PROSTHETIC REPLACEMENT FOR BENIGN AND MALIGNANT TUMORS IN THE PROXIMAL PART OF THE HUMERUS: A PRELIMINARY STUDY

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Since 1983, four patients with aggressive giant cell tumor and malignant tumor have undergone an en bloc resection of the tumor and the skeletal reconstruction with a prosthesis and massive bone allograft. In those with malignant tumor, the transfer of the trapezius and the acromion (Bateman) was supplemented following removal of deltoid. The follow-up periods were 9 to 35 months and averaged 21 months. One died of lung metastasis, but there was no recurrence. There was one nonunion. A patient with giant cell tumor had a pain-free shoulder without any difficulty in activity of daily life. Pain-free shoulders with some limitation of daily life activity, especially active overhead motion were regained in patients with malignant tumor. Although further follow-up periods are required, these observations suggest that the trapezius transfer can, to some extent, substitute for deltoid and that a prosthesis in this procedure is not a passive spacer.

1. INTRODUCTION

The cure of the disease and the preservation of maximum function in the affected part are two important factors for orthopedic surgeons to treat patients with bone tumor. In the absence of metastasis there used to be little question that amputation is effective in eradicating malignant bone tumor. The advent of systemic adjuvant chemotherapy has proven the value of the less radical surgery in managing the lesion. Although the results obtained with multidrug therapy for tumor control are based on relatively short follow-up periods¹, chemotherapy could destroy tumor cells and possibly eliminate metastasis with minimum chance of local recurrence.

Several operative procedures have been advocated for aggressive benign or malignant tumor in the proximal part of the humerus²-⁵. Since 1983, patients with aggressive giant cell tumor or malignant tumor in the proximal humerus have undergone a radical en-bloc resection of the tumor and the skeletal reconstruction with a humeral head prosthesis and massive bone allograft to preserve the function of the involved shoulder as well as the tumor-free parts. In those with malignant tumor, the transfer of the trapezius and the acromion, advocated by Bateman⁵, was added. The purpose of this paper is to show a group of patients who were treated by this procedure as a preliminary study.

2. MATERIALS AND METHODS

Since 1983, 8 patients with malignant tumor or aggressive giant cell tumor in the proximal part of the humerus have undergone the limb-preserving procedures.
Of these, a prosthetic replacement with massive bone allograft was used to reconstruct the shoulder joint in 4 patients. None of them had previous surgery except open biopsy in 2. The age of patients ranged from 18 to 54 years and averaged 38 years. All were female. The dominant side was operated upon in 2. There were one osteogenic sarcoma, one malignant fibrous histiocytoma, one metastatic thyroid cancer, and one giant cell tumor. Follow-up after the reconstructive surgery was under 1 year in 2 and 2-3 years in 2, and averaged 21 months. All patients with malignant tumor received systemic chemotherapy pre-and postoperation or postoperation alone. Prior to surgery, the patients underwent a detailed history and physical examinations as well as standard laboratory tests. In addition a skeletal survey, bone scan, chest tomography, and arteriography were performed to rule out metastatic disease and clearly delineate the extent of tumor. This procedure was indicated in 1) aggressive giant cell tumor in the proximal humerus, in which absolute curability is not expected by the combination procedure of curettage and bone graft, and 2) malignant tumor in the proximal humerus, which does not involve neurovascular bundle, does not fix to scapula and chest wall, and is covered by deltoid muscle. A surgical technique for giant cell tumor is as follows. Long deltopectoral approach was used. The rotator cuff and pectoralis major were dissected, while deltoid and axillary nerve were preserved. The humerus was osteotomized just proximal to the insertion of deltoid as an en bloc resection of tumor. The banked tibia was cut and fashioned for a prosthesis. A regular Neer prosthesis could then be passed down the medullary canal of the banked bone and the humerus. The rotator cuff was reattached to the graft with a shoulder joint in 90 degrees of abduction and the long head of biceps tendon was stay sutured. Pieces of autogenous iliac bone graft were placed in the host-graft junction. Postoperatively, an abduction brace was applied for 6 weeks. Passive range-of-motion exercise was started 6 days and active exercise 6 weeks. A surgical technique for malignant tumor was different from that for giant cell tumor in some points. The different points were: 1) a radical en bloc resection of the tumor with the proximal humerus and surrounding muscles including deltoid, while

<table>
<thead>
<tr>
<th>Case</th>
<th>Age/Sex</th>
<th>Diagnosis</th>
<th>Date of Operation</th>
<th>Procedure+</th>
<th>Complication</th>
<th>ADL</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>45/F</td>
<td>giant cell tumor</td>
<td>2/3/1983</td>
<td>All.+Pro.</td>
<td>-</td>
<td>full</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>33/F</td>
<td>MFH</td>
<td>8/25/1983</td>
<td>All.+Pro. +Transfer</td>
<td>non-union</td>
<td>some limit.</td>
<td>wear functional brace</td>
</tr>
<tr>
<td>3.</td>
<td>18/F</td>
<td>osteogenic sarcoma</td>
<td>3/8/1984</td>
<td>All.+Pro. +Transfer</td>
<td>-</td>
<td>some limit.</td>
<td>died at 9 months</td>
</tr>
<tr>
<td>4.</td>
<td>54/F</td>
<td>metastatic thyroid cancer</td>
<td>6/28/1985</td>
<td>All.+Pro. +Transfer</td>
<td>-</td>
<td>some limit.</td>
<td>-</td>
</tr>
</tbody>
</table>

+All. = allograft, Pro. = prosthesis, Transfer = transfer of the trapezius and the acromion
preserving neurovascular bundle; 2) a long-stem Neer prosthesis was used in two cases; and 3) the transfer of the trapezius and the acromion was performed. A patient with metastatic thyroid cancer who had no evidence of metastasis in any other sites underwent total thyroidectomy and modified neck dissection simultaneously. Postoperatively, an abduction brace was applied for 12 weeks. Passive range-of-motion exercise was started 3 weeks and active exercise 12 weeks.

3. RESULTS

The summary of the patient data is given in Table 1. In terms of tumor control, multiple lung metastasis was recognized 3 months after surgery in a patient with osteogenic sarcoma, who died at 9 months despite systemic adjuvant chemotherapy. Prior to surgery, lung metastasis could not be evidenced, but metastasis was considered to exist preoperatively. A relatively good incorporation of graft was obtained at 6 months. There has been no evidence of local recurrence to date. There was one nonunion at the host-graft junction. However, she refused another operation. She has had a functional brace and was satisfied with the postoperative condition. Other complications like infection and fracture were not encountered. The head of the prosthesis in each patient was stable in the glenoid clinically and roentgenographically. The transferred acromion to the grated bone was well incorporated in all of them (Figure 1). A pain-free shoulder with almost normal range of motion and muscle power was regained 35 months postoperatively in a patient with giant cell tumor. She did not have any difficulty in daily life activity. In patients with malignant tumor, pain-free shoulders with relatively good range of motion, especially external rotation, and considerably good muscle power of external and internal

Figure 1

Roentgenograms of the shoulder in a fifty-four-year-old woman with metastatic thyroid cancer. A prosthesis is stable in the glenoid. Incorporation of the transferred acromion to allograft, partial incorporation of bone graft, and no evidence of recurrence are seen.
rotation were regained in spite of removal of deltoid. Overhead motion could be achieved by supporting the elbow with an opposite hand, but they had some limitation of daily life activity. Each of them was capable of reaching the hair and a mouth and carrying 5 kilograms with arm at side because active elevation was 50 to 80 degrees and the hand and elbow functions are maintained.

4. CONCLUSION

With the advent of systemic chemotherapy, limb-preserving procedures have been performed following an en bloc resection in some cases of aggressive benign and malignant tumors. Now the orthopedic surgeons confront the new problems of reconstruction of the musculoskeletal defect. To resolve the problems, a variety of surgical techniques, including autograft, allograft, a prosthesis, and a combination procedure of them was used. Some of them had a success, but some not. When the shoulder joint with an intact glenoid is reconstructed, a repair of the rotator cuff and the deltoid as well as a spacer for bone defect should be considered to get a satisfactory result. The use of only a metallic prosthesis is not suitable for reattachment of these tendons. We used a prosthesis and massive bone allograft in four selected patients with aggressive giant cell tumor and malignant tumor. In addition, the transfer of the trapezius and the acromion was supplemented to replace the function of the deltoid in three of them. When a criterion of an indication for this procedure mentioned above was not met, other surgical techniques like forequarter amputation and the Tikhoff-Linberg procedure were used. The results of this short follow-up study encourage us to continue this type of operation.

Of interest to note is the observations that a patient with giant cell tumor had no difficulty in activity of daily life, compared with some limitation of daily life activity in three patients with malignant tumor. This results from the difference in a surgical technique between them. The deltoid muscle and the axillary nerve were preserved in the former, but not in the latter. Preserving deltoid is one of the important factor to get a satisfactory shoulder function, if possible. However, the trapezius transfer can, to some extent, substitute for deltoid, especially in this procedure. The advantages of the trapezius transfer are: 1) producing a strong sling suspending the upper end of the humerus and preventing subluxation or dislocation of the shoulder joint; 2) producing some power of abduction; and 3) having a possible role of enhancing the mineralization of the grafted bone. Although the longer follow-up periods are required, we would like to stress that a prosthesis in this procedure is not only a passive spacer, even if deltoid function is completely lost.

REFERENCES

6. personal communication to Professor Makoto Yamamoto in Department of Orthopedic Surgery, School of Medicine, Kitasato University.