

Scapulectomy for malignant tumor

Function and shoulder strength in five patients

Function and muscular strength were studied in five patients who had undergone either total or subtotal scapulectomy for malignant tumor. We found a striking difference in the functional impairment between the two patients with total and the three patients with subtotal scapulectomy. The latter three patients were able to handle light objects with their hands over their heads, and reached or nearly reached the horizontal plane in flexion and abduction of the shoulder. The two patients with total scapulectomy had a flexion and abduction range between 40 and 50 degrees. The mean isometric muscle strength in flexion relative to the non-operated side was 17 and 37 per cent for patients with total and subtotal scapulectomy, respectively, and the abduction strength 14 and 44 per cent, respectively. After scapulectomy, a reasonably good function can be expected, especially if it is possible to preserve the glenoid fossa and/or the acromion.

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In 1856, Syme performed the first scapulectomy for tumor, and he described the technique in a text-book in 1865. Since then the surgical technique has been described in detail (De Palma 1954, Das Gupta 1970), as well as the rationale of the soft tissue reconstruction (Papaioannou & Francis 1965). The salvage or cure for patients with soft tissue sarcomas in the scapular region has been reported by Ramirez et al. (1971) and Turnbull et al. (1981), but the functional postoperative results are usually only briefly mentioned in the literature; most authors report satisfactory function with a good possibility of returning to normal work.

We have analyzed the function after total and subtotal scapulectomy for malignant tumor.

Patients and methods

Between 1969 and 1983 five patients underwent a total or subtotal scapulectomy for a malignant tumor in the scapula (Table 1). All patients could be traced for follow-up; for one of them (Case 3), who died 9 years after operation of an unrelated disease, a detailed account of the functional ability 2 years earlier was available. For this patient, we could also study a movie taken about 2 years after operation.

Total scapulectomy refers to removal of the entire bone. If the inferomedial part, the acromion, the coracoid process, or the glenoid fossa is left behind the procedure is referred to as a *subtotal scapulectomy*. The reconstruction implied joining by suture those parts of the trapezius and deltoid muscles that had lost their attachment to bone. The sutures were unloaded until sound healing had taken place, so that the patient would keep good muscle strength for upward pull. The musculo-tendinous cuff was not sutured to the clavicle as some authors have proposed (De Palma 1954, Papaioannou & Francis 1965); two patients had lost the clavicle except for a small medial part.

The impairment of function was assessed with respect to pain, activities of daily living (dressing, eating, personal hygiene, social life), housekeeping, ability to manage their work, spare time activities, and sports.

Clinical examination included measurements of passive and active range of motion of the shoulder joint, and the ability to reach the back of the head and the inferior angle of the opposite scapula behind the back.

The muscle strength generated around the shoulder was measured isometrically using a Cybex II dynamometer. The measurements were done with the patient in a supine position fixed with straps over the chest and pelvis and with the axis of rotation of the

Table 1. Descriptive data of five patients subjected to total or subtotal scapulectomy.

Case	Sex	Age at examination	Side	Years after operation	Diagnosis	Operation	Active range of motion			
							F	A	O	I
1	M	58	L	1	Solitary plasmocytoma	Total scapulectomy including $\frac{3}{4}$ of the clavicle	40	30	0	90
2	F	22	L	8	Telangiectatic osteosarcoma	Total scapulectomy	30	50	0	90
3	F	59	R	7	Chondrosarcoma	Subtotal scapulectomy including $\frac{3}{4}$ of the clavicle (inferomedial $\frac{1}{3}$ of scapula left)	90	90	—	—
4	F	37	R	1.5	Solitary metastasis of breast carcinoma	Subtotal scapulectomy (acromion left)	90	70	10	90
5	M	35	L	4	Chondrosarcoma	Subtotal scapulectomy (glenoid fossa, coracoid process, and acromion left)	90	80	20	90

F = flexion, A = abduction, O = outward rotation, I = inward rotation.

dynamometer aligned to the humeral head. The strength of flexion and extension was measured with the arm fixed in 0, 45, and 90 degrees of flexion, and the strength of abduction and adduction was measured with the arm fixed in 0, 45, and 90 degrees of abduction. The best of three maximal isometric performances in each position was used. The strength was calculated in relation to the maximal strength on the non-operated side.

Results

Impairment of function

Case 4 had diffuse ache around the shoulder occasionally, but did not use analgetics. The two patients with total scapulectomy (Cases 1 and 2) could not carry out static work or heavy dynamic work with slightly abducted or flexed arms. The three patients with subtotal scapulectomy (Cases 3, 4, and 5) were able to work and handle light objects with their hands above their head.

Non-loaded precision movements in flexion and abduction were difficult to perform for three patients (Cases 1, 2, and 4); they mainly used the non-operated arm when eating. All patients could lift and handle heavy objects with the shoulder in neutral position, and the function of the elbow, wrist, and hand was nor-

mal. Dressing and personal hygiene were no problem to any patient.

Of the two patients with total scapulectomy, Case 1 could not resume his previous industrial occupation, which involved much work with lifted arms; the other was a student. The three patients with subtotal scapulectomy returned to their previous work as office-clerk, teacher and machine-seller, respectively. No patient

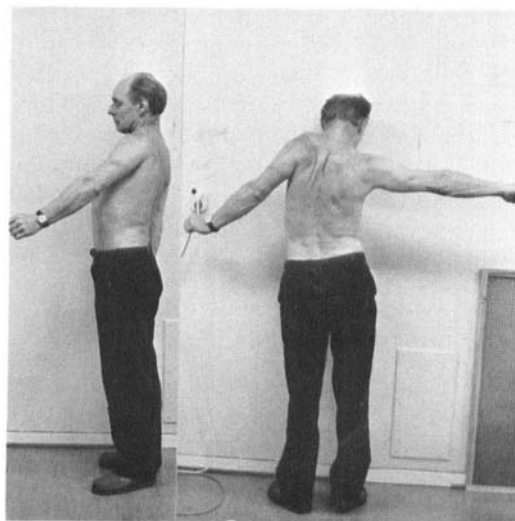


Figure 1. Case 1. Total scapulectomy and resection of the clavicle on the left side.

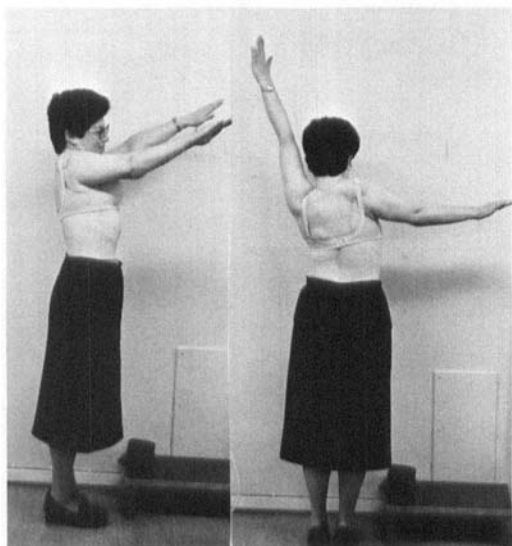


Figure 2. Case 4. Subtotal scapulectomy on the right side. The acromion was left.

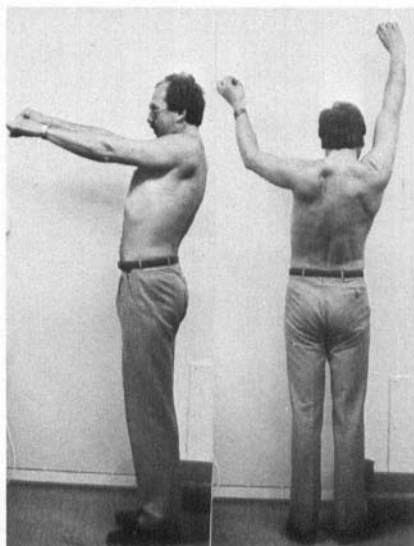


Figure 3. Case 5. Subtotal scapulectomy on the left side. The glenoid fossa, coracoid process, and acromion were left.

reported any change in sport and spare-time activities.

Clinical examination (Table 1)

The passive range of motion was within normal limits in all patients. The two patients with total scapulectomy had an active flexion-abduction range of 30–50 degrees (Figure 1). The three patients with subtotal scapulectomy reached or nearly reached the horizontal plane in flexion and abduction (Figure 2 and 3). Active outward rotation in the shoulder was much decreased in all patients and could not be performed at all in the two patients with total scapulectomy. All patients could reach the back of the head, although two (Cases 2 and 4) only with difficulty; all could reach the scapula behind the back.

Strength measurements (Figure 4)

Case 3 was not available for strength measurements. For flexion and abduction, there was a striking difference between patients with total and those with subtotal scapulectomy. If the results are given as the mean value for the two patients of each category and for the different joint positions, the flexion

strength was 17 and 37 per cent, respectively, and the abduction strength 14 and 44 per cent, respectively. The two patients with total sca-

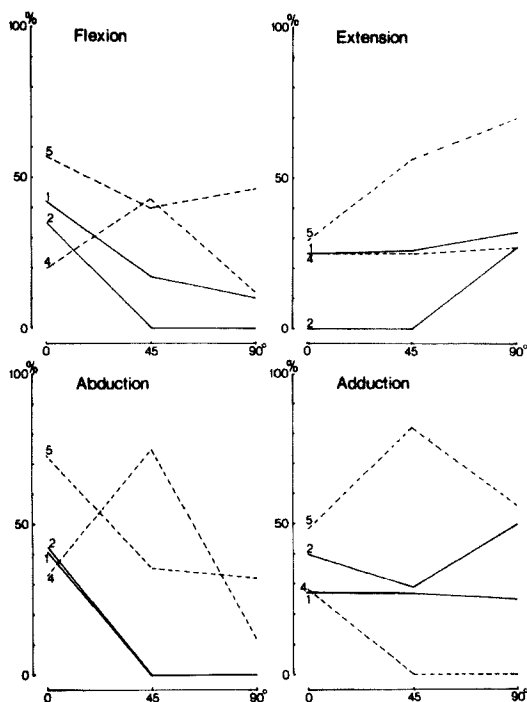


Figure 4. Shoulder strength in per cent of maximal strength on non-operated side in four patients who have undergone total (—) or subtotal (---) scapulectomy.

pulectomy could not exert any abduction strength with the arm in 45 and 90 degrees of abduction, and only Case 1 could exert any flexion strength with the arm in 45 and 90 degrees of flexion (Figure 4). In neutral position, there was no difference between total and subtotal scapulectomy. The extension strength was over 25 per cent in all measurements, except for Case 2 who could not exert any extension strength with the arm in neutral position and 45 degrees of flexion. The adduction strength was also over 25 per cent in all measurements, except for Case 4 who could not exert any adduction strength with the arm in 45 and 90 degrees of abduction.

Discussion

Removal of a part of the scapula is often indicated for benign lesions, such as osteochondroma, and does not usually impair the shoulder function. Scapulectomy, total or subtotal, is a more function-depriving procedure but is sometimes indicated in the treatment of both primary and secondary tumors of the scapula. The most common malignant bone tumor in the scapula is chondrosarcoma for which scapulectomy can be regarded as curative. Of the two patients with chondrosarcoma, one had been continuously free of tumor for 9 years when she died of an unrelated disease, and the other is free of evidence of tumor after 4 years. Das Gupta (1970) discussed indications for scapulectomy and maintains that it should usually be reserved for bone and soft tissue tumors of low malignancy grade, but that it can sometimes be considered even for a solitary metastatic lesion. Three of our cases were operated on for highly malignant tumors.

The shoulder motion is exerted by the action of "muscle force couples" (Innman et al. 1944). Scapular rotation is thus effected by the action of an upper and a lower muscle group acting in opposite directions. Flexion and abduction of the glenohumeral joint are effected by the action of a force couple consisting of the deltoid muscle, which pulls upwards, and the subscapularis, infraspinatus, and teres minor muscles, which pull downwards, thereby stabilizing the humeral head against the glenoid fossa. The

reconstruction after scapulectomy should aim at reestablishing an efficient force couple. To achieve an efficient upward pull, it is essential to suture to each other those parts of the trapezius and deltoid muscles that have lost their attachment to the scapula and clavicle. This was done in all patients. The downward pull, after loss of the subscapularis, infraspinatus, and teres minor muscles, can be effected by the latissimus dorsi and pectoralis major muscles. In Case 3, some downward pull could probably also be effected by the teres major muscle, whose origin, the inferomedial part of the scapula, was left behind; a prerequisite is, however, that this part of the scapula be fixed in place by two counteracting forces, one affected by the inferior part of the serratus anterior muscle and the other by the rhomboideus major muscle.

Stabilization of the humeral head is best achieved by leaving the glenoid fossa and/or the acromion in place if possible (subtotal scapulectomy), as was done in Cases 4 and 5; the active range of motion was greater in these two patients than in those with total scapulectomy. Unlike the patients with total scapulectomy, they were also able to exert strength with the arm flexed 90 degrees, making it possible for them to work and handle objects above the horizontal plane. De Palma (1954) and Papaioannou & Francis (1965) recommend the creation of a fulcrum to the humeral head by suturing remnants of the rotator cuff to the lateral end of the clavicle. By doing this, the range of motion can possibly be increased, and the "dragging and pulling" sensation in the neck that some patients complain of may be eliminated (De Palma 1954). This procedure was, however, impossible in Cases 1 and 3 in whom the clavicle was resected. Case 2 had no discomfort from the shoulder, but possibly she would have had a better functional result if the rotator cuff had been sutured to the clavicle.

It thus seems that the preservation or creation of a fulcrum to the humeral head leads to improved function. As seen in Case 3, in whom the inferomedial third of the scapular blade was left behind, the preservation of this part of the scapula may also result in better function. This case had the same active range of flexion as the two cases in whom a fulcrum for the

humeral head was preserved, and even better abduction. The extension and adduction strength did not differ much between total and subtotal scapulectomy; these movements are of less functional importance than flexion and abduction.

To conclude, after scapulectomy for neoplasms, a reasonably good function can be expected, especially if the glenoid fossa and/or the acromion have been preserved.

Acknowledgements

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