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## REHABILITATIVE PROGRAM AFTER FRACTURES- DISLOCATIONS OF PROXIMAL HUMERUS TREATED WITH MODULAR HEMIARTHROPLASTY.

### Abstract

*The Authors illustrate the post-operative rehabilitation program for twelve patients who have undergone shoulder prosthesis for proximal humerus fractures-dislocations or four-fragment fractures involving the humeral head, diaphysis and tuberosities.*

*In all these cases a modular cemented "Aequalis" humeral prosthesis was used.*

*We have applied the rehabilitation program as described by Neer, with a few modification, allowing hydrokinesitherapy, that in the Neer protocol is only contemplated five months after surgery, once the active work has commenced.*

*It was possible to follow-up on ten of the twelve patients for four or five years.*

*The validity of the protocol has been confirmed by the good results obtained from both the function and pain aspects, the latter being slight or absent in most cases.*

### Key words:

*Shoulder prosthesis, Fracture of proximal humerus, Rehabilitation.*

Following modular hemiarthroplasty of the proximal humerus due to serious four-fragment fractures-dislocations, as all Authors sustain, functional rehabilitation is of the utmost importance both to ensure the recovery of a valid articular extension, as well as to avoid and prevent unpleasant complications that may entirely or partially void the advantages of surgery.

For these reasons, the patient must be clearly and fully informed about the post-operative rehabilitation program, as he/she will be required to collaborate under the constant guidance of the surgeon and the therapist. This collaboration effort reduces the risk of not making full use of the rehabilitation program for fear of excess or, on the contrary, of facing the possible

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dangerous consequences of over-accelerating it.

Here we illustrate the post-operative rehabilitation program for twelve patients who have undergone shoulder prosthesis for proximal humerus fractures-dislocations with dislocation of the proximal humerus, or four-fragment fractures involving the humeral head, diaphysis and tuberosities (2,6,9,10,15,20,21).

In all these cases a modular, cemented "Aequalis" humeral prosthesis was used (12,19) that enabled the maintenance of the humerus length, an essential prerequisite for the functional recovery of the deltoid and other muscles (4). Also essential to this end is the reinsertion of the humeral tuberosities.

We have applied the rehabilitation program as described by Neer (16), with a few modifications, comprising three phases.

The first phase lasts about 5 to 6 weeks and exclusively entails a passive mobilization (14,17). The first six days after surgery are very important, during which the articular range must be reached to a great extent by means of passive exercises, beginning the day after surgery with brief exercises (5 minutes three/five times per day) and progressively introducing Codman's pendulum exercises at the intervals. The articulation is particularly stimulated in its anterior passive elevation along the scapular plane and in its external rotation with flexed elbow close to the thorax, passively and slowly mobilizing the forearm. The abduction movement is avoided, in which the passage of the greater tuberosity under the acromion reproduces the sub-achromial conflict. At first, the exercises are carried out with the patient lying on his/her back; the passive extra-rotation is introduced 4-5 days after surgery, as soon as the post-operative pain has abated. The optimal passive recovery by the end of the first week is 130/140° in anterior elevation and 30/40° in external rotation. During this time, the patient's arm is

sustained by a sling that keeps the upper limb adducted, flexed at the elbow and in intra-rotation or neutral rotation.

Essential conditions for a complete articular recovery are: the suitable length of the muscle-tendon components, the absence of adhesions, the stability of the prosthesis and of the osteosynthesis of the tuberosities. Moreover, the patient must be able to relax the shoulder muscles so as to avoid the onset of pain. For this purpose, in case of necessity, we used analgesics before the session and cryotherapy at the end. The hand and wrist are actively mobilized and the elbow by active-aided exercises.

10-15 days after surgery, passive mobilization continues through self-aided exercises under therapist guidance, with the aid of the opposite limb and, whenever necessary, of a rod or a pulley. Only the total muscular relaxation of the operated side ensures a painless mobilization. The pendulum exercises must also continue, as they improve the sliding plane of the rotator cuffs and the deltoid and prevent capsular retractions.

Self-aided external rotation is initially carried out on one's back with the aid of a rod. Self-aided extension is carried out erectly with the rod put behind and held by the hands at the two ends. Self-aided elevation may be carried out on one's back with the aid of the opposite limb or erectly by means of a pulley. This exercise may not be carried out too soon as a total muscular relaxation of the operated side is necessary in order to avoid the onset of pain. Also to be avoided is the anterior or posterior stimulation of the limb that, instead, ought to be raised on the scapular plane.

Self-aided intra-rotation is to be carried out when the patient is able to put both hands behind without feeling pain, avoiding undue pressure so as not to compromise the osteosynthesis of the greater tuberosity of the humerus. Self-aided exercises are carried out

several times per day (4 to 8) for a few minutes (4 to 5) and continue until the tuberosities are consolidated to the humeral diaphysis, monitored by X-ray (about 5-6 weeks after surgery).

Following this, the second phase programs the gradual recovery of muscular strength, initially in isometry and later through active exercises (13), followed by resisted exercises (5) and in eccentric contraction (11). In the isometric exercises, movement is impeded by the opposite limb or by a fixed structure.

Once the active work has commenced, we have allowed hydrokinesitherapy (1), that in the Neer protocol is only contemplated five months after surgery. In this way, we exploit the muscle relaxant and sedative effect of the water at 32/34°C and the ease of movement resulting from the decreased gravitational pull. Moreover, the water's resistance to movement, that varies in relation to the speed of execution of the movement itself, can be exploited to strengthen the muscles. We have preferred breast stroke movements carried out when the body, suspended on belts, is immersed in the water. The patient moves the upper limbs, recovering the articular range in elevation and in external rotation. We do not allow the same movement to be carried out erectly as, in this case, the horizontal movement of the limbs occurs with a less than 90° elevation, that is, in the critical zone for the sub-achromial conflict.

At the end of the third month after surgery, the resisted exercises were increased.

It is useful to employ elastic bands that enable the patient to adjust the resistance.

The work in eccentric contraction is used to recover the supraspinatus muscle in controlling the descent of the arm from the 140/150° elevation (so-called zenith of the arm or zero position of the shoulder). This is a privileged starting point for the active work, as the rotator cuff is protected, the ascensional

component of the deltoid is neutralized (8), the supraspinatus muscle is relaxed and the bone conflict is overcome (the greater tuberosity has already passed under the acromion).

The third phase of the rehabilitative program attempted the recovery of the full articular range, eliminating any residual limitations and recovering the elasticity of the tissues and the articular capsule. This phase commences from the beginning of the fourth month after surgery and consists in stretching exercises carried out for a few minutes (five), 3-4 times a day. Stretching may take place in passive or self-aided mode.

The work may also be carried out in a swimming pool and should continue for several months after surgery, carrying out the exercises at least twice a day (18).

### Materials and methods

Twelve patients, nine females and three males, underwent surgery between 1996 and 1997 for fractures-dislocations of the humeral head or four-fragment fractures of the proximal humerus. Their ages ranged from 51 to 74 years (average age 68,5).

In all cases a modular, cemented "Aequalis" humeral prosthesis was implanted. The above described rehabilitative protocol was carried out during the six months following surgery.

### Results

It was possible to follow up on ten of the twelve patients for four or five years (one patient died due to other causes and one was untraceable), by using Constant score for assessing the shoulder function (3,7).

In seven patients the pain was absent or very slight (visual analog scale between 0 and 10 mm), it was slight in two (VAS 10-30 mm) and moderate in one (VAS 45 mm).

The active anterior elevation was an

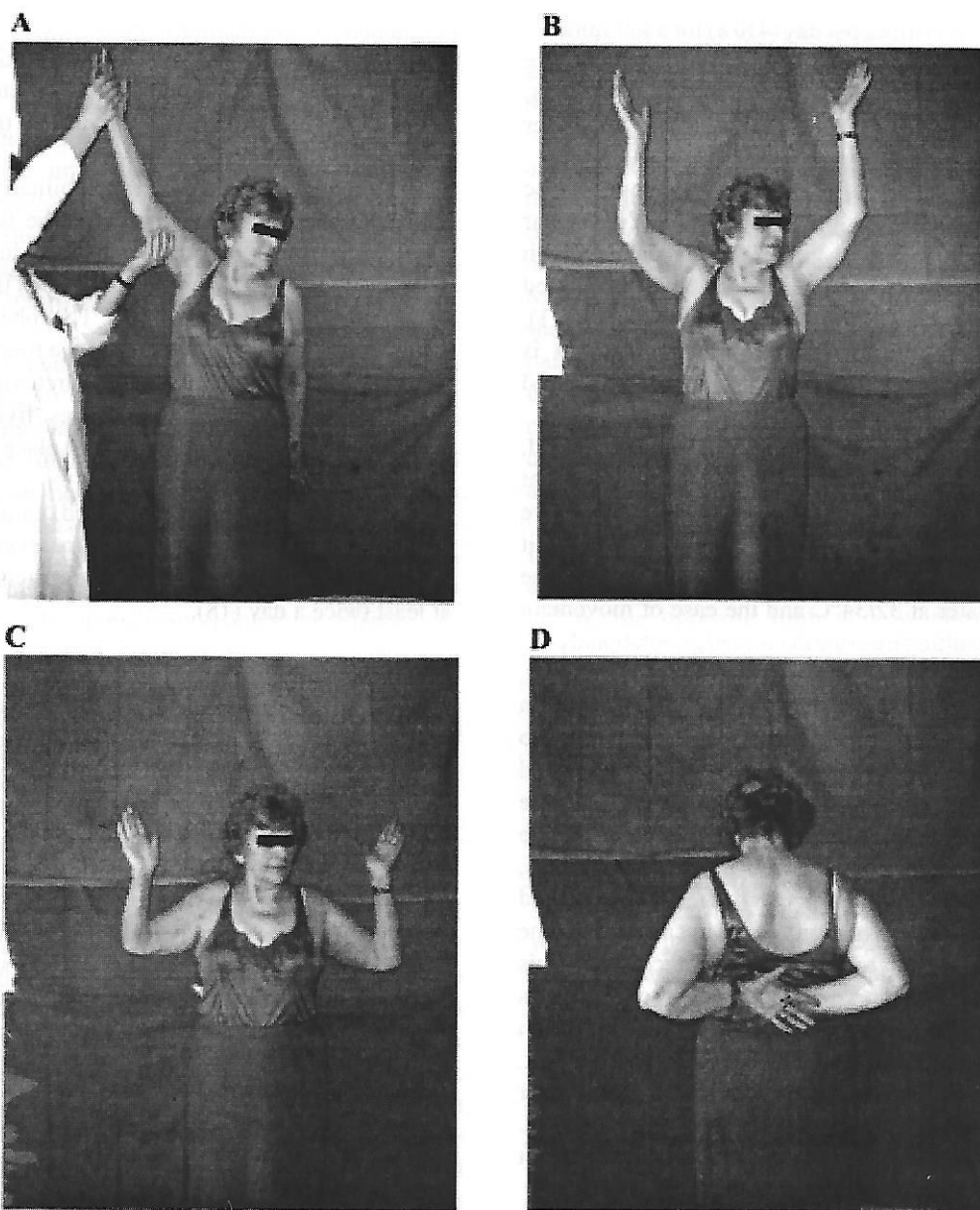


Fig. 1: C. M.L. operated at seventy years for fracure-dislocation of the right humeral head: control at the four years follow-up.

A: Passive anterior elevation.

B: Active anterior elevation.

C: Active external rotation.

D: Internal rotation in retroposition.

average of 122° (range 60°-160°); the passive anterior elevation was greater, reaching an average of 136° (range 80°- 180°); (Fig. 1 A-B).

The active external rotation (Fig. 1-C) was an average of 35° (range 10°-60°), whereas the passive external rotation reached an average of 45° (range 15°-70°).

As for the internal rotation, measured by assessing the vertebra reached by the patient's hand in retroposition, in two patients it was almost complete (level D6-D8), in six it was good (level D12-L5) and it was reduced in two cases in which the hand was only able to reach the gluteus.

Level L5 is considered functionally very important as it enables a person to wash and dress autonomously (Fig.1-D).

### Conclusions

The rehabilitative program we carried out, with respect to the classic protocols applied after modular hemiarthroplasty, has been

integrated by hydrokinesitherapy starting at the end of the second month after surgery, that is, as soon as active work is permitted. The latter is possible when the consolidation of the humeral tuberosities is confirmed by X-ray. This is necessary as a lack of consolidation of the tuberosities or their secondary dislocation would greatly compromise the shoulder's functionality.

The general principles that must guide the rehabilitation program are: both the therapist and the surgeon must constantly monitor the patient; the exercises must be carried out several times a day, but only for a few minutes; the maximum passive articular excursion must be recovered prior to any active work; the exercises must be carried out daily for at least six months after surgery in order to achieve an optimal result.

The good functional results obtained encourage us to continue with this rehabilitative protocol.

### Italian abstract

*Gli Autori presentano il programma riabilitativo post-operatorio attuato in dodici soggetti sottoposti ad intervento di protesi di spalla per frattura-lussazione della testa omerale o per fratture scomposte a quattro frammenti con coinvolgimento di testa, diafisi e tuberosità omerali. In tutti i casi è stata impiegata una protesi omerale "Aequalis" cementata, modulare. È stato seguito il programma riabilitativo descritto da Neer con qualche modifica, permettendo l'idrochinesiterapia una volta concesso il lavoro attivo e non aspettando cinque mesi dall'intervento. È stato possibile controllare a distanza di 4-5 anni dieci dei dodici soggetti operati; i buoni risultati ottenuti sia sotto l'aspetto funzionale che per quanto riguarda il dolore, nella maggior parte dei casi scarso o assente, conferma la validità del protocollo attuato.*

**Parole chiave:** Protesi di spalla, Frattura prossimale dell'omero, Riabilitazione.

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