



## Functional and oncological outcomes after total claviclectomy for primary malignancy

Zhaoxu LI, Zhaoming YE, Miaofeng ZHANG

From the Department of Orthopaedics, Second Affiliated Hospital, Zhejiang University, Hangzhou, China

Primary malignancies of the clavicle are very rare, and scarce data are available regarding the functional and oncologic outcome after total claviclectomy. This is a retrospective review of 9 patients with primary clavicular malignancy, between 2000 and 2010, treated with total claviclectomy. There were 5 females and 4 males with a mean age of 29 years (range, 16 to 56). After a mean follow-up period of 46 months (range, 24-102 months) all patients were alive and without local recurrence or metastases. Patients had almost a full range of motion without pain, without significant functional deficit. The mean Constant-Murley score (best possible score = 100) improved from 26 to 79 ( $p < 0.001$ ), while the VAS for pain improved from 8.7 to 2.4 ( $p < 0.001$ ). Therefore, total claviclectomy may be a useful salvage procedure for primary clavicular malignancy.

**Keywords:** clavicle ; functional outcomes ; primary malignancy ; claviclectomy.

### INTRODUCTION

Tumours of the clavicle are rare, with an incidence of less than 1% of all bone tumours (8). Although almost every variety of bone lesion has been described in the clavicle, none is common at this site (10). Moreover, most tumours of the clavicle are primary malignant lesions (3). Up to now, scarce literature is available regarding the outcomes of total claviclectomy for primary malignancies. Orthopaedic oncologists consequently have limited

experience in the diagnosis and management of tumorous conditions of the clavicle.

It is generally accepted that relatively good functional results are obtained after claviclectomy, without reconstruction, for trauma or infection (7). On the other hand, allograft reconstruction after claviclectomy is not justified for malignancies in terms of functional outcomes (8). Therefore, total claviclectomy without reconstruction is obviously the procedure of choice for clavicular malignancies, if a definitive cure is the goal.

The purpose of the present review is to report the long-term functional and oncologic results in 9 patients who underwent total claviclectomy for primary clavicular malignancies.

### PATIENTS AND METHODS

Nine patients underwent unilateral total claviclectomy between 2000 and 2010. There were 5 women and

- 
- Zhaoxu Li, MD, Orthopaedic Surgeon.
  - Zhaoming Ye, MD, Professor of Orthopaedic Surgery.
  - Miaofeng Zhang, MD, Specialist Orthopaedic Registrar.  
*Department of Orthopaedics, Second Affiliated Hospital, College of Medicine, Zhejiang University, Hangzhou 310009, China.*
- Correspondence : Miaofeng Zhang, Dept of Orthopaedics, Second Affiliated Hospital, College of Medicine, Zhejiang University, Hangzhou 310009, China.  
E-mail : zhangmfhz@gmail.com  
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4 men, with an average age of 29 years (range 16-56). The average follow-up period was 46 months (range, 24-102 months). The lesions were located in the lateral third of the clavicle in 5 patients, in the middle third in 3, and in the medial third in one. The majority presented with swelling and pain, but one patient (case 6) only complained of a painless stiffness of the shoulder. None of the patients showed a neurovascular deficit or a pathologic fracture. All patients were staged with plain radiographs, CT-scan and MRI of the involved shoulder, CT-scan of the thorax and whole-body technetium scan. Open biopsy was done in 3 cases, while 6 patients underwent fine-needle aspiration biopsy. Eight patients received neo-adjuvant chemotherapy. The surgical technique described by Krishnan *et al* (7) was applied. All patients underwent wide excision of the tumour and total claviclectomy, without bone reconstruction (Fig. 1). The incision incorporated the biopsy scar. Microscopical examination of the specimen confirmed the biopsy findings in all cases. Postoperatively, the operated shoulders were immobilized with an arm sling for 3 to 6 weeks, followed by rehabilitation and physical therapy. Surveillance for local recurrence and metastases consisted of physical examination, radiographs and lung CT every 3 months for the first year and every 6 months thereafter.

The functional outcome was assessed with the Constant-Murley score (100 being the best possible result) (4). In addition, patients were asked to indicate their pain level on a visual analog scale (VAS 0 representing no pain and VAS 10 representing the worst pain).

The preoperative and the postoperative Constant-Murley scores were compared by means of Student's t-test;  $p$  values  $< 0.05$  were considered as statistically significant.

## RESULTS

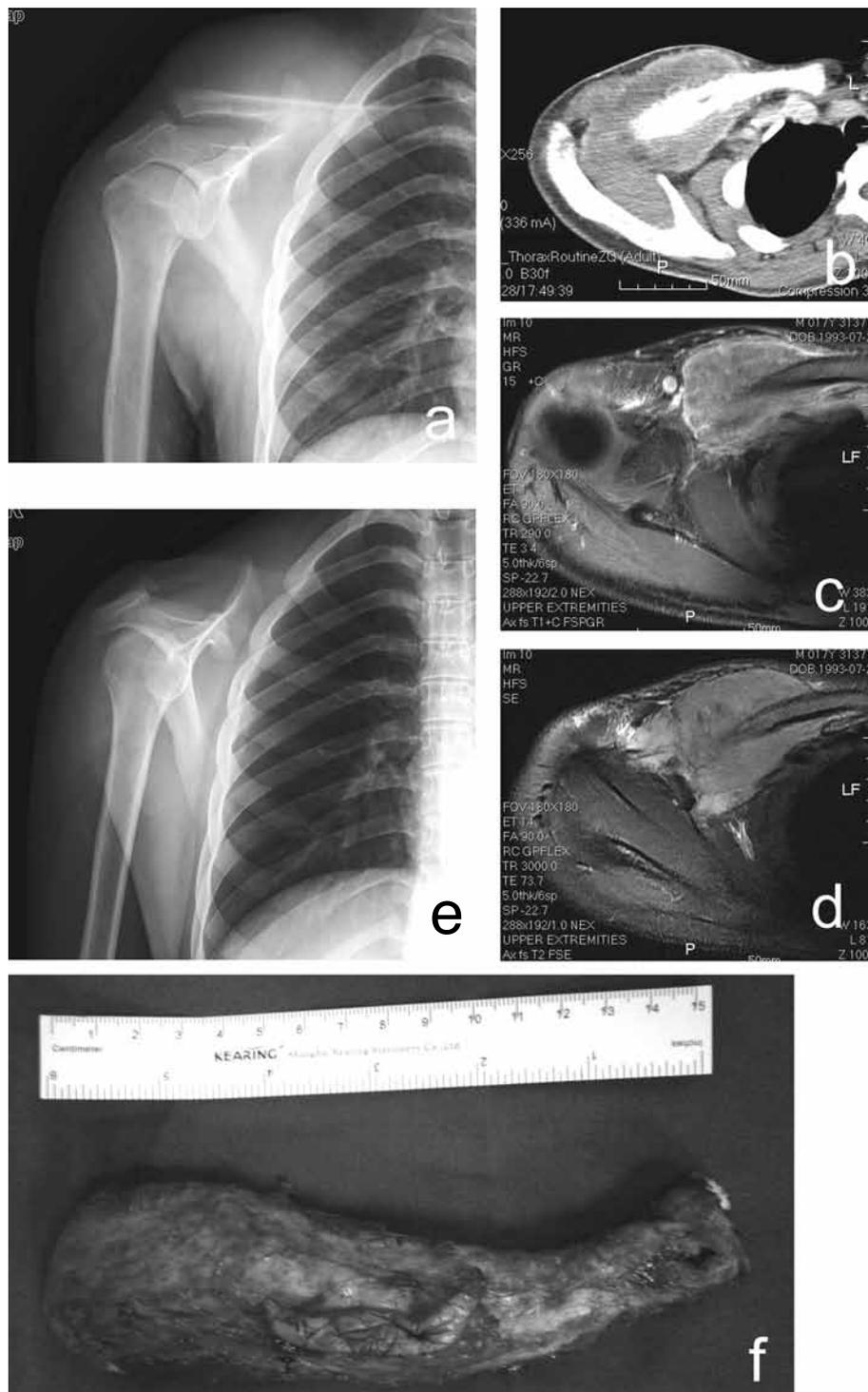
The patients' characteristics are presented in Table I: there were 3 PNETs (primitive neuroectodermal tumours), 2 myelomas, 2 osteosarcomas, one chondrosarcoma, and one synovial sarcoma. Five out of 9 tumours were localized in the lateral third. Neither local recurrence nor metastases were observed at follow-up.

The functional outcomes at final follow-up are summarized in Table II. Preoperatively the mean Constant-Murley score of the affected side was 26 (range, 18 to 40), and the mean pain score 8.7. Postoperatively the mean Constant-Murley score improved to 79 (range, 69 to 90) ( $p < 0.001$ ), and the mean pain score to 2.4 ( $p < 0.001$ ). Moreover, the mean postoperative Constant-Murley score of the affected side was 88% of the normal side. The mean time from surgery to full range of motion was 3.4 weeks. None complained of any significant functional deficit, but a mild decrease in strength during lifting was reported. Two patients had a superficial infection (prevalence, 22%) which was treated with oral antibiotics.

Table I. — Patients' characteristics

Patient number	Gender/age (years)	Side	Diagnosis	Location	Chemotherapy
1	female 37	left	myeloma	middle	yes
2	male 18	right	PNET*	lateral	yes
3	female 16	left	PNET	middle	yes
4	female 21	left	osteosarcoma	middle	yes
5	male 23	right	osteosarcoma	lateral	yes
6	male 56	right	chondrosarcoma	lateral	no
7	female 47	left	synovial sarcoma	lateral	yes
8	female 25	right	myeloma	lateral	yes
9	male 20	right	PNET	medial	yes
Mean	29 years	5right/4left		5 lat ; 3 middle ; 1 medial	8 yes/1 no

\*PNET = Primitive Neuro-Ectodermal Tumour.



**Fig. 1a-f.** — Eighteen-year-old male with PNET in the lateral third of the right clavicle. a : preoperative a-p plain radiograph ; b : preoperative axial CT-scan ; c : preoperative axial MRI (T1W1) ; d : preoperative axial MRI (T2W1) ; e : postoperative a-p plain radiograph ; f : surgical specimen.

Table II. — Functional outcome : Constant-Murley score and VAS for pain

Patient number	Follow-up (mo)	Co-Murl*	Co-Murl*	Co-Murl*	Co-Murl*	VAS pain	VAS pain
		preop.	preop.	postop.	postop.	preop.	postop.
		operative side	contralat. side	operative side	contralat. side		
1	102	21	95	78	93	10	1
2	60	18	93	81	90	10	2
3	51	33	95	90	92	9	2
4	46	25	91	86	91	9	1
5	40	20	92	79	91	8	3
6	32	36	86	71	86	7	5
7	30	18	89	80	89	9	2
8	28	40	88	69	88	9	2
9	24	22	85	73	84	8	4
Mean	46	26	90.5	79**	89.5	8.7	2.4**

\* = Constant-Murley score (100 = best possible).

\*\* =  $p < 0.001$ .

## DISCUSSION

### Incidence and diagnosis

Clavicle tumours are rare ; their incidence ranges from 0.45 to 1.01% of all bone tumours (6). The clavicle is the third site for tumour appearance in the shoulder girdle (2,3) and the fifth in the thoracic skeleton (13). Myeloma, Ewing's sarcoma and osteosarcoma are the most common primary malignant tumours (10), but clavicular metastases are very rare (11). A striking feature was the relative predominance of PNETs in the current series : 3 out of 9 cases.

### Functional outcome

Wessel and Schaap (14) reported good pain relief in two malignancy cases and one chronic osteitis case, but persistent pain in 3 traumatic cases. Rossi *et al* (9) found that total claviclectomy in 4 patients with primary malignant tumours was associated with adequate shoulder mobility and only a mild functional deficit. The current study confirms these positive findings. However, Wood (15) warned that

total claviclectomy should be avoided in case of trapezius dysfunction, due to the potential for severe functional loss and drooping of the shoulder.

### Complications

Krishnan and Schiffen (7) reported 5 complications in 6 patients : one subclavian vein laceration requiring repair, 2 deep infections and 2 superficial infections. This is understandable, given the subcutaneous localization of the clavicle. In the current study only two superficial infections occurred, and peroral antibiotics were sufficient. Patients with allograft reconstruction after total claviclectomy had more complications than patients without reconstruction (8).

### Limitations

The current series was small and retrospective, due to the rarity of primary malignancies in the clavicle. For the same reason, randomization to various treatments was impossible. Multicenter trials are indicated.

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