloroform, rats were killed. The thorax was opened and then the lungs were removed en bloc in a laminar flow hood using sterile technique and put into ice-cold sterile Phosphate Buffer Solution (PBS: NaCl 0,13M + KCl 2,6mM + Na2HPO4 x12 H2O 8mM + KH2PO4 1,4mM). 1mm tissue pieces were

animals of each lot were send to Cacica and Dej Salt Mine for 14 days and maintained in the salt mine medium, as in speleotherapy treatment.

## Results:

Speleotherapy of Wistar rats had induced significant differences in cell morphology and electrophoretic expression of primary dermal cells cultures. The data obtained support the protective effects of speleotherapy by comparing with ovalbumin sensibilised animals.

## Conclusions:

The results of this study indicate the fact that speleotherapy induces changes on the morphology and protein expression of dermal cells in vitro, and these changes support the beneficial effects of speleotherapy.

## Key words

speleotherapy, dermal cells culture, salt mine

suspended in 0.125% trypsin and 0.001% DNase and repeatedly stirred for 6 minutes and centrifuged at 1000g. The pellet was resuspended in HAM-F12 medium with 4500mg/l glucose, 25 mM HEPES, 100 U/ml penicillin, 100 µg/ml streptomycin and 50 µg/ml neomycin and 10% fetal bovine serum (Sugiura et al, 2007; Foster et al, 1990; Nunez et al, 1995).

## Phase Contrast Microscopy

Phase contrast microscopy, first described in 1934 by Dutch physicist Frits Zernike, is a contrast-enhancing optical technique that can be utilized to produce high-contrast images of transparent specimens, such as living cells (usually in culture), microorganisms, thin tissue slices, lithographic patterns, fibers, latex dispersions, glass fragments, and subcellular particles (including nuclei and other organelles).

## SDS-PAGE Electrophoresis

The proteins electrophoresis from the total homogenate has as the purpose to establish the changes, which are revealed at the proteic level of fibroblasts cultures obtained from rats held on saline mine medium for the speleotherapy.

The proteins electrophoresis in gel of polyacrylamide was done in the denaturated conditions in the conformity with the techniques described by Laemmli (1979). The cultures have been washed with PBS, curetted from the culture plate and lyzed in buffer containing 0,5M Tris-HCl, pH 6,8 + 0,05% BPB + 10% glycerol + SDS 10%.

## Results

Control pulmonary fibroblasts culture of 9 days has a homogenic aspect with a high pre-confluence level. The cell division is to a high level and the cell morphology shows a typical microscopic view, described in the specific literature.

Pulmonary fibroblasts cultures of 9 days obtained from Ovalbumin sensitised rats presents many morphological changes from the control pulmonary fibroblasts culture, being observed an sensible number reducing of pulmonary fibroblasts in culture, the diminished cellular dividing frequency and an accentuated cellular morphopathology of the cells in culture. After 9 days of culturing, the pre-confluence level is much lower than in the control case.

Pulmonary fibroblasts cultures of 9 days obtained from Ovalbumin sensitised rats and treated by speleotherapy in Cacica Salt Mine shows an improvement of the morphological parameters of the cells comparative with the cultures obtained from Ovalbumin-challenged asthmatic rats. By phase contrast microscopy, it is possible to observe a rising of the cells number.

Pulmonary fibroblasts cultures of 9 days obtained from Ovalbumin sensitised and treated by speleotherapy in Dej Salt Mine shows also an improvement of the morphological parameters of the cells comparative with the cultures obtained from Ovalbumin-challenged asthmatic rats. It is observed the rising of the cell population density and that of cell viability.

Pulmonary fibroblasts were homogenized with Laemmli buffer pH 6,8, and the proteins of the obtained homogenate were separated by 10 % SDS polyacrylamide gel electrophoresis that maintains polypeptides in a denatured state once they have been treated with strong reducing agents to remove secondary and tertiary structure.

Samples of 10µl were loaded into wells in the gel. One lane was reserved for Sigma molecular markers mixture of 205; 116; 97; 66; 55; 45; 36; 29; 24; 20,1; 14,2 and 6,5 KDa

Following electrophoresis, the gel was stained with Coomassie Brilliant Blue R-250, that allowed visualization of the separated proteins. After staining, different proteins appeared as distinct bands within the gel (Towbin et al., 1979).

Analysis with GeneTools version 4 software from SynGene of each track of the electrophoresis (figure 1), allowed us to compare the profiles of the total proteins expression.

## Discussion

The present study evaluated morphological phenotypes related to repair and remodeling in fibroblasts obtained from control Wistar rats and from Ovalbumin-sensitized and -challenged rats, a model of asthma that results in airway hyperresponsiveness and chronic airway remodeling, as other authors had presented.

Compared with control fibroblasts, fibroblasts obtained from lung parenchyma of the "asthmatic" rats and Ovalbumin-sensitized rats treated in Cacica and Dej Salt Mines demonstrated the positive role of the saline medium for the "asthmatic" rats.

The current study focused on fibroblasts, which are believed to be cells that play a major role in the maintenance and remodeling of interstitial connective tissue. In this context, fibroblasts are believed to play a key role in maintaining and altering tissue structure. The ability of fibroblasts to migrate in response to chemotactic stimuli and to proliferate in response to specific growth factors is believed to control their accumulation at sites undergoing tissue repair. The ability of fibroblasts to produce and remodel extracellular matrix is thought to contribute to tissue structural changes. Remodeling of tissues likely involves fibroblast contractile activity.

In summary, the present study supports the concept that phenotypically altered fibroblasts can contribute to airway remodeling in asthma. Fibroblasts cultured from the lungs of chronically OVA-sensitized and -challenged animals demonstrated consistently augmented repair responses for a number of functional assays (Sugiura et al., 2007).

## Conclusions

Phase contrast microscopy analyses of primary fibroblasts cultures reveals an cellular regeneration after animal exposure to saline medium in Cacica and Dej Salt Mines, comparative with the cells morphology of cultures from Ovalbumin sensitised rats.

The morphological observations are confirmed by the electrophoretic analyses, which demonstrate through rising of the expression of many proteins and of total protein amount that the exposure of Ovalbumin-sensitised animals to the saline medium from Cacica and Dej Salt Mines is reversing the cells morphopathology of pulmonary fibroblasts in cultures;

Wistar rats sensitised with Ovalbumin have a low number pulmonary fibroblasts output cultures, with a more sensitive morphopatologic level.

## Acknowledgments

This study will be finished in 2011 and is granted by The National Authority for Research- CNMP, contract nr. 42120/2008, project: Complex of medical-biological study of potential therapeutic factors related to salt mines and karst environments for effective use in health and balneo-turism; development and modelling solutions of these factors.

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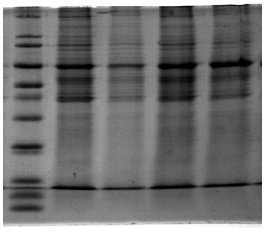
**TABLE 1: SDS polyacrylamide gel electrophoresis of the dermal cells cultures**

| | |
|---|---|
|  | Samples |
| | **1** - 9 days dermal cells culture from Ovalbumin-sensitised rats exposed to the saline medium of Dej Salt Mine |
| | **2** - 9 days dermal cells culture from Ovalbumin-sensitised rats exposed to the saline medium of Cacica Salt Mine |
| | **3** - 9 days dermal cells culture from Ovalbumin-sensitised rats |
| | **4** - 9 days Control dermal cells culture |
| **5 4 3 2 1** | **5** - Sigma molecular markers |

## Fig. 1 – Electrophoretic profile of dermal cells cultures

**Track 4 9 days Control dermal cells culture**

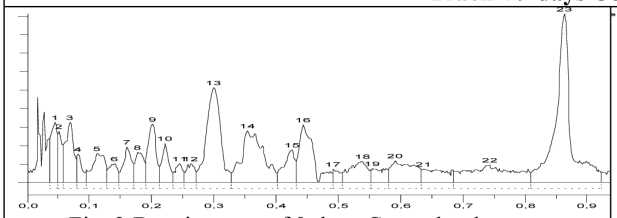


Fig. 2 Densitogram of 9 days Control pulmonary fibroblasts culture

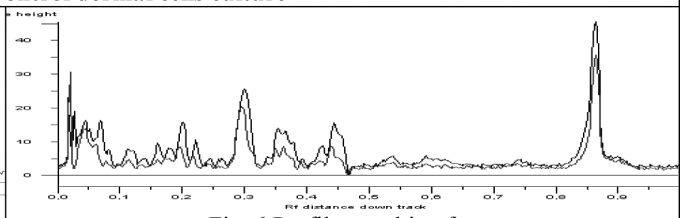


Fig. 6 Profile matching for **CONTROL ( ▬ ) – OVALBIMN (▬ )**

**Track 3 9 days dermal cells culture from Ovalbumin-sensitised rats**

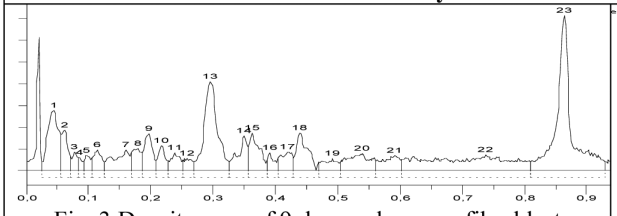


Fig. 3 Densitogram of 9 days pulmonary fibroblasts culture from Ovalbumin-sensitised rats

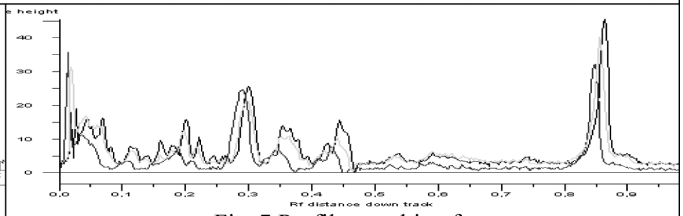


Fig. 7 Profile matching for **CONTROL ( ▬ ) - DEJ (▬ ) - CACICA(▬ )**

**Track 2 9 days dermal cells culture from Ovalbumin-sensitised rats exposed to the saline medium of Cacica Salt Mine**

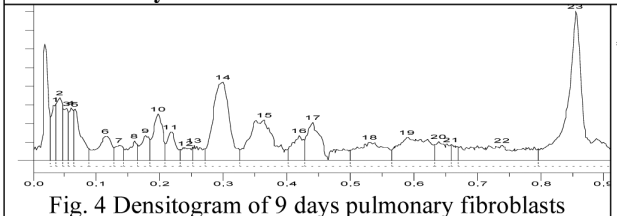


Fig. 4 Densitogram of 9 days pulmonary fibroblasts culture from Ovalbumin-sensitised rats exposed to the saline medium of Cacica Salt Mine

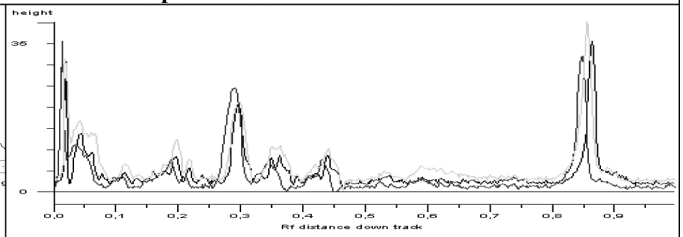


Fig. 8 Profile matching for **OVALBUMIN (▬ ) - DEJ (▬ ) - CACICA(▬ )**

**Track 1 9 days dermal cells culture from Ovalbumin-sensitised rats exposed to the saline medium of Dej Salt Mine**

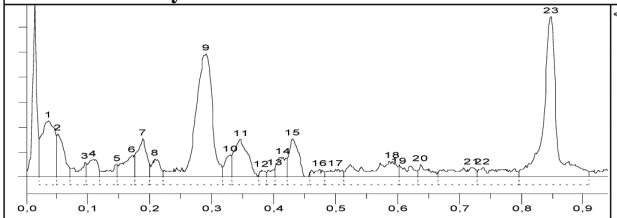


Fig. 5 Densitogram of 9 days pulmonary fibroblasts culture from Ovalbumin-sensitised rats exposed to the saline medium of Dej Salt Mine

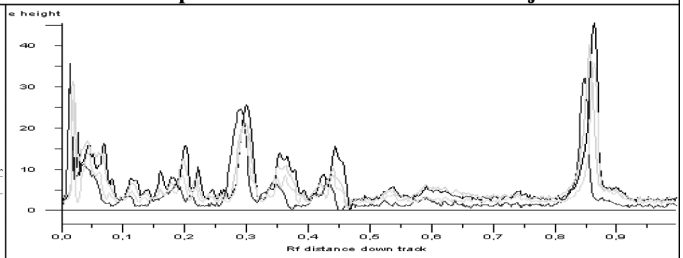


Fig. 9 Profile matching for **CONTROL ( ▬ ) OVALBUMIN (▬ ) - DEJ (▬ ) - CACICA(▬ )**

TABLE 2 Protein expression analysis of the dermal cells cultures

| Peak Nr. | Peak weights molecular limits (KDa) | CONTROL Quantity (μg/10μl) | OVALBUMIN Quantity (μg/10μl) | CACICA Quantity (μg/10μl) | DEJ Quantity (μg/10μl) |
|---|---|---|---|---|---|
| 1 | 225 – 240 | 3,80 | 5,61 | 2,60 | 5,56 |
| 2 | 220 – 225 | 1,81 | 2,19 | 3,58 | 2,19 |
| 3 | 210 – 220 | 4,78 | 0,92 | 2,07 | 0,92 |
| 4 | 200 – 210 | 1,66 | 0,37 | 2,04 | 1,25 |
| 5 | 190 – 200 | 3,55 | 0,80 | 3,86 | 0,80 |
| 6 | 160 – 190 | 1,61 | 1,35 | 3,39 | 1,86 |
| 7 | 140 – 160 | 2,81 | 2,73 | 1,12 | 2,50 |
| 8 | 120– 140 | 2,53 | 1,59 | 1,56 | 1,13 |
| 9 | 105 – 120 | 4,73 | 2,61 | 2,00 | 20,03 |
| 10 | 100 –105 | 2,75 | 1,45 | 4,28 | 1,02 |
| 11 | 90 – 100 | 1,32 | 1,36 | 2,45 | 3,77 |
| 12 | 63 – 90 | 1,61 | 0,90 | 1,21 | 0,29 |
| 13 | 55 – 63 | 13,14 | 9,93 | 1,36 | 0,34 |
| 14 | 42 –55 | 11,32 | 2,75 | 12,25 | 1,29 |
| 15 | 40 – 42 | 3,48 | 3,20 | 9,62 | 2,72 |
| 16 | 37 – 40 | 8,12 | 0,92 | 2,72 | 0,56 |
| 17 | 35 – 37 | 1,01 | 1,76 | 6,35 | 0,72 |
| 18 | 34 – 35 | 3,70 | 3,65 | 4,73 | 3,22 |
| 19 | 32 – 34 | 1,96 | 1,41 | 6,55 | 1,08 |
| 20 | 30 – 32 | 4,89 | 3,30 | 2,28 | 0,87 |
| 21 | 23 – 30 | 3,19 | 2,08 | 0,86 | 1,62 |
| 22 | 19 – 23 | 8,00 | 10,27 | 8,11 | 1,78 |
| 23 | 6 – 19 | 24,72 | 18,30 | 23,20 | 30,22 |
| TOTAL amount of proteins in 10 μl of sample: | | **116,5** | **79,45** | **108,19** | **85,74** |

Fig.10 TOTAL amount of proteins in 10 μL of sample

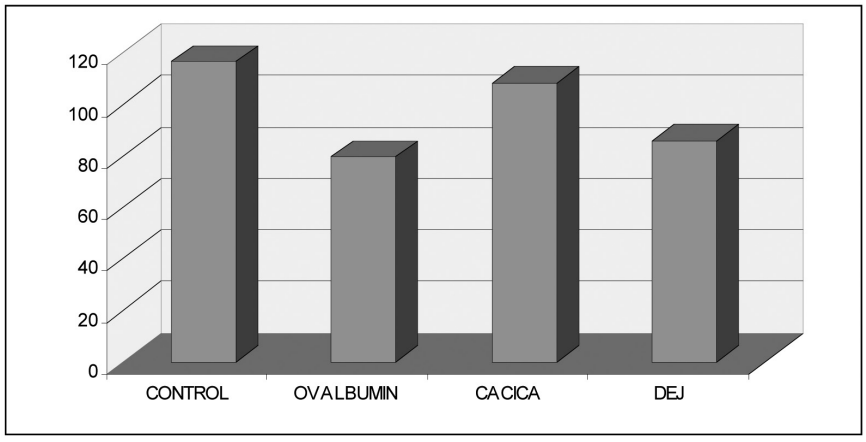


Fig. 11 Control dermal cells culture of 9 days, A-B X 150, C-D X 300

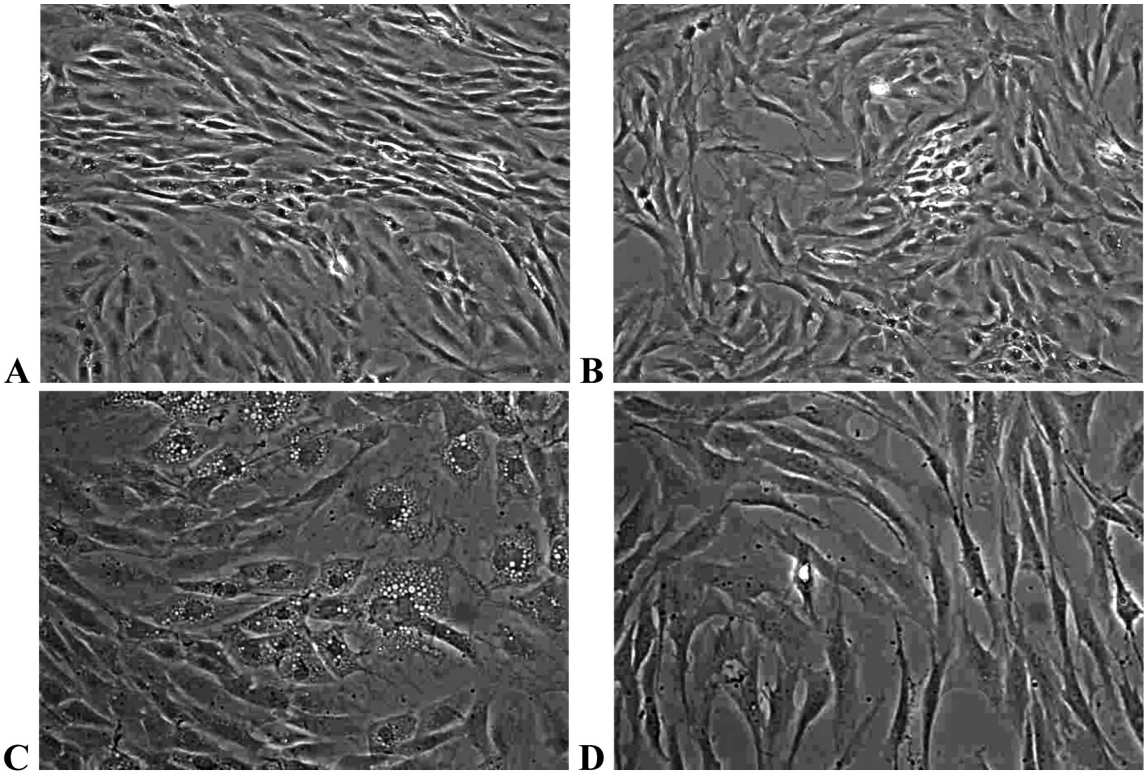



Fig. 12 9 days dermal cells culture from Ovalbumin-sensitised rats, A-B X 150, C-D X 300

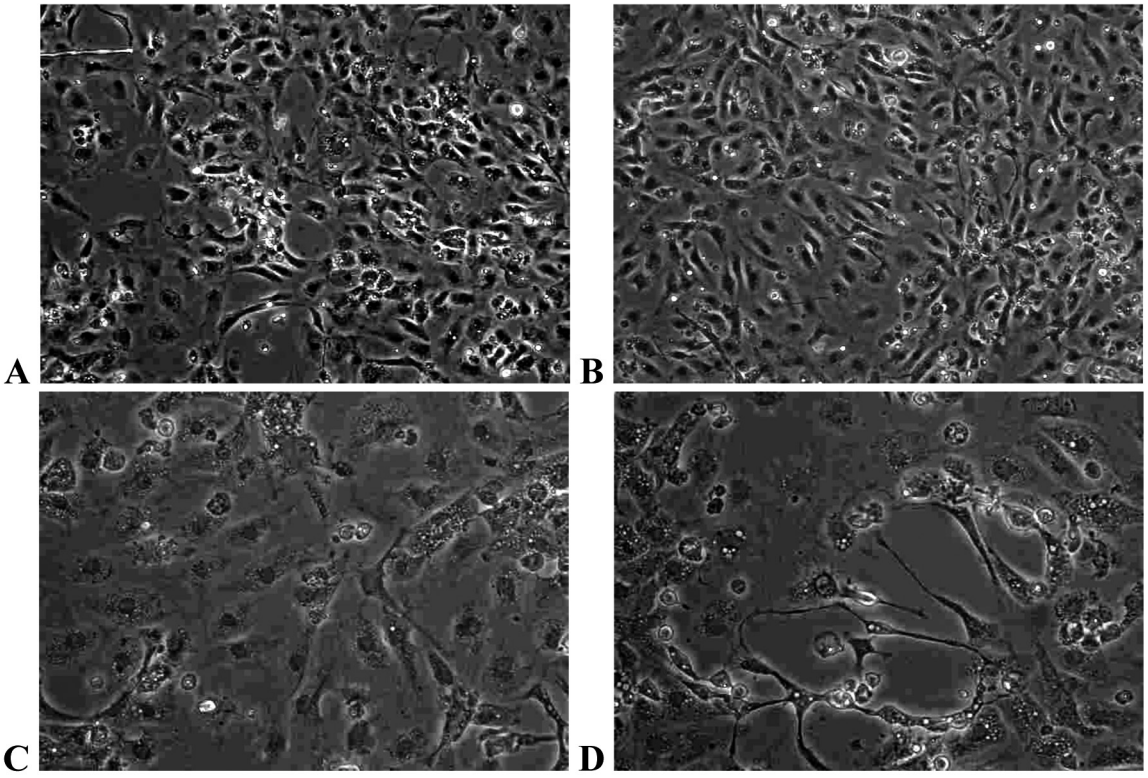


Fig. 13 9 days dermal cells culture from Ovalbumin-sensitised rats exposed to the saline medium of Cacica Salt Mine, A-B X 150, C-D X 300

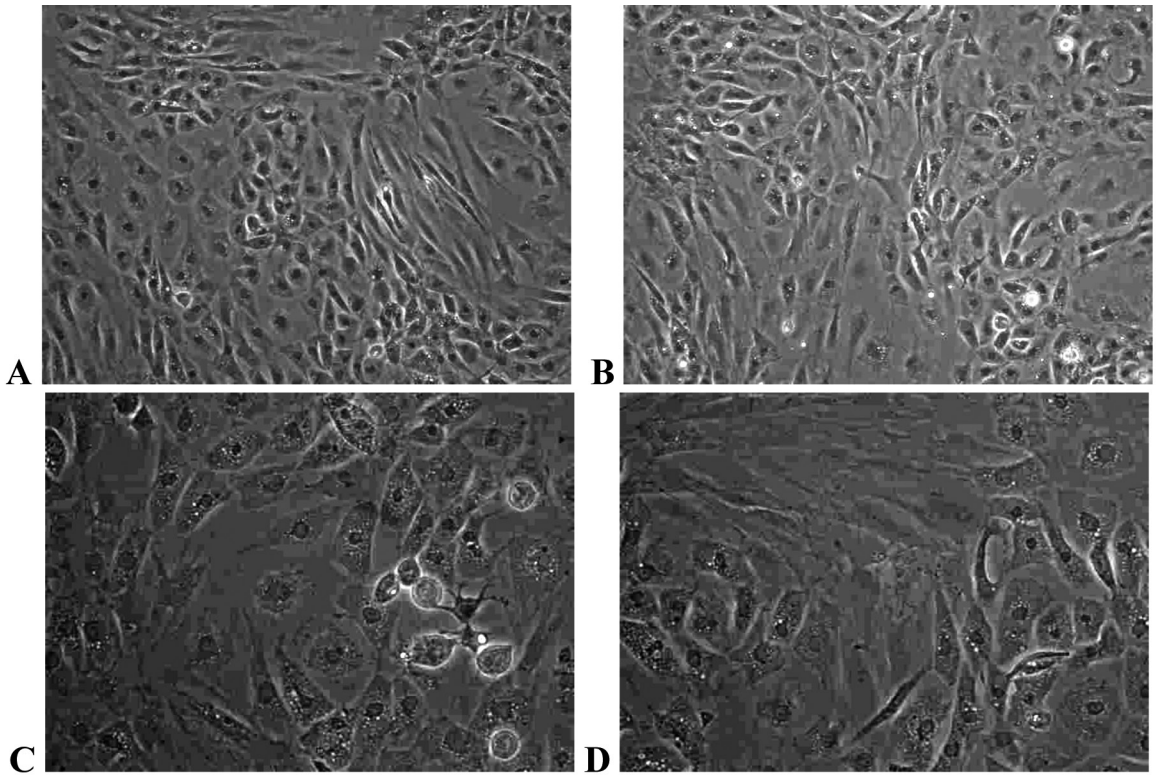
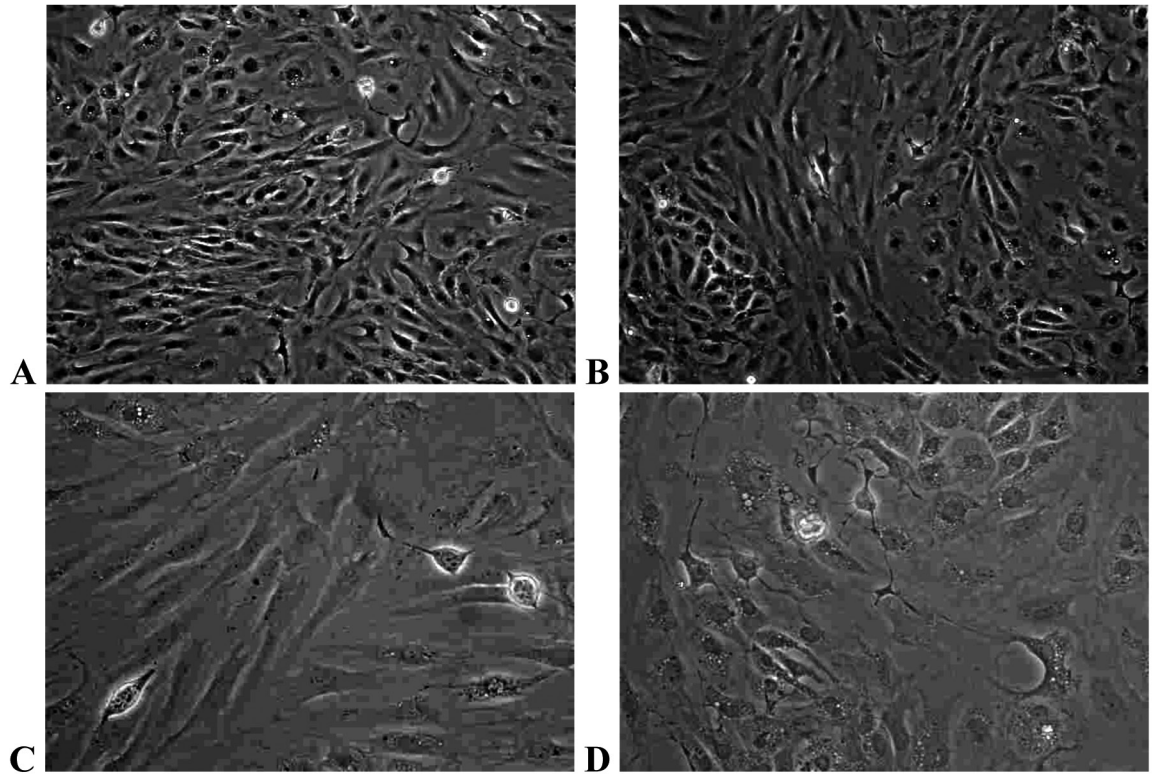



Fig. 14 9 days dermal cells culture from Ovalbumin-sensitised rats exposed to the saline medium of Dej Salt Mine, A-B X 150, C-D X 300



# Hand grip in rheumatoid arthritis patients

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## Rezumat

Prezentul studiu (un trial randomizat prospectiv) s-a fundamentat pe faptul că prezervarea şi corectarea prehensiunii la pacientul cu poliartrită reumatoidă (PR) este un act medical complex. Sunt prezentate, în detaliu, interesarea articulaţiilor pumnului şi mâinii în cadrul procesului reumatoid precum şi particularităţile programului de reabilitare adaptat anormalităţilor patogenice biomecanice.

Am evaluat aspectele clinice şi funcţionale din cadrul programului de reabilitare al complexului mâinii reumatoide, derulat timp de 3 săptămâni, precum şi implicaţiile sale în ameliorarea infirmităţilor şi limitării activităţilor la femeile cu PR.

36 paciente diagnosticate cu PR în conformitate cu criterii ACR au fost incluse în studiu, în decursul anilor 2008 şi 2009. Asistenţa medicale de reabilitare a fost derulată timp de 3 săptămâni, cuprinzând 20 şedinţe.

S-a urmărit evoluţia clinico-funcţională a complexului mâinii în corelaţie cu scorurile scalelor pentru durere (VAS – visual analogue scale) şi HAQ, iniţial şi după aplicarea programului recuperator.

Am constatat, că la pacientele aflate în stadiul funcţional II şi III s-a reuşit înlocuirea penselor termino-laterale şi de forţă cu cele digito-palmare şi termino-laterale, aspect esenţial pentru

## Introduction. Objectives.

Rheumatoid arthritis (RA) - a serious, systemic autoimmune disease characterized by chronic inflammatory process (1) - represents one of the rheumatic disorders characterized by a clinical-functional and therapeutic pathogenic complexity which affects especially diarthroidal joints (typically, the bilateral joints of the wrists, fingers, knees, ankles, or feet have been affected) (2).

With an incidence rate of 0.03% and a point prevalence of 0.5 to 1%, RA is a major cause of morbidity, mortality and health care utilization (3). Persons affected by RA experience functional limitation related to both complex joint impairmen3t and skeletal muscle dysfunction. RA has a major impact on well-being and quality of life (4).

Work disability rates for patients with RA range between 26% and 50% within 10 years of diagnosis and are higher for those with longer disease duration. Survival rates for persons with RA are lower than in the general population (5).

RA often causes destruction of the hand joints' connective tissues, which leads to weakness of the tissues and an imbalance of active and passive forces, and subsequently, instability, pain, and deformity (6). It is estimated that the hands and wrists are affected in 80 – 90 % of RA patients (7); the metacarpophalangeal and proximal interphalangeal joints in the hands are often involved; the fingers are forced into distorted positions that hamper movement (8).

The diagnosis of the rheumatoid arthritis requires confirmation (positive diagnosis based on the specific clinical, laboratory, and radiological criteria), to differentiate it from other joint diseases and must imply the establishing of the evolution phase and the activity phase of the disease, with the patient functional screening. We must screen the rheumatoid arthritis patient in one of the 4 classes of functional-clinic classification.

Optimal management of RA is multidisciplinary (4) and involves more than pharmacologic therapy (physical and occupational therapy, surgery and patient education) (3, 4). Essential components of management include systematic and regular evaluation of disease activity, patient education/rehabilitation interventions, use of disease-modifying antirheumatic drugs (DMARDs), possible use of local or low-dose oral glucocorticoids, minimization of the impact on the individual's function, assessment of the adequacy of the treatment program, and general health maintenance (3).

Rehabilitation, including physical therapy - the judicious use of exercise and methods for relieving pain and reducing inflammation and occupational therapy, complements drug therapy in the management of symptoms in patients with rheumatoid arthritis (6). Approximately 26% of patients with rheumatoid arthritis receive a referral for rehabilitation by rheumatologists (9).

The methods used by rehabilitation program will get a maximal improvement of the global functionality for each mio-arthro-kinetic segment, the patient will be able to do ordinary activities (prehension – hand grip, walking) and even one slinked to his/her profession. Because the hand's joints are most interested in rheumatoid arthritis, one of the components of the rehabilitation program represents the prehensile capacity maintaining reeducation, with the preservation of the conditions of the normal vital functions, without the risk of other organs and systems perturbation (cardiovascular, respiratory, musculoskeletal).

The hand prehensile capacity has unique human features. These include among others the motion of the thumb with ability to oppose to the fifth digit and the grip and pinch. Hand function is recognized as being important (7) to all patients diagnosed with RA.

Physiotherapy modalities are commonly used in the treatment of RA. The effectiveness of hand exercises in RA has been recently reviewed (10, 11).

Controlled studies performed with adequate numbers of cases and using validated objective measures to evaluate various physiotherapy and rehabilitation methods in RA are quite rare; until 2006, only ten eligible studies have mentioned the use of hand exercises as part of their treatment intervention (3).

îmbunătățirea statusului funcțional al pacientelor, cu ameliorarea parametrului de durere. Statusul funcțional global, apreciat cu ajutorul scalei HAQ, s-a ameliorat pentru întregul lot studiat cu 29% după performarea programului de reabilitare. Reabilitarea în PR este un act medical laborios, cu inițiere cât mai precoce de către o echipă medicală multidisciplinară. Metodele şi mijloacele terapeutic – recuperatorii interferă cu verigile patogenice ale bolii. Prin respectarea decalogului principiilor kinetice, asociat medicației de fond în PR, se asigură menținerea unei prehensiuni optime, cu o calitatea a vieții corespunzătoare.

**Cuvinte cheie**
prehensiune, poliartrita reumatoida, recuperare medicala

**Abstract**

The present study (a prospective trial) was based on the fact that the correction and preservation of the prehension (hand grip) in rheumatoid arthritis represents a complex medical act. This paper will discuss in detail rheumatoid involvement of the hand and wrist and rehabilitation program performed in correlation with the pathologic biomechanical abnormalities. We evaluate the clinical and functional effectiveness a complex hand therapy on changes in impairment and activity limitation in women with RA over a 3 week period. 36 patients (women) with RA according to the ACR criteria (3) were included in the study, between 2007 and 2008. The studied patients were treated by means on physical therapy for a period of 20 days (14 sessions).

We assesses the clinical and functional evolution of the hand complex in correlation with scale VAS and HAQ scores, at the beginning and after the rehabilitation program.

In the patients with RA, 2 and 3 functional stage the terminal-lateral pincers and the hand grip power were replaced by finger-palm and terminal-lateral pincers which had an important contribution to the functional status improvement, more exactly to the pain parameter. The global functional status, estimated with the help of HAQ questionnaire was improved with 29%.

The rehabilitation in rheumatoid arthritis is complex and multidisciplinary. It must be initiated as soon as possible. The methods and therapeutic means are correlated with pathogenic disease aspects. If everyone respects the kinetic principles of the rehabilitation program, associated with the correct pharmacological treatment, all patients have optima hand grip and adequate quality of life.

**Key words:**
hand grip, rheumatoid arthritis, rehabilitation program

This paper will discuss in detail rheumatoid involvement of the hand and wrist and rehabilitation program performed in correlation with the pathologic biomechanical abnormalities.

We evaluate the clinical and functional effectiveness a complex hand therapy on changes in impairment and activity limitation in women with RA over a 6 week period.

## Material and methods

### *Patients.*

36 patients (women) with RA according to the ACR criteria (3) were included in the study, between 2007 and 2008. The patients were recruited from the in-patient clinics of Physical Medicine and Rehabilitation, Hospitals no.1 and 2, in Craiova.

The inclusion criteria of our study were:

- disease lasting at least 1 year, with modifying anti-rheumatic drugs (DMARDs) treatment,
- no oral corticosteroid therapy within the previous 2 months (intra-articular, intramuscular injection or more than 7,5 mg daily),
- no surgery of upper limb and no sensory or other neurological impairment of the hand,
- impairment of hand defined as abnormal range of motion (ROM) and grip strength,
- disease activity score (DAS) < 3,7,
- erythrocyte sedimentation rate (ESR) < 50 mm in the first hour.
- All patients gave verbal consent for participation in our study.

Our study was a prospective trial. The studied patients were treated by means on physical therapy for a period of 20 days (14 sessions). In Table 1 we mentioned the demographic and other clinical characteristics of subjects.

### *Study interventions.*

The monitoring of the patients was done initially, at the admission in the monitored group (T1 - a baseline evaluation), and at the 21-day study period (T2) the rehabilitation program was finished. The careful assessment which preceded the rehabilitation program was performed in the first part of the day and included:

- a general clinic estimation,
- the subjective and physical examination of all segments of skeletal status and especially of the hand (joint balance, manual muscle testing, the disturbed trophies examination),
- paraclinic estimation (the results of the paraclinic investigations are interpreted, imagistic examination-ultrasound and radiological estimations are made); all patients had conventional posterior-anterior radiographs of the hands and wrists (the radiograph aspects were graded according to the Steinbrocker criteria); we performed the following laboratory evaluations: erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), rheumatoid factors (RF), complete blood cell count, creatinine level, hepatic enzyme levels, urinalysis.
- functional estimation- the grouping of patients according to the American College of Rheumatology 1991 revised criteria for classification of global functional status in RA, the VAS scale completion (necessary for the daily pain quantification) and the Health Assessment Questionnaire HAQ questionnaire (to appreciate life quality). The patients have completed the VAS scale, and the HAQ questionnaire, initially (T1) and finally (T2).

Through a systematic examination of the superior member we could notice a particular attitude, the deformed joints and limited mobility with impact on the functional status and the appearance of the pain. We did not omit the psycho-affective reactivity of the woman patient, which influences the clinic symptoms and conditions the recovery program, especially the kinetic one.

### *Outcome measures.*

Inflammation process of hand was evaluated by ESR and CRP level, and the level of pain in the hands. The intensity of the pain was measured by a visual analog scale 0 – 10 (0 indicated a painless status and 10 a most severe pain).

Functional status of hand was assessed by palmar pinch (in centimeters) and activities of daily living and the level of pain in the hands. The palmar pinch was

obtained with patients sitting in standardized posture – elbow flexed at 900 and wrist in a neutral position; we used the best value of three attempts.

The important activities of daily living were assessed and included in the HAQ questionnaire.

### *Rehabilitation program.*

After the multidisciplinary examination a complete program (educational, medication, physical, kinetic) was applied for 20 days, 1 session daily, 5 days a week.

All rehabilitation team efforts were focused to alleviate pain and to decrease the inflammation, to control the joint damage and the loss of hand function, to maintain function for activities of daily living and work, and maximize quality of life.

The components of the complex assistance, adapted to the illness stage were:

- hygiene-diet and life regime, including the education the patient about the disease and the consequences of joint damage and disturbing hand function; all subjects received a joint protection writing rules – the principles of joint protection, energy conservation aspects, postural advice and fundamental adaptations for household activities;
- the medical treatment (the treatment which every patient had before coming to the rehabilitation clinics was observed; all patients continued to take their previously prescribed oral medication);
- physical treatment (daily faradic hands bath at 370 C for 20 minutes, the intensity of the faradic current was 20 mA; 1 hour later, a 450 C wax pack upon both hands were applied one day, and another day we performed ultrasound to both hands);
- massage (sedative and the Cyriax massage); the entire upper limbs were been massaged before and after kinetic session; massage required 15 – 20 minutes; we recommended the massage 30 minutes after heat therapy (wax pack or ultrasound);
- kinetotherapy (exercises were balanced with rest, in painless and functional hand positions). The functional positions for all segments will be kept - lying on the back with a pillow under the neck, inferior limbs extended, shoulder bent 450 -600, elbows bent 700 – 800, the hand in semi flexion as if holding an orange, with fingers slightly bent and thumb in opposition. The physical therapist performed an individual hand exercise program, including passive and active ROM exercises (a maximum ROM of all small joints of the wrist – flexion, extension, pronation, supination, circumduction; thumb – interphalangeal flexion, opposition; fingers – global flexion, extension and abduction), slow and progressive stretching (for flexor muscles of the fingers and opposite and abductor muscles of thumb, especially), strengthening (isometric and resistive) exercises for intrinsic and extrinsic hand muscles (wrist extensor muscle), and global exercises specific for prehensile hand function (pinch grip exercises and routine daily activities). The isometric exercise parameters were: moderate contractures hold for 4 - 6 seconds, with a 15 second rest between contractions, and repeated 5-10 times each day. Each kinetic session was 30 minutes longer.

All subjects were requested to inform the members of rehabilitation team of any unpleasant sensation that appeared in the one of the component of complex daily assistance. Pain was been a signal for stop the program.

### *Statistical analysis.*

SPSS 9.0 software package was used to perform the analysis and statistical significance was recognized at the level of $p<0.05$. Comparisons between variables were performed by analysis of variance. Comparison of HAQ scores with ACR revised global functional class was performed using analysis of variance.

## Results

The biographical data of our patients, with persistent RA are shown in Table 1.

The median patient age was 48.08 yrs (range 38 and 56 yrs).

33 % subjects had positive RF form disease (12 females). Median disease duration was 7.41 yrs (range 2 and 14 yrs).

**Table 1**

<table>
<tr><th>Life conditions</th><th colspan="2">30 - 39 years</th><th colspan="2">40 – 49 years</th><th colspan="2">50 – 59 years</th></tr>
<tr><td rowspan="5">24 urban (U)<br>12 rural (R)</td><td colspan="2">6 patients (p)</td><td colspan="2">12 patients (p)</td><td colspan="2">18 patients (p)</td></tr>
<tr><td rowspan="3">Stein-broker Class</td><td rowspan="3">6 p. std. II</td><td rowspan="3">Stein-broker Class</td><td>7 p. std. II</td><td rowspan="3">Stein-broker class</td><td>7 p. std. II</td></tr>
<tr><td>4 p. std. III</td><td>7 p. std. III</td></tr>
<tr><td>1 p. std. IV</td><td>4 p. std. IV</td></tr>
<tr><td colspan="2">5U +1R</td><td colspan="2">8U + 4R</td><td colspan="2">11U + 7R</td></tr>
<tr><td colspan="7">Patients' average age = 48.08 years (SD = 6.88)<br>Average of disease age = 7.41 years (SD = 4.23)</td></tr>
</table>

The distribution of RA studied women by level of functional capacity on the ACR revised global function classification (Steinbroker classification) is mentioned in Table 1 (6 patients / 16.66% were categorized in class I – complete ability to perform all usual activities, 12 patients / 33.33% were categorized in class II - adequate for normal activities, despite handicap of discomfort or limited motion at one

or more joints and 18 patients / 50% were categorized in class III – limited functional capacity, only to little or none of duties of usual occupation or self-care).

The values of the disease evolution parameters allowed an optimal rehabilitation program. So, the average of the ESR for the studied group was 41.5 mm (SD=5.49), and the reactive protein was checkable with 50% of patients.

In Table 2 are shown the average values of the ESR, obtained in the clinic study including the two categories of patients depending on the presence or absence of the RF.

**Table 2**

| VSH | Functional classification | | | RF | | CRP | |
|---|---|---|---|---|---|---|---|
| | II | III | IV | absence | presence | absence | presence |
| Average value | 40.7 (5.63) | 40.62 (6.56) | 41.5 (4.81) | 38. 85 (5.84) | 43.5 (4.38) | 45. 23 (5.15) | 34.75 (2.06) |
| RF = Rheumatoid factor; CRP = C-reactive protein<br>Between brackets is presented the standard deviation (SD) | | | | | | | |

There is a very important concordance between the average value of the ESR and the RF positive form of the disorder.

The parameter pain was appreciated with the visually-analogue scale which all patients completed at the moments T1 and T2 of the evaluation. The average value of the value of the scale score for the entire group improved with 39%. At the beginning the average value of the score VAS=4.83 (SD=1.28) and at the end of the evaluation the score VAS=2.91 (SD=0.87).

All patients have been presented the involvement of the tendons and joints of the hand, with variable loss of function (hand grip).

The difficulty of closing the fist was measured using a ruler, putting down the centimeters between the phalanx distal extremity of 2 and 5 fingers and the fold of the radiocubitocarpian area. In table 3 we mentioned the principles values for the each functional stage for our patients.

**Table 3**

| Functional stage (Steinbroker classification) | Average value of the fist closing defect (cm) | | | |
|---|---|---|---|---|
| | Minim | Maxim | Mean value | SD |
| II | 1,5 | 4,0 | 2,667 | 0,7715 |
| III | 2,0 | 4,5 | 3,462 | 0,8282 |
| IV | 4,0 | 6,0 | 5,250 | 0,7071 |

We found that the initial average value was 3.58 cm, for all patients, and at the end the average value decreased to 2.16 cm (SD=0.92).

A relation between the average value of fist closing movement and the clinical stage of the disease was found.

When doing the regressing equation for the initial and final average value of the fist closing I noticed a very good correlation between the pair of values 0,929 with a square ‚r' of 0,862 which means a very good predictivity of final value as compared to the initial one. 86% of the cases submit to regressing equation pattern with an improvement percentage of parameter with 41% and the graphic of the cases frequency was acceptably superposed on the real curve (table 4, table 5 and figure 1).

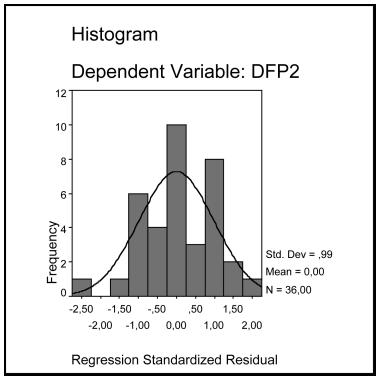
**Table 4**

| Fist forming defect (FFD) | | | |
|---|---|---|---|
| | Average value | Standard deviation | N |
| Final FFD | 2.097 | 0.9244 | 36 |
| Initial FFD | 3.528 | 1.2532 | 36 |

**Table 5**

| Correlations between the average values of the fist forming defect FFD) | | | |
|---|---|---|---|
| | | Final FFD (DFP 2) | Initial FFD (DFP 1) |
| Pearson Correlation | DFP2 | 1.000 | 0.929 |
| | DFP1 | 0.929 | 1.000 |
| Sig. (1-tailed) | DFP2 | 0. | 0.000 |
| | DFP1 | 0.000 | . |
| No. Patients | DFP2 | 36 | 36 |
| | DFP1 | 36 | 36 |

## Figure 1




In the patients with RA, 2 and 3 stage the terminal-lateral pincers and the hand grip power were replaced by finger-palm and terminal-lateral pincers which had an important contribution to the functional status improvement, more exactly to the pain parameter.

The global functional status, estimated with the help of HAQ questionnaire was improved with 29%. The initial average value, at the T1 moment was 12.5 (SD=1.91), and at the end the average score had an average value 8.91 (SD=1.48). In table 6 we mentioned the values for HAQ scale for functional stages.

When we made the regression equation for the initial and final average values of the score HAQ questionnaire (tables no 7, 8, 9) we observed a correlation of 0.704 square R was nearly 0.5, so half of the studied cases respect the model of a regression equation, as can be seen from ANOVAs analysis, when the square values sum is almost equal between the values submitted of the equation and the residual one.

## Table 6

| Functional stage (Steinbroker classification) | HAQ value | | | |
|---|---|---|---|---|
| | Minim | Maxim | Mean | Standard deviation |
| II | 9 | 14 | 11,2 | 1,26 |
| III | 11 | 16 | 12,92 | 1,49 |
| IV | 12 | 16 | 14,13 | 1,24 |

## Table 7

| Life quality questionnaire score (HAQ) | | | |
|---|---|---|---|
| | Average value | Standard deviation | N |
| final HAQ | 8.92 | 1.481 | 36 |
| Initial HAQ | 12.47 | 1.765 | 36 |

## Table 8

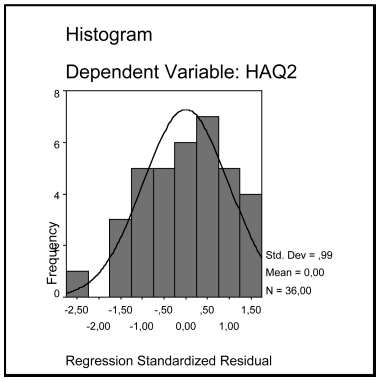
| Correlations between the average values of the HAQ questionnaire score | | | |
|---|---|---|---|
| | | Final HAQ (HAQ 2) | Initial HAQ ( HAQ1) |
| Pearson Correlation | HAQ2 | 1.000 | 0.704 |
| | HAQ1 | 0.704 | 1.000 |
| Sig. (1-tailed) | HAQ2 | . | 0.000 |
| | HAQ1 | 0.000 | . |
| No. Patients | HAQ2 | 36 | 36 |
| | HAQ1 | 36 | 36 |

## Table 9

| ANOVA(b) | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 38.079 | 1 | 38,079 | 33,479 | ,000(a) |
| | Residual | 38.671 | 34 | 1,137 | | |
| | Total | 76.750 | 35 | | | |
| a Predictors: (Constant), HAQ1 | | | | | | |
| B Dependent Variable: HAQ2 | | | | | | |

Frequencies graphic is closer to the ideal curve (figure 2).

**Figure 2**




## Discussion

We consider, in accordance with the Guidelines for the Management of RA (3), that the complex impairment of physical function may be aggravated by quotidian physical activity. So, the rehabilitation program is necessary to control the complex function of hand in RA patients. In the kinetic session we established the periods of rest, changes in activities of daily living, the resistance exercise for intrinsic hand muscles and mean aspects for energy conservation rules.

All patients of our study could performed the rehabilitation program for hand function because had a good prognosis of RA. Poor prognosis is suggested by earlier age of disease onset, high titer of RF, elevated ESR and swelling of > 20 joints (or DAS > 3.7).

Our results are in accordance with other studied (12 - 15). Optimal management of RA involves more than pharmacologic therapy. Early in the course of the disease, the patient needs to learn to accept that he or she will be living with RA and will need to become involved in the process of making decisions about treatment. Instruction in joint protection, conservation of energy, and a home program of joint range of motion and strengthening exercises are important in achieving the treatment goal of maintaining joint function. Physical therapy and occupational therapy may help the patient who is compromised in activities of daily living. Regular participation in dynamic and even aerobic conditioning exercise programs improves joint mobility, muscle strength, aerobic fitness and function, and psychological well being without increasing fatigue or joint symptoms (12, 13).

The hand is frequently affected in RA as we can speak of a lesion predilection of the disease for the hand. Because of the inflammation of the capsule, ligaments and sinovial, the joints become unstable and get deformed under the action of muscular pressure. As the finger and wrist joints are frequently involved in this disease, the assessment and the management of the severity of impairment and disabilities would represent an important aspect in hand rehabilitation of RA patient.

The functional peculiarities of the hand explain these deformations and the lesional aspect of the hand. All these types of prehension – hand grip are affected in reumathoid arthritis because of the existing complex deformations of all joint elements.

The preservation of optimal clinic-functional state of the hand complex in arthritis rheumatoid presupposes a complete medical assistance and moving is most important. (16). The methodology of the recuperation program in the rheumatoid hand is adapted to the phase of the disease evolution and function (14, 17).

The current rehabilitation treatment consists of rest and general supportive measures (heat, parrafin baths, gentle physical therapy and adaptive splint) (16).

In our rehabilitation program performed in the all studied subjects we took into consideration the fundamental principles in kynetotherapy for a patient with RA:

- perfect knowledge of the morphology and bio-mechanics of the hand,
- early application,
- joint rest in acute phase, which can help to alleviate the pain, but prolonged rest increases stiffness, osteoporosis and muscle atrophy. Rest is recommended until the acute symptoms improve. During the night the functional positions for all segments will be kept- lying on the back with a pillow under the neck, inferior limbs extended, shoulder bent 45-60 degrees, elbows bent 70-80 degrees, the hand in semiflexion as if holding an orange, with fingers slightly bent;
- continuous adaptation of kinetic technique to the evolution of the disease,
- joint mobility within the limits of functional amplitude,
- avoiding strong hand grip,
- avoiding discomfort and pain during treatment and after,
- correction of gesture activity that generates information,
- continuous treatment as " essential therapy" in all periods of the disease.

The objectives of kinetotherapy with the rheumatoid hand are prevention and correction of preexistent deformations. We must take into consideration the different factors:

- early affection of metacarpophalangeal joints by the proliferating sinovitis,
- anatomical characteristic of metacarpophalangeal joints: the metacarpian head shape, with a longer condil on the radial side; ligament asymmetry, the radial one is askew the cubital vertical,
- radial deviation of fist,
- flexion- extension relation of force favouring the flexors,
- interosseous of cubital part of hand more powerful than interosseous of radial part,
- the greater use of the hand in flexion in most gestures.

The kinetic program applied in hospitalized conditions must be adapted at discharge to be applied at home, a continuous treatment being one of secretes of the success to increase the quality of the patient's life.

Prior to establishing an exercise program for patients with RA, the following characteristics should be considered: whether the involvement of the joints is local or systemic, stage of the disease, age of the patient, and compliance of the patient with the therapy. Duration and severity of the exercise are adjusted according to the patient. ROM exercises, stretching, strengthening, aerobic conditioning exercises, and routine daily activities may be used as components of exercise therapy.

In other studies it was emphasized the important kinetic aspects for the rehabilitation program (14 - 16). There should be no straining exercises during the acute arthritis. However, every joint should be moved in the ROM at least once per day in order to prevent contracture. In the case of acutely inflamed joints, isometric exercises provide adequate muscle tone without exacerbation of clinical disease activity. Moderate contractures should be held for 6 seconds and repeated 5-10 times each day. It should be remembered that if isometric exercises are performed in a magnitude of more than 40% of maximum voluntary contraction, they may lead to

impairment in blood circulation and fatigue after the exercise. If the disease activity is low, then isotonic exercises should be performed by using very low weights. If pain persists more than 2 hours or too much fatigue, loss of strength, or increase in joint swelling occurs after an exercise program, then it should be revised. Producing excessive stress over the tendons during the stretching exercises should be avoided. In sudden stretches, tendons or joint capsules may be damaged. Finally, in chronic stage with inactive arthritis, conditioning exercises such as swimming, walking, and cycling with adequate resting periods are recommended. They increase muscle endurance and aerobic capacity and improve functions of the patient in general, and they also make the patient feel better.

Our study has several limitations.

The study was based exclusively on hand clinical assessment and rehabilitation, without dynamometer measures. Rehabilitation program in complex management of RA patients covers comprehensive multidisciplinary assistance of functioning, taking into consideration the personal conditions, environmental factors and the participation of patient to the different compartments of life – all these conditions and factors were not been very well analyzed in our study. The occupational therapy may help the patient who is compromised in activities of daily living. No patient of our study had followed an occupational therapy for improvement of hand function.

More studies on the efficacy and effectiveness of physiotherapeutic interventions / rehabilitation program in the management of RA patients are needed.

## Conclusions

The immune and inflammatory status is not an important condition factor for the hand grip in RA patients.

Quality of life and hand grip are correlated with the functional stage in RA patient.

Rehabilitation in rheumatoid arthritis is a complex medical act with early initiation by a multidisciplinary medical team. Without a rehabilitation program the consequences can be definite, invalidating, with negative impact on the reeducation of the hand grip.

Applied kinetotherapy in rheumatoid arthritis to correct and keep the hand functionality with optimal hand grip is adapted to the hand lesions and is considered as essential therapy.

There is no standard kinetic modality to be applied in rheumatoid arthritis to reconstruct and keep optimal prehension – hand grip, but there is a complex of modalities to be applied individually.

By observing the kinetic principles associated with essential therapy in rheumatoid arthritis, we can ensure an optimal hand grip with high quality of life.

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# III. PRACTICAL ISSUES

## Clinical and morphological correlations in primary osteoporosis type I

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**Rezumat**

Definiția osteoporozei este încă subiect de discuție. Se pare că putem vorbi mai degrabă de un sindrom decât de o boală, sindrom evidențiat de o fractură apărută după un traumatism minor la o persoană cu masă osoasă redusă.

**Obiective**

Studiul de față își propune evidențierea unor corelații între manifestările clinice, considerate ca și repercursiuni ale osteoporozei și modificările morfologice osoase.

**Material si metode**

Studiul s-a realizat pe un număr de 47 de pacienți care au suferit o fractură de col femural, au fost protezați și ulterior au necesitat program complex de recuperare. Indicația de artroplastie a permis obținerea de material biologic necesar studiului histologic.

**Rezultate**

Lotul de studiu a cuprins preponderent pacienți de sex femeiesc, vârsta medie a lotului fiind de 62 ani. Rezultatele, în acord cu datele din literatura de specialitate, au evidențiat că fracturile de col femural datorate osteoporozei sunt mai frecvente la persoanele de sex femeiesc și sunt în relație directă cu vârsta pacienților. Ca și intensitate a traumatismului care a generat fracturarea osului, procentul pacienților care au afirmat un traumatism de intensitate mică a fost cuprins între 89 și 94.

### Introduction

Currently, osteoporosis can be considered as a "disease of the skeleton characterized by low bone mass and micro-architectural deterioration of bone tissue, that leads to enhanced bone fragility and susceptibility to fracture". Looked into more deeply, this definition refers to bone mass reduction without including other risk factors(1).

Osteoporosis affects mostly women after the age of 50, the women / men ratio being 3:1, 4:1. According to the statistics released by OMS, a tendency of ageing in population was noticed in relation with the increase of life expectancy so that a rapid 87% growth in population with ages between 65 and 74 is estimated by the year 2025. It was demonstrated that if in 1960 the number of persons over 60 years old was around 250 millions, in 2020 it will reach 1 billion(2). Most frequently, osteoporosis is diagnosed based on X-ray examination for rheumatic affections or following fractures. Fractures may be the first manifestation of osteoporosis or complications of it. Osteoporotic fractures occur at different levels, the most serious being the ones affecting the spine and hips(3).

The hip fracture is associated with an important disability and a death rate of 20-24% in the first year that fallows its occurrence, whereas mortality due to fractures in the vertebrae is double. These aspects generate increased costs for the patient, but also for the society if we take into account the large number of hospitalization days followed by long term special care, in most cases implying dependence on family or specialized institutions for help.

Primary or idiopathic osteoporosis stands for more than 75% of all osteoporosis cases and represents the involution osteoporosis. The bone loss rate depends on the type of bone: trabecular or cortical. The loss of cortical bone starts after the age of 40 and is linear, registering an annual loss of 0, 5-1% in both genders. The reduction of trabecular bone starts between 30-35 years and is linear in men and women before menopause (1-4% a year). After menopause, an acceleration of bone loss is registered, reaching up to 10% a year. (4)

The induction of osteoporosis is due to a number of factors, the most important being age and sex (especially after menopause). Several other factors may interfere either as helping factors as it happens in primitive osteoporosis, or as prevailing factors as in secondary osteoporosis. Thereby, we can mention: hormonal factors (early menopause, late puberty, mental anorexia), genetic factors (family osteoporosis), ethnic factors, anthropometric factors (low height, asthenia), nutritional factors (insufficient calcium intake, vitamin D insufficiency), environmental factors (smoking or excess alcohol, low sun exposure), iatrogenic factors (glucocorticoid treatment, thyroid hormones, heparin), lack of exercise (sedentary life, prolonged immobilizations).

There are many factors that reduce bone resistance. One of them is the reduction of osteoforming activity in bone cells, a process that may be genetically induced. Literature analysis showed that after the age of 40 the bone production decreases progressively, due to the reduction in osteoblast number and function, while the bone resorption processes are kept at the same rate, leading to a decrease of bone mass after this age noticed in both genders. In what concerns old persons, besides the reduction in osteoblast activity, there is also a secondary hyperparathyroidism that, for unknown reasons, determines an increase in osteoclast activity that affects especially trabecular bones(5). Another factor that participates in bone mass lowering is the decrease of the intestinal calcium absorption. The calcium absorption is age correlated and becomes more important after the age of 70, in both genders, due to the relative vitamin deficit and lower tissue response to their metabolites.

Knowing the factors that may cause osteoporosis helps at choosing the most appropriate treatment for each case.

## Concluzii

Modificările ţesutului osos afectat de osteoporoză au fost prezente atât la nivelul osului cortical cât şi la nivelul osului spongios. Fracturile de şold s-au datorat reducerii rezistenţei osoase prin apariţia osteoporozei, în special la persoane peste 70 de ani iar cel mai frecvent mecanism de producere a fracturii a fost prin cădere de la propria înălţime.



## Cuvinte cheie

osteoporoză, fractură, os cortical şi spongios.



## Abstract

The definition of osteoporosis is still subjected to debate. It appears to be more of a syndrome than a disease, becoming obvious after a fracture that follows a minor trauma at a person with reduced bone mass.

## Aim

The present study aims to emphasize some correlations between clinical manifestations, considered as repercussions of osteoporosis, and the morphological changes in bones that lead to this type of manifestation of the disease.

## Material and methods

The study involved a number of 47 patients who suffered femoral neck fractures, had replacement arthroplasty and then needed a complex rehabilitation programme. The indication of arthroplasty enabled specialists to obtain biological material needed for the histological study.

## Results

Hip fractures are due to a loss in bone resistance by the appearance of osteoporosis, especially in advanced stages and after the age of 70. In what concerns the way the fracture was produced, we established that most of them took place after falling from very low heights (usually while standing) and the trauma intensity was appreciated as being very small in 89-94% of cases.

## Conclusions

Osteoporosis leads to trabecular bone structure changes consisting in bone rod number reduction. The most frequent cause that led to fracture was falling from one's height and the trauma intensity was evaluated as minor in most patients.



## Key-words

osteoporosis, hip fracture, trabecular bone structure.


## Material and methods

This study aims to show possible correlations between clinical parameters and bone structure modifications in patients diagnosed with osteoporosis. The study involved a number of 47 patients that suffered from femoral neck fractures, had replacement arthroplasty and then needed a complex rehabilitation programme. The indication of arthroplasty enabled specialists to obtain the biological material needed for the histological study.

## Results

The patients' ages were between 51 and 92 (with an average of 62), 14 were male and 33 females.

### Table no 1. The mean-age of studied patients

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| VARSTA | 47 | 51 | 92 | 62.05 | 3.046 |
| Valid N (listwise) | 47 | | | | |

Therefore, we may say that in women the hip fracture incidence is about 3 times more frequent than in men. This data is correlated with the one in the existing literature showing that femoral neck fractures due to osteoporosis are more frequent in women.

Hip fractures are due to a loss in bone resistance by the appearance of osteoporosis, especially in advanced stages and after the age of 50. The femoral neck fractures incidence tends to become higher as age progresses, most fractures being in the 71-80 years group. After the age of 80, the number of osteoporotic hip fractures shows a false decrease because the number of people over 80 years old is lower than the one of other ages taken into account.

21 of the patients considered for this study had been diagnosed with osteoporosis, but only 13 were on antiosteoporotic medication.

In what concerns the way the fracture was produced, we established that most of them took place after falling from very low heights (usually while standing) and the trauma intensity was appreciated as being very small in 89-94% of cases, medium in 5,1-9,2% and important in up to 1,15% of cases (car crash induced). The large number of fractures produced by small trauma confirms the reduction of bone resistance in persons affected by osteoporosis.

Gathering all clinical and biological data, we can say that there is a large number of factors involved in the appearance and evolution of osteoporosis, some partly unknown. Also, osteoporosis affects mostly women, especially after menopause.

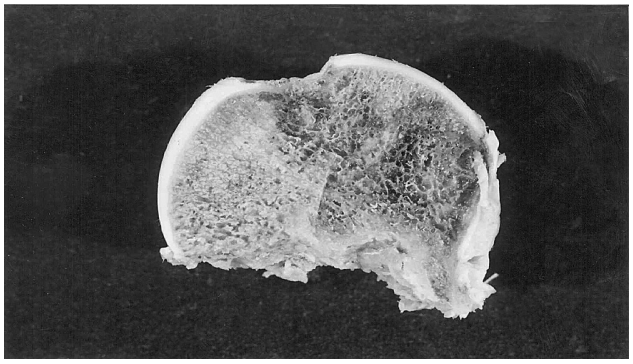
Starting from the fact that cellular injuries and tissue changes vary from one part of the bone system to another and that these changes are more severe in the neck and head of the femur, we analyzed fragments of bone tissue from 18 patients (12 women and 6 men), with ages between 56 and 83, who needed hip arthroplastya after a femoral neck fracture. The bone part was sliced in 5mm pieces using the oscillatory saw. In order to prevent the deterioration of the biological material represented by femoral neck and head slices, they were immediately set in 10 % neutral formol for 3 weeks, at room temperature.

The macroscopic aspect of the femoral neck and head architecture varied from one patient to another according to age and sex. Thereby, in older patients the cortical bone was a lot thinner and the trabecular bone rods were more attenuated and thinner compared to those of younger patients. The trabecular bone plates from the femoral head and neck, had a larger surface, were filled with yellow and / or fibrous bone marrow and only in some parts with red bone marrow depending on how much time had passed from the installation of osteoporosis and on its nature: primary or secondary.

In some patients the bone tissue digression started in the central part of the bone and extended towards the margins, such as the eccentric bone atrophy. In other cases, the remaining bone rods suffered a process of compensatory thickening, creating the aspect of hypertrophic bone atrophy. (picture 1)

## Picture 1

A 63 years old female patient with osteoporotic femoral neck fracture.
Thickened resistance rods can be seen, as well as thinned interconnecting ones.

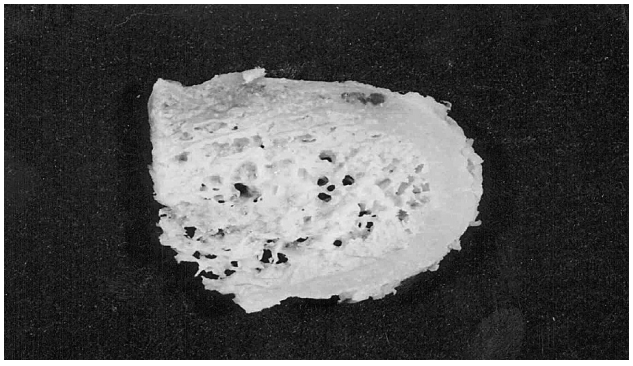


In regard to advanced osteoporosis, we noticed severe trabecular structure disruption in trabecular bones, due to resistance rods extinction, with the occurrence of large cavities with irregular outlines. These cavities appear as a result of an increased osteoclastic activity or of bone rods micro fractures followed by bone necrosis and subsequent bone resorption. Red bone marrow is replaced by a yellow adipose one and in the final stages of osteoporosis by fibrous bone marrow. The damaging of cortical bone of femoral head and neck contributes to the advanced drop in bone resistance.

Atrophic changes in osteoporosis were seen in the femoral neck slices, even more intensely than in the corresponding femoral head. At this level, eccentric atrophy seems to prevail. Thus, we noticed that while the femoral head rods suffered only thinning and compensatory thickening, in the femoral neck rods important ruptures could be seen. (picture 2)

## Picture 2

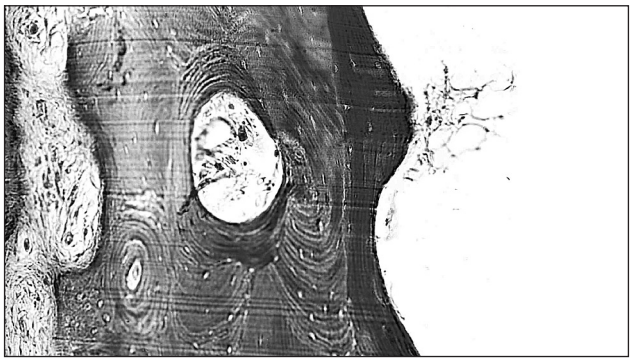
A 1mm slice from femoral neck in a 59 years old female patient.
Broken interconnecting rods and thinned resistance ones can be seen.



The microscopic study enabled us to highlight the changes in quantity and quality appeared in the trabecular and compact bones from the femoral neck and head. A first thing to be noticed is that the bone shows a different coloration from one bone fragment to another, even though they were identically processed. We believe this microscopic aspect is due to the fact that the osteoporotic bone contains quantities of minerals varying from one part to another probably because the bone matrix is uneven decalcified. (picture 3)

## Picture 3

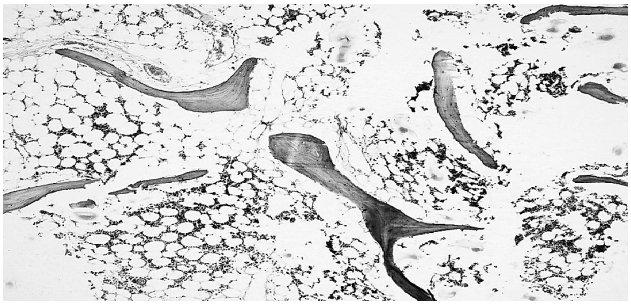
Different coloration in bone rods can be seen
Hematoxilin-eozine coloration X 100



We noticed that thinned leftovers with sharp ends remained from the trabecular bone rods. (picture 4)

## Picture 4

Bone disruption can be seen, with few thin, parted bone rods
Hematoxilin-eozine X 100



## Conclusions

Hip fractures are due to low bone resistance by the appearance of osteoporosis, especially in advanced stages and after the age of 70.

The most frequent cause that led to fracture was falling from one's height and the trauma intensity was evaluated as minor in most patients.

Osteoporosis leads to trabecular bone structure changes consisting in bone rod number reduction.

The changes in bone tissue affected by osteoporosis were present both in cortical and trabecular bones.

In the cortical bone a reduction of cortical thickness could be seen in the femoral head and neck along with the drop of bone density and the increase of bone transparency.

In the spongy bone, we could notice a reduction in the bone rod number, the decrease in thickness for the ones left, areolar space increase and a colourless aspect of the trabecular architecture.

All these macroscopic and microscopic changes indicate a loss of the bone structure, the reduction of bone matrix mineralization as a result of osteoblast and osteocite activity decrease, the increase of bone fragility, and explains the bone fractures that occur in patients with osteoporosis.

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# Gait analysis in the elderly

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## Abstract

Gait analysis refers to: kinematic, kinetic, metabolic analysis and dynamic EMG. One feature of gait that has been used to identify people who are at risk for falling is gait unsteadiness. An unsteady gait pattern will be characterized with greater kinematics variability. Decreasing variability of walking patterns may help to prevent falls by achieving a more stable gait pattern, thus improving the control of the while-body position and by reducing the mediolateral momentum of the center of mass. Walking were slowly, with a higher STF and shorter STL, may help to stabilize the gait pattern and allow greater adjustment and flexibility to change in walking conditions (increasing or decreasing walking speed), especially in patients with history of falls. Compared with elderly with no history of falls, elderly people who are at risk for falls will have the following characteristics of gait: decreased ankle plantar flexion and hip extension during push-off, increased hip flexion during the swing phase, reduced mediolateral sway, decreased reaction time.

## Keywords

elderly, gait analysis, falls.

## Gait analysis

Includes: kinematic analysis, kinetics, metabolics, dynamic EMG and poli EMG dynamic.

**a) Kinematic analysis of gait**

It is a method of measuring some walking parameters of a gait cycle. Walk cycle - functional unit of the gait - is divided from a functional point of view, in stance and the swing. The stance phase includes:

- initial contact ,
- loading response,
- single limb stance with mid stance and terminal stance.

Swing includes the forward movement of the lower limb, subdivided into:

- preswing, which begins at the end of the stance phase and coincides with the push-off,
- initial swing ,
- median swing ,
- terminal swing.

Kinematic of the gait cycle is organized in order to reduce the movement of the gravity center of the body vertically and horizontally, providing an efficient walk. The center of gravity, determined experimentally, is located above the second sacral vertebra. During walking, the center of gravity makes through each step, a sinusoidal top-down vertically and medio-lateral on the horizontal trajectory. Vertical movement is approximately 50 mm for men at a normal speed of walking. Horizontal movement is achieved by a medio-lateral movement from left to right.

During walking in elderly, the peak of the vertical displacement occurs before the lateral movement, the route followed by the center of gravity being in the shape of "8".

***Determinants of walking***

Major mechanisms by which the body reduces the movements of the gravity center during walking are:

- Pelvic rotation: in the transverse plane, it reduces the lowering of gravity center while standing on both feet; it was assessed the effect of pelvic rotation as adeterminant of gait, by reducing the vertical displacement of center of gravity (COM) during a comfortable walking speed. The estimated effect of the pelvic rotation, as a result of the reduced movement of COM, was 35 ± 11 mm, calculated only for 12% of the actual reduction. During a normal gait, with a comfortable speed, made by robust subjects, pelvic rotation contributes only in a small percent to the actual reduction of vertical displacement of COM, compared to the walking model.
- Obliquity of the pelvis: a pelvic tilt of a small amount (Trendelenburg position) reduces the peak of the center of gravity during unipodal support;
- Lateral movement of the pelvis: its reduction is influenced by 2 factors – movement of the body to the supporting leg during the response to the load and the valgus formed between the femur and tibia;
- Interrelation between the knee-ankle-foot is a mechanism wich reduces the vertical displacement of center of gravity during walk.

Alternation of movement between the knee, ankle and foot, is a mechanism to reduce the vertical displacement of center of gravity while walking. The ankle makes plantar flexion, controlled during loading, and the knee is slightly flexed to reduce the maximum peak displacement of center of gravity during the unipedal support. Also, while unipedal support there is a gradually dorsiflexion of the ankle which reduces the top of the center of gravity displacement. The ankle makes plantar flexion during bipedal support, and the value of the lowest center of gravity point increases. All these

actions occur gradually and they are smoothing the curve of the motion of the center of gravitation during walking.

Gender differences were studied in a three-dimensional analysis of walking on 98 healthy Korean adults (47 women, 51 men), using an opto-electronic analysis system and force platforms. For women were found: height and stride length shorter ($p < 0.05$), lower cadence, pelvic tilt higher to forward, increased angle of flexion, adduction and internal rotation at the knee joint level ($p < 0, 05$).

**b) Kinetic analysis of gait**

It refers to the forces that develop during walking, external forces (represented by gravity and ground) and internal forces generated by the neuro-myo-artro-kinetic system. During the balance in a walk cycle, most of the external moments occur in the lower limbs joints as a result of gravitational and inertial forces of the individual segments of the limbs.During the balance, the foot weight and the inertial force of the lower limb, will generate an external moment, plantar flexor that need to be counterbalanced by an internal dorsal-flexion moment (provided by the dorsal flexors of the ankle) to prevent the fall of the foot. During the static period of a gait cycle, most of the external moments occur in hip, knee and ankle joints and are produced by the reaction force of the ground (GRF).

Any force requires a reaction force: during the static period, weight pushes to the ground, and it will react with an equal and opposite reaction force, of which vector passes through the support base toward the center of gravity of the body. During walking, the ground reaction force is an effect of the body weight and of the accelerations and decelerations.

**c) Metabolic analysis of gait**

It refers to the energy consumption, which is the higher the more body weight is greater. For the same constant speed of walking, a person of 100 kg will have double the energy consumption that an individual of 50 kg. Walking on irregular ground or ascending a slope with inclination of 15 ° leads to doubling of energy consumption. Elderly patients can maintain low energy consumption by decreasing the walking speed; energy consumption per unit of time can be decreased, but energy consumption compared to the distance already made will be greater. Energy consumption is correlated with the movements of the center of gravity, respectively with the kinematic f gait. Sudden acceleration or deceleration increases the energy consumption while walking, and it is maximum at the end of the balance, during the initial contact and during the push-off.

**d) Dynamic EMG and dynamic poliEMG**

In addition to the main use for the diagnosis of various neuromuscular disorders, EMG is an essential technique in human motion analysis. Following the musculoskeletal organization, activating a muscle by the command coming from the CNS can affect the kinematic of many joints. These kinematic changes may affect the dynamics (length-force relations and power-velocity) and joint geometry (length of the arm strength). The result of a central command depends on the state of the kinetic musculoskeletal system (muscle length, muscle velocity, length of arm strength). To highlight the interdependence between the nerve command and muscle and segmentation dynamic, it can be used a series of investigations including EMG and dynamic poliEMG.

Dynamic EMG route identifies the degree of muscular effort for an activity, but does not specify the actual muscle strength. This is defined by the type and the speed of the contraction, the length of the muscle fiber, which, at her turn is determined by the joint position. Other parameters that have to be taken into account are the arm of force for each joint and the contribution of the synergistic muscle.

## Characteristics of gait in elderly

A characteristic of the gait used to identify people at risk of falling is the variability of gait. An unstable gait pattern is characterized by an increased kinematic variability. Decreasing the variability of the gait type can help to prevent falls and get a more stable gait pattern, thereby improving control of position and proportions of the whole body and reducing the medio-lateral movement of the center of gravity. Going slower, increasing STF (stride frequency) and shortening the STL (stride length) may help to the stabilization of the gait type, allowing a better adjustment and flexibility to the changing walking conditions - increasing or decreasing the speed is made particularly in patients with a history of fall.

From this perspective, flexibility is defined as the ability to adopt new patterns of movement, following the changes necessary for the specific requirements.

The interaction between upper and lower limbs during walking can be indicated by the changes of a 2:1 ratio (2 arm swings on a gait cycle) to a 1:1 ratio (1 arm swing on a gait cycle) with increasing the speed of the walk, which requires an intrinsic adaptability; for the elderly with a history of falls that change is difficult to make because of the reduced adaptability.

In people over 70 years, average walking speed decreases by 12-16% every decade, stride frequency (STF) increases, stride length (STL) is lower for a given speed of walking, duration of the double support increases to 26%. It was found that older people have a lower speed of stepping over obstacles, reduced stride length, a smaller distance of touching the ground with the heel after crossing the obstacle.

Possible explanations for changes in walking speed and gait parameters with aging include: reduced energy costs by decreasing walking speed, compensation for muscle failure, poor balance with increased gait variability. For example, decreased STL in elderly coincides with hip extensors and plantar flexors failure, reduced separation phase of the foot from the ground, increased swing phase and reduced ability to propel the body forward during walking. Muscle insufficiency and poor balance also appear associated with increased STF and with an increased duration of the double support. Some of these gait adaptations in the elderly may be related to the prevention of falls and history of falls.

Thus, compared with older people without a history of falls, the ones with a high risk of falls will have the following features: low plantar flexion and hip extension during the phase of detachment of the foot from the ground, increased hip flexion during the swing phase, reduced medio-lateral balance, decreased reaction time.

Biomechanical changes that were specific for the gait were studied, regardless of speed, in healthy elderly compared with young healthy adults. The subjects walked with a comfortable and then with an increased speed. At both speeds, differences that remain between the groups were: peack's reduction of the hip extension, increased anterior pelvic tilt, reduced plantar flexion, founded in the elderly group.

Space-time adjustments to the elderly likely to falls, may be mechanical type solutions, while trying to reduce increased gait variability by performing a direct attempt to minimize the forces acting on the musculoskeletal system during static and dynamic phase . A faster elevation of the leg during the swing phase, with an increased velocity at the hip and at the knee level - for flexion, in opposition to the normal separation of the foot from the ground, can be motivated by the fact that the forces that propel the body forward are minimized.

These types of space-time adjustments will reduce propelling and medio-lateral forces that act on the body during walking. During the propulsion phase of the gait, it is known that is generated the widest medio-lateral moment (by the largest movement of the center of gravity), which is counteracted by the gluteus muscles to maintain the body's center of gravity within the support base. Insufficiency of the gluteus medium in elderly with a history of falls, makes them adopt a gait model that minimizes the medio-lateral forces. An increase in the STL is associated with an increased propellant forces and a reduction in the STL, (with increased STF to maintain the speed), will minimize these forces. Similarly, an increase in STF shortens the entire gait cycle and thus the unipodal support time – by reducing the time and the amplitude of the center of gravity movement outside the support base.

The gait model shown by decreased stride length or increased stride frequency requires a shortening of the static period and a reduction of the time that is necessary for the center of gravity to cross outside the support base of the body.

## Conclusions

Increased STF (stride frequency) and shortness of STL (stride length) may help to stabilize the type of walking, allowing a better adjustment and flexibility to the changing conditions - increased or decreased walking speed, particularly in patients with a history of falls.

Compared to older people without a history of falls, the ones with a high risk of falls will have the following features of gait: decreased plantar flexion and hip extension during the phase of push-off, increased hip flexion during the swing phase, reduced medio-lateral swing, decreased reaction time. These changes do not reveal a true pathology of the gait, they are rather compensatory mechanisms that make the walking secure. These movement patterns serve to protect the elder against falls, increasing energy consumption during the walk.

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# The rehabilitation principles after total knee arthroplasty (part I)

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## Rezumat

Articolul doreste sa prezinte principalele elemente in cadrul tratamentului de recuperare dupa artroplastia de genunchi si cuprinde informatii despre principiile generale ale recuperarii, indicatiile si contraindicatiile protezarii genunchiului, scopurile principale ale programului de recuperare si profilaxia celei mai redutabile complicatii postoperatorii, tromboza venoasa profunda.

## Abstract

The article wishes to present the main elements of the rehabilitation protocol after total knee arthroplasty and consists informations about the general principles of rehabilitation, the indications and contraindications of knee arthroplasty, the main goals of the rehabilitation programme and the prophylaxis of the most aggressive postoperatory complication, meaning the deep vein thrombosis.

## Keywords

Total knee arthroplasty, rehabilitation principles, indications , contraindications, prophylaxis.

## Introduction

Total knee arthroplasty(TKA) is among the most common operative procedures performed in the orthopaedic centers worlwide and over the past three decades the use of this procedure has grown constantly, providing relief from pain and improving the quality of life for many patients with arthritis of the knee. During this time, the role of rehabilitation has been emphasized as an integral part of the postoperative management of the patient, because patients now begin functional activities as early as the first postoperative days.

TKA is indicated for those patients who have severe disabling pain as a result of destruction of the joint and either have not responded to nonoperative management or are not candidates for less aggressive procedures(synovectomy).

Common causes of joint destruction include osteoarthritis, rheumatoid arthritis, traumatic arthritis. The established risk factors for osteoarthritis of the knee are obesity, advanced age, osteoarthritis at other sites, previous knee trauma or injury, previous knee surgery and the female gender. The controversial risk factors are physical activity, genetics, smoking and the estrogen deficiency(1).

The goal of any rehabilitation program following TKA is not only to maximize the patient's functional status with respect to mobility and activities of daily living but also to minimize postoperative complications. Finally, the rehabilitation program should provide the basis for a safe return to the home setting, allow resumption of premorbid activities and integrate patients back into the social life of the community.

## General principles for TKA

Most surgeons use similar protocols after TKA, no matter if the implants are cemented or not, because the initial fixation of noncemented components is considered good that loosening is uncommon and the stability achieved is adequate to allow full weight-bearing. But if the bone is osteoporotic or the surgeon makes concomitant osteotomies or structural bone grafting, weight-bearing should be delayed, until healing has been achieved. So progression to weight-bearing must be based on the surgeon's indication and intraoperative observations.

Component design, fixation methods, bone quality and operative techniques affect perioperative rehabilitation.

Postoperative return of 90 degrees of knee flexion is generally considered the minimal requirement for activities of daily living(ADL) with involvement of one knee, but if both knees are replaced, it is important that one knee be capable of more than 105 degrees of flexion to allow the patient to rise from bed(7).

Continuous passive motion(CPM) may began after surgery, but if it used for long periods, a fixed flexion contracture of the knee may develop and the patient must work also at achieving full extension. We must limit aggressive or prolonged CPM use in patients with the potential for wound problems(diabetes or obesity).

Immediately after surgery, patients frequently have a flexion contracture because of hemarthrosis and irritation of the knee but it resolves with time and appropiate rehabilitation. It is very important that full extension be achieved in the operating room, because patients who have been left with a fixed flexion contracture are frequently unable to achieve full extension(9).

Manipulation under anesthesia may be required with the use of a muscle relaxant if the patient has not achieved greater than 70 degrees of flexion after 1 week postoperatively. Many surgeons believe that the patient will be able to regain the motion loss so rarely perform this procedure. Late manipulation under anesthesia, after 4 weeks, risks serious injury to the knee(8).

Reflex sympathetic dystrophy(RSD) of the knee is rare after TKA and is usually

diagnosed late. The simptoms are continuous chronic pain, allodynia or skin tenderness. In consequence, these patients fail to achieve normal range of motion(ROM) and develop a flexion contracture.

## Indication for TKA(6)

Indications for TKA include:

- disabling knee pain with functional impairment
- radiographic evidence of significant arthritic involvement
- failed conservative measures: weight loss, activity modification, NSAIDs, cane in the opposite hand, viscosupplementation of the knee.

## Contraindication for TKA(6)

### Absolute Contraindication

- recent or current joint infection(unless carrying out an infected revision)
- sepsis or systemic infection
- neuropathic arthropathy
- painful solid knee fusion, usually due to RSD, which is not helped by surgery.

## Relative Contraindication for TKA

- severe osteoporosis
- debilitated poor health
- nonfunctioning extensor mechanism
- painless, well-functioning arthrodesis
- significant peripheral vascular disease

## Classification of tricompartmental total knee implants

**1. UNCONSTRAINED**

This type relies on soft tissue integrity to provide joint stability and are rarely used in TKA.

**2. SEMICONSTRAINED**

Most knee prostheses fall into this group and with judicious soft tissue releases and proper implant selection, flexion contractures up to 45 degrees and angular deformities up to 25 degrees can be corrected.

**3. FULLY CONSTRAINED**

This type is fully constrained in one or more planes of motion and because of restriction of motion, implant stresses are very high, with a higher incidence of loosening, excessive wear and breakage.

They are reserved for severe instability and severe deformity, too large for semiconstrained implants.

## Rehabilitation goals after TKA(10)

1. Prevent hazards of bed rest(deep vein thrombosis, pulmonary embolism, pressure ulcers).
2. Assist with adequate and functional ROM, by strengthening knee musculature and assisting patients in achieving functional independent ADL.
3. Independent ambulation with an assistive device.

## Consideration on perioperative rehabilitation

Component design, fixation method, bone quality and the operative technique will affect perioperative rehabilitation(3).

There are 3 types of fixation methods for total knee implants:

1. Cemented: are used for older, more sedentary patients.
2. Porous ingrowth fixation: this should not deteriorate with time(unlike cemented fixation) so are the ideal choice for younger or more active patients.
3. Hybrid technique is represented by a noncemented "ingrowth" femoral and patellar component with a cemented tibial component, a combination of the 2 previous methods.

In cemented TKA the patient has the ability for weight-bearing as tolerated with a walker from the first day after surgery.

In the hybrid or ingrowth TKA the rule is touch-down weight-bearing only with a walker for the first 6 weeks and then, next 6 weeks, begin crutch walking with weight-bearing as tolerated.

## Continuous passive motion (CPM)

Several studies have shown a shorter period of hospitalisation with the use of CPM in TKA by decreasing the length of time required to achieve 90 degrees of flexion. However, has also been reported an increased incidence of wound complications(2).

Transcutaneous oxygen tension of the skin near the incision for TKA has been shown to decrease significantly after the knee is flexed more than 40 degrees. Therefore, a CPM rate of 1 cycle per minute and maximal flexion limited to 40 degrees for the first 3 days are recommended(4).

If a CPM unit is used, the knee cannot achieve full extension, so the device must be removed several times a day so that the patient can work to prevent the development of a fixed flexion deformity(5).

## Complications after TKA

The patient-related risk factors for postoperative complications in TKA are the following:

- chronic use of corticosteroids
- smoking
- obesity
- malnutrition
- diabetes mellitus
- immunosuppressive use
- hypovolemia
- peripheral vascular disease.

## Deep vein thrombosis (DVT) prophylaxis

The incidence of DVT after TKA is much higher than originally suspected. Based on clinical detection, the DVT rate after TKA ranges from 1% to 10%. Recent studies found that 30% of thrombi developed postoperative day 12 and 23% between 12 and 24 days after surgery. The risk for DVT appears to be highest during the first 3 weeks after surgery.

Several factors increase the risk for thromboembolism:

- prior episode of thromboembolism
- previous venous surgery and varicose veins
- previous orthopaedic surgery
- advanced age
- malignancy
- congestive heart failure and chronic lower extremity swelling
- immobilization
- obesity
- oral contraceptives and hormones
- excessive blood loss and transfusion.

Spinal anesthesia and epidural anesthesia carry a lower risk for DVT than general anesthesia(13% versus 27%).

Multiple pharmacologic agents are available for prophylaxis but the most commonly used are low-dose warfarin, low-dose heparin, adjusted-dose heparin, dextran and aspirin.

Most authors recommend early ambulation, leg elevation and the use of graded-pressure stockings. External sequential pneumatic compression devices may decrease the overall incidence of DVT, but they are less effective in reducing the formation of more proximal thrombi(10).

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# Protocol de recuperare in boala Parkinson

Viorel Tutu Pata
INRMFB, Clinica II

## I. Definirea bolii pentru care se instituie tratamentul de recuperare

**BOALA PARKINSON** a fost descrisă de James Parkinson în 1817 şi denumită „paralizia agitantă" („Boli şi deranjamente ale sistemului nervos" de Marshall Hall, 1841)

Parkinsonismul este un sindrom care constă într-o combinatie variabilă de tremor, rigiditate, bradikinezie şi o tulburare caracteristică a mersului şi posturii.

## II. Stadializarea funcțională

**EVALUARE**

**SCALA UPDRS: SCALA UNIFICATĂ DE EVALUARE A BOLII PARKINSON**

Scala unificată de evaluare a BP (UPDRS, 1984). UPDRS conține 6 secțiuni, fiecare utilizabilă separat Evaluarea funcțiilor cognitive revine secțiunii I (UPDRS I) ce permite aprecierea "deficitului intelectual" sau deficitului mnezic (itemul 1), "tulburărilor de gândire", sinonime cu halucinațiile (itemul 2), depresiei (itemul 3) şi motivației (itemul 4). Este posibil un total de 16 puncte. Compartimentului motor al bolii îi revin secțiunile II (UPDRS II), III (UPDRS III), IV (UPDRS IV) şi V (UPDRS V) ale acestei scale multidimensionale.

**UPDRS V: STADIILE HOEHN ŞI YAHR**

Secțiunea V (UPDRS V) este reprezentată de stadializarea Hoehn şi Yahr, realizată în 1967, permițând o evaluare globală în BP, clasificând-o într-o evoluție de la 1 la 5. Se cotează prin examen clinic în starea de "off" şi de "on" pentru a putea evalua instabilitatea posturală, - item important în această scală. Evaluarea testului cu L-dopa vine în sprijinul diagnosticului de BP idiopatică în cazul unui minim de ameliorare cu 30% a scalei UPDRS (Secțiunea III-a).

St. 0 - lipsa semnelor maladiei;
St. 1 - semne şi simptome unilaterale, handicap funcțional minim sau nul;
St. 1,5 - semne unilaterale cu afectare axială;
St. 2 - simptome bilaterale, afectarea mersului şi posturii;
St. 2,5 - afectare bilaterală uşoară cu recuperarea echilibrului la testele de derobare;
St.3 - simptome bilaterale cu o anumită instabilitate posturală, bolnavul rămâne totuşi independent;
St.4 - handicap sever cu pierderea parțială a autonomiei;
St.5 - bolnavul în scaun rulant sau la pat, fără autonomie.

## III. Criteriile de admitere in programul de recuperare

**Criteriile de diagnostic al BP** *(Gelb şi colab., 1999)*

***1. Simptome motorii cardinale***

- tremor de repaos, distal (3-6 Hz)
- rigiditate musculară ;
- bradikinezia
- afectare asimetrică (constituie cea mai frecventă modalitate de distribuire inițială).

***2. Reactivitatea bună la L-Dopa;***

Testul cu L-Dopa (100-250 mg per os) sau Apomorfina s/c 50-100 mg/kg poate fi un indice predictiv al răspunsului cronic la L-Dopa (pozitiv în 80%-90% cazuri; din păcate răspunsurile fals negative pot să atingă uneori 40%, mai ales în stadiile inițiale ale bolii).

***3. Criteriile de excludere a BP***

- instabilitate posturală precoce ≥3 ani
- fenomene de "freezing precoce"
- paralizie supranucleară oculara
- semne precoce de insuficienţă vegetativă precoce
- semne precoce de demenţă avansată
- semne cerebeloase
- date anamnestice de ictusuri cerebrale repetate
- semnul Babinski pozitiv
- tratament cu neuroleptice în anamneză
- mişcări involuntare patologice atipice şi precoce
- encefalită certă în anamneză sau crize oculogirale
- remisie îndelungată
- manifestări strict unilaterale ale bolii în decurs de mai mult de 3 ani
- prezenţa de tumoare cerebrală sau hidrocefalee
- intoxicaţia cu MPTP
- reacţia negativă la doze mari de L-Dopa

**Diagnosticul* posibil:**

- prezenţa a cel puţin 2 din 4 simptome cardinale (dintre care unul trebuie să fie tremorul de repaus sau bradikinezia)
- absenţa simptomelor atipice
- răspuns documentat la terapia cu L-Dopa sau agonişti dopaminergici (AD) sau lipsa unei tentative de tratament cu aceste preparate.

**Diagnosticul probabil:**

- prezenţa a cel puţin 3 din 4 simptome cardinale
- absenţa simptomelor atipice cel puţin timp de 3 ani de la debut
- răspuns documentat la terapia cu L-dopa sau AD.

**Diagnosticul definit:**

- prezenţa tuturor criteriilor de diagnostic al BP posibile
- confirmare anatomopatologică.

*(Deoarece fiecare simptom în parte nu este un parametru clinic suficient de sensibil şi specific, Gelb şi col., au propus variaţii ale combinaţiilor de parametri clinici, evidenţiind diferite nivele de certitudine diagnostică: posibil, probabil, definit.)

## IV. Pachetul minimal de investigaţii:

- probe biologice
- probe ventilatorii
- electrocardiograma
- ecografie abdominala

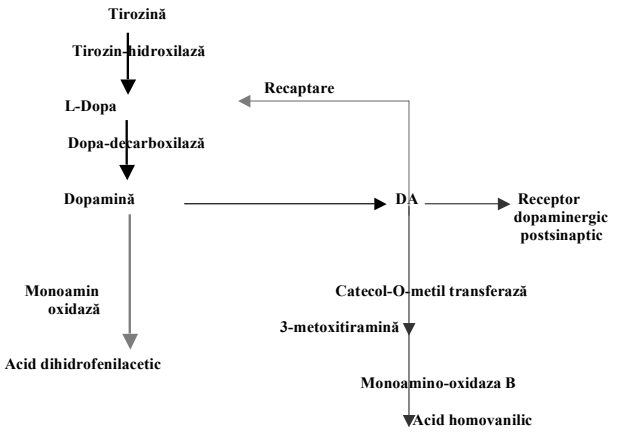
## V. Tratament medicamentos specific

**Principii de tratament, medicamente, mecanisme de actiune:**

- Dozele eficace sunt variabile de la un individ la altul. Tratamentul începe cu doze mici, care cresc progresiv, la câteva zile, timp de săptămâni, în funcţie de efecte sau reacţii adverse. În funcţie de particularităţile farmacologice, doza zilnică se divide în mai multe prize.
- Durata tratamentului, luni sau ani, depinde de eficacitate şi tolerabilitate.
- Întreruperea sau schimbarea unui medicament nu se face brusc ci, progresiv, în mai multe zile:
- Pot fi folosite asocieri pentru obţinerea de efecte terapeutice superioare.

**Medicamente, mecanisme de actiune**

- Anticolinergicele de sinteză: trihexifenidil- Romparkin, Artan, Akineton, Parkopan, Cicloolum , mesilat benztropină- Congentin, prociclicline, ethopropazine (Parsidol), cicrimine, biperiden.
- Amantadina (Vyregit-K, A-Parkin)
- Levodopa + inhibitori ai dopadecarboxilazei-(Carbidopa, Madopar- Synemet)
- Inhibitorii monoamino-oxidazelor: -L-Deprenil, Eldepryl (Selegilina, Selecim, Selegos, Jumex )
- Inhibitorii catecol-O-metil transferazei (COMT): Comtan (Entacaponum); Tasmar
- Agoniştii dopaminergici -Bromcriptina (Pardodel), Lergotilul, Piribedil (Trivastal), Lisuridum (Cuvalit, Lysenil) Pergolidum, Carbegoline (Dostinex), Pramipexole (Permax, Mirapexin) şi Ropinirole (Requip)




## VI. Echipa de recuperare-componenţă:

- **medic de recuperare** -evaluarea compartimentului motor al bolii îi revin secţiunile II (UPDRS II), III (UPDRS III), IV (UPDRS IV) şi V (UPDRS V) ale scalei unificate de evaluare a bolii Parkinson, stabilirea programului de recuperare
- **psiholog** - evaluarea funcţiilor cognitive revine secţiunii I (UPDRS I). Pentru evaluarea de finețe a gradului depresiei se foloseşte scala HAMILTON ( adaptată de Hedlung şi Vieweg -1979), iar pentru aprecierea funcţiilor cognitive prin evaluarea orientării temporo-spaţiale, atenţiei, limbajului şi praxisului constructive se utilizează MINI MENTAL STATE ( MMSE -examinarea minimă a statusului mintal, adaptată de către Folstein -1975)
- **logoped** - evaluarea şi tratarea tulburarilor de vorbire şi deglutiţie-exerciţii specifice, programul Lee Silverman (LSVT)
- **kinetoterapeut** - stretching activ şi pasiv, mobilizări pasive, active
- **erogoterapeut** - evaluare ADL-uri şi stabirea diverselor amenajări în baie, bucătarie, dormitor etc.
- **dietetician** - este necesar un consum redus de proteine: 0,8-1g proteine/kg corp/ zi (raport hidrocarbonate/ proteine de 9:1, 8:1, 7:1, 6:1, 5:1, etc. in funcţie de nivelul glicemiei, necesarului caloric, afecţiuni associate etc.); disfagia necesită ajustarea structurii alimentelor solide şi consistenţa celor lichide.

**Model de meniu 7:1** (considerat cel mai optim)

***Mic dejun***

*(52o calorii-88gr hidrocarbonați, 13 g proteine, 7 g fibre, 125mg calciu)*

18o ml suc de prune, 1/2 ceaşcă prune uscate, 1 felie de pâine prăjită, 1 linguriță de unt, 2 linguri de sirop, 1 ou gătit, după gust

*(530 calorii-106 g hidrocarbonați, 15 g proteine, 8 g fibre, 400 mg calciu)*

1 ou gătit după gust, 25o ml suc de portocale îmbogățit cu calciu, 2 felii pâine integrală prăjită cu unt, 2 linguri gem, jeleu sau miere, ½ ceaşcă de fructe

***Prânz***

*(832 calorii-134g hidrocarbonați, 19 g proteine, 6g fibre, 114mg calciu)*

1 ceaşcă de spaghetti cu 1/2 ceaşcă de sos, 1 chifteluță de carne, 2 felii de pâine cu usturoi, 1 ceaşcă de varză de Bruxelles sau brocoli cu suc de lămâie şi unt, 3ooml suc de afine, 2 prăjituri

*(770 calorii-140g hidrocarbonați, 21 g proteine, 13 g fibre, 526mg calciu)*

Salată de ton şi macaroane: 30 g ton conservat, 1 ceaşcă macaroane gătite, 2 linguri maioneză uşoară, ¼ ceaşcă salată de varză, tăiată mărunt, ½ ceaşcă morcovi, ½ ceaşcă de fructe, 240 l suc de portocale cu adaus de calciu, ½ ceaşcă înghețată.

***Cină***

*(615 calorii-110g hidrocarbonați, 16g proteine, 13g fibre, 429mg calciu)*

½ ceaşcă de supă de fasole păstăi, 2 biscuiți mari de secară, 18o ml de lapte de soia sau orez, 2 prăjituri cu ciocolată

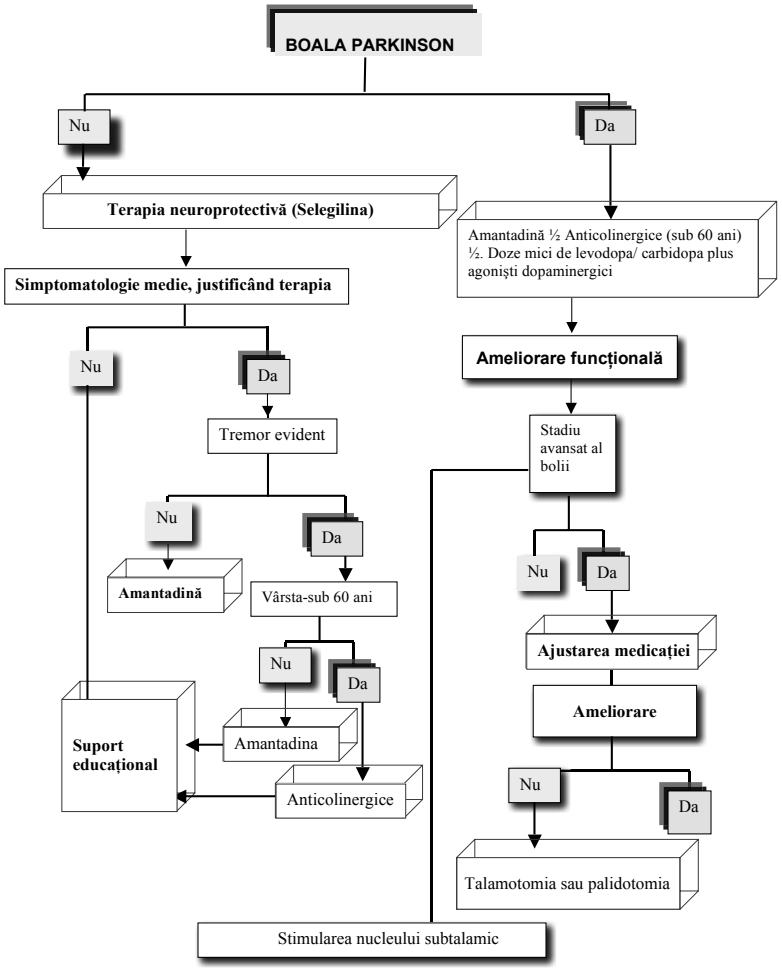
*(662 calorii-112g hidrocarbonați,16g de proteine,12g fibre,105mg calciu)*

3o g şuncă prăjită, 1 ceaşcă de cartofi înăbuşiți (18og) cu 1 linguriță de unt sau margarină, 1/2 ceaşcă de morcovi copți cu o linguriță unt sau margarină, 250 ml de suc de roşii cu conținut redus de sodiu, o felie de pâine integrală cu o linguriță unt sau margarină, o felie de plăcintă cu fructe

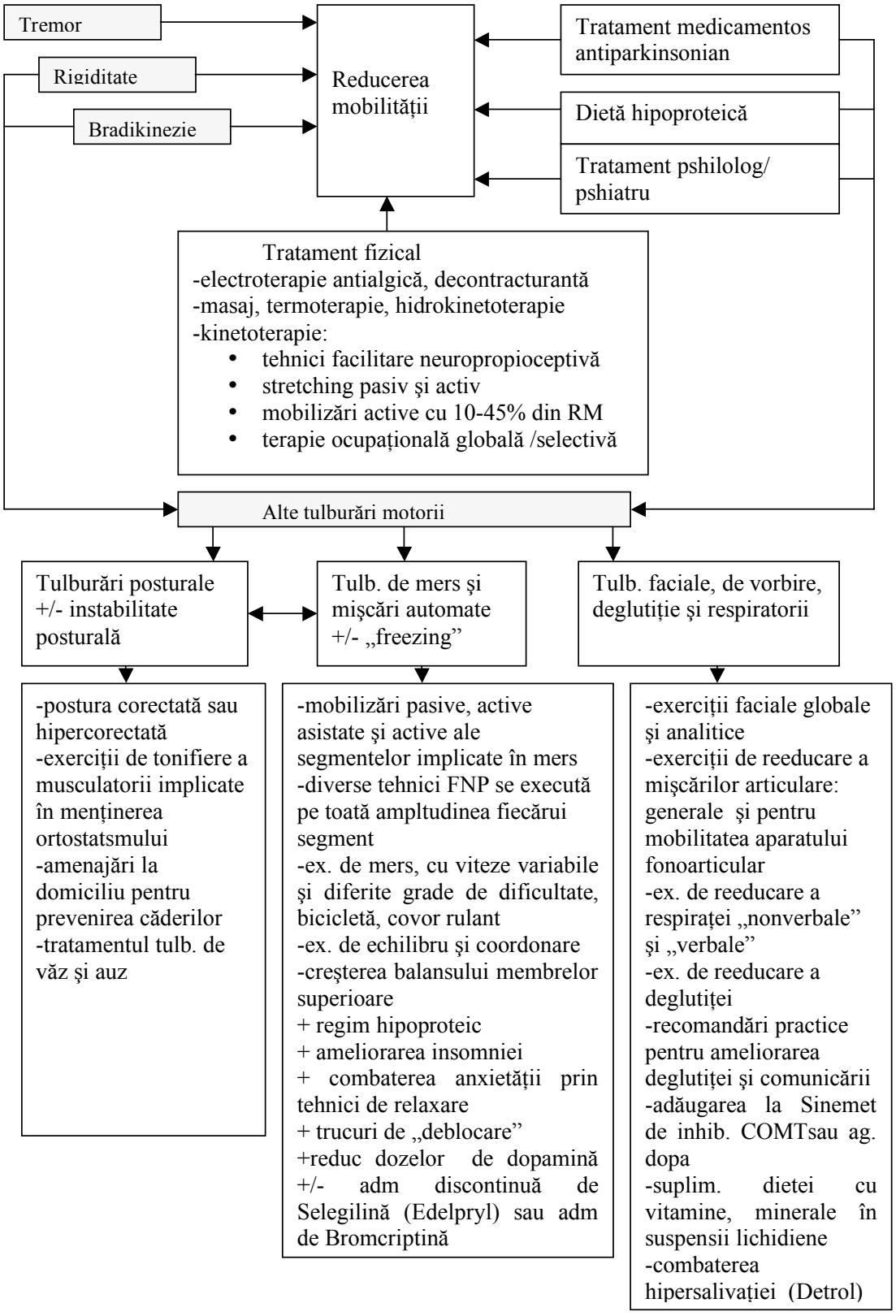
*(875 calorii-133g hidrocarbonați, 20g proteine, 7 g fibre, 196 mg calciu)*

6og carne, ½ ceaşcă de piure de cartofi, ½ ceaşcă salată de Bruxelles cu unt şi suc de lămâie, o bucată de pâine de grâu cu o linguriță unt, o lingură de jeleu, gem sau miere, 24o ml suc de fructe (mere, struguri, etc.), o prăjitură glazurată.

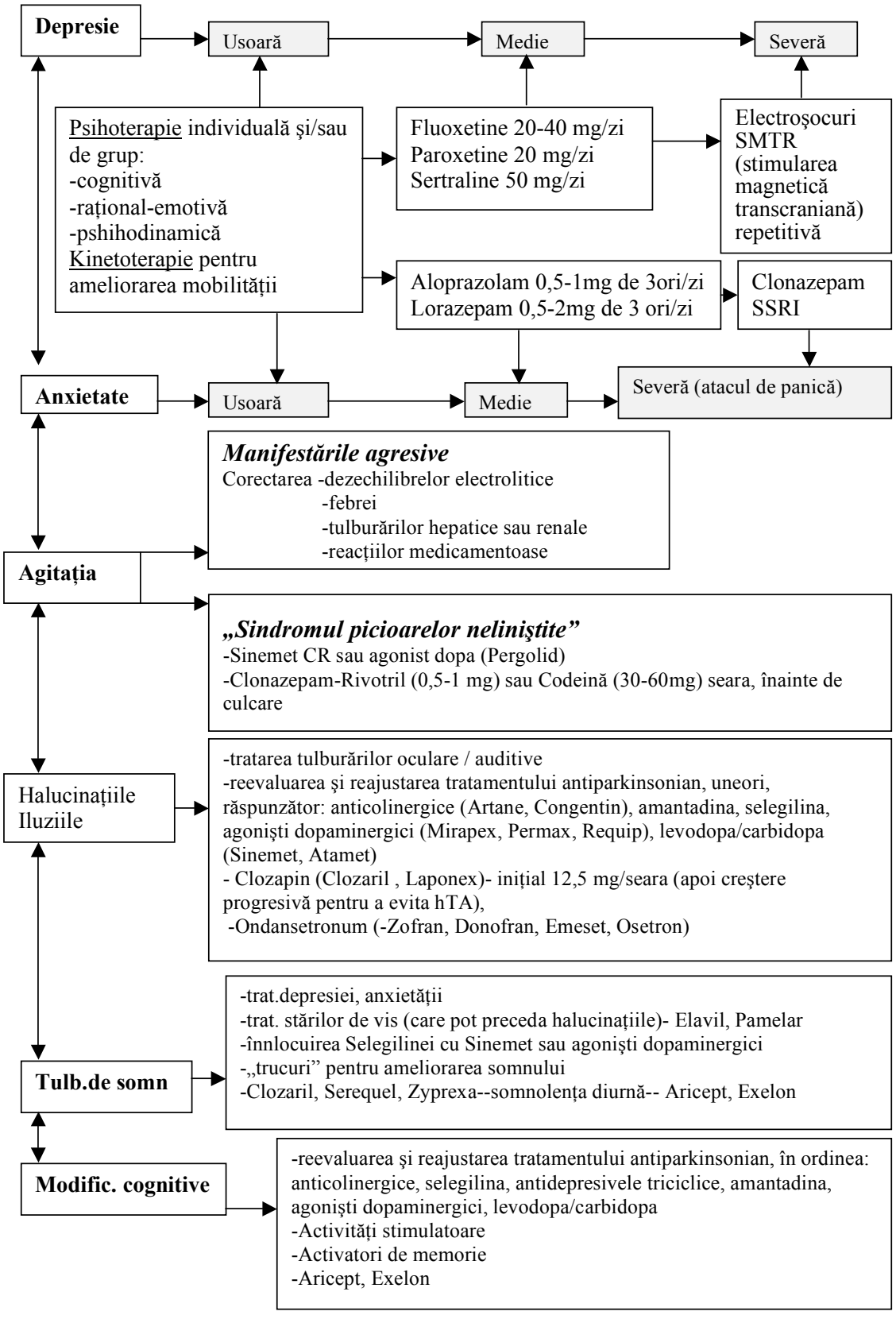
- **asistenta fizioterapie** - electroterapie (joasă, medie şi înaltă frecventă), termoterapie
- **maseur** - masaj antialgic, decontracturant
- **medic neurolog** - evaluare şi modelare a tratamentului medicamentos
- **medic internist** - evaluarea şi tratamentul medicamentos al tulburărilor respiratorii, cardio-vasculare, digestive, urogenitale
- **medic oftalmolog, ORL** - evaluarea şi corectarea tulburărilor de vedere şi auz



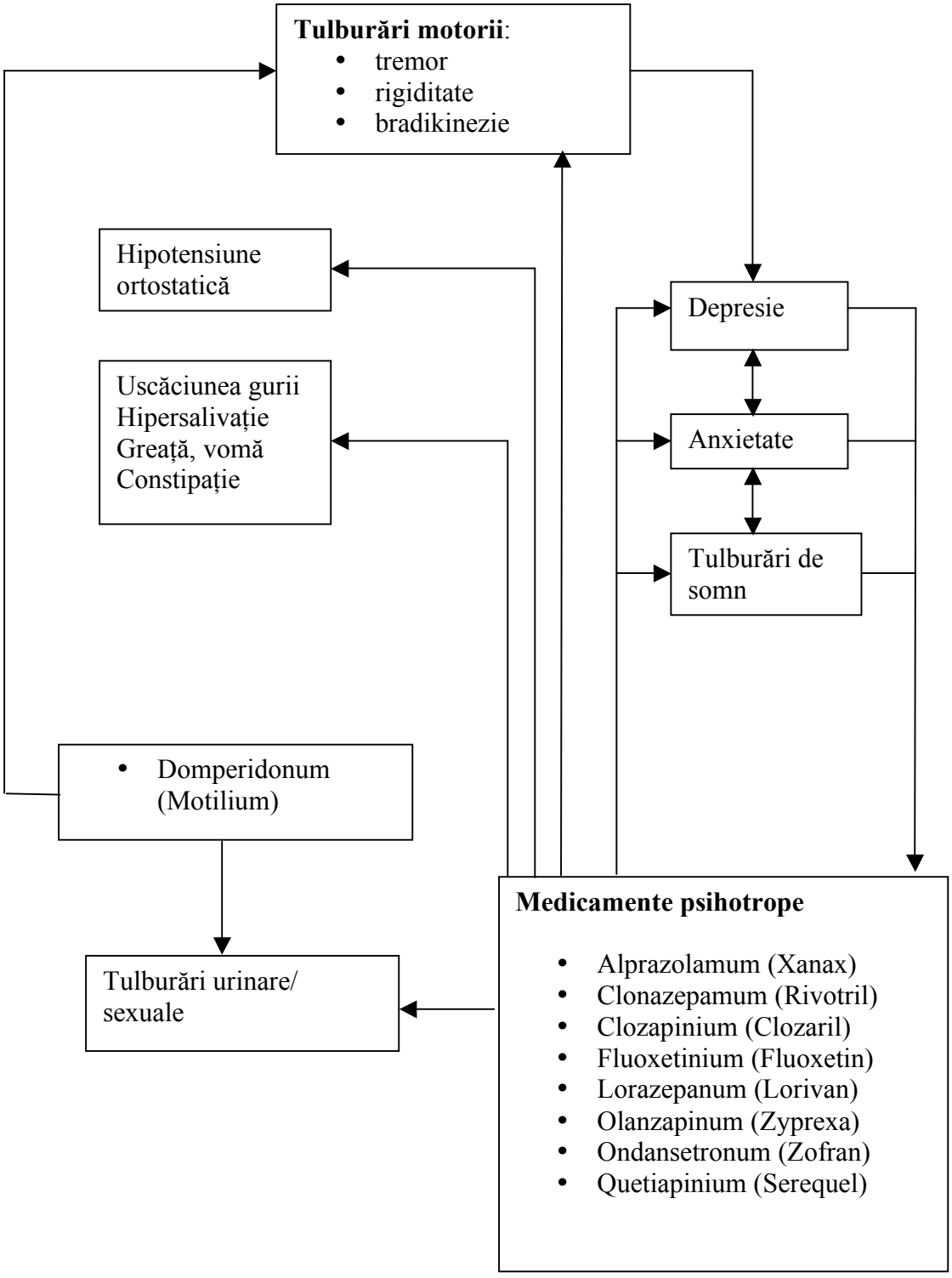
## RECUPERAREA TULBURĂRILOR MOTORII

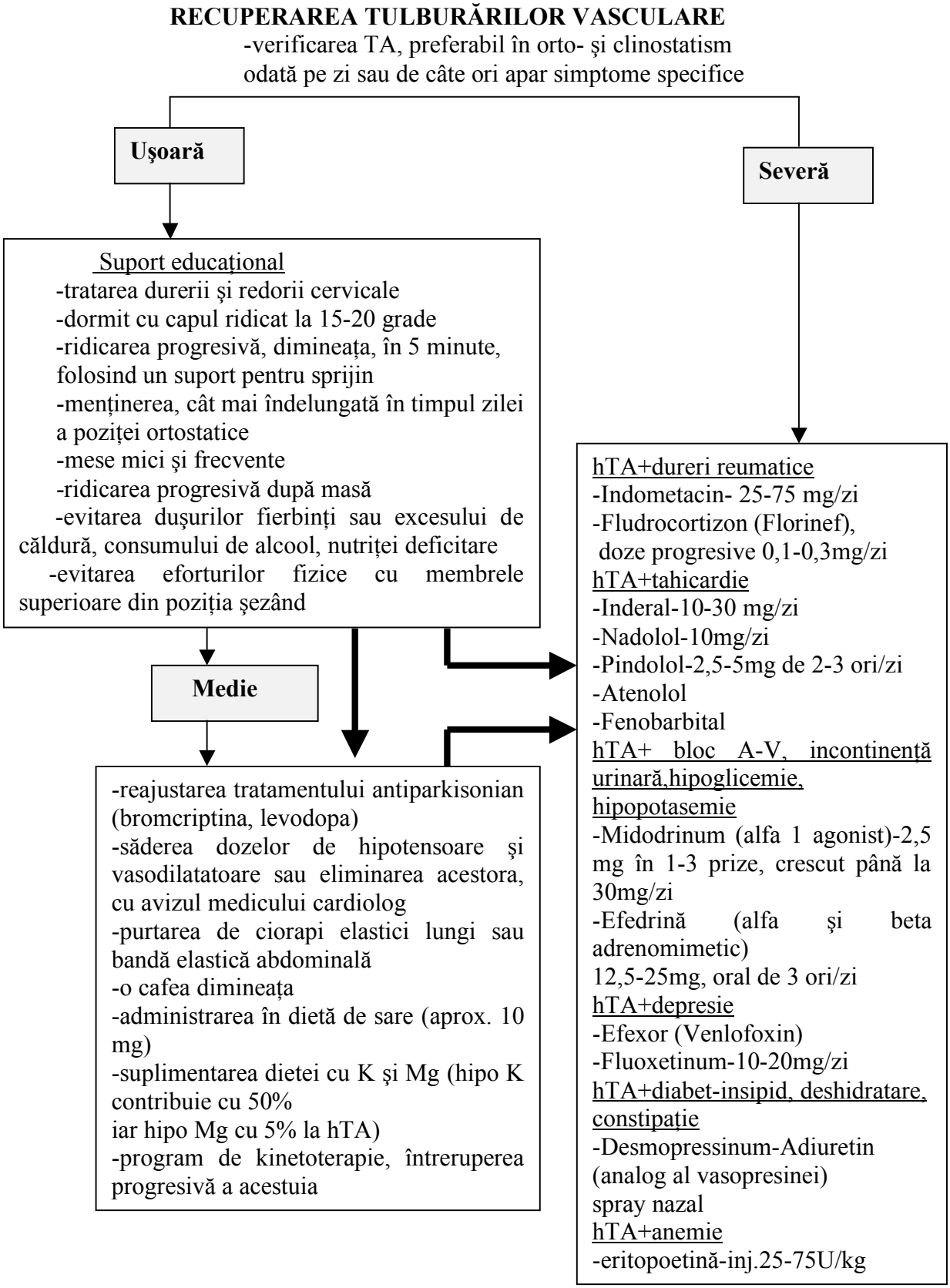


## RECUPERAREA TULBURĂRILOR PSIHO-COGNITIVE

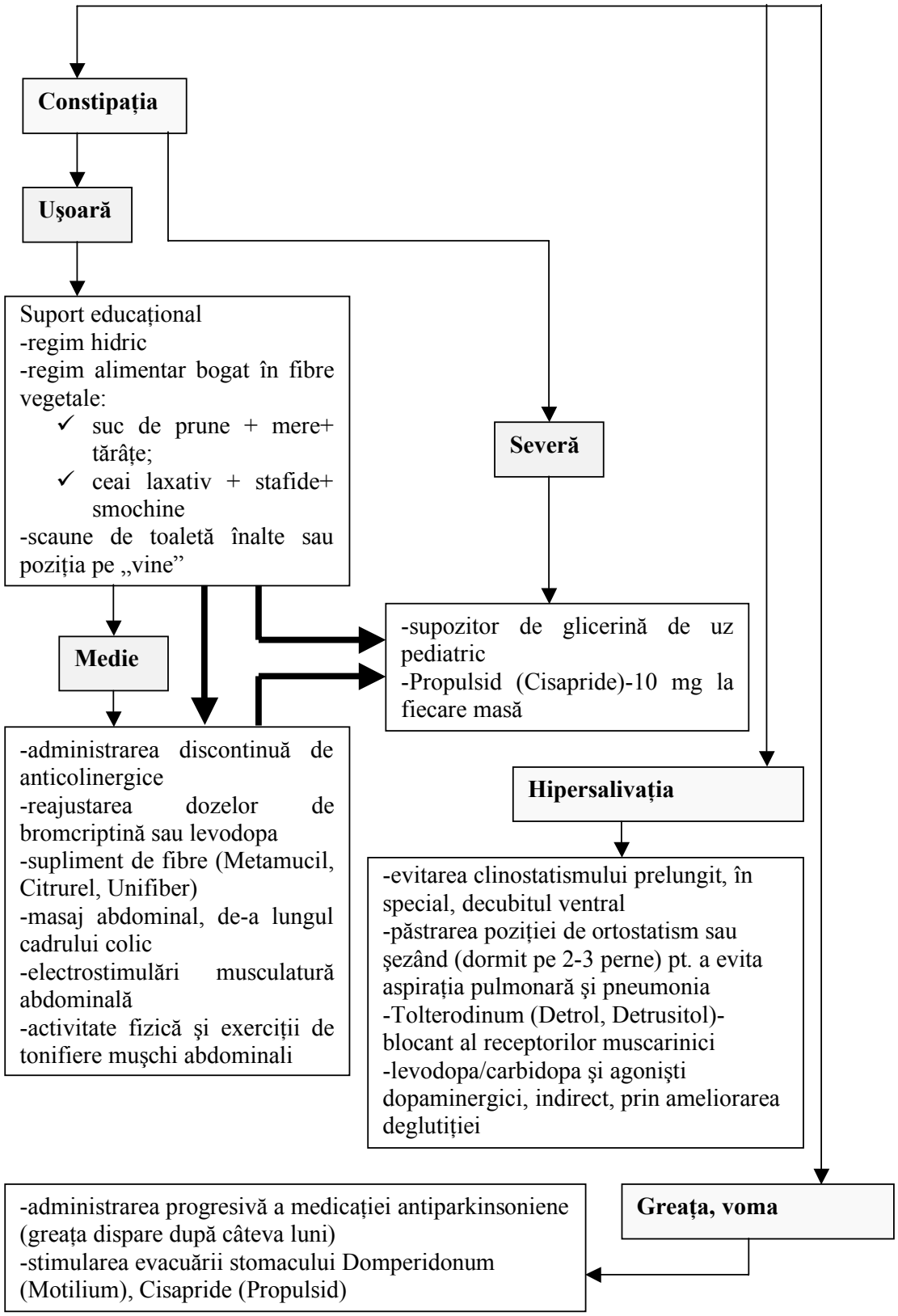


## INTERACȚIUNILE MEDICAMENTOR PSIHOTROPE CU TULBURĂRILE MOTORII, VEGETATIVE, PSHICE




RECUPERAREA TULBURĂRILOR VASCULARE
-verificarea TA, preferabil în orto- şi clinostatism
odată pe zi sau de câte ori apar simptome specifice
Uşoară
Severă
Suport educaţional
-tratarea durerii şi redorii cervicale
-dormit cu capul ridicat la 15-20 grade
-ridicarea progresivă, dimineaţa, în 5 minute, folosind un suport pentru sprijin
-menţinerea, cât mai îndelungată în timpul zilei a poziţiei ortostatice
-mese mici şi frecvente
-ridicarea progresivă după masă
-evitarea duşurilor fierbinţi sau excesului de căldură, consumului de alcool, nutriţei deficitare
-evitarea eforturilor fizice cu membrele superioare din poziţia şezând
Medie
-reajustarea tratamentului antiparkisonian (bromcriptina, levodopa)
-săderea dozelor de hipotensoare şi vasodilatatoare sau eliminarea acestora, cu avizul medicului cardiolog
-purtarea de ciorapi elastici lungi sau bandă elastică abdominală
-o cafea dimineaţa
-administrarea în dietă de sare (aprox. 10 mg)
-suplimentarea dietei cu K şi Mg (hipo K contribuie cu 50%
iar hipo Mg cu 5% la hTA)
-program de kinetoterapie, întreruperea progresivă a acestuia
hTA+dureri reumatice
-Indometacin- 25-75 mg/zi
-Fludrocortizon (Florinef), doze progresive 0,1-0,3mg/zi
hTA+tahicardie
-Inderal-10-30 mg/zi
-Nadolol-10mg/zi
-Pindolol-2,5-5mg de 2-3 ori/zi
-Atenolol
-Fenobarbital
hTA+ bloc A-V, incontinenţă urinară,hipoglicemie, hipopotasemie
-Midodrinum (alfa 1 agonist)-2,5 mg în 1-3 prize, crescut până la 30mg/zi
-Efedrină (alfa şi beta adrenomimetic)
12,5-25mg, oral de 3 ori/zi
hTA+depresie
-Efexor (Venlofoxin)
-Fluoxetinum-10-20mg/zi
hTA+diabet-insipid, deshidratare, constipaţie
-Desmopressinum-Adiuretin (analog al vasopresinei)
spray nazal
hTA+anemie
-eritopoetină-inj.25-75U/kg

## RECUPERAREA TULBURĂRILOR DIGESTIVE



## VIII. Contraindicaţiile metodelor de recuperare adaptate patologiei individuale

Criterii de excludere.

- Existenţa unor decompensări ale unor afecţiuni viscerale coexistente
- Demenţa senilă
- Boli psihice decompensate
- Etilismul cronic
- Afectări marcate ale văzului şi auzului
- Anchiloze
- Boli infectocontagioase

## IX. Manengementul pe termen lung

**1. adaptarea mediului,** Igiena, îmbrăcarea şi alimentarea sunt cele mai bune metode de evaluare a performanţelor bolnavului, iar terapeutul ocupaţional poate preciza care funcţii sunt alterate şi poate recomanda echipamentele şi strategiile compensatorii. (ex:- amenajări în camera şi toaletă: covor de cauciuc aderent, cu ventuze, evitând pe cele mici care se pot strânge sau aluneca, preferând un covor din perete în perete, care se poate fixa de una din margini; covoraşe pentru cadă sau duş, cu ventuze; greutăţi cusute în tivul perdelelor de baie le menţin ancorate, astfel jetul de apă nu udă podeaua care ar devini alunecoasă; sonerie pe chiuvetă sau vasul de toaletă; telefon fără fir pentru persoanele care locuiesc singure; robot telefonic pentru înregistrarea mesajelor pentru a nu precipita deplasarea în dorinţa de a răspunde, etc.

**2. initierea unui program de recuperare ambulatorie sau la domiciliu;** programul de kinetoterapie trebuie individualizat în funcţie de posibilităţile pacienţilor, după regula celor 3 R: raţional, regulat, realist:

***-în stadiile incipiente***, recăpătarea capacităţii de fitness poate fi efectuată cu exerciţii rezistive; la cei cu capacitate păstrată, pot fi intercalate şi exerciţii de forţă, însă, încă de la graniţa dintre stadiile II şi III, se evită exerciţiile izometrice solicitante sau tendinţa iniţială a bolnavului nesupravegheat de a-şi depăşi propriile limite, în speranţa unei ameliorări rapide, care pot determina dificultăţi şi mai mari de mobilizare ( bolnavul este avertizat că exerciţiul fizic nu este o variantă mai ieftină a tratamentului medicamentos). Programele care includ dansul sau exerciţiile de coordonare, tip tai chi, karate sunt mai uşor de performat. În stadiile precoce, pacientul trebuie încurajat să-şi continue toate activităţile, sportive, profesionale sau recreative. Programul de exerciţii aerobice trebuie să se efectueze de cel puţin 3 ori pe săptămână pentru ca pacientul să beneficieze de efectul maxim al acestora. Trebuie stabilită o perioadă acceptabilă pentru program;

Atunci când este posibil, efectuarea exerciţiilor (rotaţii, rostogoliri, asuplizări) înainte de administrarea medicaţiei pot menţine mobilitatea pe o perioadă mai lungă, aproximativ 1 ½ ore. Exerciţiile şi medicaţia au un efect variabil de la un bolnav la altul, niciunul din pacienţi neprezentând rezultate simetrice. În concluzie fiecare pacient trebuie să efectueze exerciţiile şi să-şi ajusteze medicaţia după orarul cel mai bun pentru el.

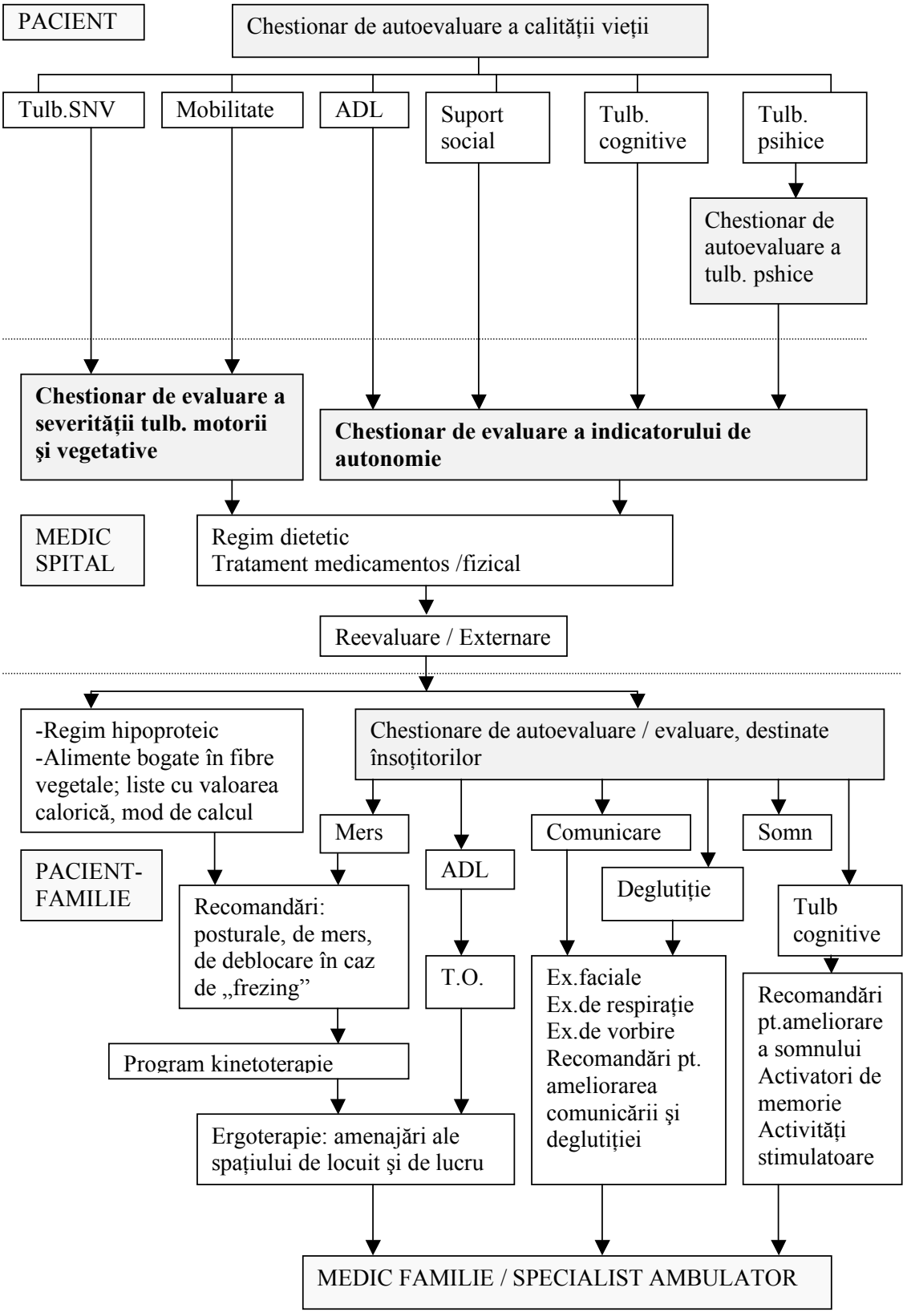
***-în stadiile tardive***, optimizarea medicaţiei are prioritate şi condiţionează buna desfăşurare a programului de reeducare; este necesară şi o mai strictă monitorizare cardio-respiratorie (puls, tensiune arterială) la începutul şi sfârşitul programului, în special pentru exerciţiile cu membrele superioare, care necesită un consum energetic cresut; în stadiul IV, îmbunătăţirea mersului şi a capacităţii de autoîngrijire prin exerciţii de tonifiere musculară şi coordonare este un scop ideal, deseori, dificil de realizat; în stadiul V programul trebuie orientat spre promovarea respiraţiei şi mobilităţii, posturări şi transferuri, influenţarea componentei pshihologice, evitarea complicaţiilor (aspiraţii şi stază pulmonară, atelectazii, tromboflebită, escare etc.)

**3. tratament de staţiune** - recomandări de tratament balneo-climateric în funcţie de afecţinile asociate

## X. Reintegrarea in familie şi societate

- chestionare de evaluare şi autoevaluare destinate bolnavilor şi familiei (chestionare simple destinate unei observări şi aprecieri a evoluţiei anumitor simptome specifice)
- recomandari practice destinate bolnavilor şi familiei, de ex: pentru ameliorarea deglutiţiei (înghiţiţi saliva înainte de a vorbi, înghiţiţi bucăţi mici, alternaţi mâncarea cu băutura, nu vorbiţi în timpul mesei, evitaţi alimentele greu de mestecat şi înghiţit -legume, fructe crude, nuci etc.); recomandări posturale ( schimbaţi-vă poziţia cât mai des posibil, cel puţin odată la fiecare oră, în timpul unei zile; efectuaţi frecvent mişcări de rotaţie ale gâtului şi umerilor; menţineţi poziţia dreaptă a capului şi contactul vizual în timpul conversaţiei; evitaţi să adormiţi pe scaun, aşezaţi-vă într-un scaun pliant sau, mai bine, într-un pat pentru a adormi cu capul şi regiunea cervicală susţinute); seturi simple de exerciţii, de ex: exerciţii faciale (zâmbeşte- menţine zâmbetul- relaxează-te, repetă; strânge buzele- menţine-le-relaxează, repetă,; alternează strânsul buzelor cu zâmbetul; strânge buzele foarte tare şi zâmbeşte cât de tare poţi, pentru a creşte eficienţa exerciţiului, apropie sprâncenele când strângi buzele şi ridică-le când zâmbeşti, etc);
- programe de terapie ocupaţională corespunzatoare deficitului funcţional, de ex:
- pentru antrenarea umărului (atingerea unor obiecte aşezate din ce în ce mai sus, mişcările cu ruloul de zugrăvit, pe un perete vertical); pentru mişcărle de prono-supinaţie (înşurubarea şi deşurubarea unui nit cu şurubelniţa, înşurubarea şi deşurubarea unui bec), etc.

## ETAPE ÎN EVALUARE, DIAGNOSTIC ŞI TRATAMENT



# Paralysis of sciatic nerve after total hip replacement: Case report

**Roxana Popa**
**INRMFB**

## Subject:

Sciatic nerve can be easely damaged during hip surgery because of his close anatomical disposition from hip joint.

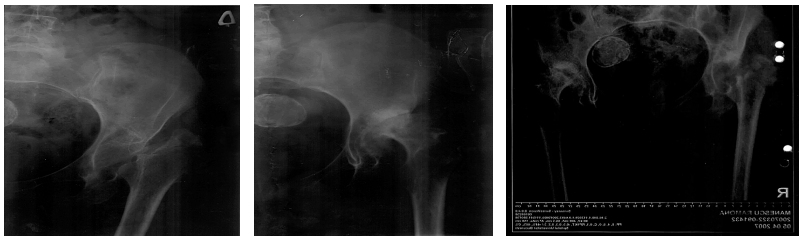
## Matherial and methods:

We present the case of a 47 years old woman, who attended our clinic for: burning pain of lateral lower leg, dorsum and sole of the right foot, pain in both hip joints, difficulty in walking and low back pain.

Patient history: she had a congenital hip dislocation and secondary bilateral hip osteoarthritis. After total right hip replacement, the paralysis of sciatic nerve was noticed. Electrodiagnostic test showed for motor conduction: no signal for tibial and peroneal nerves and for sensitive conduction: very decreased amplitude of potentials.

Physical examination: significant weakness of dorsal and plantar flexion of right foot(muscular force=3), slightly dorsal and plantar flexion of toes(muscular force=1);moderate sensory loss in the territory of sciatic nerve. Achilles stretch reflex was missing; achilles tendon contracture. The right foot was flat and dropped. The left hip had limitated range of motion. We noticed that the right leg was shorter than the left with 4 cm and a moderate lumbar scoliosis was present.

The patient had difficulty in walking, using 2 crutches. Hip joint x-ray: absence of femoral right neck and head, with superior migration of femur bone and severe joint narrowing in the left hip.



The patient received drug treatment, physical therapy and kinetotherapy. Also she used an ankle-foot orthoses with orthotic appliances and bigger heel for the right foot.

## Results:

After 2 weeks we obtained an increased mobility of right ankle, decreased pain in the hips, less in right lower leg and foot and increased muscular force in hip,thigh and leg muscles, not in dorsal and plantar flexors of toes. The coordination and balance in walking improved, as well as stability of the pelvis.

## Conclusions:

In this case the risk of complications is high: injury secondary to falls, exacerbation of Achilles tendon contracture and progressive restriction of right ankle mobility, progressive and irreversible left hip joint deterioration, exacerbation of lumbar scoliosis.

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# Lymphatic Drainage Therapy in rehabilitation medicine

**Dr Sebastian Diaconescu**

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**Clinica IV**

**Abstract**

**Lymph Drainage Therapy (LDT)** is an original hands-on method of lymphatic drainage developed by Bruno Chikly. It first became known in 1935 (dr Emil Vodder) and it has progressed from manual technique to machine

The techniques of lymphatic drainage must be performed slowly and gently – nevertheless, the application must be strong enough not to glide over the skin, but to stretch the skin gently in the desired drainage direction. The techniques must never be so strong as to compress the lymphatic vessels

**Benefits** of lymphatic drainage are:

- reduction in edema
- regeneration of tissues
- immune system stimulation
- reduction of symptoms of chronic fatigue syndrome and fibromyalgia
- pain relief
- deep relaxation to aid insomnia, depression and stress

That`s why lymphatic drainage is used in rehabilitation medicine: edema control, pain control, eliminating metabolic wastes and toxins and transporting nutrients and oxygen will

**decrease disability and will improve functioning.**

## Lymphatic System - What are the Facts?

Lymphatic system is a specialized subcompartment of the extracellular space with an almost ubiquituous presence throughout the body, accompanying venous trunks everywhere except in the central nervous system and in the cortical bony skeleton

Disruption of these blood-lymph loop promotes tissue swelling and is also responsible for a variety of syndromes characterized by scarring, wasting, imunodeficiency and dysangiogenesis

Lymphatic system is composed of: vascular conduits, lymph nodes, spleen, Peyers patches, thymus, nasopharyngeal tonsils and circulating cellular elements such as lymphocytes and macrophages.

The functions of lymphatic system are:

- Fight against infections (bacteria, fungi and viruses) through lymphocytes, located within the chain of lymph nodes
- Homeostasis: maintaining a steady state of fluid level in tissue by draining away excess fluid, fats, proteins and other by-products of cell metabolism into the circulatory system
- Circulation of the lympha have some characteristics:
- it percolates slowly outside the bloodstream as a tissue fluid-lymph suspension of lymphocytes through lymph vessels and lymph nodes in one directional flow ( comparison with other body fluids)
- it completes a closed loop for by returning liquid, macromolecules and other blood elements that ''escape" or ''leak" from blood capillaries
- changes in pressure force most of the fluid (80-90%) and waste products to be reabsorbed into the capillaries of the veins and transported back towards the heart
- the remaining 10-20 % is forced into the lymphatic capillaries, propelled by valves and vessel contractions, through the lymph nodes and ultimately into the large subclavian veins which carry all the blood back to the heart

## Drainage areas

There are two separate and very unequal right and left drainage areas. Structures within each area carry lymph to its destination, which is to return to the circulatory system. Normally, lymph does not drain across the invisible lines separating them

**Right drainage area**

***Drains lymph from***

- the right side of the head and neck
- the right arm
- upper right quadrant of the body

***Lymph from this area flows into the right lymphatic duct which empties it into the right subclavian vein***

**Left drainage area**

***Drains lymph from***

- the left side of the head and neck
- the left arm
- the left upper quadrant
- the lower trunk and both legs

***The cisterna chyli temporarily stores lymph as it moves upward from the lower areas of the body***

***The thoracic duct transports lymph upward to the left lymphatic duct which empties it into the left subclavian vein***

Lymph flows entirely in one direction and at rest ammounts to only 2 to 2,5 L/24 hours, while blood flows in a circular pattern at several liters per minute. Unlike

blood, which is pumped by the heart, lymph propulsion originates from spontaneous intrinsic segmental contractions of larger and probably also small lymph trunks and to a lesser extent from extrinsic " haphazard forces" such as breathing, sighing, yawning, muscular squeezing and transmitted arterial pulsations. Like venous and arterial vasomotion, lymphatic truncal contraction is mediated by sympathomimetic agents, by products of arachaidonic acid metabolism and neurogenic stimuli. Ordinarily, resistance to flow in the lymphatic vessels is relatively high and low in the venous system. Te pumping capacity of the lymphatics generates intraluminal pressures of 30 to 50 mm Hg and sometimes even equals or exceeds arterial pressure, overcoming these impedance

**Lymphedema (LE)** is a progressive, usually painless swelling of the extremity caused by :decreased transport capacity of the lymphatic system. The diagnosis is suspected in most patients after obtaining the history and performing a physical examination. The congenital absence and the radical excision of regional lymph nodes are both associated with edema

## Etiologic classification of LE

***1. Primary lymph edema***

A. Congenital (before 1 year of age)
   1. Nonfamilial
   2. Familial

B. Praecox (met 1 to 35 years of age)
   1. Nonfamilial
   2. Familial

C. Tarda (after 35 years of age)

***2. Secondary lymph edema***

A. Obstruction or injury to the lymphatic system caused by:

1. parasitic infestation with filariasis
2. surgical excision and irradiation of the axillary or inguinal lymph nodes (breast or cervical cancer, soft tissue tumor or malignant melanoma of the leg )
3. tumors invading the lymph vessels and nodes, bacterial or fungal infections, lymphoprolipherative diseases and trauma
4. contact dermatitis, tuberculosis, rheumatoid arthritis and infection (after a snake or insect bite)

B. Filariasis

1. Caused by the developing and adult forms of three parasites: Wuchereria bancrofti, Brugia malayi and Brugia timori
2. Transmitted by different types of mosquitoes
3. Characterized by lymph node fibrosis, reactive hyperplasia and dilatation of the lymphatic collecting channels caused by worm products, physical injury to the valves and vessel walls by the live worms and by immune response of the host
4. Lymph node excision and irradiation
5. LE is the most distressing and unpleasant complication of breast cancer surgery
6. Independent risk factors included extensive axillary lymphadenectomy, axillary radiotherapy and pathological nodal status
7. Extensive axillary lymph node dissection followed by radiotherapy resulted in the highest utkutincidence with 38.3 % of the patients developing LE

C. Infection

1. Obstructive lymphangitis, caused most frequently by beta hemolytic streptococcus or, rarely, staphylococcus is not only a severe complication of an already existing LE but also an important cause of secondary LE
2. Swelling may develop following an episode of cellulitis caused by insect bite, trauma, excoriation or fungal infection

## Signs and symptoms of LE

***EDEMA***

- Slowly progressive, painless swelling of the limb
- Characteristic distribution of swelling starts distally in the extremity (toes or fingers)
- Involvement of the perimaleollar area with disappearance of the contours of the ankle in advanced cases
- Involvement of the forefoot, resulting in the typical appearance of a " buffalo hump"
- Limbs may become grossly enlarged and distorted in contour with exaggerated skin creases, folds and lobules

***SKIN CHANGES***

- Pinkish red color and a mildly elevated temperature due to increased vascularity in the early stage
- Skin hyperkeratosis and development of a "peau d'orange"
- Pain
- Heaviness of the limb is a frequent complaint but significant pain is rare
- Marked pain is an indicator for infection or neurotic pain in the area of scar tissue
- Pain caused by swelling could be an indicator of venous edema or reflex sympathetic dystrophy

## Complications of LE

***INFECTION*** - fungal infections, such as dermatophytosis or onycomycosis; fungal infections in the interdigital spaces are also sites of entry of bacteria, which may cause cellulitis or lymphangitis in the affected lymb; cellulitis may present with high fever and chills and the skin of the affected extremity is red and tender

***MALNUTRITION AND IMMUNODEFICIENCY*** - lymphangiectasia with protein losing enteropathy or chylous ascites or chylotorax may result in severe loss of proteins, long chain TG, cholesterol and calcium

***MALIGNANCY*** - lymphangiosarcoma following longstanding secondary LE is a rare malignant disease that frequently results in loss of a limb or even the life of the patient

***LE*** is a chronic problem leading to loss of function, physical discomfort, body image issues and cosmetic deformity, psychological consequences, recurrent episodes of erysipelas and cellulites. According to The American Cancer Society, 10-15% of breast cancer survivors will be diagnosed with LE in their lives

## Treatmen of Lymph Edema

There are two type of management measures for lymphedema:

- Non surgical management
  - Preventive
  - Physical
  - Medical
  - Psychological
- Surgical management

**A. Non operative management of chronic LE - preventive measures**

- Filarial disease - precautions to avoid transmission of the parasite, prompt therapy when infections are discovered
- Malignancy (breast, pelvic, prostate) - the incidence and severity of postoperative LE may be minimized when less extensive axillary or inguinal lymph node dissections are performed
- Judicious use of adjuvant radiotherapy is equally important

**B Physical therapy management known as "Complete decongestive therapy" (CDT)** – it has to be performed until the reduction of fluid volume has plateaued, often after 3 to 8 weeks. This therapy consist of:

- Manual lymph drainage
- Compression bandaging
- Remedial exercise
- Meticulous skin and nail care
- Instruction in self care
- The goals of complete decongestive therapy are:
- Decrease edema
- Increase lymph drainage from the congested areas
- Reduce sub dermal fibrosis
- Improve the skin condition
- Enhance patient's functional status
- Enable the patient to adhere to an independent self-care program
- Reduction of swelling and pain

Eventually, CDT will improve functioning through: the restoration of limb function, improvement of the cosmetic outcome of the affected limb, increase in quality of life.

Exercises goals (walking, swimming, isometrics) are to stimulate the lymphatic system to improve lymph flow (used in conjunction with compression in order to resolve swelling) and to help provide good health, both physical and mental

Mechanical reduction of limb swelling is usually the primary goal of therapy; early in the course of the disease, when the tissues are still soft, it may be possible to return the limb to its original size; after fibrosis has developed, the brawny tissues typically do not become fully normal following reduction maneuvers and residual swelling may have to be accepted. It can be accomplished by a variety of techniques.

**Elevation** is a simple and effective method for reduction of lymphedema. The patient is positioned comfortably and the limb is elevated as tolerated, usually to 45 degrees or more. An 4-6 inch high blocks placed under the legs of the bed to provide overnight elevation

**Massage or manual lymphatic drainage** (MLD) Simple massage of the affected limb, performed on a regular basis, can help to promote lymphatic drainage and keep the tissues soft and decompressed. MLD is performed in sequential steps. The trunk is divided into 4 quadrants (upper and lower, right and left) and treatment is initiated by massaging the quadrant controlateral to the affected limb. In theory, massage stimulates lymphatic flow and helps to drain cutaneous lymph fluid from the "normal" skin located opposite to the affected side, thus preparing it to receive lymph fluid from the adjacent involved area. Next, the massage is performed over the trunk quadrant adjacent to the affected limb. Fluid is pushed out, some of it draining directly into the veins or deep lymphatics and some of it crossing through the anastomotic lymph vessels into the freshly drained controlateral quadrant. The process is repeated in stages along the length of the limb, moving slowly in a proximal-to-distal direction, but massaging each segment in a distal-to-proximal fashion

Massage sessions are performed two times per week for up to a month to achieve the maximum reduction in limb swelling. At the end of the treatment program, the patient is fitted with elastic stocking or sleeve.

**Compression pumping.** An alternative method for achieving limb size reduction involves the use of intermittent pneumatic compression. The affected limb is placed in a pneumatic cuff or sleeve, which is intermittently inflated and deflated; the subsequent pressure gradient thus created forces lymph fluid out of the affected limb and back into the trunk; these devices may utilize either a single uniform pressure sleeve or a series of overlapping chambers within the sleeve that can be inflated sequentially. A theoretical disadvantage of the single chamber device is that high pressure is exerted both proximally and distally and can potentially force fluid into the more distal extremity. Because of the longer duration of the pressure cycle, it may also be uncomfortable for the patient

Richmand and associates failed to achieve an acute response in 30 % of patients treated with a single chamber pump; these authors also found that the proximal portion of the limb responded poorly to the unicell device

The data of Zanolla and colleagues, however, support the effectiveness of a single chamber device in the treatment of postmastectomy LE; in this study, the acute treatment period of 1 week included 6-hour treatments daily, using a 90 mm Hg cuff presure with a ratio of 1:3 for compression and decompression; a 24 % reduction in limb circumference was achieved and maintained at 3 months in 20 patients

With the sequential pneumatic compression device, the chambers are inflated in a distal-to-proximal direction, thus producing a dynamic pressure gradient and a " milking "action on the limb. Pressures of 100 mmHg or more are typically tolerated with these devices owing to the short duration of each inflation cycle (typically ranging from 20 seconds to 1 or 2 minutes). Treatment sessions may last anywhere from 1 hour to as long as 8 to 10 hours or more, depending of the magnitude and refractoriness of the edema.

In a recent prospective nonrandomized clinical study, Pappas and O Donell confirmed the long term effectiveness of compression treatment for LE.Their protocol included a 2 to 3 day hospitalization and daily 6 to 8 hour of treatment sessions with sequential high pressure intermitent pneumatic compression. This was followed by maintenance of the limb volume by custom made two way strech elastic compression stockings. Limb girth measurrements at nine levels were obtained serially during a follow up period that averaged 25 months in 49 patients. This protocol resulted in long term maintenance of limb girth reduction in 90% of the patients and the improvement remain excelent at late follow up in 26 of 49 patients. The most important factor affecting outcome was the degree of subcutaneous fibrosis involved.

More than 80 % of patients with a poor response had had LE for more than 10 years. These data also confirm that conservative compression treatment should be started early, before a chronic inflammatory reaction has developed and irreversible fibrosis in the subcutaneous tissues has occurred. The use of intermmitent, nonpneumatic high pressure using a mercury-filled chamber was introduced recently for the treatment of chronic LE. The mercury

filled chamber generates a very high pressure gradient along the limb, with 500 to 800 mm Hg pressures present at the ankle. These high pressures are applied in six cycles pre treatment, each lasting for 6 minutes

In 12 patients, good early results were achieved without any apparent side effects, pain or injury to the skin. Larger experience with this technique is needed to evaluate the long term results and the potential deleterious effects of the high pressures on the subsutaneous tissue Temporarly obstruction of arterial inflow in some patients carries an elevated risk for complications

Maintenance of the results are done with draduated elastic support (strict daily use of properly fitting, appropriately graduated). The elastic compression stockings remains the key to maintaining limb size for most patients

**Medical therapy** as diuretics, benzopyrones, intralymphatic steroid injections could be used, but pharmacological agents have limited use in the direct treatment of lymph edema. Their role is best defined in the prophylaxis and treatment of bacterial infections by antibiotic.s

**Psychological issues,** like the emotional problems related to edema, especially in teen-agers, could have a great impact on lifestyle. Psychological management due to the deterioration of the QOL and the patient's self image is a must.

**Indications for LDT** are:

- Venous insufficiency, prevention of DVT
- Ischemic disease of lower limbs
- Diabetic angiopathy
- Algodystrophic syndrome
- Chronic edemas
- Osteoarthritis
- Carpal tunnel syndrome ( pre and post operation)
- Obesity
- Post-traumatic and post-surgery edema

**Contraindications of LDT** include: acute neuropathy, acute pulmonary oedema, acute soft tissue trauma, acute thrombophlebitis, uncompensated cardiovascular diseases, epilepsy, erysipelas, febrile conditions, glaucoma, hepatic/renal insufficiency, infectious diseases, known ( or suspected ) DVT, lymphangitis, occlusive processes in lymphatic paths, pacemaker, obscure pain in abdominal area, pathological pregnancy, tumors

**Possible side effects** are: temporary increase of pain, petechiae, capillary rupture - if pressure exceeds the recommended level, hematoma, vegetative reaction, lymphatic congestion in untreated areas

**Conclusions:**

- Conservative management is the mainstay of treatment of limphedema
- Preventive measures prove to give results
- Mechanical reduction of LE is achieved by elevation, CDT, ***intermittent pneumatic compression***
- Maintenance is achieved by regular use of high compression elastic stockings
- Pharmacologic treatment may occasionally help
- Psychological aspects should be detected and dealt with

# Protocol de recuperare - sindroamele de entrapment

**Dr Victorita Marcu**

**Umf Carol Davila**

## Definitie

Sindroamele de entrapment reprezinta ansamblul manifestarilor neurologice (motorii si sensitive) datorate iritarii mecanice a unui nerv in interiorul unui defileu (canal) osteo-ligamento-muscular preformat si inextensibil.

Compresia unui nerv intr-un spatiu stramt se produce in situatiile:

- nervul trece printr-un orificiu fibros sau un canal osteo-fibros
- nervul trece printr-un muschi hipertrofiat
- nervul trece printr-o cicatrice constrictiva, deformare osoasa sau o masa tumorala

Forme clinice:

1. compresie intensa – forme grave (tratament chirurgical)
2. compresie moderata – forme medii (tratament de recuperare)a
3. forme intermitente – cu manifestari clinice care se pot remite si reapare

**SINDROMUL DE APERTURA TORACICA SUPERIOARA**

- se datoreaza iritatiei plexului brachial si arterei subclavie in zona subclaviculara, prin canalul delimitat superior de muschiul subclavicular; inferior de prima coasta; anterior de muschiul scalen anterior; posterior de muschiul scalen mediu

1. sindromul costoclavicular: intre clavicula si prima coasta – a fost descris la soldatii care purtau ranita (comprimarea plexului brahial si a vaselor de vecinatate); dupa fracturi claviculare cu formare de calus
2. sindromul scalenilor datorat hipertrofiei acestor muschi – sindrom de compresie neurovascular, in spatial dintre muschiul scalen anterior si prima coasta; este aproape intodeauna unilateral
3. sindromul costovertebral = sindromul de coasta cervicala; poate fi uni sau bilateral
4. sindromul micului pectoral = sindrom de hiperabductie (tendonul acestui muschi in hiperabductie determina compresie=semnul Kalb si Roth) – sindrom de compresie neurovasculara intre zona superioara costala anterolaterala si muschiul micul pectoral
5. pareza de nerv lung toracic
6. paralizia de nerv subscapular

**SINDROAME DE ENTRAPMENT ALE NERVULUI MEDIAN**

1. compresia nervului median la brat – apare des ca o paralizie profesionala: la vizitii, dupa aplicare de garou; clinic este o paralizie totala de nerv median
2. sindromul pronator (paralizia interosoasa anterioara) – miscarile repetate de pronatie ale mainii si miscarile de flexie fortata ale degetelor produc traumatizarea cronica a nervului median prin: hipertrofia muschiului pronator sau prin ingrosarea arcadei m flexor superficial al degetelor
   - este conditionat de faptul ca nervul median trece pe sub muschiul rotund pronator printr-un loc restrans
   - cauze: tumori de vecinatate, traumatisme directe, tenosinovite, benzi fibroase si musculo-fibroase in jurul nervului median sau a nervului interosos anterior, fracture, nevrite interstitiale
   - a fost descrisa ca paralizie a scriitorului si cazuri un ice la pianist, sculptor in lemn, cantaret la chitara
   - clinic: parestezii pe marginea radiala a mainii si in teritoriul digital si rar semen de deficit functional motor
3. sindromul tunelului carpian (cea mai frecventa paralizie intracanaliculara) – este determinat de compresia nervului median in canalul carpian, pe care-l

strabate, impreuna cu tendoanele flexorilor degetelor. Canalul carpian este format din oasele carpului (inapoi) si din ligamentul inelar anterior (ligamentul transvers) al carpului (inainte)
- apare de doua ori mai frecvent la femei decat la barbati, maximum de incidenta in decadele 5-6
- sindromul de tunnel carpian, ca neuropatie ocupationala apare la miscarile de flexie si de extensie repetate ale pumnului (dactilograf, spalator, pianist, tamplar, dulgher, lacatus, tobosar, lucrator la camp, operator telephonic,etc)
- cauze locale care duc la aparitia acestuia unilateral: anomalii ale oaselor carpiene, mai ales scafoid, trapez; anomalii ale muschilor; tumori (lipom, fibrolipom); infiltratie grasoasa a nervului median; neurofibrom; tenosinovite din cursul PR, tbc; fracture prost consolidate; luxatii; boala Paget
- cauze generale care duc la aparitia sindromului uni- dar mai ales bilateral: acromegalie, mixedem, sarcina, diabet zaharat, amiloidoza, sarcoidoza, TBC, colagenoza
- uneori boala are caracter familial (ligament transvers al carpului anormal de gros)
- clinic – tulburari sensitive, motorii si trofice in teritoriul tributar acestui nerv

4. compresia nervului median in palma
   - cauze: microtraumatisme cronice; manuirea unor unelte; neuropatie ocupational la stomatolog, gradinar, fierar, biciclist, tamplar, croitor, cizmar
   - clinic: pareze discrete si limitate ale muschilor tenari insotite de tulburari ale sensibilitatii subiectiva si eventual obiectiva

**SINDROAME DE ENTRAPMENT ALE NERVULUI CUBITAL**

1. compresia nervului cubital la brat – rara; realizeaza semiologia integrala specifica a nervului cubital
2. compresia nervului cubital la cot = sindromul de tunel cubital
   - este a doua neurapatie de entrapment a membrului superior ca frecventa
   - tunelul cubital este un sant intre partea posterioara a epicondilului medial al humerusului si olecran, acoperit de o expansiune fibroasa a muschiului flexor comun: lig epicondilo-olecranian
   - la acest nivel, nervul este in contact strans cu humerusul si este foarte vulnerabil la presiuni din afara, la luxatii, la modificari artrozice
   - cauze: luxatie recidivanta, completa sau incompleta, a nervului in afara santului cubital in timpul miscarilor din articulatia cotului, printr-o predispozitie anatomica particulara; traumatisme; cubitus valgus congenital, la femei; proces supracondilian al humerusului; artroza; artrite (septice, PR, guta); tbc; tumori de nerv; osteocondrite; atrofii tabetice sau siringomielice; compresiune la pacientii cu decubit prelungit la pat
   - paralizie ocupationala: taietori de sticla, mecanici, vaslitori, jucatori de sah; perforatori, stantatori
3. compresia nervului cubital la antebrat: rara
   - localizarea compresiunii este la nivelul antebratului, proximal de originea ramului dorsal al mainii
   - cauze: ocupational (brutar, casier,etc); traumatisme cu calus; lipoame; tumori
4. compresia nervului cubital la pumn, in tunelul Guyon = sindromul de ram terminal profund (sindromul Ramsay-Hunt)
   - este mult mai rara decat compresia nervului median
   - tunelul (loja) Guyon: medial are osul pisiform si carligul osului cu carlig; anterior are o expansiune fibroasa; posterior ligamentul transvers al carpului
   - cauze: microtraumatisme; artroze; fractura carligului osului cu carlig; bursita osului pisiform; chisturi; tumori ale nervului; anomalii anatomice

**SINDROAME DE ENTRAPMENT ALE NERVULUI RADIAL**

1. compresia nervului radial la brat: este cea mai frecventa situatie a paraliziilor de nerv radial. Aceasta compresie trebuie deosebita in cadrul unei neuropatii reale de entrapment, de o neuropatie compresiva, care, de obicei, se produce mai catre axila; este o compresiune externa-carje, efort la hamali, dupa aplicare de garou, la vizitii,etc
2. compresia nervului radial la nivelul antebratului – exact deasupra capului radiusului, nervul radial se imparte in 2 ramuri:
   - ramul superficial senzitiv = cheiralgia parestezica – apare la subiecti care prin profesia lor exercita o compresiune indelungata pe ramul digital dorsal care este senzitiv (clinic: dureri si tulburari de sensibilitate pe fata dorsala a mainii si a primelor trei degete)
   - ramul profund, motor (ramul interosos dorsal sau posterior) = sindromul supinatorului – lipom, neurinom, ggl al cotului, compresiune mecanica asupra nervului in momentul in care strabate muschiul supinator, ca si in cazul unor miscari ample si neobisnuite ale antebratului; epicondilita radiala; inflamatia bursei bicipitoradiale; tumori ale nervului de tipul schwannomului. Simptomatologia se instaleaza lent si progresiv in luni si ani de zile

**NEUROPATIA DE ENTRAPMENT A NERVULUI FEMUROCUTANAT (MERALGIA PARESTEZICA)**

- in traiectul nervului exista numeroase puncte in care este vulnerabil la compresiune. Sediul cel mai frecvent este locul prin care nervul trece intre cele 2 cute ale ligamentului inghinal
- cauze: tumori ale pelvisului; cicatrici operatorii; compresia din afara, prin centura,etc
- clinic: parestezii si disestezii pe fata laterala a coapsei; senzatie de piele cartonata; dureri care uneori pot fi mari; extensia coapsei pe bazin este dureroasa si limitata antalgic, pozitia coapsei vicioasa in F si ROE; presiunea pe SIA este dureroasa

**NEUROPATIA DE ENTRAPMENT A NERVULUI OBTURATOR**

- cauze: hernia obturatoare; leziuni traumatice; leziuni ale pubisului (osteita)
- sindromul Howstup-Romberg – senzatie dureroasa in articulatia genunchiului, a carei regiune posterioara este inervata de ramul posterior al nervului obturator

**SINDROMUL PIRIFORMULUI (sciatica tronculara)**

- se realizeaza prin iritatia mecanica a nervului de catre

muschiul piramidal in stare de tensiune sau de trecerea nervului prin acest muschi
- se caracterizeaza prin dureri in regiunea gluteala, care iradiaza spre sacru, articulatia soldului si fata posterioara a membrului inferior. Manevra de punere in evidenta consta din flexia fortata a soldului cu rotatie interna
-

**SINDROMUL DE ENTRAPMENT AL NERVULUI SPE**
- nervul inconjoara capul peroneului, impartindu-se in ramul profund si ramul superficial – sediul de compresiune
- cauze: compresia din afara (pozitie ghemuita sau picior peste picior); paralizie profesionala (culegatorii de cartofi, parchetari, agricultori, mineri,etc); inactivitatea si sedentarismul prelungit; bolnavi imobilizati la pat; lezarea nervului se poate produce prin miscarea repetata de flexie a genunchiului; tumori ale nervului; tunel osteo-fibros in jurul nervului, etc
- paralizie motorie integrala, tulburari de sensibilitate pe fata dorsala a piciorului

**SINDROMUL DE TUNEL TARSIAN**
- neuropatia de compresiune a nervului sciatic popliteu intern
- tunelul tarsian se afla la nivelul gleznei, posterior si inferior de maleola interna
- cauze: traumatisme, microtraumatisme (mers fortat), tulburari de statica, ortostatism prelungit
- clinic: parestezii si dureri in planta si in degete

## Stadializarea functionala

**Stadializare clinica:**
1. stadiu usor: parestezii, dureri noaptea, fara oboseala musculara, fara atrofii
2. stadiu moderat: parestezii, dureri noaptea, scaderea fortei musculare, oboseala musculara, eventual modificari ale sensibilitatii
3. stadiu sever: diminuare marcata a fortei musculare, atrofii musculare, tulburari de sensibilitate, tulburari trofice

**Repercursiunile functionale au gravitate variabila in functie de tipul de afectare:**
1. neurapraxia: intreruperea influxului motor, in mod indirect prin traumatismul pe tesuturile moi din vecinatatea nervului, pastrand integritatea si traseul nervului; refacerea se realizeaza ad integrum in 3-6 luni
2. axonotmezis: intreruperea influxului motor in mod direct, prin interesarea axonului cu pastrarea tecii de mielina; refacerea este partiala in 1-2 ani
3. neurotmezis: intreruperea influxului motor in mod direct, prin interesarea intregului tronson al nervului, prin sectionare, necesitand neurorafie

## Criteriile de admitere in programul de recuperare

- durere
- redoare articulara
- edem
- scaderea fortei musculare, deficit motor de diferite grade
- dificultate in gestica uzuala
- modificari in forta sau abilitatea de a executa anumite miscari
- tulburari de sensibilitate

Nu se admit in serviciul de recuperare pacienti care prezinta afectiuni decompensate sau netratate (cardiace, pulmonare, digestive, renale, etc); urgente medico-chirurgicale; pacienti febrili; cu suspiciune de tromboza venoasa profunda; cu afectiuni tumorale maligne; absenta unor teluri terapeutice realizabile.

## Pachet minimal de investigatii necesare

- examenul clinic obiectiv: inspectie, palpare, bilant articular si muscular (clinic, dar si prin goniometrie si dinamometrie), examen neurologic, manevre semiologice particulare
- radiografia simpla are o utilitate limitata, in anumite forme etiologice
- electrodiagnosticul si studiul electromiografic sunt obligatorii in leziunile de nervi periferici – explorarea electrica a conducerii senzitive si motorii a nervului arata o incetinire de conducere, in special a conducerii senzitive (importanta pentru diagnostic, alegerea mijloacelor terapeutice)
- examene de laborator: vizeaza in special prezenta si intensitatea fenomenului inflamator (VSH, proteina C, fibrinogen), dar si etiologia acestuia (poliartrita reumatoida, guta, diabet etc) sau determinari care pot fi utile pentru diagnostic etiologic sau diferential
- scintigrafia si RMN nu sunt de rutina, dar pot fi utile in diagnosticul leziunilor de parti moi(chiste, teci sinoviale, tendoane), iar CT in leziunile de parti osoase(tumori)

## Tratament medicamentos specific

- analgetice: uzuale(Paracetamol 1-2g/zi, Piafen), analgetice de treapta II (codeine phosphate, Tramadol, DHC continus, oxycodone)
- AINS oral/i.m./supozitoare : neselective sau COX2-selective (coxibi)
- infiltratii locale cu corticoid (Diprophos) sau cu anestezic local (Xilina 1%, 2-3 ml)
- medicatia specifica afectiunii sistemice (guta, PAR, LES, DZ)
- neurotrope pentru fenomenele radiculare: vitamine B1 si B6, Milgamma N, Thiogamma
- vasodilatatoare periferice tip Pentoxifilin
- anxiolitice usoare, antidepresive usoare ( in cazurile cu sd.psihic accentuat)
- solutie de sulfat de magneziu 60g/l pentru comprese reci in perioada acuta, cu edem important
- unguente topice cu antiinflamator/anestezic local/ capsaicin/ulei de masline – pentru masaj local

## Echipa de recuperare – componenta

- medicul specialist in Recuperare medicala, Medicina fizica si Balneologie (intocmire, supraveghere si evaluare program terapeutic global)
- asistent de fizioterapie (pentru aplicarea electro / hidro / termoterapiei)
- kinetoterapeut (pentru programul de kinetoterapie si kinetoprofilaxie)

- asistent medical (pentru aplicarea tratamentului medicamentos)
- ergoterapeut (pentru programul de terapie ocupationala)+ergoterapia la locul de munca/domiciliu
- psihoterapeut (asistarea pacientilor cu durere intensa sau cronica si sd.psihic accentuat)
- ortezist
- asistent social (reinsertia socio-profesionala a pacientului in functie de restantul functional )
- colaborare permanenta cu medicul ortoped, chirurg plastician, reumatolog, neurolog

## Program de recuperare

Imobilizarea segmentului sau a membrului in totalitate pentru prevenirea dezvoltarii pozitiilor vicioase datorate dezechilibrelor musculare secundare paraliziei

**RECUPERAREA SINROMULUI MOTOR**

Obiective:

- evitarea aparitiei deformarilor si atitudinilor vicioase
- evitarea atrofierii muschilor paralizati
- cresterea fortei fibrelor musculare restante sanatoase
- refacerea imaginii kinestezice
- cresterea in continuare a fortei si rezistentei musculare
- recastigarea coordonarii si abilitatilor
- recuperarea mobilitatii si fortei segmentelor neafectate de paralizie

**A. Evitarea aparitiei deformarilor si atitudinilor vicioase**

Paralizia unor grupe musculare determina dezechilibru in fortele aplicate asupra unui segment. Musculatura intacta, antagonista, determina aparitia de deviatii: apar retracturi musculo-tendinoase ale acestei musculaturi, care pot fi mai tarziu cauza de disfunctionalitati. Reaparitia inervatiei antagonistilor va gasi segmentul cu deficit anatomo-functional sip e antagonisti, ceea ce va intarsia sau chiar compromite recuperarea eficienta.

***I. Trebuie combatute complicatiile cutanate si ale tesuturilor subcutanate***

a. edemul va duce la aparitia aderentelor si redorilor articulare
   - posturi antideclive
   - masaj classic si masaj de drenaj veno-limfatic prin manevre de presiune dinamica in sensul intoarcerii venoase
   - comprese reci, crioterapie locala
   - electroterapie cu effect trofic si resorbtiv

b. asuplizarea cicatricilor: laser, US, masaj

***II. Trebuie mentinuta supletea articulatiilor***

a. posturi

Posturarile se realizeaza cu ajutorul atelelor simple, ortezelor simple sau dinamice, benzilor adezive corectoare. Aceste posturi se mentin permanent in afara perioadelor de activitate recuperatorie. Ortezele au doua roluri: profilaxia pozitiilor vicioase si compensarea deficitului functional.

b. mobilizare pasiva
   - se face pentru toate articulatiile membrului afectat
   - este precedata de proceduri de incalzire locala si masaj
   - se face analitic (articulatie cu articulatie)
   - amplitudinea miscarii passive in fiecare articulatie depinde de anumiti factori (sutura nervului sau a tendonului; durere; consolidarea osoasa a focarului de fractura)

c. intinderi musculare si capsule-ligamentare

Intinderile musculare si capsule-ligamentare au ca obiectiv prevenirea dezvoltarii retracturilor musculo-tendinoase secundare dezechilibrului de forte dintre agonisti/antagonisti. Manevrele de intindere se adreseaza grupelor musculare sanatoase (antagonisti)

***III. Procedurile de hidrokinetoterapie au ca efecte:***

- antialgic si biotrofic global
- efect trofic vascular la dusul scotian
- efect trofic muscular la baile si dusurile cu apa calda si presiune scazuta
- efect trofic articular si tendinos la baile cu bule
- efect trofic cutanat la dusurile cu jet filiform si cu presiune mare

***IV. Ultrasunetul*** se aplica in zona de trecere muschi-tendon (zona de electie a retracturii)

**B. Evitarea atrofierii muschilor paralizati**

Se folosesc stimulari electrice, KT (intinderea musculara pentru declansarea stretch-reflexului, mobilizari passive pentru mentinerea imaginii kinestezice si a supletei articulare, tehnici de facilitare prin exercitii contralaterale pe membrul afectat sau pe cel neafectat, se utilizeaza toate tehnicile de promovare proprioceptiva, exteroceptiva,etc)

Problema centrala a muschilor somatici partial sau total denervati este mentinerea proprietatilor contractile si evitarea transformarii lor in tesut conjunctiv fibros, inextensibil, pe toata perioada de timp necesara reinervarii.

***I. Electrostimularea*** – se executa zilnic; aceasta nu grabeste reinervarea muschiului, cid oar apara muschiul de atrofie pana la producerea fenomenului spontan de reinervare.

Se pregateste substratul cu current galvanic continuu timp de 5-8 min cu electrodul negative pe muschi; astfel, se activeaza circulatia si creste excitabilitatea muschiului; in acelasi scop se poate folosi si o aplicatie calda: baia partiala de 10 min

a. curenti interferentiali pentru grupele musculare partial denervate; care la testing au valoarea cel putin 2; rol de mentinere a troficitatii; pentru a creste eficienta se pregatesc cu termoterapie locala, ionizari cu clorura de calciu
b. curenti excitomotori exponentiali de joasa frecventa
   - raspund doar fibrele musculare denervate, nu si cele normal inervate, care se acomodeaza
   - parametrii se stabilesc cu datele de electrodiagnostic
   - cu cat muschiul este mai denervat cu atat el va raspunde la o panta mai lunga (400-800-1000ms)
   - electrozii se aplica pe capetele muschiului, pentru a prinde un numar cat mai mare de fascicule musculare (tehnica bipolara)
   - tehnica monopolara se poate aplica la muschii partial denervati polul active pe punctual motor
   - este importanta pozitia in care se plaseaza segmentul (pentru inceput evitam contractile contra gravitatiei)

***II. Kinetoterapia***

a. mobilizarile pasive
   - intinderea pasiva a unui muschi mentine troficitatea acestuia
   - trebuie sa realizeze alungirea muschiului, pentru a

determina stretch-reflexul, care determina contractia muschiului intins si relaxarea antagonistului
- se fac 8-10 intinderi de cate 4-5 ori pe zi
- se pregateste cu masaj cu gheata (3-5min) pe muschiul denervat; creste posibilitatea de intindere pasiva si creste capacitatea de contractie musculara
- stadii initiale ale denervarii, cu forta egala cu 2

b. tehnici de facilitare a contractiei musculare
- se realizeaza contactia excentrica a muschiului (pornesc din pozitia cu capetele musculare apropiate)
- rezistenta manuala se datoreaza astfel incat sa se poata indeparta progresiv capetele
- numarul de repetitii se stabileste cu atentie la oboseala musculara
- autoantrenamentul cu bio-feedback EMG scurteaza timpul recuperarii

c. tehnici de facilitare ce au la baza iradierea influxului nervos de la muschiul mai puternic la cel cu actiune sinergica, dar mai slab
- se folosesc pe masura ce reinervarea musculara progreseaza si sunt activate sincron un numar tot mai mare de fibre motorii

d. exercitii izometrice si izodinamice impotriva unei rezistente maximale
- pentru a creste forta si volumul muscular
- se folosesc cand inervatia muschiului a devenit mult mai bogata

**C) Cresterea fortei fibrelor musculare restante sanatoase**

In majoritatea cazurilor lezarea nervului nu afecteaza toate fasciculele sau fibrele din structura muschiului, la unele dintre ele se conserva inervatia muschiului. Se foloseste toata suita de facilitare neuroproprioceptiva.

**D) Refacerea imaginii kinestezice**

Pentru punctele C si D:

a. stimulare electrica – se prefera metoda in care pacientul isi declanseaza singur contractia prin apasarea unui buton; in acest fel se primesc continuu informatii proprioceptive de la tendon-muschi-capsula articulara, informatii care, combinate, reformeaza treptat imaginea kinestezica a zonei paralizate
b. mobilizari passive, apoi pasivo-active
c. mobilizari active si active cu rezistenta
d. tehnici de facilitare proprioceptiva: reflexoterapia, iradierea excitatiei, inductia succesiva, rezistenta maxima, scheme de reducare

**E) Cresterea in continuare a fortei si a rezistentei musculare – se face pe masura ce are loc reinervarea**

**F) Recastigarea coordonarii si a abilitatilor – este etape finala a refacerii complete. Coordonarea este un process complex, care implica integritatea perfecta a cailor motorii si sensitive. Trebuie evitati factorii care cresc incoordonarea miscarilor: durerea, oboseala musculara si nervoasa, emotia, frica, pauzele mari intre exercitii**

**G) Recuperarea mobilitatii si fortei segmentelor neafectate de paralizie – se folosesc exercitii active pe toata amplitaudinea miscarilor; pentru forta musculara se fac exercitii resistive sau/ si izometrice**

**RECUPERAREA SINDROMULUI SENZITIV**

Primul obiectiv este depasirea perioadei de anestezie cu evitarea lezarii segmentului respective. Reeducarea sensibilitatii se bazeaza pe principiul asocierii: pe de o parte invatarea perceptiei sensitive cutanate, utilizand perceptia vizuala si perceptia acelorasi stimuli din zona identica contralaterala, iar pe de alta parte, memorizarea acestor senzatii prin repetitii realizate in absenta controlului vizual.

**RECUPERAREA SINDROMULUI VASCULOTROFIC**

Exercitiile facute in scopul recuperarii sindromului motor au un efect favorabil asupra sindromului vasculotrofic. Local se contraindica toate procedurile de electroterapie si termoterapie.
- Sunt utile:
- KT pentru mobilitate, dar si pentru circulatia si troficitatea segmentului. Cuprinde si gimnastica Burger sau variantele, pentru circulatia periferica
- Posturi, fese elastice, ciorapi, manusi elastice
- Masajul cu ulei caldut sin u cu talc
- Baile caldute cu vartejuri de apa (whirl-pool), 20-30 min de 1-2 ori pe zi
- Mofetele partiale, pe durate de 30 min, de 2 ori pe zi, unii autori folosesc baile cu oxygen in recipiente, ca la mofete
- Hidrotermoterapia alternanta, mai ales sub forma afuziunilor alternante, este mai bine suportata de pacient
- Terapia pneumatica, de tipul angiomatului, pentru indepartarea edemului si a stazei veno-limfatice
- Terapia reflexa
- Mentinerea igienei perfente a segmentului afectat, evitarea obiectelor taioase sau ascutite, a friguluinsi a oricarui factor fizic sau chimic care ar putea traumatize tesuturile

## Contraindicatiile metodelor de recuperare

**CONTRAINDICATIILE ELECTROTERAPIEI:**
- afectiuni cutanate ce impiedica aplicarea electrozilor(leziuni cu solutii de discontinuitate, alergii, eczeme,boli eruptive, TBC cutanat, infectii supurative cutanate); exceptie - aplicarea unde scurte regim pulsat
- neoplazii sau leziuni precanceroase indiferent de localizare- exceptie TENS
- boli febrile, boli infecto-contagioase, sepsis
- stari hemoragice, tulburari de fragilitate capilara, tulburari de coagulare
- boli cu risc de decompensare somatice/viscerale
- pusee acute sau decompensari ale bolilor cronice severe
- sarcina, sterilet, perioada menstruala
- materiale metalice- cu exceptia undelor scurte regim pulsat
- boli psihiatrice, stari casectice

**CONTRAINDICATIILE MASAJULUI TERAPEUTIC:**
- fenomene inflamatorii locale exacerbate
- boli infectioase in stadiu evolutiv
- fragilitate vasculara, terapie cu anticoagulante
- malignitati
- afectiuni cutanate – dermatoze majore, micoze, supuratii, hematodermii

**CONTRAINDICATIILE TERMOTERAPIEI:**

- in leziuni ale pielii: arsuri, plaga, vezicule incomplet vindecate
- in grefele de piele
- in infectiile mainii
- in cazul unei circulatii arteriolare deficitare, cu tendinta la ischemie/gangrena (fen.Raynaud, ischemie Volkmann)
- in cazul zonelor cu tulburari de sensibilitate/anestezie (risc de arsura)

**Managementul pe termen lung** (inclusiv adaptarea mediului la domiciliu, initierea unui program de recuperare ambulatorie sau la domiciliu, tratamentul in statiune etc)

Programul de recuperare trebuie facut continuu, zilnic, cu monitorizare periodica clinico-functionala si ajustare permanenta a programului de catre medicul de recuperare si in colaborare interdisciplinara cu ortopedul/ reumatologul/ neurologul/ medicul de familie. Se va recomanda la domiciliu, zilnic, executarea unei game largi de activitati cu scop de terapie ocupationala directionata pe deficitul functional restant

Terapia ocupationala – scopuri:

- ameliorarea miscarii articulare, a fortei musculare si a coordonarii miscarilor in cadrul restabilirii stereotipurilor dinamice
- obisnuieste pacientul sa se ajute singur, sa redevina independent in activitatile uzuale; deci pregateste reinsertia sociala
- evalueaza necesitatile ulterioare (provizorii sau definitive) de ajustari ale obiectelor casnice, de munca, in concordanta cu invaliditatea si, in general, evalueaza capacitatea de munca restanta
- pregateste reinsertia profesionala, utilizand elementele ergoterapiei

Uneori se pune problema schimbarii locului de munca sau a readaptarii acestuia in functie de deficitul clinico-functional restant al pacientului.

**Reintegrare in familie si societate**

NOTE

NOTE