MUSCLE TRAINING FOR PECTORAL CINEPLASTY

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Amputation through the upper arm produces the dual problem in any prosthetic replacement of restoring elbow flexion as well as closing the terminal hand unit. These two actions can be separately provided in a long above-elbow amputation by using stump flexion or abduction to activate the elbow mechanism and a shoulder harness for the hand movements. It is in the short above-elbow stump or shoulder disarticulation, where stump function is severely reduced, that an extra motor is required to work in conjunction with the shoulder harness. Pectoral cineplasty is reserved for these short humeral stump patients who may then independently activate the hand unit by the pectoral muscle motor while flexing the elbow by shrugging the shoulder.

The general principles of cineplasty training have previously been outlined with particular reference to the more commonly indicated biceps cineplasty (Gale and Hueston, 1957). The same procedure is followed with patients undergoing pectoral cineplasty with some important variations arising from differences in muscle anatomy and stump structure.

PREPARATION FOR OPERATION

Three weeks' preoperative training is regarded as necessary and may be summarized as follows:

(*a*) Static contractions of pectoralis major are practised for five minutes hourly. These can be assisted by placing the fingers beneath the anterior wall of the axilla and exerting an upward pressure. The patient attempts to depress the fingers without moving shoulder or arm stump. This will produce a good contraction of pectoralis major.

(*b*) Static contractions of pectoralis major on the sound side.

(*c*) Hard resistance exercises for the pectoral muscles are performed bilaterally to prevent the development of trick movements; pulling 14 to 18 lbs. weight through 500 lifts three times daily is done to build up strength and muscle bulk.

(*d*) Shoulder mobility exercises on the amputation side, as this joint is often stiff after the period of immobilization and disuse in the initial convalescent stage.

(*e*) Bilateral strengthening exercises for the shoulder girdle to build up the strength of the weak, wasted muscles and to prepare them for the ultimate management and control of the elbow joint of the prosthesis.

(*f*) Strict postural correction. Pectoral cineplasty is reserved for short amputations of the upper limb; these patients are more liable to have fallen into postural errors than below-elbow amputees because the greater loss of weight on the affected side is inclined to upset the postural reflexes. Also, owing to the initial bed rest and immobilization following amputation, the periscapular muscles on the affected side become weak and less efficient as postural muscles. Postural deformities occur very rapidly and easily with weakness of some or all of these muscles, namely, deltoid, supraspinatus, infraspinatus, rhomboids, trapezius, serratus anterior, and latissimus dorsi. These faults must be corrected and the muscle strength and bulk built up to equal the sound side

POSTOPERATIVE CARE

At operation a skin tunnel is constructed just above and lateral to the nipple. This is passed through the pectoralis major after this muscle has been divided from its insertion. The clavicular fibres are divided from their origin to render the muscle pull more directly medial since this pull then depends entirely on the sternocostal origin. Care is taken to preserve the lateral pectoral nerve. A thick split skin graft is used to cover the exposed muscle belly.

Postoperative exercises may commence when healing has occurred, usually during the third week. The same procedures as we have described for biceps cineplasty are followed, with digital traction on the tunnel until an acrylic pin can be used. The pin is inserted as soon as the muscle is felt to contract well with good voluntary control.

The awkward position of the tunnel and the relatively hyperæsthetic skin area make pin traction more attractive to both physiotherapist and patient. The care of the skin tunnel has been described elsewhere.

Frame Exercises

A frame and pulley is an early requisite in pectoral muscle motor training. Such an arrangement is illustrated in Figure I. In the early stages, while the tunnel margins

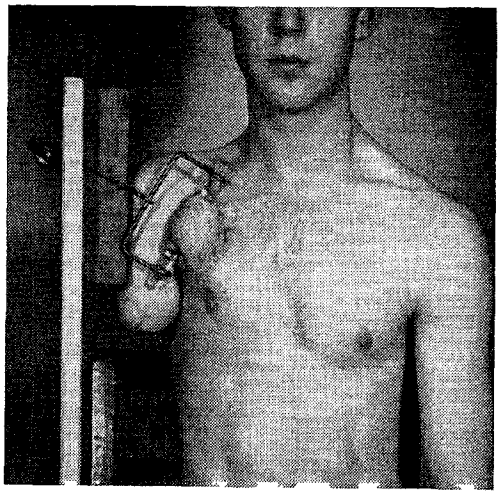

FIGURE I: Patient with a pectoral cineplasty using a simple training frame Such a device if modified may be used standing, sitting or lying down

are still relatively rigid from recent healing, the upper end of the tunnel may appear tight during active use; this is a result of distortion due to lack of support for the upper end by the ineffectual clavicular fibres. The lower powerful muscle belly provides good support for the lower end.

An interesting difference from biceps tunnel training is that the pectoral tunnel rapidly acquires a good excursion using very light weights (Fig. II) but is slow to gain the necessary strength to pull heavy weights through the same distance. This contrasts with the biceps which rapidly gains the strength to carry the heavy loads but only slowly stretches to give the required tunnel excursion to operate the prosthesis. Hence in pectoral cineplasty the aim at this stage is to increase the muscle power by very slowly increasing the weights until the required minimum of 20 lbs. moved through two inches is reached.

Frame exercises are commenced with weights not exceeding 3 lbs. (1·3 Kgm.) and only when these can be lifted 300 times is the load increased to 5 lbs. (2·3

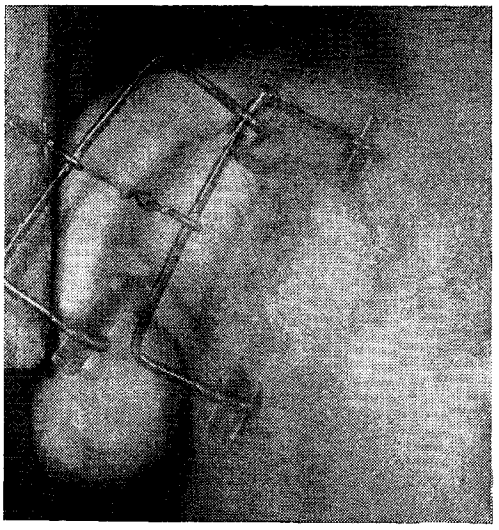

FIGURE II Double-exposure photograph to show the excursion of the skin tunnel on contraction of pectoralis major

Kgm.). For the first month, depending on the tolerance of the skin tunnel, a lighter weight should be used at the start of each session and steadily increased; for example:

2½ lbs for 300 lifts, then 5 lbs for 200 lifts.
5 lbs for 300 lifts, then 8 lbs for 200 lifts
7½ lbs for 200 lifts, then 10 lbs for 300 lifts
9 lbs for 200 lifts, then 12 lbs for 300 lifts

As stated above, the required standard to operate a prosthesis is a 20 lb. (9 Kgm.) pull through two inches. The less efficient prosthesis provided for these short humeral stump amputees, with the long cables providing considerable frictional resistance, necessitates regular use and home exercises to retain and improve the muscle motor power.

We have one patient with a humeral stump of only five inches who has returned to his previous occupation as a toolmaker using an upper limb prosthesis with the terminal device operated by a pectoral cineplasty.

REFERENCE

GALF, A. F., and HUESTON, J T. (1957), "Muscle Training for Biceps Cineplasty", AUSTRALIAN JOURNAL OF PHYSIOTHERAPY, 3· 148.