**PRINCIPLES OF REHABILITATION AFTER PROXIMAL HIP FRACTURE IN AN OSTEOPOROTIC BONE**

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**Abstract**

Osteoporosis is defined as a systemic skeletal disease characterised by low bone mass and microarchitectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture. So the clinical significance of osteoporosis lies in the fractures that arise both in axial skeleton and peripheries. Proximal hip fracture is one of the most common complication of this condition and remains an important health burden. It is associated with substantial mortality and many patients could experience long-term disability.

The diagnosis of the disease relies on the quantitative assessment of bone mineral density (BMD) -through DXA method - which is a major determinant of bone strength.

Proximal hip fracture in an osteoporotic bone implies three important issues: vital risk, disability, dependency in older adults. The purpose of rehabilitation and re-education is to obtain a good social reinsertion and a minimum dependency. Very often , the return of the patient to his home needs social , therapeutical and institutional support.

A complex rehabilitation program is established based on clinical and functional assessment dynamically changed according to the patient evolution and pre-determined goals. Rehabilitation of an operated hip should be made following general protocols but individually adjusted according to history of the operated joint and the functional results obtained and measured with evaluating scales.

**Keywords:** fracture, femur, osteoporosis, rehabilitation, osteodensitometry.

**Rezumat**

Osteoporoza este o afecțiune sistemică scheletală caracterizată prin densitate osoasă scăzută și deteriorarea arhitecturii țesutului osos, cu creșterea fragilității osoase și a riscului de fractură. Deci, semnificația clinică a osteoporozei constă în fracturile pe care le favorizează. Fractura proximală de șold este una dintre cele mai comune complicații ale acesteia și rămâne o povară majoră pentru sistemul de sănătate. Se asociază cu mortalitate substantială și mulți pacienți se confruntă pe termen lung cu dizabilități. Diagnosticul acestei afecțiuni se bazează pe evaluarea cantitativă a densității minerale osoase (BMD)- prin metoda DXA- care este un determinant major al rezistenței osoase.

Fractura proximală de șold pe os osteoporotic implică trei chestiuni majore: riscul vital, dizabilitatea, dependența. Scopul reabilitării și reeducări este acela de a contribui la o reinserție socială bună a pacientului, cu dependență minimă. Foarte frecvent, la întoarcerea acasă a pacientului este nevoie de suport social, teraputic și institutional.

Un program complex de reabilitare este stabilit pe baza evaluărilor clinice și funcționale, fiind modificat în dinamică conform cu evoluția pacientului și cu obiectivele predeterminate. Reabilitarea unui șold operat ar trebui să fie făcută conform unor protocoale generale, dar ajustată individual conform cu istoricul articulației operate și rezultatele funcționale obținute și măsurate prin scalele de evaluare.

**Cuvinte cheie:** fractură, femur, osteoporoză, reabilitare, osteodensitometrie.

Osteoporosis is defined as a systemic skeletal disease characterised by low bone mass and microarchitectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture. So the clinical significance of osteoporosis lies in the fractures that arise both in axial skeleton and peripheries. Proximal hip fracture is one of the most common complication of this condition and remains an important health burden. It is associated with substantial mortality and many patients could experience long-term disability.

For the past 20 years , the assessment of bone mineral density (BMD) had been done trough DXA (Dual Energy X-ray absobtiometry) method and this method has developed and diversified but the connection between BMD and hip fracture incidence remains a hot topic , this method doesn’t have a certain prognostic role. This technique is used for diagnostic and assessment purposes for patients with osteoporosis and introduces a diagnostic threshold and less a fracture threshold. The maintenance of a sufficient BMD won’t allow the prevention of a possible fracture as a result of a fall, so it is not a prevention method. The patient who already had a fracture has a high risk to have another one. In other words, the fracture risk of femoral neck increases 2-3 fold if the patient had had a wrist fracture after trauma compared cu another patient with the same BMD. So, bottom line, beside the purpose of increasing and maintain BMD , reducing the risk of fall is an important goal in order to reduce the fracture risk in a osteoporotic bone.

**Proximal hip fracture in an osteoporotic, three important issues**

* Vital risk is important in elderly (physiological and psychological fragile). A minor trauma (often home accidents) can cause serious complication. The mortality in these patients despite the therapeutic progress, in short and long term in high (10-30% according to some studies)
* Functional and social prognosis reflects very well the gravity of this type of fracture. The purpose of re-education and rehabilitation of these patients is to obtain a good social reinsertion and a minimal dependency. Very often, the return of the patient to his home needs social , therapeutic and institutional support. Functional prognosis depends on many factors: age, social status, early intervention, previous gait autonomy, type of fracture ( extra capsular have a low outcome then the cervical one) , montage , cognitive impairment. The role of the falls was evoked in many studies being secondary to many prediction factors for hip fractures
* Gait disorders (decreased velocity with low cadence, difficulties in swing phase , palsy of deferent causes , impaired sensitivity both superficial and proprioception, myopathies ) are one of the main reason for morbidity and mortality in elderly , being the main cause of fallen at this age group with serious consequences on autonomy. 10- 20% of people after 60 years have gait disorders in varies degrees. This percentage can go up to 50% in the people over 80 years old. In this circumstances the risk of having a hip fracture is high. More than half of deaths are caused by complications of this type of fracture. (in USA 84% from the patients with a hip fracture were over 65 years old).

**Mechanisms behind falls in elderly people**

Mechanisms behind falls in elderly are particular, one way they lack muscular , protective factor ( gluteus weakness caused by suboptimal use) , on the other way it is the slow defence reflex on the sole impact . The elderly tend to drop in place (on the lateral thigh or sideways) the trauma being on the posterior or lateral aspect of the thigh. The medium muscular deficit in this age group is 20-30% in flexors and 50% in extensors and this values change the rapport extensors/flexors less then 1 (the normal rapport is 1.3). The endurance force decreases and the neuromuscular time of reaction increases (histologic and enzymatic changes of the muscular fibres with atrophy of the type II fibres-fast acting and maintenance of the type I-slow acting)(1).

The treatment of the proximal hip fractures (intertrochanteric or femoral neck) has the purpose to increase the vital and functional prognosis. The type of intervention varies according to the physiological age, so for the femoral neck fractures in a patient older than 65 years, active ,open internal fixation is preferred(2) ( the risk of osteonecrosis is low in Garden I and II type fractures) or total hip arthroplasty (for Garden III and IV).

In the case of pertrochanteric fractures (rich in spongy bone tissue , do not disrupt the blood supply to the femoral head) internal fixation is the treatment of choice –such as sliding hip screw or screw-plate regardless the patient age. The trochanteric –diafisis fractures are unstable and can benefit from intramedullary fixation with gamma nail with distal impaction.

The physical rehabilitation program starts early post operation being adjusted to the type of fracture and the ostheosintetis material used, general condition of the patient, previous functional resources. A complex rehabilitation program is established based on clinical and functional assessment dynamically changed according to the patient evolution and pre-determined goals.

The re-education must be assessed periodically and very carefully, not to omit any sign of a possible complication that it is usually noticed by the physical therapist. Rehabilitation of an operated hip should be made following general protocols but individually adjusted according to history of the operated joint and the functional results obtained and measured with evaluating scales. The quality of initial assessment sets the ground for a good therapeutically option.

**Main goals post operation**

* Prevention of decubitus complication (maintenance of good hydration , albumin>35g/l, the presence of diabetes or chronic lower limb ischemia can affect microcirculation leading to eschares). The use of dynamic mattresses anti-eschares especially when bedsores are already constituted .
* Reducing the support time on pressure points changing positions , initially trough progressive standing of the patient on the standing table (prevents orthostatic hypotension) Pressure points are checked every day and they are massage daily for local circulation to be activated.
* Prevention of the thrombotic complication (especially those coming from solear muscle),most of the authors recommend vascular ultrasonography fallow up for the 7th and 14th post operation (especially if the patient wasn’t mobilised). The anticoagulant treatment will be prescribed for minimum 6 weeks regardless the type of fracture or montage used, this can be prolonged according to the patient condition. The trigger factor for DVT is venous stasis and this can be prevented by wearing elastic compressive stockings and isometric rhythmic pumping exercises in association with diaphragm exercises. All this manoeuvres and the positions that facilitate the venous drainage reduce the frequency OF post operation DVT.

**Prevention of the orthopaedic complications**

Before the rehabilitation programme is started the patient is evaluated both clinical and functional in order to find any sensor impairment or muscular deficit that appeared post operation and we assess their level of intensity, muscular or tendon retraction , or vicious posture (antalgic);

Adequate posture of the operated inferior limb to prevent any vicious posture that can frequently appear in elderly with degenerative joint disease. We have to posture inferior limb in axis and avoid internal rotation and adduction. The ankle must be in axis, at 90 degrees dorsal flexion to avoid Achilles tendon retraction , the posture of the thigh –extension and the knee small flexion (not to tension the popliteal venous axis)(3).

**The treatment for post operation pain**

Once we eliminated trigger factors such as infection, phlebitis, decompensated osteoarthritis, small trochanter fracture responsible for weight bearing pain, post operation pain will be evaluated with questionnaires ( visual analogue scale or DN4 for neuropathic pain) , being the objective of a very well controlled task , continuously evaluated after the administration ofetiologicaltreatment.

**Obtaining the range of motion**

Loss of mobility is the main cause for capsular retraction and periarticular muscle and tendon retraction, frequently associated with osteoarthritis pain with loss of motion in an articular segment.

This mechanism limits the kinesthesis information received by the patient from the articular structures, stimulus so necessary for walking. For this reason, early assisted mobilisation both active and passive is necessary, for full range of motion with some restriction according to patient’s tolerance and the operation approach. Easy stretching exercise are started in the first week , progressively , to stretch the anterior aspect of the capsule and hip flexors to avoid or treat flexed hip (Thomas stretch exercises).

Peripheral muscular control is initiated trough direct exercises or cross exercises on abductors, adductors , internal rotators and pelvic-trochanteric muscles in a isometric contraction in the bed plan or in a position similar with the walking one. As soon as possible new exercises will be introduced – active with progressive resistance, excentrical contraction (easy to be executed and better tolerate).

Passive mobilisation will be executed with passive mobilisation machines, amplitude of movement is an important element with a time to stop set according to patient tolerance, manually controlled by the patient.

**Standing up and restarting the walking**

Fear of a new fall is mainly psychological and it delays early walking. The goal in this stage is to reassure the patient and direct him trough safe, balanced positions and being taught to use walking aids (walking frame, crouches).

Before standing, under the supervision of the physical therapist the patient should practice transfers (from lying in bed to the site and standing).

To all this manoeuvres, a cardio-vascular deconditioning syndrome may appear, orthostatic hypotension with reflex tachycardia, and posterior imbalance (tendency of the trunk to go backwards is common in elderly) that increases the previous muscular imbalance.

If the montage and the general condition allow it, orthostatic position is initiated, progressively between parallel bares or suspended on treadmill with weight-bearing restriction on the operated inferior limb. The advantage obtained trough this device is the possibility for weight bearing to be adjusted according to the physical therapist advice, the patient can change the direction of walking with no risk ( prosthesis displacement), can walk progressively on a inclined plane (5-10%). The patient can learn the correct ambulation adjusting the speed and length of the steps(4).

Early progressive weight bearing is very important, the densitometry measurement after one year have shown increased bone peak , this being highly influenced by ground reaction force.

In the absence of any contraindication (general condition impairment, severe dementia, bedsores, urinary or anal incontinence, severe cardiovascular disorders) gait training can be done in health facility pools that can allow active movement with resistance or facilitating exercises , also the fracture site can be progressively loaded, and the movement scheme can be restored. Balance can be also re educated. Gait training can be initiated as well.

**Re education of posture, postural reflexes and balance impairment**

Retropulsion shows loss of postural reflexes affecting orthostatic position and gait. The patient has the tendency to fall backward (back on bed or armchair) as soon as he stands up without vertiginous syndrome. In addition to that we can observe the flexed knees who can lead to patient collapse (the patient cannot control the flexed knees). The patient can develop oppositional hypertonia and major anxiety(5).

Our goal is for patient to regain confidence, trough progressive weight bearing exercises and swing in all movement plans, this have the role to improve balance and reassure the patient. Ambulation training can be done in parallel bars exercising all walking phases and half step backwards(9). Muscular tone is maintained trough close cinematic chain exercises that allow the maintenance of movement scheme and sensory and proprioception afferent signals.

Protection and postural control reflexes can be improved trough enlargement of the support base and complex exercises with resistive walking that will balance the retropulsion tendency , controlled swings in anterior and posterior plane and sideways , proprioception re education exercises on the swing plate , walking with obstacles , stair climbing(5).

In these cases the therapeutic protocol is lead very carefully in order to achieve the therapeutic goal by combining functional electrical stimulation with biofeedback session , this allowing the patient to straighten a certain muscular group. The variety of biofeedback exercises, aiming the functional goals do avoid monotony and repetition. Combining biofeedback with electrical stimulation allows physical therapist the possibility to evaluate and re educate a neurosensory impairment , motor or proprioceptive ( trough conditional stimulation , threshold EMG stimulation to reach –biofeedback EMG)(6).

In the mean time around prosthesis or femoral montage a process of remodelling can take place tis result in bone resorption that can lead to loosening of the prosthesis. For this reason check x rays should be done according to a pre-existing protocol.

For the past few years it was studied the possibility to evaluate peri-prosthesis bone mineral density trough DXA method. The results are optimistic, trying to elaborate some protocols to fallow-up the montage, the advantage being to evaluate a loss in bone density more precocious than trough a simple X ray. This method will show diagnostic efficiency in time.(7)

**To conclude with:**

For elderly with on osteoporotic fracture on hip, physical exercise along with diet and medication is very important not only for maintenance but for increasing of bone density, and this fact was demonstrated in many studies trough DXA measurements.

The complex treatment applied to this patients resulting in balance and coordination improvement had a major impact on stability and gait.

When it comes to the method of rehabilitation for proximal hip fracture there is no general protocol , latest studies demonstrates that re education programs should be adjusted for each patient and can be more effective than group programs .

Lately, it is searched the application of a program of exercises that would improve the level of compliance.

***Bibliografie:***

1. *Berteanu M. – Leziunile de nerv periferic si investigatia EMG in afectiunile ortopedico-traumatice. Vol. 1 – P755, Patologia aparatului locomotor – Dinu M. Antonescu – Editura Medicala 2006*
2. *X. Flecher, J.N. Argenson, J.M. aubaniac. Prothese de hanche et de genou - Anales de readaptation et de Medicine Physique Volume 47, issue 6, 2004, pages 382-388*
3. H. Dinu, L. Dumitru, A. Iliescu, L. Dumitrescu, R. Badea, C. Toma, V. Mardale, M. Berteanu – Congresul National de Recuperare Medicina fizica si Balneologie Poiana Brasov 2008 - Argumente fiziopatologice recente privind exercitiile profilactice in fracturile osteoporotice - Clinica de Recuperare Medicala Spitalul Universitar de Urgenta Elias
4. *Kerstin M Palombaro, Rebecca L Craik, Kathleen K Mangione, James D Tomlinson - Determing Meaningful Changes in Gait Speed After Hip Fracture – Physical Therapy – Volume 86. Number 6 – june 2006*
5. *Gal Christian/ Mandrino Alain, Reeducation des protheses totales de hanche Isola 2000- avril 2005,*
6. *Association Nationales des Medecins Specialistes de Reeducation, Medicine Physique et de Readaptation no.59 2 eme trimestre-2002 La chute, consequences traumatiques et reeducation*
7. *Fabienne Goyon,Marco Brath, Sophie Berseth phisyotherapeutes Hopitaux de Geneve - Les fractures proximales du femur et leur traitements*
8. *Sinaki M - Musculoskeletal Rehabilitation in Patients with Osteoporosis – Rehabilitation of Osteoporosis Program (ROPE) – 2010 17. (2), 60 – 65.*
9. *Ram R. Miller, Shoshana H. Ballew, Michelle D. Shardell, Gregory E. Hicks, William G. Hawkes, Barbara Resnick, Jay Magaziner - Repeat falls and the recovery of social participation in the year post – hip fracture – Age and Ageing, 38 : 570 – 575, published electronically 8 july 2009*

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