

**SHOULDER GIRDLE RESECTION - MADRAS CANCER INSTITUTE EXPERIENCE****N. Mayilvahanan\*, M. Snehalatha\*\****From The Cancer Institute and Apollo Cancer Centre, Chennai, India***INTRODUCTION**

The concept of non amputative surgery for the treatment of primary malignant tumors of bone and soft tissue is not a new one. Because of high local recurrence rate attempts to carry out the local resection of malignant tumors was abandoned in the early 1900's (1,2). Limb salvage procedure has nevertheless improved because of the development of chemotherapy and the surgical techniques used to treat malignant bone and soft tissue tumors.

The object of this paper is to report the results of 30 cases of limb salvage and reconstruction in the treatment of bone and soft tissue tumors around the shoulder girdle. The aim of the limb salvage is to retain the integrity of the skeleton and preserve a limb with useful function. Custom mega prosthesis plays a vital role in the reconstruction of these skeletal defects. Limb salvage by custom prosthesis is still in its infancy in India due to the developing technology for fabrication and high cost. The present paper analyses our experience and results with custom prosthesis in shoulder girdle resections.

Before embarking on the mainpaper I would briefly like to touch upon the anatomy of the shoulder girdle, historical review of shoulder girdle resections and surgical classification of shoulder girdle resections.

The shoulder girdle includes the upper end of humerus, the scapula and the clavicle as well as the surrounding soft tissue and axillary contents. Bone tumors of the shoulder girdle occur most frequently in the proximal humerus followed in decreasing order by the scapula and the clavicle. The deltoid and posterior supra spinal areas of the scapula are the most frequent sites for soft tissue tumors around the shoulder.

An extensive literature concerning shoulder girdle resections reveals a basic problem. The lack of an accurate and precise classification system for the multitude of modifications and variations of surgical procedures performed to remove tumors of the shoulder girdle. The

need for a universal classification system based on modern orthopedic oncological concepts is essential to assess the effectiveness of different treatment protocols and to compare series from different surgeons and centers.

When one analyses reports about the Tikhoff - Linberg resection on case by case basis, it is obvious that a multitude of modifications have been performed. Different amounts of scapula, clavicle or humerus are resected and same is true for the muscles. A variety of ways are described for reconstructing a new joint and of reconstructing the soft tissues.

**SURGICAL CLASSIFICATION**

A surgical classification system must be easy to use,

universally applicable,

based on staging studies, surgical and functional anatomy,

consistent with oncological principles of treatment,

correspondent to the magnitude of surgery and

reproducible.

Malawer et al developed a surgical classification system for limb sparing shoulder girdle resections based on the results of 38 patients.

Type I - Intra articular proximal humeral resection.

Type II - Partial scapular resection

Type III - Intra articular total scapulectomy

Type IV - Extra articular total scapulectomy and humeral head resection.

Type V - Extra articular humeral and glenoid resection

Type VI - Extra articular humeral and total scapular resection

A - Intact abductor mechanism.

B - Partial or complete resection of abductor mechanism.

Types IA to IIIA - Intra compartmental resections

IB - IIIB } - Extra Compartmental resections  
IV - VI }

I - III - Intra articular resection

IV - VI - Extra articular resection

\* Head Orthopaedic Oncology Service

\*\* Asso. Prof. of Surgical Oncology

Address for Correspondence:

**Dr. N. MAYILVAHANAN**  
Head, Orthopaedic Oncology service,  
Cancer Institute, Madras, INDIA

**Table 1 shows in brief the historical review of shoulder girdle resections**

AUTHOR	YEAR	TYPE OF SURGERY	DIAGNOSIS
Liston (3)	1819	Partial scapulectomy	Ossified aneurysmal bone cyst
Mussey (4)	1837	Near total scapulectomy with resection of the clavicle	Recurrent chondrosarcoma after glenohumeral disarticulation
Syme (5)	1856	Total Scapulectomy	Tumor scapula
DeNancrede (7)	1909	Nothing less than forequarter amputation	Shoulder girdle tumors.
Pack and Crampton (6)	After 50 yrs	Revival of procedure	<i>(Contd... on next page)</i>
Pranishkov (8)	1908	Removal of scapula & surrounding soft tissues with resection of head of the humerus & Outer third of the clavicle shoulder attached to clavicle with metallic sutures	Sarcoma Scapula
Bauman & Linberg (8,9)	1914 1928	Interscapulo thoracic (Tikhoff Linberg)	Sarcoma of scapula
Papaioannou Francis	1965	Limitations & Indications of 26 cases of Scapulectomies.	
Macson (10)	1968	" 15 cases	
Marcone et al (11)	1977	" 17 cases	
Malaver et al (12,13)	1985	" 10 cases	
Guerra et al (14)	1985	" 21 cases	

This system is based solely upon the structures removed and does not depend upon the type of reconstruction.

To obtain a satisfactory functional result, the best conditions are humeral resection without arthroectomy and conservation of abductor mechanism.

**RECONSTRUCTION** - The following types of reconstruction procedures are available.

- a. No reconstruction (or simple attachment of the humerus to the scapula or clavicle by muscular transfer or artificial ligament.
- b. Arthrodesis of the shoulder.
- c. Spacer the aim of which is reattachment of the humerus to the shoulder girdle but without an actual articulation.
- d. Prosthesis which may be
  - Anatomical, with a shape adapted to the glenoid fossa (Such as the neer prosthesis)

- Total with an articular scapular component
- Constrained, sutured to the shoulder girdle to avoid luxations & with built in intraprothetic mobility.

Grafts may be considered from a functional point of view, whether as a spacer (eg. fibular graft) or as an anatomical prosthesis (eg. humeral allograft).

Surgical concepts of shoulder girdle resections (Tikhoff Linberg)

- The Tikhoff - Linberg resection is a limb sparing option to be considered for bony & soft tissue tumors in and around the proximal humerus & shoulder girdle.
- Careful selection of patient whose tumor does not involve the neurovascular bundle in the axilla is required.
- The distal clavicle, upper humerus & part or all of the scapula are resected.

- Optimal function is achieved by muscle transfers & skeletal reconstruction.
- A custom prosthesis is used to maintain length & stabilize the distal humerus. This gives improved function after resection.
- Absolute contraindications include extension of tumor to the neurovascular bundle or to the chest wall.
- Relative contraindication may include pathological fracture, extensive involvement of the shaft of the humerus or tumor contamination of the operative area from hematoma following biopsy or unwise placement of biopsy incision.
- Useful preoperative studies include physical examination, computerized tomogram of the shoulder girdle, arteriogram and venogram & bone Scan.
- Surgical procedure is discussed in detail in any standard text book.

#### To Summarise

- Incision should encircle the previous biopsy scan
- Axilla should be explored first to determine resectability
- the neurovascular bundle should be dissected
- the neck of the scapula is exposed after division of the muscle groups anteriorly.
- Posterior flap raised & posterior group of muscles divided
- Clavicular, scapula & humeral osteotomies performed
- The prosthesis is secured
- Soft tissue reconstruction performed and skin closed with suction catheters
- Rehabilitation is the most important step to obtain good functional results.

#### MATERIALS AND METHODS

Thirty major shoulder girdle resections were performed at Cancer Institute, Adyar, between January 1989 and December 1996. There were 16 men and 14 women in our series. The mean age at operation was 27 yrs (range 10-55yrs).

Diagnosis and Stage of the 30 cases; 26 were primary bone tumors and four were soft tissue tumors. There were 20 primary malignant tumors including 12 Osteosarcomas, 4 Chondro sarcomas, 2 Malignant fibrous histiocytoma, and 2 soft tissue sarcomas. There were 3 metastatic lesions; one in the scapula and 2 in the proximal humerus. Of the seven benign tumors 5 of them were giant cell tumors and 2 aggressive fibromatosis.

#### ANATOMICAL SITE

Twenty four lesions were located in the proximal humerus or the deltoïd muscle region. Six lesions were located in the scapula and the surrounding soft tissues. No lesions of the clavicle were included in the present series.

#### TYPES OF RESECTION

Types of shoulder girdle resection according to Malawers classification were - Type I: 12 cases, Type II: 3 cases, Type IV: 2 cases, Type V: 12 case and Type VI: 1 case. The margins were marginal in 13 cases, wide in 14 cases and radical in 3 cases.

#### TYPES OF RECONSTRUCTION

Twenty seven of the cases had reconstruction with custom prosthesis and three cases did not require any reconstruction. All the prosthesis were cemented for stability. Soft tissue reconstruction was done for good cover.

**Adjuvant treatment:** Of the 23 patients, 14 received adjuvant Chemotherapy with or without local irradiation therapy, based on the histological type and grade of the tumor and the surgical margins achieved during operation.

**Results:** The follow up period was 3 months to 92 months (7.7.yrs) with average of 50 months (4.2 yrs).

**Oncological results:** To date 7 follow up patients had died. Local recurrence occurred in 3 patients who refused further treatment (amputation) and died. Four of the others had pulmonary metastases.

**Functional results:** According to Enneking's rating system the final functional results were excellent 8 cases (78%) good in 4 cases (70-79%) fair in 5 cases (60-69%) and not satisfactory in 6 cases (50-59% in 2 cases & 50% in 4 cases) 7 cases had died in the follow up period.

The functional results depend mostly on the tumor size and location and on post-operative radiotherapy. The result is nearly always improved by good reattachment of the preserved muscles and tendons to the prosthesis.

**Complications:** Deep infection occurred in 2 patients and the prosthesis was removed. Dislocation of the head of the prosthesis occurred in 2 patients. Fracture of stem of prosthesis occurred in 1 which was converted to a total humeral prosthesis.

#### CONCLUSIONS

Lump sparing surgical options are feasible for bone and soft tissue tumors around the shoulder girdle. It permits a curative, non ablative alternative to fore quarter amputation. Despite the magnitude of resection the surgical morbidity is minimal and functional results are good. The patients have 30° of circumduction at shoulder following a prosthetic replacement with excellent elbow and hand function.

## REFERENCES

1. Enneking WF (1981) The effect of the anatomic setting on the results of surgical procedures for soft part sarcoma of the thigh, of surgical procedures for soft sarcoma of the thigh, *Cancer* 47:1005-1022.
2. Rosenberg SA (1982) The treatment of soft tissue sarcoma of the extremities - *Ann.surg* No.305-315.
3. Liston R (1820) Ossified aneurysmal tumor of the subscapular artery. *Eduit Med J* 16:66-70.
4. Mussey R D (1837) Removal by dissection of the entire shoulder blade & Collar bone *AM J Med Sci.*21:390-394.
5. De Nanaredec BG (1909) The original results after total excision of the scapula for sarcoma *Ann Surg.*30:1-22.
6. Pack G T Crampton RS (1961) The Tikhoff - Linberg resection of the Shouldr girdle *Clin Orthop* 19:148-161.
7. Adam YG, Rosen A Oland J, Halery A (1983) Scapulectomy revisited soft part sarcomas of the posterior shoulder.*Isr.J.Med Sci* 19:176-179.
8. Bauman P K (1914) Resection of the upper extremity in the region of the shoulder joint *Khirurg Arkh Velyaminora S. Peterh* 30:145-149.
9. Linberg Be (1928) Interscapulo - Thoracic resection for malignant tumors of the shoulder joint region. *J. Bone joint Surgery* 10:344-349.
10. Macson N J (1968) Modification des resection interscapulo thoracalis (Tikhoff Lunbersche Operation) *Beitrago Zur Orthopaedic and Traumatologic* 15:87-88.
11. Marcove R C Lewis MM Havos AG (1977) Enbloc upper humeral interscapulo thoracic resection, The Tikhoff-Linberg procedure *Clin Othop* 124:219 - 228.
12. Malawer MM Sugar Baker PH, Lampert MH, Baker AH Gerger LH (1984) The Tikhoff - linberg procedure and its modifications. In Sugar baker PH (ed) *Atlas of Sarcoma surgery*, JP lippin Cott, Philadelphi, PP 203 - 226.
13. Malawer MM, Sugar baker PH, Lampert MH, Baker AH, Gerber NL (1985) The Tikhoff-Linberg procedure: report of ten patients and presentation of a modified technique for tumors of the proximal humerus - *Surg.*97:518 - 528.
14. Guerra A>Crpanna R, Biagini R, Ruggieri P, Campanacci (1985) Extr articular resection of the shoulder (Tikhoff-Linberg) *Ital J Orthop Traumatol* 11:151 - 157.