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Review Article

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ENDOPROSTHETICS IN TUMOR OF THE HUMERUS TREATMENT

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ABSTRACT

The article presents data on 44 patients with a tumor lesion of the proximal humerus. During the study, the results of surgical treatment were evaluated. All patients underwent an open biopsy, the diagnosis was verified by histological examination. After segmental resection of the bone of the proximal humerus, the defect was replaced with an endoprosthesis of the shoulder joint. The developed endoprosthesis of the shoulder joint allows for organ-preserving surgical treatment in patients with tumors of the proximal humerus. The functional results of the operation and the quality of life of patients were evaluated.

KEYWORDS: Segmental resection of the humerus, endoprosthesis, surgical treatment, shoulder joint.

Primary malignant bone tumors account for 0.2 to 2.0% of all malignant neoplasms.[1] Morphologically, the most common are osteosarcoma (35-63%), chondrosarcoma (17-25%) and tumors of the Ewing sarcoma family (8-15%).[2,3] Also, other solid tumors often metastasize to the bones. Metastatic skeletal lesion is detected in 65-73% of patients with breast cancer, 56-68% with prostate cancer and 30-36% with lung cancer.[4,5,6] Primary malignant and metastatic bone tumors can affect any segment of the skeleton, but are most often localized in the metadiaphyses of the femur, humerus and tibia.[7,8] The main clinical manifestations of a tumor lesion of bones are pain syndrome, impaired limb function and, as a consequence, a decrease in the quality of life of the patient. In modern oncoortopedia, the standard of surgical treatment of this category of patients is segmental bone resection with oncological endoprosthetics.[2,10,11]

The proximal humerus is a favorite localization of tumors affecting the bones of the upper limb, and occupies the 3rd place among all lesions of the skeleton with tumors.[12] Resection of the proximal humerus is one of the modifications of surgical interventions on the shoulder girdle with the general name "Tikhov-Linberg surgery".

M. Malover in 1984 developed a classification of surgical interventions on the shoulder girdle, which included resection of the proximal humerus as one of the sections.[5,10] A feature of surgical interventions for tumors of the shoulder girdle bones is the preservation or resection of the neuromuscular mechanism of shoulder abduction and flexion, which largely depends on the nosological form of the tumor and the prevalence of the oncological process. These surgical interventions are conditionally divided into 2 types: type A, when the mechanism of shoulder retraction and flexion is preserved, and type B, when this mechanism is resected. With any modifications of the Tikhov-Linberg operation, the functions of the forearm and hand do not suffer.[10] The main task of reconstructive surgical measures for these resections is to restore the function of shoulder abduction and flexion.

According to various authors, endoprosthetics as the main method of reconstruction of osteoarticular defects in these clinical cases has been used for a long time with different functional outcomes.[2,3,7,9]

J.C. Wittig et al. (2002) are supporters of endoprosthetics and provide data on the restoration of the function of the upper limb in the amount of 80-90% with any type of resection.[8]

M.I. O'Connor et al. ((1996) and M.E. Lei et al. (2004) indicate the absence of restoration of shoulder function in type B resection after endoprosthetics.[7,9] These authors suggest that when planning resection, take into account the state of the mechanism of shoulder abduction and flexion and, depending on this, offer the patient a method of reconstruction. The development and

improvement of methods of organ-preserving operations in these patients is an urgent problem of modern oncoortopedia. The introduction of bone and joint replacement techniques into oncoortopedia allowed not only to expand the indications for organ-preserving operations for patients with tumors of the distal parts of the forearm and lower leg bones, but also to significantly improve the functional results of treatment and the quality of life of these patients. In the domestic and foreign literature, the number of publications devoted to this topic is limited, they are mainly presented with descriptions of clinical cases or brief reports.

OBJECTIVE

To present the results of endoprosthetics of the shoulder joint in tumors of the proximal humerus.

MATERIAL AND METHODS

44 patients with tumors of the proximal humerus were examined and treated in the surgical department of tumors of the musculoskeletal system and the Ministry of Health of the Republic of Uzbekistan from 2007 to 2019. All patients underwent surgical intervention in volume - segmental resection of the proximal humerus with replacement of the defect with a metal endoprosthesis. There were 21 males (47.7%) and 23 females (52.3%). The age of the patients ranged from 16 to 72 years, the average was 36 years. It should be noted that the majority of patients were aged from 16 to 40 years (72.2%). In all patients, the tumor was localized in the proximal humerus. The length of the resection was 5 - 14 cm . Of 44 patients, 28 had a lesion of the right humerus and 18 of the left humerus.

When analyzing clinical symptoms, it was found that out of 44 patients, 38 had pain, 29 had a tumor, 21 had a tumor and pain, 32 had a tumor + pain + shoulder joint dysfunction.

The study of the duration of the anamnesis showed that in 12 patients it was up to 3 months, in 18 patients 3-6 months and in 14 patients more than 6 months.

The clinical course and duration of the anamnesis depended on the histological structure of the tumor process. Among patients with benign tumors, the duration of the anamnesis was longer due to the long course and slow growth of the tumor, less pronounced clinical symptom of the disease. Therefore, patients of this group did not go to the doctor for a long time and were treated for various diseases.

On the contrary, in the group of patients with malignant tumors, the duration of the anamnesis was short with rapid development of the disease.

All patients underwent complex research methods: general, clinical, anamnesis, blood and urine, instrumental (X-ray, ultrasound, MRI, MSCT, if necessary PET CT), morphological studies (cytological, morphological, immunohistochemical). In all patients, the diagnosis was verified by histological examination with clarification of the histological affiliation and the degree of malignancy of the tumor.

Radiography was performed in all 44 patients. Out of the 44 patients, 18 (40.9%) had a lesion of the proximal epimetaphyseal humerus, 11 (25%) of the metadiaphyseal region and 15 (34.1%) had a total lesion of the head, metaphysis and upper third of the diaphysis of the humerus. The extent of the lesion ranged from 7 to 12 cm. In 11 (25%) cases, a pathological fracture was detected. At the same time, a cellular-trabecular form was detected in 12 (27.3%) patients, a lytic form in 14 (31.8%) and a mixed tumor form in 18 (40.9%). Osteogenic sarcoma was found in 6 (13.6%), and chondrosarcoma in 5 (11.4%) patients. (Fig. No. 1,2,3,4).

Fig. № 1.

Fig. № 2.

Radiograph: Pain-I: T. 58 years. Diagnosis: osteosarcoma of the proximal part of the right humerus. G 2. T2N0M0. II In stage. Condition after the 4th course of pct

Fig. № 3: Radiography: Patient B., 48 years old. **Diagnosis**: Malignant giant cell tumor of the proximal epimetaphyseal part of the right humerus

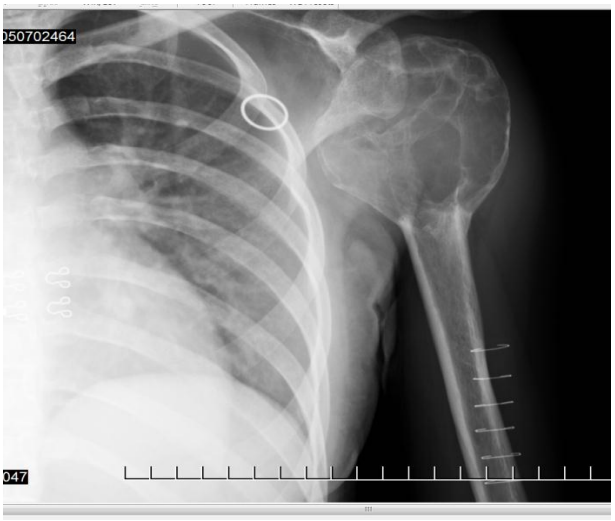

Fig. № 4: Radiography: Patient: A. 22 years old. **Diagnosis**: giant cell tumor of the left humerus.

The **MSCT** study was performed in 36 patients. Of the 36 patients, 14 (38.9%) had epimetaphyseal lesion, 10 (27.8%) had metadiaphyseal lesion, 12 (33.3%) had total damage to the metaphysis and the upper third of the diaphysis of the humerus. The extent of the lesion ranged from 5.2 to 12.4 cm . In 11 (30.6%) cases, a pathological fracture was detected. (Fig. No. 5,6,7,8).

Fig. № 5. **Fig. № 6.**

MSCT: Patient K., 27 years old. **Diagnosis:** osteosarcoma of the proximal part of the left humerus. G 3. T2N0M0. II In stage. Condition after the 4th course of PCT. Complications: Pathological fracture

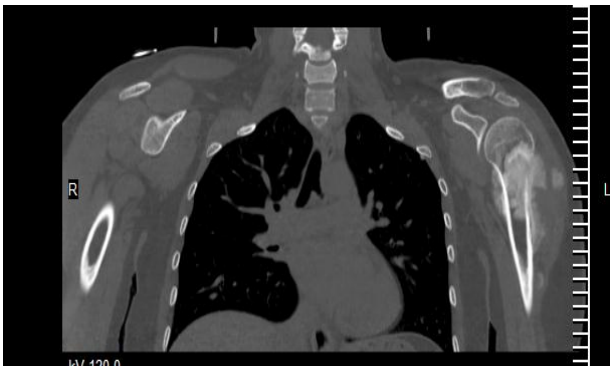

Fig. № 7. **Fig. № 8.**

MSCT: Patient Sh., 32 years old. **Diagnosis:** chondromyxoid fibroma of the left humerus. SPO (2009). Relapse.

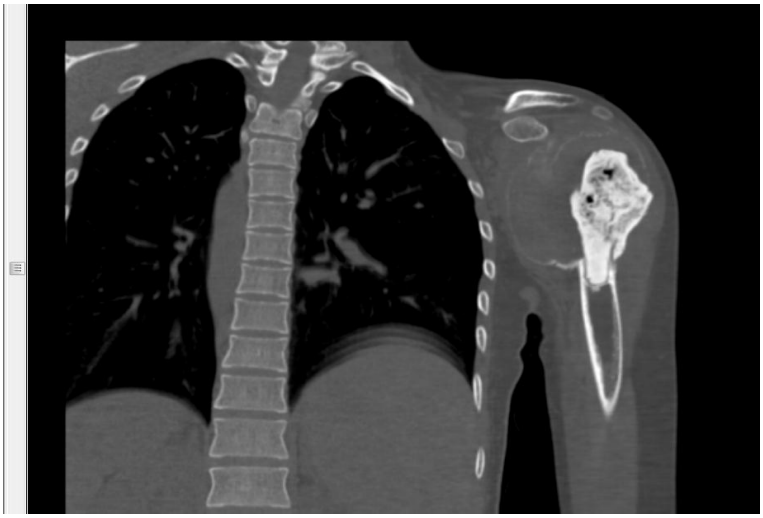

Fig. № 9.

Fig. № 10.

MSCT: Patient O., 32 years old. **Diagnosis:** WKO of the left humerus. SPO (2017). Relapse.

Ultrasound examination was performed in 32 (72.7%) patients. The ultrasound picture in malignant tumors was diverse. The symptom complex in each individual case depends on various factors - the nature of the tumor, its localization, size, direction of growth with a predominance of osteoplastic or osteoclastic factor, the nature and degree of periosteal reaction, etc. In all cases of observation, the size of the affected area of the bone was determined from 5 cm to 10.0 cm, but its contour was indistinct.

Ultrasound only in 40% showed the presence of an altered area in soft tissues in the form of formations of reduced echogenicity ranging in size from 1.6 cm to 6 cm. In its structure, sections of different echo density, partitions and inclusions, a contour of irregular shape, without a clear border were determined.

Magnetic resonance imaging (MRI) was performed in 20 patients. The advantages of the MRI method are: the possibility of direct visualization of the pathological formation, clarification of the structure, the nature of growth, more accurate determination of the tumor boundary, changes in the cortical layer, the spread of tumor infiltration, evaluation of the extraossal component, the ratio of the surrounding soft tissues with the main vessels. General MRI-signs of malignant neoplasms of the skeleton: tumors are highly aggressive, infiltrative, irregular in shape, they are characterized by pitting, randomness, disproportionality. MRI is the method of choice in assessing the extent, size of the lesion of the cortical layer, the boundaries of tumor infiltration, the relationship with various muscle groups, the neurovascular bundle. Of the 20 patients, 8 (40%) had a metadiaphyseal lesion, 7 (35%) had an epimetaphyseal lesion, and 5 (25%) had a total lesion of the head of the metaphysis and the upper third of the diaphysis of the humerus, the extent of the lesion was 5.0-12.4 cm. During an MRI examination of 20 patients, a soft tissue component of the tumor was determined in 12 patients.

Fig. № 11.

Fig. № 12.

MRI: Patient F., 24 years old. **Diagnosis:** chondromyxoid fibroma of the left humerus.

PET CT examination was performed in 6 patients. Of the 6 patients, 3 (50%) had epimetaphyseal lesion, 2 (33.3%) had metadiaphyseal lesion, and 1 (16.7%) had total lesion of the head of the metaphysis and the upper third of the diaphysis of the humerus. PET CT examination of 6 patients revealed lung metastases in 2 patients.

Morphological examination was carried out in all 44 patients. The first stage was a puncture biopsy followed by cytological examination. At the same time, malignant cells were detected in 16 patients.

Histological examination of 44 patients revealed a benign giant cell tumor in 18 (40.9%), a malignant giant cell tumor in 8 (18.2%), osteogenic sarcoma in 6 (13.6%), chondrosarcoma in 5 (11.4%), fibrotic dysplasia in 3 (6.7%), malignant hemangiopericytoma in 1 (2.3%), metastases in 1 (2.3%). adenocarcinomas of the thyroid gland, in 1 (2.3%) - chondromixoid fibroma and in 1 (2.3%) - chondromixoma.

Immunohistochemistry. Out of 44 patients, 7 (15.9%) underwent immunohistochemical examination. Results: 4 (9.1%) - osteogenic sarcoma, 2 (4.5%) - chondrosarcoma, 1 (2.3%) - malignant giant cell tumor. Unfortunately, little is known about the antigenic specificity of normal bone tissue and bone neoplasia, and although several potential antigens have been studied, reagents for detecting specific antigens for bone tissue are not yet available.

Fig. № 13: PET CT: Patient N., 36 years old.

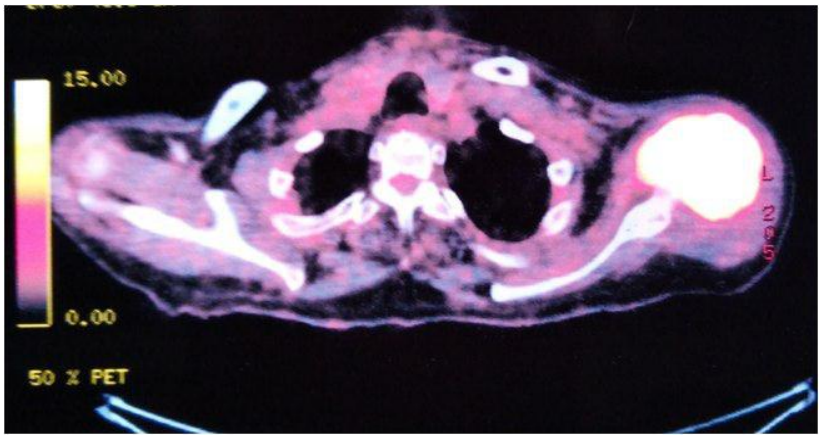

Fig. № 14: Diagnosis: chondrosarcoma of the left humerus.

In the group of patients with osteogenic sarcoma, 6 patients underwent combined treatment. Treatment began with neoadjuvant chemotherapy according to standard treatment protocols.

With thyroid metastases and malignant hemangiopericytoma, surgical intervention was carried out in the second stage. In chondrosarcoma, due to the low sensitivity of the tumor to chemotherapy, surgical treatment was performed at the first stage.

In other forms (giant cell tumor), treatment began with surgery and shoulder joint replacement was performed. In benign forms of the tumor and tumor-like lesions (chondromyxoma, chondromyxoid fibroma and fibrotic dysplasia), patients underwent surgical intervention in the volume of segmental resection of the proximal humerus with shoulder joint replacement.

Let's imagine the stages of shoulder joint replacement surgery

As a rule, an anterior approach is used, in which the deltoid muscle with the axillary nerve innervating it is not damaged, according to sulcus deltoideopectoralis. In case of extensive bone destruction with the presence of a soft-tissue tumor component, resection within healthy tissues is mandatory, leaving the affected muscle layer on the tumor, including the deltoid muscle, rotator cuff. The incision begins 1 cm below the clavicle, at the outer edge of the cranial process of the scapula, extends along the deltoid-thoracic furrow, after which, if necessary, it is extended distally, along the lateral furrow of the biceps.

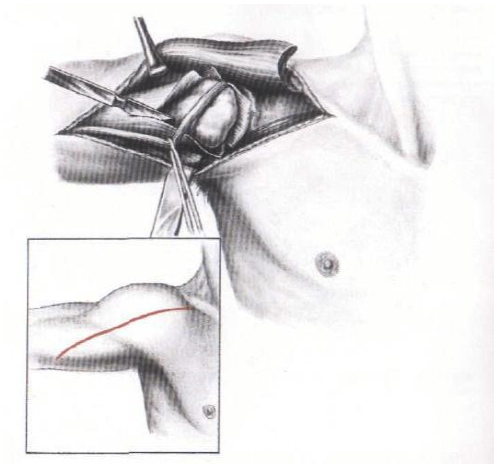

Fig. № 15: The cut line. Allocation of the humerus.

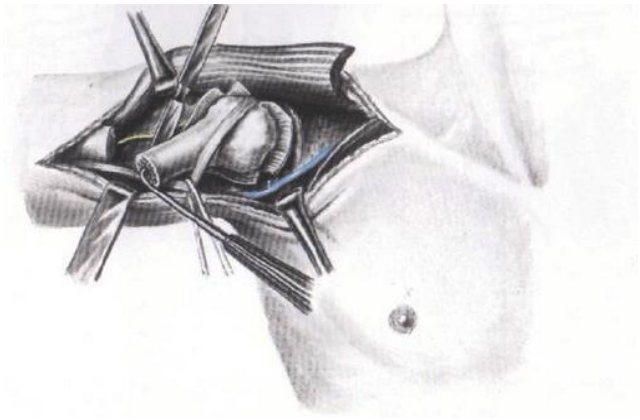

Fig. № 16: Isolation of the neurovascular bundle and resection of the proximal humerus.

The tendon of the large pectoral muscle is stitched with thick dacron ligatures, taken on a holder and intersected within healthy tissues. Due to the rotation of the upper limb inside, the allocation of the tendon of the long head of the biceps is facilitated, which is withdrawn or taken on a holder and intersects (in case of involvement in a tumor). The capsule of the shoulder joint is dissected along the synovial sheath of the tendon of the long biceps head along and transversely, along the line of the anatomical neck of the humerus.

The tendons of the subacute, supracute and small round muscles intersect within healthy tissues. Then, when the shoulder rotates outward, the tendons of the large round and cranio-brachial muscles, the widest back muscle, are cut off and taken on the holders. The next step is to isolate, bind and cross the anterior vessels that encircle the humerus. Special care should be taken when isolating a pathological formation, often soldered to the main vessels and large nerve trunks on the inner surface. Having isolated the humerus distal to the lower border of the tumor by 4-5 cm, it is crossed transversely with a Jigsaw saw. After that, the posterior surface of the humerus is allocated, leaving part of the muscles on its surface. Caution should be observed when isolating the radial nerve and the deep artery of the shoulder, axillary nerve and vessels. The articular bag is cut off within healthy tissues at the place of attachment to the humerus, after which the proximal articular end of the humerus, together with the pathological focus, is removed ablastically within healthy tissues.

The bone marrow canal of the humerus is processed by scans under the diameter and along the length of the leg of the endoprosthesis, after pre-filling the canal with bone cement, the leg of the prosthesis is installed in it and fixation is performed. The remains of the joint capsule are fixed around the endoprosthesis head with a lavsan suture. Careful fixation of the crossed muscles and tendons is performed through the holes in the upper part of the endoprosthesis. The wound is sutured in layers with the active drainage remaining.

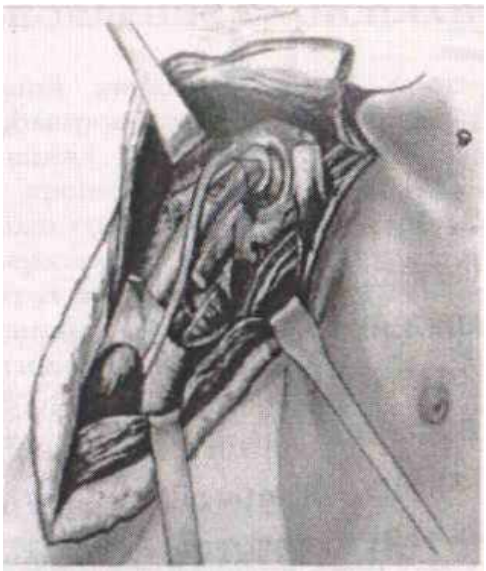

Fig. No. 17: Installation of a shoulder joint endoprosthesis

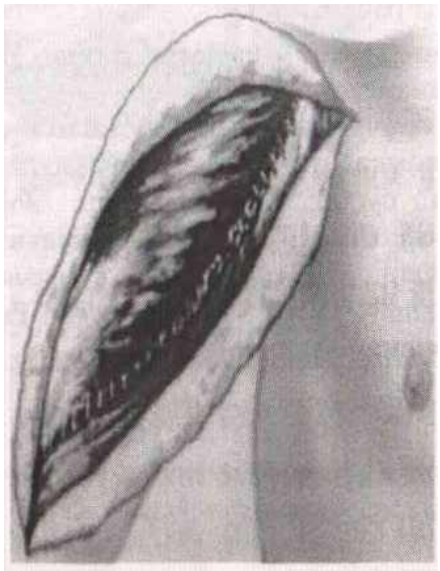

Fig. No. 18: Installation of a shoulder joint endoprosthesis.

Treatment results. The patients were followed from 6 months to 15 years. After surgery, the following complications were observed in patients: 1 patient had a complication in the form of instability of the endoprosthesis leg and a fistula 3 years after surgery (the endoprosthesis was removed, no other joint reconstruction was performed). In addition, 2 patients developed complications in the form of dislocation of the endoprosthesis head. In two cases, joint replacement was performed. Infectious and inflammatory complications were observed in 3 (6.8%) patients. 1 patient was treated conservatively, 2 underwent reendoprosthetics.

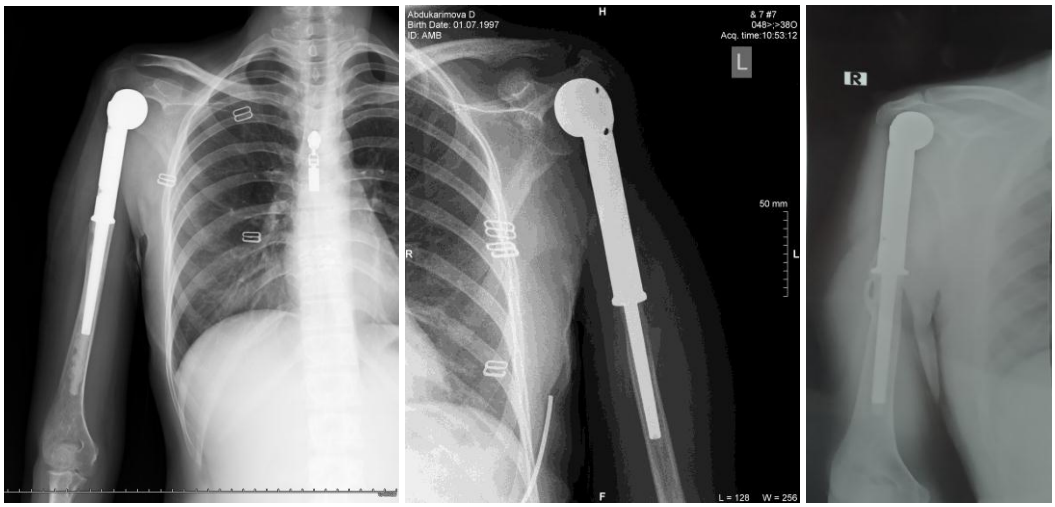

Fig. № 19: Radiography after surgery.

Table No. 1.

Types of complications	Total	Type of treatment		
		Conservative	Re-Endoprosthetics	Removal of the endoprosthesis, excision of the fistula
Infectious and inflammatory	3 (50%)	1 (16,7%)	2 (33,3%)	-
Dislocation of the head	2 (33,3%)	-	2 (33,3%)	-
Instability of the endoprosthesis leg, formation of a fistula	1 (16,7%)	-	-	1 (16,7%)
Total	6 (100%)	1 (16,7%)	4 (66,6%)	1 (16,7%)

After reconstructive interventions, 2 (8.0%) patients had a local relapse (1 patient with osteogenic sarcoma and 1 with chondrosarcoma). In 5 (11.4%) cases, lung metastases were detected (in 2 patients with osteogenic sarcoma after 12 months, in 2 with PHC after 10 months, in 1 with chondrosarcoma after 15 months). 80% of patients in the postoperative period did not feel pain. Depending on the volume of the operation, the patients were activated for 1-2 days, which makes it possible to self-service and continue special treatment. The functional state was assessed according to the MSTS scale (1986) after shoulder joint replacement in 77% of patients. Anatomical and functional results on the Enneking scale showed that 10 patients were rated as excellent, 28 as good and 6 as satisfactory.

CONCLUSIONS

1. With a tumor lesion of the proximal humerus in the absence of a soft tissue component and destruction of the cortical layer, as well as the transition of the tumor to the articular surface of the bone, the method of choice is surgical treatment in the volume of segmental resection of the bone with replacement of the defect with an endoprosthesis.
2. The developed endoprosthesis of the shoulder joint allows for organ-preserving surgical treatment in patients with tumors of the proximal humerus.
3. In case of a tumor lesion of the proximal humerus, performing safe surgical interventions in the volume of segmental resection with replacement of the defect with a metal endoprosthesis allows partially or completely relieving the pain syndrome, improves the functional state of the limb in 86.3% of patients (assessed as excellent and good) and the quality of life of patients.

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