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Surgical Treatment of Benign Bone Tumors in Children

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Abstract: Benign bone tumors in children are a common pathology of the musculoskeletal system, causing pain syndrome, bone deformation, and impaired limb function. The study conducted a retrospective analysis of 31 patients aged 6-17 with solitary bone cysts, osteochondromes, osteoid-osteomas, and endochondromes. The main treatment methods were curettage with bone grafting, edge resection, and radiofrequency ablation. Postoperative results showed high effectiveness of surgical treatment: complete restoration of limb function was noted in 29 patients (93.5%), relapses - in 1 patient (3.2%). Organ-preserving interventions ensure minimal tissue damage and optimal functional outcomes.

Keywords: benign bone tumors, children, curettage, marginal resection, radiofrequency ablation, functional result.

Introduction

Benign bone tumors in children are a common pathology of the musculoskeletal system, accounting for up to 45% of all bone neoplasms in childhood [1]. Despite the absence of malignant potential, these formations can cause significant clinical discomfort: pain syndrome, bone deformities, pathological fractures, and impaired limb function. The characteristics of the child's skeleton, particularly the presence of active growth zones, impose specific requirements on surgical tactics: aggressive intervention can disrupt bone growth and lead to functional and cosmetic defects [2], [3], [4].

Among benign tumors, solitary bone cysts, osteochondromes, osteoid osteomas, and enchondromes are most common. Treatment of these pathologies depends on the morphological structure, localization, clinical manifestations, and the risk of complications [5], [6] . In recent years, organ-preserving methods, including curettage with bone grafting, edge resection, and radiofrequency ablation, have been actively implemented in pediatric orthopedics, which minimizes tissue damage and accelerates the restoration of function [7], [8], [9]. Despite the widespread use of these methods, the issues of optimal choice of surgical intervention, assessment of postoperative outcomes and frequency of relapses remain relevant and require systematic study based on modern clinical observations and international experience [10]. Purpose of the study: To assess the clinical effectiveness and functional results of various methods of surgical treatment of benign bone tumors in children, taking into account the nosological structure, localization, and age of patients.

Materials and methods:

A retrospective analysis of 31 patients aged 6-17 who were treated in the pediatric orthopedics department between 2019 and 2025 was conducted. Of these, 18 are boys and 13 are girls. The main nosological forms were:

Single bone cyst - 11 cases
Osteochondroma - 9 cases
Osteoid-osteoma - 6 cases
Enchondroma - 5 cases

Diagnostics included radiography, MSCT, and MRI of the affected segments. Indications for surgical treatment: pain syndrome, risk of pathological fracture, progressive deformation, and impaired limb function.

Surgical intervention methods:

1. Bone grafting curettage is an organ-preserving method used for solitary bone cysts and enchondromas.

2. Edge resection - used in osteochondromes, allowing for the preservation of growth zones and limb function.
3. Radio frequency ablation - used for osteoid osteomas, providing minimal invasive pain relief.
Postoperative monitoring lasted from 12 to 36 months, including clinical examination, radiological monitoring, and assessment of limb function according to the MSTS (Musculoskeletal Tumor Society) scale.

Results and Discusion

Analysis showed that the choice of intervention method corresponded to the nosological form and clinical indications. Complete restoration of function was noted in 29 patients (93.5%), partial restriction - in 2 (6.5%). Recurrences were recorded in one patient after curettage of the solitary bone cyst (3.2%). Postoperative complications were transient and were observed in 2 patients (6.5%) [11], [12].

Distribution of patients by age revealed the peak incidence in the 10-13 age group (45.2%), which coincides with the period of active bone growth and increased detection of pathology. Sex composition: 58.1% boys and 41.9% girls, which corresponds to literature data on the predominantly male fraction of the child population. Organ-preserving interventions (curettage with bone grafting) provided high efficiency with minimal bone tissue trauma. Radiofrequency ablation demonstrated rapid pain relief and reduced hospitalization time, which is confirmed by foreign studies [13]. Edge resection of osteochondromes allowed for the preservation of limb function and bone growth activity.

The research results confirm the high effectiveness of modern surgical methods in the treatment of benign bone tumors in children [14]. The frequency of recurrence after curettage (3.2%) is lower than the average values described in the literature (5-15%), which may be due to the careful selection of patients and the use of bone grafting.

Minimally invasive methods, including radio frequency ablation of osteoid osteomas, allow for rapid elimination of pain syndrome without significant bone tissue damage and shortening the rehabilitation period. These observations are consistent with the results of foreign authors [15].

Particular attention should be paid to the preservation of growth zones in children, as a violation of their integrity can lead to segment shortening and secondary deformations. Edge resection of osteochondroma allows preserving the growth zone with complete removal of the pathological formation.

The retrospective nature of the study and the limited sample size are its main limitations, however, the data allow us to conclude the rationality of an individual approach to the choice of treatment method and can be used to optimize surgical tactics.

Conclusion

1. Surgical treatment of benign bone tumors in children is highly effective and safe when the intervention method is chosen correctly.
2. Organ-preserving methods (curettage with bone grafting) demonstrate high effectiveness in solitary bone cysts and enchondromas.
3. Radio frequency ablation of osteoid-osteomas provides rapid relief of pain syndrome and minimal tissue damage.
4. Edge resection of osteochondroma allows for tumor removal while preserving limb growth and function.
5. Individual selection of the surgical treatment method, taking into account the age, localization, and morphological form of the tumor, ensures optimal functional and clinical results.

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