

Treatment and Outcomes of 4,973 Unicameral Bone Cysts: A Systematic Review and Meta-Analysis

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INTRODUCTION: Unicameral bone cysts (UBC) occur predominantly in children and adolescents and represent around 3% of all primary tumors in the first two decades of life. Despite their benign nature, these lesions increase the risk of pathological fractures of both long and short bones. While a plethora of studies have reported outcomes of treatment of UBCs, data is highly heterogeneous and the results are conflicting. Our study sought to assess: **1)** What is the success rate of each treatment modality for UBCs? **2)** Does decompression of the cyst wall in patients treated with injection lead to higher success rates? **3)** Does the material used for packing the bone defect after curettage of the lesion affect treatment success rates? **4)** Does curettage of the lesion prior to elastic stable intramedullary nailing affect treatment success rates?

METHODS: A systematic review and meta-analysis following PRISMA guidelines was conducted. We performed a comprehensive search of the PubMed and Embase databases from inception to May 1, 2023. We reviewed 140 manuscripts for eligibility. To be included, studies had to discuss surgical or nonsurgical treatments for UBCs, report treatment success based on radiological assessment, and involve at least ten patients with a minimum follow-up period of six months. We excluded case reports, non-peer-reviewed publications, studies with non-human subjects, and articles focusing on UBCs of the mandible. After study eligibility and quality assessment, we included 109 studies (Figure 1). Our primary outcome of interest was cyst healing evaluated radiologically, following Capanna's modification of Neer's score. modality (e.g., injection, curettage), and categories within a treatment modality (e.g., injection with MPA, injection with bone marrow) were calculated. A meta-analysis of dichotomous outcomes (success or failure) was performed. This study was submitted to PROSPERO (3956759).

RESULTS: A total of 4,973 patients were included, the male-female ratio was 2.2:1. Most of the cysts were in the humerus (52.06%) (Table 1). Conservative treatment showed the lowest success rate (44.7%). Treatment with injection was performed in 1,806 patients (36.3%) and had an overall success rate of 64.95% (Table 2). Decompression of the inner cyst wall during injection treatment was associated with a higher success rate (77.4% vs. 62.37%) (Figure 3). The most common treatment approach was curettage (37.04%) and the success rate was 79.97% (Figure 2). Packing the bone defect with bone substitute (BS) after curettage showed a UBC healing rate of 87.07%. Use of allograft or autograft to fill the bone defect after curettage resulted in a healing rate of 78.48% and 62.32%, respectively. (Figure 4). Elastic stable intramedullary nailing (ESIN) reliably had higher success rates, regardless of whether curettage was performed or not (91.05% and 87.1%, respectively) (Figure 5).

DISCUSSION AND CONCLUSION: Curettage with bone substitute and elastic stable intramedullary nailing were highly successful techniques for the treatment of UBCs. Decompressing the cyst wall after injection, regardless of the compound used, was associated with a higher success rate than injection alone. When curettage was performed, packing the defect with bone substitute demonstrated a higher success rate than with autograft, making it the recommended option for patients with UBCs. Additionally, ESIN proved to be a successful technique, and prior curettage of the lesion did not appear to impact outcomes significantly.

