

A study of eccentric isokinetic reinforcement of the lateral rotator cuff muscles of the shoulder in private office practice



Summary:

Isokinetic reinforcement of the joint complex of the shoulder is an approach that is difficult to perform in office practice due to lack of appropriate equipment. This study allowed us to implement a protocol for muscle reinforcement in office practice with the "Kinevolution" isokinetic equipment on a group of patients who underwent arthroscopic surgery.

Results show the feasibility of such a protocol in the setting of private office practice and also a gain in muscle strength obtained in spite of a disparity in variables between patients.

INTRODUCTION

OBJECTIVES:

Development of surgical and anaesthetic methods in the setting of rupture of the rotator cuff muscles has undergone a real development with increased use of arthroscopy and loco-regional anaesthetic blocks. In this context, post-operative management of rehabilitation has adapted to improved understanding of biomechanical principles of the scapula-humeral complex and by a manual treatment approach which is always more perfected for the structures of this joint. Today, development of new highly technical devices should make it possible to improve post-operative management to increase even more the level of efficiency of protocols.

In this context, it appeared useful to set up a programme using novel isokinetic equipment designed for functional workout in private office practice: the Kinevolution. This device makes it possible to quantify deficits in the strength-joint pair but also to set up a programme for reinforcement in a predefined group of patients in order to evidence the ability of a deficient shoulder to recover in terms of the lateral rotator muscles of the shoulder.

Let us note that set up of the working protocol was done in the setting of private office practice focused on treatment of the shoulder. The aim of this private practice context is to use the machine under actual conditions of use.

Usually reserved only for a physical rehabilitation centre, isokinetic equipment is difficult to utilise outside of these centres for obvious reasons of space, time and cost. Kinevolution, which has been entrusted to us, should make it possible to integrate into daily activity of office practice while strictly complying with the established test protocol.

POPULATION

The set up of the test protocol performed in office practice over a period of a few weeks for loan of the equipment was a challenge for office practice physiotherapists. The other difficulty lay in finding a group of patients who, after their interventions, presented with a deficit of the lateral rotator cuff muscles while having had a sufficient amount of time elapse since their operations in order to comply with the recommendations of the national health authority in terms of isokinetic muscle reinforcement. In the end, we succeeded in applying the protocol to a test group of ten patients corresponding to predefined criteria. This group, although it may appear to be of limited size, gave us a good indication of the possible options offered by this approach and has revealed a statistical trend.

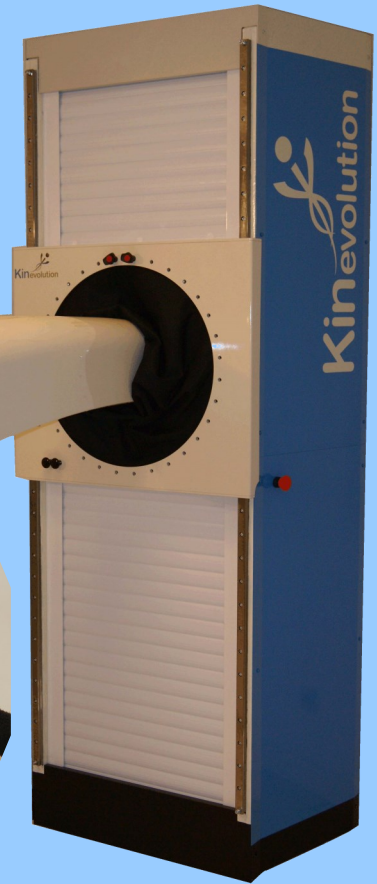
Screening criteria:

- All patients underwent surgery with surgical suturing of the supra-spinatus muscle together with acromioplasty.
- All patients underwent their procedures after an average time of six months after the static test for evaluation of initial strength.
- These patients who underwent surgery all presented with the particular aspect of having developed moderate post-surgical stiffening, which delayed their rehabilitation. Initially they were treated in the office for capsulo-ligamentary stiffening together with joint decentring.
- They presented with a deficit of the lateral rotator cuff muscles and had had the necessary time elapse after having undergone their procedures. They all were at the end of rehabilitation, having recovered the totality of joint amplitudes of the joint complex of the shoulder and different tests of decentring and conflicts were negative.
- One patient in the initial group of ten was excluded from the protocol following an intercurrent disorder requiring his hospitalisation.

With a mean age of 55.5 years, three men and six women thus participated in the test. The variable in age showed a standard deviation of 6.4 years.

Equipment used:

Isometric tests and isokinetic exercises were carried out with the Kinevolution product. This new generation of equipment uses the possibilities offered by research in isokinetics and control of trajectory for use in private office practice and with a technical set up. It gives an analytical and functional workout while separating the work of agonist and antagonist muscles with passive return to initial position or while performing concentric/concentric, eccentric/eccentric or concentric/eccentric workout. Kinevolution is also a tool for evaluation to quantify deficits in the joint-force pair. It authorises an objective approach in the diagnostic assessment and allows the progress of a patient to be followed over his health care course of activity or comparatively to a group test.



The oldest patient was 68 and the youngest was 47 years of age.

Criteria for exclusion from the study:

Any occurrence of painful symptoms as well as occurrence of neuromotor fatigue evidenced by an erratic curve on the monitor were considered as a criterion for stopping.

Any absence or discontinuity in the predefined protocol was considered to be a criterion for stopping.

REFERENCE POSITION OF PATIENT

The subject was standing, positioned orthogonally compared to the articulated arm. The patient's hand which was to undergo the test held the grasping tool of the machine in neutral position of pronosupination. The arm was positioned at an angle of 45° abduction while complying with the plane of the scapula. A balloon whose size was chosen to maintain an angle of 45° abduction in spite of the difference in patient morphology was placed between the inner aspect of the shoulder and the thorax. This placement made it possible to maintain a functionally neutral position of the shoulder and of the upper limb and to provide more comfort to the patient.

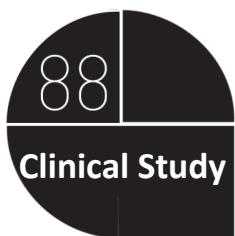
INITIAL TEST

This test made it possible to establish the standard for the subject's strength.

The patient was placed in the reference position in neutral rotation of the shoulder. The initial measurement consisted of 3 repetitions of measurement of the peak of the pair deployed by the patient in the isometric mode during attempted lateral rotation of the shoulder. The test was carried out with facilitation of double biofeedback: under auditory stimulus by the physiotherapist in charge of the protocol and visual observation on the screen of the machine, which enabled cognitive monitoring of the patient.

EXERCISE AND PROTOCOL

The equipment makes it possible to apply different modes of contraction. We chose use of the eccentric isokinetic mode in order to increase resistance to stretching of the muscle-tendon complex, and to stimulate the fibroblast by facilitating realignment of newly synthesised fibres in their physiological axes of traction. These are elements which help the patient to support mechanical stresses generated by daily activity.



The exercise consists of three series of ten repetitions separated by a 30 second rest period. Pre-tests on a population free from any disorder made it possible to test different speeds ranging from 10 mm/sec to 120 mm/sec in movement. The speeds chosen appeared to us as a means of combining efficacy of reinforcement, the criterion of progression and safety. The speeds of isokinetic exercises applied were 100 mm/sec, 60 mm/sec and 30 mm/sec respectively for each of the three series of ten exercises.

The number of sessions was set at three per week over a four week period.

At the outset, during each application of the protocol for reinforcement, the patient underwent a session of gentle mobilisation of his shoulder complex with verification of joint centring.

The patient then was placed in the reference position. The equipment passively brought the subject's upper limb into lateral rotation. Total amplitude of the controlled movement was 40°. The practitioner verified the proper scapula-humeral positioning. When he was ready, the patient pressed a predefined button on the upper part of the handle or started his movement in lateral rotation. The machine, detecting this contraction, triggered an opposite proportional force opposing the patient's rotation.

The therapist was in contact with the patient orally throughout the phase of contraction. In addition to this solicitation, there was visual biofeedback provided by the screen of the machine. The patient constantly followed his effort during the movement by means of a real time display of the force developed compared to curves of standard of force/minimum and maximum displacement defined on a case by case basis by the therapist.

Thanks to this visual biofeedback in real time, the patient modulated his contraction so as to remain within the range of the specification throughout the trajectory of the movement. The specifications chosen for this study all followed the same diagram comprised of a gradient for establishment, a plateau and a decreasing gradient.

The Criteria on progress:

During the different sessions, we considered that the criterion for progress was the patient's ability to control his gestures and his effort with the help of biofeedback and increasing strength developed by means of the exercise.

FINAL TEST

The final test exactly replicated the initial test and made it possible to establish a comparison in terms of progress.

The CONCLUSION

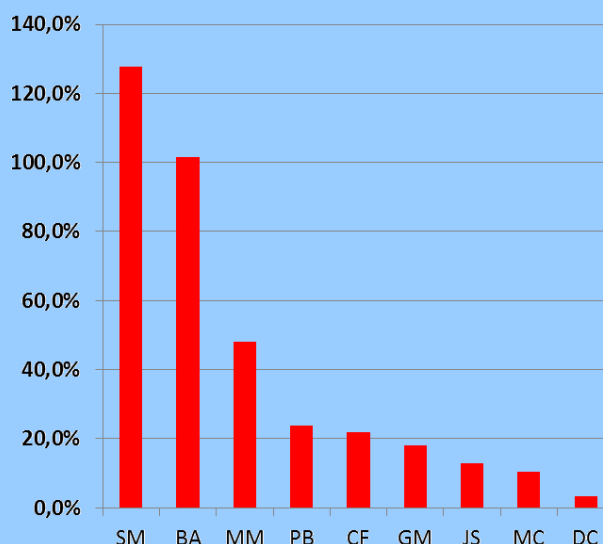
As is often the case, we observed a wide disparity between the different data on each subject. Although results at start of treatment seemed similar in terms of gain, it was observed that the variable between patients was already high. This should be contemplated whilst taking into account the large number of variables specific to each patient: age, morphology type, general condition, etc. The mean of results of initial tests range from 4.15 kg to 7.47 kg (see table).

Results of the Isometric tests

Comparisons between the initial test (before isokinetic exercises) and the final test (after 4 weeks) per patient.

Patient	Initial strength	Gain	Relative gain
SM	5,3	6,8	127,7%
BA	7,0	7,1	101,4%
MM	4,2	2,0	48,2%
PB	7,5	1,8	23,9%
CF	6,5	1,4	22,0%
GM	6,7	1,2	17,9%
JS	5,4	0,7	13,0%
MC	4,3	0,5	10,5%
DC	4,5	0,2	3,3%

Relative Gain



For the same reasons, the results of the end of the test were also very heterogeneous with a maximum gain of 127.7% and a minimum gain of 3.3%, with a mean of about 40.9% improvement. These results are logical if we compare the very large number of variables between subjects. First, variables of age, morphology type, general condition, condition of the scar and pain were present. The specific condition of each subject, success of surgery, of physiotherapy, etc. were also added to these variables.

We will keep in mind that the protocol enabled all patients to improve their "strength pair" of the lateral rotator cuff muscles. Therefore the trend was appreciably favourable.

Overall, we noted that the patient's experience with regard to the equipment was positive. The gentleness and control with which the movement was exercised were greatly appreciated. We believe that the principle of triggering dynamic resistance in detection at start of the patient muscle contraction has a large part in the comfortable and safe aspect described by subjects.

In terms of implementation of the test and thus of incorporation of the Kinevolution equipment in office practice, in the end everything went without any real difficulties. The set up of the different exercises is relatively simple and easy to reproduce once the parameters are incorporated.

Beyond the limited aspect of this study, therefore, we will conclude that reinforcement in isokinetic mode always provides an actual plus in management of disorders of the shoulder and in particular that this technology now is applicable in the setting of office practice.

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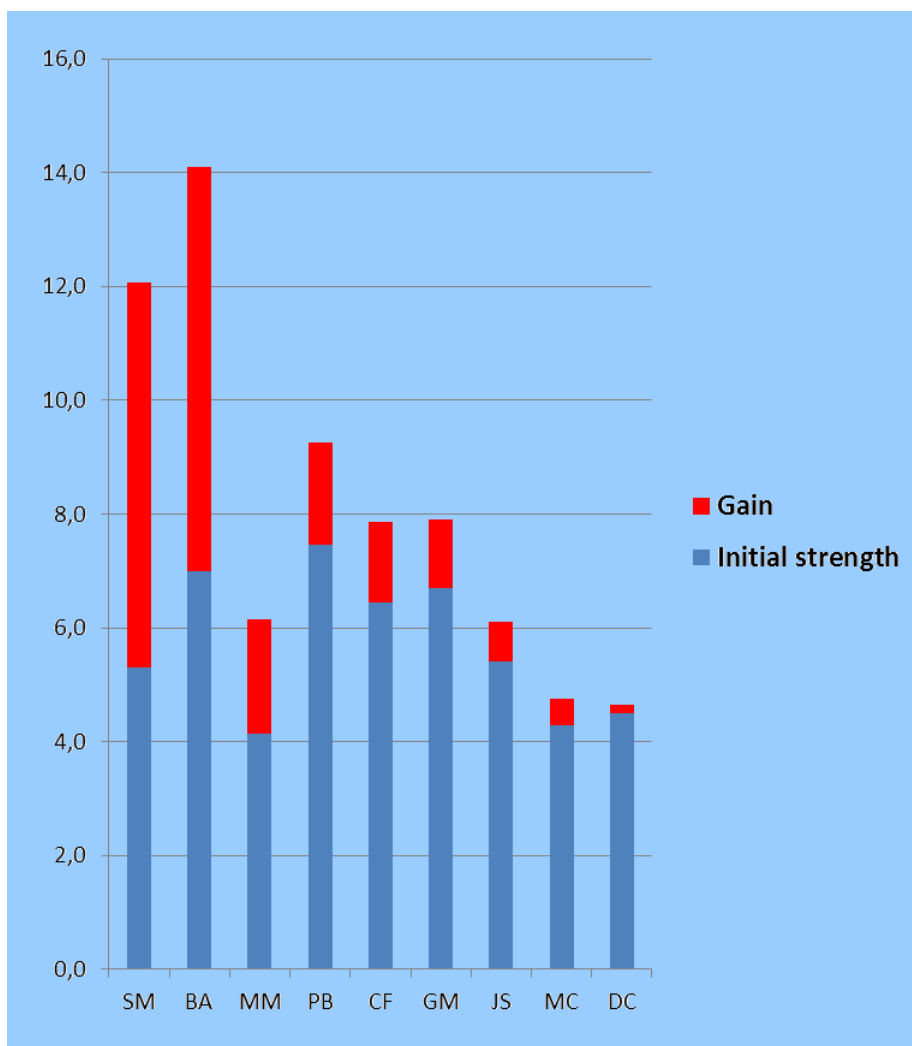
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