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ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

Comparative healing outcomes after β-tricalcium phosphate grafting in pediatric aneurysmal bone cysts, simple bone cysts and non-ossifying fibroma

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SUMMARY

Introduction/Objective Aneurysmal bone cysts (ABC), simple bone cysts (SBC), and non-ossifying fibromas (NOF) are common in children. The standard treatment is curettage with defect filling. The graft selection and surgical approach vary according to the lesion type. While synthetic β-tricalcium phosphate (β-TCP) is a biocompatible graft, its efficacy in pediatric cases remains unclear. This study assessed radiographic healing, graft integration, complications, and recurrence rates after curettage and β-TCP grafting.

Methods We retrospectively reviewed 63 patients (23 ABC, 21 SBC, and 19 NOF) treated at a pediatric hospital from 2015 to 2023. All underwent intralesional curettage with β-TCP grafting. Healing was assessed using Wu, modified Irwin, and modified Neer criteria. The stable healing time, recurrence, complications, and morphometric predictors were also analyzed.

Results Radiographic healing rates were 73.9% for ABC, 85.7% for SBC, and 100% for NOF. Stable healing occurred at 13.5 ± 5.7 months for ABC and approximately 8.7–8.8 months for SBC and NOF ($p = 0.0004$). ABC healed more slowly and inconsistently; larger and relation length ratio lesions delayed healing in both ABC and SBC. Recurrence was observed in 26% of ABC cases (mean 16.7 months), 14% of SBC cases (mean 13.8 months), and none in NOF.

Conclusion β-TCP grafting is safe and effective for pediatric benign bone lesions; however, healing varies by lesion type. ABC requires longer monitoring due to a higher recurrence risk; SBC mostly stabilizes within a year; and NOF reliably remodels regardless of size. Focusing on follow-up of high-risk lesions may improve outcomes and reduce unnecessary interventions.

Keywords: aneurysmal bone cyst; simple bone cyst; non-ossifying fibroma; β-tricalcium phosphate; pediatric orthopedics; bone grafting

INTRODUCTION

Benign bone lesions frequently occur in children and adolescents and usually show characteristic features on imaging. They are often found incidentally after trauma but can also present with pain, swelling, and pathological fractures. Among the most prevalent are aneurysmal bone cysts (ABC), which exhibit local aggressiveness and can rapidly destroy bone; simple bone cysts (SBC), which tend to recur but progress at a slower rate; and non-ossifying fibromas (NOF), which are generally asymptomatic unless they compromise structural stability [1].

Their optimal management remains challenging because of the lack of standardized treatment protocols [2]. The absence of clear guidelines leads to variability in surgical approaches and reconstructive materials, posing significant challenges for pediatric orthopedic surgeons. The need for effective, safe, and reproducible treatment strategies is paramount, given the long-term growth and functional implications for young patients. Current surgical interventions typically involve curettage followed by defect filling [3, 4, 5]. Bone defects can be reconstructed using autologous, allogeneic, or synthetic grafts. There is no ideal bone graft available. Autologous bone grafting is considered the gold standard but is limited in pediatric patients because of donor-site morbidity, longer surgery times, and restricted harvest volume [6]. Allografts and xenografts serve as alternatives; however, they may produce inconsistent outcomes and pose potential immunological risks to the host, including graft rejection, inflammation, and transmission of zoonotic diseases [7]. Although synthetic bone grafts, such as beta-tricalcium phosphate (β-TCP), exhibit good biocompatibility, osteoconductivity, and predictable resorption [8, 9], clinical evidence regarding their efficacy and safety in treating benign bone lesions in children is limited. Radiological scoring systems, such as the Wu and Irwin criteria, offer a framework for assessing postoperative healing [10]. However, their usefulness is limited by the wide variation in healing rates, recurrence, and risk of complications among benign bone lesions. This variation highlights the need for direct clinical studies to understand the different outcomes and guide the treatment of specific lesions.

This study compared healing, graft integration, complications, and recurrence rates in

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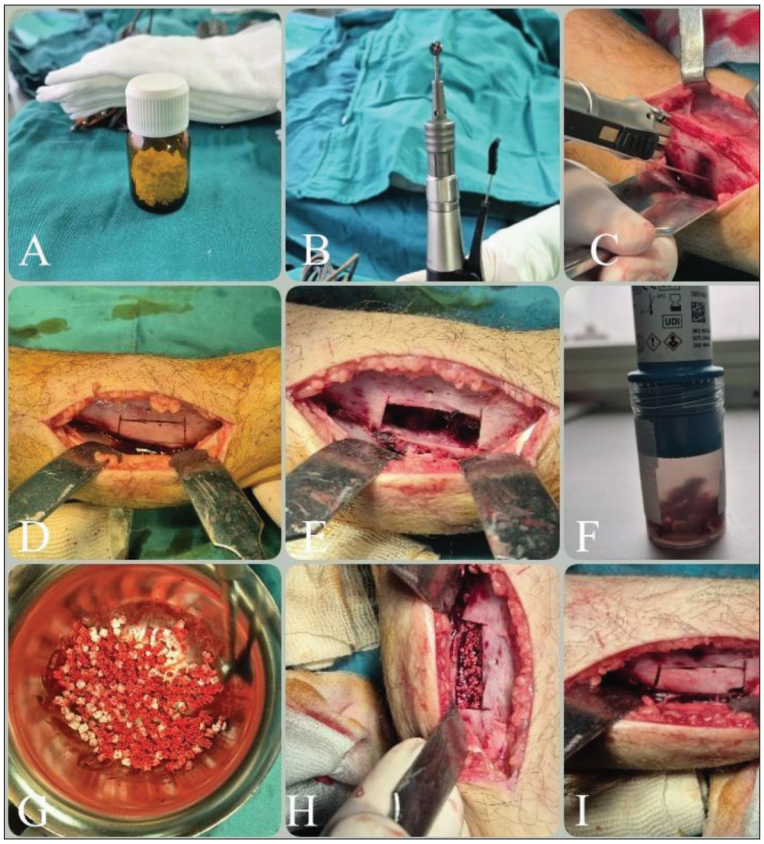

Figure 1. Surgical technique; A – β-tricalcium phosphate (β-TCP) granules; B – high-speed burr used to carefully remove bone around the lesion; C, D – Creating a cortical window to access the lesion; E – opening the cortical window and performing curettage; F – tissue obtained from the bone lesion for histopathology; G – β-TCP granules combined with patient blood; H – defect filled with granules; I – replacing and securing the cortical window after filling the defect

pediatric patients with ABC, SBC, and NOF after curettage and β-TCP grafting. The findings aim to guide better treatment and follow-up strategies for each benign bone lesion type in children and adolescents.

METHODS

Study design and population

This retrospective observational study included 63 pediatric patients (aged 4–18 years) treated at the University Clinical Center of Nis, Serbia, from January 2015 to December 2023 with standardized intralesional curettage and β-TCP filling for benign bone lesions (ABC, SBC, and NOF). Outcomes were compared among the three types of lesions. Inclusion criteria were pathohistologically confirmed ABC, SBC, or NOF; curettage with β-TCP filling; and at least 12 months' follow-up. Patients with malignant tumors, prior surgery, incomplete imaging, non-standard adjuvants, or less than 12 months of follow-up were excluded. Eligible patients were identified using ICD-10 diagnostic codes for benign bone lesions and subsequently confirmed by histopathological examination. From this initial pool, patients who met the inclusion and exclusion criteria were selected. Based on histopathological examination, there were 23 ABC, 21 SBC, and 19 NOF cases in this study.

Patient demographics, lesion details, pathological fractures, surgery data, and outcomes were obtained from records and radiographs. All patients underwent standardized intralesional curettage with β-TCP filling, as described below.

Surgical technique

All procedures were performed under general anesthesia, using a sterile technique. The lesion was located via fluoroscopy, and a cortical window, typically 1–2 cm in length, was created using an osteotome. The lesion cavity was thoroughly curetted until healthy bleeding bone was observed. A high-speed burr was used as needed to debride the cyst wall, remove the pathological lining, or enlarge cavities with thick bone septa. The cavity was thoroughly washed and packed with β-TCP granules (ChronOS™, DePuy Synthes, Raynham, MA, USA or TriOSS®, Bioceramed, Guimarães, Portugal), mixed with autologous blood. The cortical cap was returned and sealed with medical wax, if necessary. Large or unstable defects were fixed internally using plates or titanium-elastic nails. The incision was closed in layers, and the operated limb was immobilized as needed to stabilize the surgical site during early recovery (Figure 1).

Postoperative protocol and follow-up

Postoperative care involved a period of limited weight bearing, followed by gradual increases in activity and weight bearing as tolerated, guided by clinical assessment and radiographic healing. Clinical and radiographic evaluations occurred every 6–8 weeks for six months, then every 4–6 months until healing, and annually until full consolidation. Full activity and sports were permitted after adequate bone remodeling and graft integration were confirmed.

Radiological assessment

While magnetic resonance imaging or computed tomography scans were performed in certain cases for diagnostic purposes, only standard anteroposterior (AP) and lateral radiographs were used for the main outcome analysis to ensure consistency. Radiographic images, collected as part of the patient data, were analyzed using RadiAnt DICOM Viewer® 2025.2 (Medixant, Poznań, Poland) by a single experienced pediatric orthopedic surgeon. Postoperative healing was evaluated using three validated radiological scoring systems applied to standard AP and lateral radiographs.

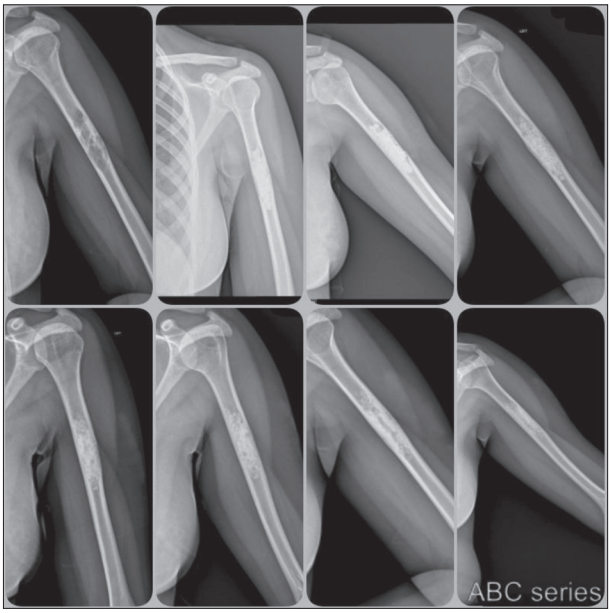

Figure 2. ABC – aneurysmal bone cyst; two years of follow-up

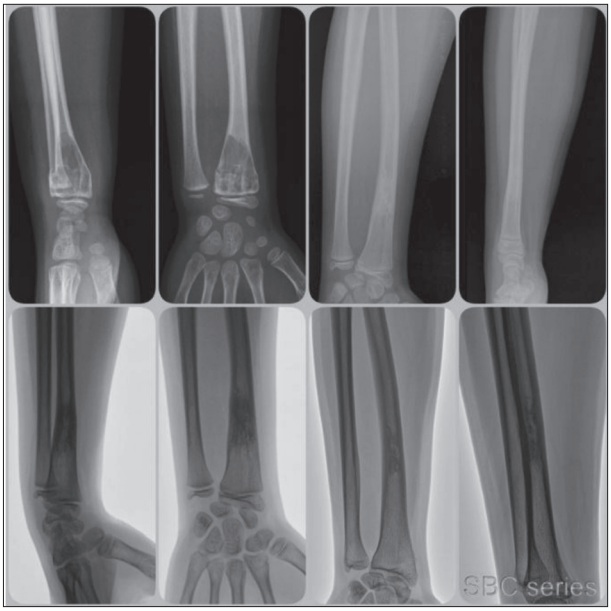

Figure 3. SBC – simple bone cyst; three years of follow-up

- Wu criteria for defect filling (quantifying cavity fill): I < 50%; II 50–75%; III 75–90%; IV > 90%;
- Modified Irwin criteria for graft incorporation (assessing biological graft integration): I clear; II hazy; III incorporation; IV remodeling;
- Modified Neer criteria for overall healing outcome: I complete healing; II healing with residual defects; III persistent defect; IV recurrence.

Outcome measures

Primary outcomes

1. Healing outcome was classified as "healed" if lesions simultaneously achieved all three criteria: a Wu Grade III or IV (for filling), an Irwin Stage III or IV (for incorporation), and a modified Neer Criteria I or II (for overall outcome);
2. Stable healing time: the number of months from surgery until X-rays first show sufficient cortical healing and trabecular bridging, along with clinical stability and no recurrence or refracture.

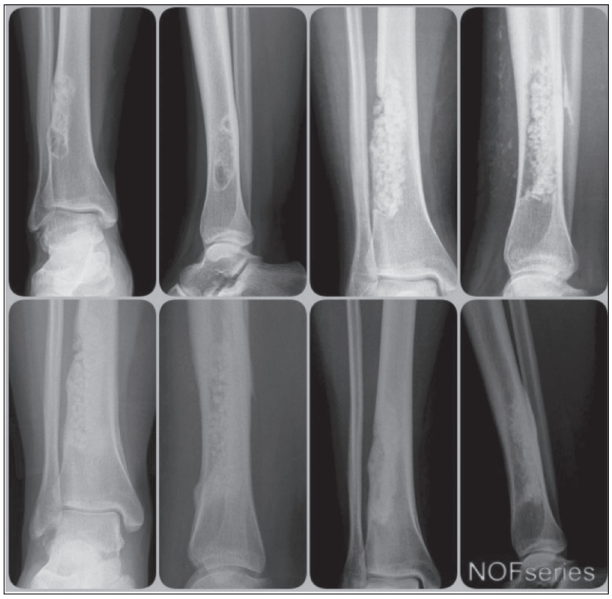

Figure 4. NOF – non-ossifying fibroma;14 months of follow-up

Secondary outcomes

1. Recurrence (radiographic evidence, symptomatic recurrence, need for re-intervention);
2. Pathological fracture;
3. Postoperative complications (infection, nerve injury, hardware failure, delayed wound healing).

Examples of all three benign bone lesions with follow-up are shown in Figures 2, 3, and 4.

Baseline characteristics

The baseline characteristics included patient age, sex, lesion location (bone and anatomical region), tumor length [$V = (\pi/6) \times \text{length} \times \text{width} \times \text{height}$], tumor volume (longest craniocaudal distance in AP or lateral radiography), relation length (lesion length divided by the total length of the affected bone), and presence of pathological fracture at presentation.

Statistical analysis

Sample size was calculated in G*Power 3.1.9.2 (one-way ANOVA, effect size 0.25, $\alpha = 0.05$, power = 0.95, three groups). Analyses were performed in IBM SPSS Statistics version 30.0 (IBM Corp., Armonk, NY, USA). Variable normality was checked with the Shapiro–Wilk test. Depending on distribution, either one-way ANOVA or Kruskal–Wallis test was used. Results are shown as mean ± SD or median (range). Categorical data were analyzed with

Table 1. Demographic and anatomical characteristics of patients with ABC, SBC, and NOF

Variables	ABC (n = 23)	SBC (n = 21)	NOF (n = 19)	p
Age (years)				
Mean ± SD	11.35 ± 3.13	10.76 ± 3.36	12.32 ± 3.31	ANOVA p = 0.013
Median	11	10	14	KW p = 0.011
Range	5–17	4–18	4–17	—
Gender				
Male, n (%)	15 (65.2%)	15 (71.4%)	7 (36.8%)	$\chi^2 = 6.94$; p = 0.031
Female, n (%)	8 (34.8%)	6 (28.6%)	12 (63.2%)	—
Bone location				
Humerus	11 (47.8%)	10 (47.6%)	0 (0%)	
Femur	7 (30.4%)	4 (19%)	9 (47.4%)	
Tibia	4 (17.4%)	1 (4.8%)	10 (52.6%)	$\chi^2 = 52.8$; p < 0.0001
Radius	0	4 (19%)	0	
Fibula	0	1 (4.8%)	0	
Calcaneus	0	1 (4.8%)	0	
Foot bones (Cuboid/PxPh)	2 (8.7%)	0	0	

ABC – aneurysmal bone cyst; SBC – simple bone cyst; NOF – non-ossifying fibroma; n – number; SD – standard deviation; ANOVA – mean comparison; KW – median comparison; χ^2 – Chi-square test for categorical variables; PxPh – proximal phalanx

Table 2. Results of ABC, SBC, and NOF treated with synthetic bone graft

Variables	ABC (n = 23)	SBC (n = 21)	NOF (n = 19)	p
Initial pathological fracture (%)	15(65%)	12(57%)	5(26%)	$\chi^2 = 6.81$; p = 0.033
Healing: Healed (%)	17 (73.9%)	18 (85.7%)	19 (100%)	$\chi^2 = 4.51$; p = 0.105
Healing: Not healed (%)	6 (26%)	3 (14.3%)	0	
≤ 6 months healed (%)	0%	23.8%	21.1%	
≤ 9 months healed (%)	33.3%	57.1%	63.2%	
≤ 12 months healed (%)	58.3%	85.7%	89.5%	
Stable healing time (mean ± SD)	13.48 ± 5.68	8.67 ± 3.38	8.84 ± 2.81	ANOVA p = 0.0004
Median stable healing	12	8	9	KW p = 0.0057
Stable healing range	7–24	4–15	4–14	
Tumor length (mean ± SD)	6.25 ± 3.08	5.59 ± 2.3	4.82 ± 1.7	ANOVA p = 0.18
Tumor volume (mean ± SD)	22.31 ± 19.85	12.37 ± 9.64	7.52 ± 4.33	ANOVA p = 0.0024
Relation length (mean ± SD) (lesion to total bone length)	0.23 ± 0.14	0.22 ± 0.07	0.15 ± 0.07	ANOVA p = 0.029

ABC – aneurysmal bone cyst; SBC – simple bone cyst; NOF – non-ossifying fibroma; SD – standard deviation; χ^2 – Chi-square test; ANOVA – one-way analysis of variance; KW – Kruskal–Wallis test; p < 0.05 considered significant; relation length – lesion length/total bone length

χ^2 or Fisher's exact test. Kaplan–Meier analysis assessed recurrence time. Statistical significance was set at p < 0.05.

Ethics: The study was approved by Institutional Ethics Committees (UCC Niš: 14396/6; Medical Faculty of Niš: 12-14250-2/2) in accordance with the Declaration of Helsinki. Written informed consent was obtained from parents or guardians, and patient confidentiality was maintained.

RESULTS

Patient demographics varied across groups, with patients with ABC and SBC being notably younger (mean age 11.35 and 10.76 years, respectively) than patients with NOF (mean age 12.32 years; ANOVA, p = 0.013). Males were predominant in the ABC (65%) and SBC (71%) groups, whereas females were more prevalent in the NOF group (63%) (p = 0.031) (Table 1).

The location of the lesions also differed significantly (p < 0.0001); ABC and SBC were most frequently located in the humerus (48% each), whereas NOF was found exclusively in the femur (47%) and tibia (53%) (Table 2).

The incidence of pathological fractures as initial presentations varied significantly among the lesion types ($\chi^2 = 6.81$, p = 0.033), with a notably lower frequency observed in NOF (26%) compared to ABC (65%) and SBC (57%).

ABC lesions had significantly longer stable healing times (mean 13.5 ± 5.7 months) than SBC (8.7 ± 3.4 months) and NOF (8.8 ± 2.8 months) (ANOVA p = 0.0004; Kruskal–Wallis p = 0.0057). However, the overall healing success rates were similar (ABC: 74%, SBC: 86%, NOF: 100%; $\chi^2 = 4.51$, p = 0.105), indicating comparable long-term outcomes.

Tumor length was similar across groups (p = 0.18); therefore, initial lesion size was not a distinguishing factor. ABC lesions had the greatest volume (ANOVA p = 0.0024), whereas NOF lesions had the smallest volume. The relation index was highest in ABC and SBC and lowest in NOF (ANOVA p = 0.029; Kruskal–Wallis p = 0.0013), indicating more bone involvement in ABC and SBC.

Correlation analysis showed that stable healing time was affected by various factors across the diagnostic groups. For ABC, healing time moderately increased with larger tumor volume (r = 0.34) and relation length (r = 0.28) but decreased notably with better healing outcomes (r = -0.56); tumor length and age had a minor impact. In SBC, healing time strongly correlated with tumor volume (r = 0.63), relation length (r = 0.52), and tumor length (r = 0.45); younger age sped up healing (r = -0.36), and better outcomes shortened stabilization time (r = -0.58). NOF had mild links between healing time and tumor size, and age had minimal influence (r = 0.06).

Overall, healing time decreased from ABC to SBC to NOF, with tumor volume and size serving as the primary predictors of delayed healing. Age was insignificant, except for SBC cases (Figure 5).

The cumulative healing rates for ABC, SBC, and NOF at six, nine, and 12 months are shown in a side-by-side bar chart. ABC had the slowest healing (0%, 33.3%, 58.3%), SBC showed intermediate rates (23.8%, 57.1%, 85.7%), and NOF healed fastest (21.1%, 63.2%, 89.5%) (Figure 6).

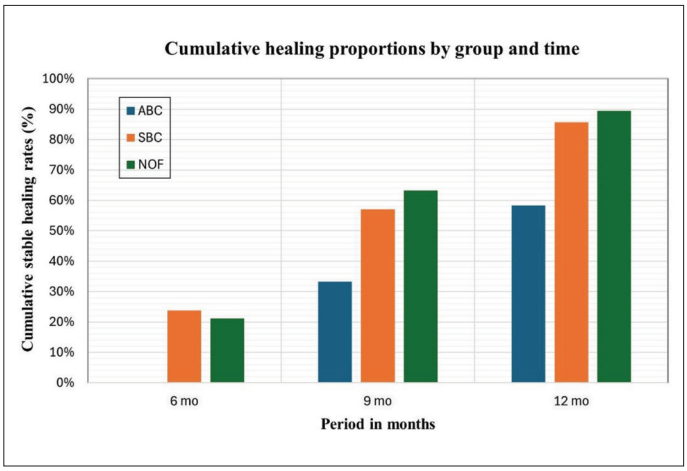

Figure 5. Cumulative healing proportions

ABC – aneurysmal bone cyst; SBC – simple bone cyst; NOF – non-ossifying fibroma; mo – months (follow-up interval)

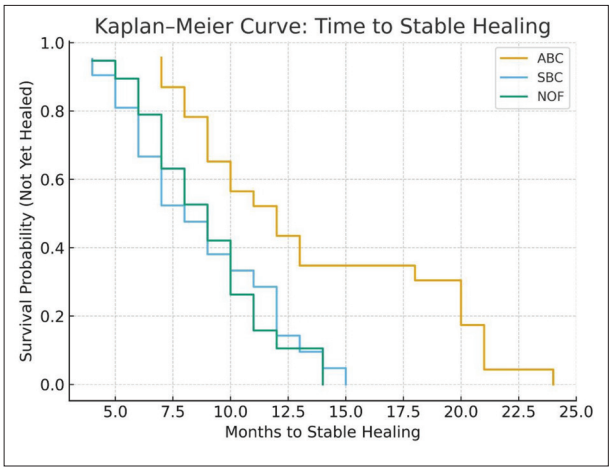

Figure 6. Kaplan–Meier curve: time to stable healing by lesion group

ABC – aneurysmal bone cyst; SBC – simple bone cyst; NOF – non-ossifying fibroma

The Kaplan–Meier curve offers a visual representation of the duration required to achieve stable healing in the ABC, SBC, and NOF groups. ABC lesions heal more slowly and unpredictably than SBC and NOF, with approximately 30% taking over 20 months to show stable radiographic healing. SBC lesions usually stabilize in 7–15 months, with approximately 80% showing variable healing. NOF lesions are more consistent, with approximately 95% stabilizing in 10–12 months and showing clear radiographic improvement.

This study evaluated the healing and complication rates for each lesion type and treatment. No major infections or adverse reactions were observed with the β-TCP grafts. For ABC, six out of 23 surgical patients had recurrences (26%) after an average of 16.7 months, and one had a pathological proximal humeral fracture. In SBC, three of 21 treated patients experienced recurrence (14.2%) after approximately 13.8 months, with one pathological distal femoral fracture reported. NOF cases showed no recurrence or significant complications.

DISCUSSION

This study evaluated the healing patterns, morphometric predictors, and recurrence rates of ABC, SBC, and NOF treated with curettage and β-TCP grafting. Although all three are benign pediatric lesions, they demonstrate distinct biological behaviors and postoperative consolidation profiles.

Demographic and anatomical features

The age distribution of our cohort (10–12 years) aligns with the known peak incidence of benign cystic and fibro-osseous lesions in late childhood and early adolescence [3, 11, 12]. ABC and SBC showed male predominance, consistent with epidemiological data reporting a higher incidence in boys. In contrast, NOF in our cohort showed female predominance, likely reflecting sample characteristics rather than a true epidemiological shift. Lesion locations were typical: ABC and SBC primarily affected the proximal humerus and femur, while NOF was confined to the femur and tibia, consistent with its preference for metaphyseal regions near the knee. Mechanical stress and high activity in boys during rapid skeletal growth can interfere with bone remodeling, making them more prone to metaphyseal lesions, benign bone cysts or fibrous conditions, and fractures [13, 14].

Healing outcomes and stable healing time

Healing rates were high across all groups (ABC 73.9%, SBC 85.7%, NOF 100%), aligning with published outcomes, where ABC demonstrated the greatest variability (65–90%), SBC typically achieved 75–90% healing, and NOF showed near-universal resolution. ABC heals more slowly and variably, reflecting its biologically active and expansile nature and the frequency of cortical destruction. SBC showed rapid and predictable healing, with most cases stabilizing within 12 months, paralleling the existing literature that highlights mechanical recovery once cortical integrity improves. NOF heals completely and predictably, as it is self-limiting [15, 16].

ABC had the slowest and most variable healing (mean 13.5 months, range 7–24 months). SBC and NOF stabilized at similar rates, with median healing times of eight and nine months, respectively. ABC requires extended osteoconduction and shows unpredictable bone growth after curettage. SBC typically heals 6–12 months post-curettage and grafting, although complications such as lesion expansion or delayed healing may occur. NOF consistently heals within 10–12 months, confirming its status as a self-limiting, reliably remodeling lesion [17].

The Kaplan–Meier further illustrated these differences: ABC demonstrated prolonged stabilization with subset healing beyond 20 months, SBC improved steadily during the first year, and NOF showed a uniform, self-limiting course.

The Kaplan–Meier curves in our study highlighted the unique healing patterns of benign pediatric bone lesions. Healing time decreased from ABC to SBC to NOF, reflecting biological differences and aggressiveness of the lesions.

Morphometric predictors of healing

Morphometric characteristics play a crucial role in determining healing kinetics. In ABC, a larger lesion volume and greater lesion-to-bone relation length were associated with delayed consolidation, supporting reports by Dormans et al. [17] and Restrepo et al. [12], who observed that cortical thinning and extensive cystic activity prolonged graft incorporation due to sustained biological turnover.

SBC showed the strongest morphometric correlations, mainly with tumor volume and relation length, indicating that mechanical factors are crucial for healing. Larger lesions increase biomechanical demands and the risk of delayed recovery or fracture [18]. Younger patients recovered faster, supporting earlier research that pediatric bones remodel more efficiently under stress [10, 14].

NOF exhibits unique remodeling, with healing being minimally affected by tumor size, location, or age. Studies have indicated that outcomes rely more on biological maturation than on graft mechanics [19].

Complications and recurrence

No significant early or late postoperative complications were observed, except for one pathological fracture in the ABC group and one in the SBC group, findings consistent with the published literature [20].

Our ABC recurrence rate was 26%, with a mean recurrence of 16.7 months, aligning with previous pediatric reports of 20–30% [17]. Most recurrences occur between 12 and 24 months, but some are observed up to 4–5 years, highlighting the need for prolonged follow-up [15]. Long-term studies (mean follow-up: 81 months) further emphasize the importance of extended monitoring for late recurrences and complications [21].

Recurrence in our SBC series was 14% with a mean time of 13.8 months, aligning with published data and likely due to residual mechanical stress and lesion size [4, 18, 22]. Larger SBCs have higher recurrence rates (41.7%), and Flont et al. [23] recommend follow-up beyond three years for early detection and management.

No recurrences or complications were reported for NOF, reflecting its benign nature and lack of aggressive postoperative outcomes in existing literature.

Comparison of synthetic grafting outcomes

β-TCP was chosen for its safety, biocompatibility, osteoconductivity, and predictable resorption, enabling effective healing. Our study found no graft-related complications, supporting β-TCP as a treatment for pediatric lesions requiring structural support [24].

Clinical implications

This study highlights the importance of lesion-specific management. The natural characteristics of the lesion play a significant role in healing patterns.

- ABC requires rigorous long-term monitoring because of its biological aggressiveness and risk of late recurrence;
- SBC benefits from early mechanical stabilization and shows rapid healing when the cortical support is restored;
- NOF requires minimal intervention and reliably remodels even when grafted, making extensive postoperative imaging unnecessary in most cases.

Morphometric assessment, particularly lesion volume and cortical involvement, provides valuable prognostic information and should be incorporated into treatment planning and follow-up scheduling.

Strengths and limitations

The strengths of this study include consistent surgical technique, standardized radiologic evaluation using multiple scoring systems, and the use of stable healing time as a quantitative endpoint. Limitations include the retrospective design, modest sample size, and lack of comparison with other graft types or adjuvant therapies. Future prospective studies with larger cohorts and comparative grafting techniques are warranted to refine the treatment guidelines.

CONCLUSION

Synthetic β-TCP demonstrated safe and effective integration across all groups, supporting its use as a valuable biomaterial for pediatric orthopedic reconstruction. Healing outcomes after curettage and β-TCP filling in pediatric benign bone lesions are strongly influenced by the lesion type and morphometric characteristics. ABC have the longest and most variable healing times and the highest recurrence rates, whereas SBC heal moderately. NOF remodel predictably, and healing remains biologically stable. Lesion-specific approaches are crucial. Patients with larger ABC and SBC require careful planning, fracture prevention, and follow-up for at least two years. In contrast, NOF generally requires minimal postoperative surveillance.

Further studies with larger cohorts are required to validate these findings and optimize the management protocols for each lesion type.

Conflict of interest: None declared.

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Ретроспективно поређење резултата реконструкције анеуризмалних и солитарних коштаних цисти и неосификујућег фиброма код педијатријских пацијената применом синтетског коштаног графта (*β-TCP*)

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САЖЕТАК

Увод/Циљ Анеуризмалне коштане цисте (АКЦ), једноставне коштане цисте (ЈКЦ) и неосификујући фиброми (НОФ) чести су у педијатријском узрасту. Стандардни третман подразумева киретажу са попуњавањем коштаног дефекта. Избор графта и хируршки приступ зависе од типа лезије. Иако се синтетски бета-трикалцијум-фосфат (*β-TCP*) користи као биокомпатибилни графт, његова ефикасност у педијатријској популацији није потпуно разјашњена. Циљ ове студије био је да процени радиографско зарастање, инкорпорацију графта, компликације и учесталост рецидива после киретаже и попуњавања *β-TCP* гранулама.

Методе Ретроспективно су анализирана 63 пацијента (23 АКЦ, 21 ЈКЦ, 19 НОФ) лечена у дечјој болници у периоду од 2015. до 2023. године. Сви пацијенти су подвргнути интралезионалној киретажи са *β-TCP* графтовањем. Зарастање је оцењивано применом *Wu*, модификованих *Irwin* и *Neer* критеријума, а анализирани су и време до постизања стабилног зарастања, рецидиви, компликације и морфометријски предиктори.

Резултати Радиографско зарастање постигнуто је код 73,9% АКЦ, 85,7% ЈКЦ и 100% НОФ. Стабилно зарастање остварено је за 13,5 ± 5,7 месеци код АКЦ и за око 8,7–8,8 месеци код ЈКЦ и НОФ ($p = 0,0004$). АКЦ је показала успоренije и варијабилно зарастање; веће и лезије са већим односом лезија–кост спорије су зарастале код АКЦ и ЈКЦ. Рецидиви су забележени код 26% АКЦ (просечно 16,7 месеци) и 14% ЈКЦ (просечно 13,8 месеци), док код НОФ није регистрован ниједан рецидив.

Закључак *β-TCP* графтовање представља безбедну и ефикасну опцију у лечењу бенигних коштаних лезија код деце, али се обрасци зарастања значајно разликују међу типовима лезија. АКЦ захтева продужено праћење због већег ризика од рецидива; ЈКЦ најчешће постиже стабилизацију у првој години; НОФ поуздано ремоделира независно од величине. Усмерено праћење високоризичних лезија може побољшати исходе и смањити непотребне интервенције.

Кључне речи: анеуризмална коштана циста; једноставна коштана циста; неосификујући фибром; бета-трикалцијум-фосфат; дечја ортопедија; коштани графт