

2026

Benign jaw bone lesions in athletes exposed to craniofacial trauma: Surgical treatment and bone regeneration using biphasic calcium sulfate

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Recommended Citation

Dudek D, Chwarscianek A, Pabin I, Jaworski L, Warmusz O, Wyrobiec G, Kłodzinska E. Benign jaw bone lesions in athletes exposed to craniofacial trauma: Surgical treatment and bone regeneration using biphasic calcium sulfate. *Balt J Health Phys Act.* 2026;18(3):Article7. DOI: 10.29359/BJHPA.18.3.07

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Abstract

Benign cystic and tumor lesions of the jaw bones represent relatively frequent pathological conditions encountered in oral and maxillofacial surgery. Although these lesions are often asymptomatic and slow-growing, they may lead to progressive weakening of bone structure. In individuals exposed to repetitive mechanical forces, such as athletes participating in contact sports, the presence of such lesions may significantly increase the risk of pathological fractures of the facial skeleton. The aim of the present study was to present a clinical case series of a benign jaw bone lesion treated surgically using a biphasic calcium sulfate biomaterial and to discuss the potential relevance of such lesions in athletes exposed to craniofacial trauma. The treatment involved surgical enucleation of the lesion followed by reconstruction of the bone defect using a biphasic calcium sulfate biomaterial (Bond Apatite®). Postoperative healing was uneventful, and radiological follow-up demonstrated progressive bone regeneration and gradual replacement of the biomaterial with newly formed bone tissue. The presented case series highlights the importance of early diagnosis and appropriate surgical management of jaw bone lesions, particularly in athletes exposed to craniofacial trauma. Reconstruction of bone defects using modern biomaterials may contribute to restoration of bone integrity and reduction of pathological fracture risk during sports activity.

Keywords

jaw bone lesions, bone regeneration, biphasic calcium sulfate

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Cover Page Footnote

Special thanks to Prof. Ewa Kłodzińska for her expert assistance in developing and writing this paper.

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Article

Benign jaw bone lesions in athletes exposed to craniofacial trauma: Surgical treatment and bone regeneration using biphasic calcium sulfate

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Citation: Dudek D, Chwarscianek A, Pabin I, Jaworski L, Warmusz O, Wyrobiec G, Kłodzinska E. Benign jaw bone lesions in athletes exposed to craniofacial trauma: Surgical treatment and bone regeneration using biphasic calcium sulfate. *Balt J Health Phys Act.* 2026;18(3):Article7. DOI: 10.29359/BJHPA.18.3.07

Academic Editor: Paweł Ciężczyk

Received: March 2026

Accepted: May 2026

Published: September 2026

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Abstract. Benign cystic and tumor lesions of the jaw bones represent relatively frequent pathological conditions encountered in oral and maxillofacial surgery. Although these lesions are often asymptomatic and slow-growing, they may lead to progressive weakening of bone structure. In individuals exposed to repetitive mechanical forces, such as athletes participating in contact sports, the presence of such lesions may significantly increase the risk of pathological fractures of the facial skeleton. The aim of the present study was to present a clinical case series of a benign jaw bone lesion treated surgically using a biphasic calcium sulfate biomaterial and to discuss the potential relevance of such lesions in athletes exposed to craniofacial trauma. The treatment involved surgical enucleation of the lesion followed by reconstruction of the bone defect using a biphasic calcium sulfate biomaterial (Bond Apatite®). Postoperative healing was uneventful, and radiological follow-up demonstrated progressive bone regeneration and gradual replacement of the biomaterial with newly formed bone tissue. The presented case series highlights the importance of early diagnosis and appropriate surgical management of jaw bone lesions, particularly in athletes exposed to craniofacial trauma. Reconstruction of bone defects using modern biomaterials may contribute to restoration of bone integrity and reduction of pathological fracture risk during sports activity.

Keywords: jaw bone lesions, bone regeneration, biphasic calcium sulfate.

1. Introduction

Craniofacial injuries represent a significant proportion of trauma observed in athletes participating in contact and combat sports. Epidemiological studies indicate that injuries of the facial skeleton may account for approximately 3–29% of all sports-related injuries, while fractures of facial bones may constitute up to 10–42% of maxillofacial trauma depending on the sport discipline and studied population [1–3].

Sports disciplines such as boxing, martial arts, wrestling, rugby and football are associated with particularly high exposure to craniofacial trauma. Repeated mechanical

forces acting on the facial skeleton may lead not only to acute injuries but also to structural weakening of bone tissue. In the presence of pre-existing pathological lesions, even relatively minor trauma may result in pathological fractures.

Jaw bones represent a unique anatomical structure due to the presence of teeth and tissues of odontogenic origin. This anatomical specificity predisposes the maxilla and mandible to the development of various odontogenic cysts and benign tumors [4–7]. Among the most frequently diagnosed lesions are radicular cysts, dentigerous cysts and odontogenic keratocysts.

Although these lesions are typically benign and slow-growing, they may lead to progressive bone resorption and thinning of cortical bone structures. In athletes exposed to repetitive craniofacial trauma, such structural weakening may significantly increase susceptibility to fractures.

Various surgical approaches have been proposed for the treatment of odontogenic cysts and benign jaw lesions. These include decompression, marsupialization and complete surgical enucleation [8–10]. The choice of treatment depends on the size of the lesion, its anatomical location and the potential risk of recurrence.

Following removal of pathological tissue, reconstruction of the resulting bone defect becomes an important clinical challenge. Various grafting materials have been used in oral and maxillofacial surgery including autogenous bone grafts, allografts and synthetic biomaterials.

Calcium sulfate has been used in bone surgery for more than a century. The first clinical use of this material was described by Dreesmann in 1892 [11]. Due to its biocompatibility and predictable resorption characteristics, calcium sulfate has been widely applied as a bone graft substitute.

In recent years, biphasic calcium sulfate biomaterials have gained increasing attention due to their favorable physicochemical properties and ability to support bone regeneration [12].

Despite numerous reports describing maxillofacial injuries in athletes and the widespread use of biomaterials in oral surgery, relatively little attention has been paid to the clinical significance of pre-existing jaw bone lesions in individuals exposed to repetitive craniofacial trauma. In particular, the potential role of such lesions as a predisposing factor for pathological fractures in athletes remains insufficiently explored in the literature.

The aim of the present study was to present a clinical case of a benign jaw bone lesion treated surgically using biphasic calcium sulfate biomaterial and to discuss the relevance of such lesions in athletes exposed to craniofacial trauma.

2. Materials and methods

The present study describes a clinical case series of a patients diagnosed with a benign lesion of the jaw bone. The diagnosis was established based on clinical examination and radiological imaging.

The surgical procedures were performed under local anesthesia. After elevation of a mucoperiosteal flap, the lesion was carefully exposed and completely enucleated. The pathological tissue was removed and submitted for histopathological examination.

The resulting bone defect was reconstructed using a biphasic calcium sulfate biomaterial Bond Apatite® (Augma™, Caesarea, Israel). The material was placed directly into the defect according to the manufacturer's recommendations.

Biphasic calcium sulfate biomaterials are characterized by favorable biological properties including high biocompatibility and osteoconductive potential. The material gradually resorbs and is replaced by newly formed bone tissue during the healing process.

The surgical site was closed using standard suturing techniques. Preoperative follow-up included radiological imaging.



Figure 1. Patient 1. Irregular structure of ossifying fibroma in the front mandible

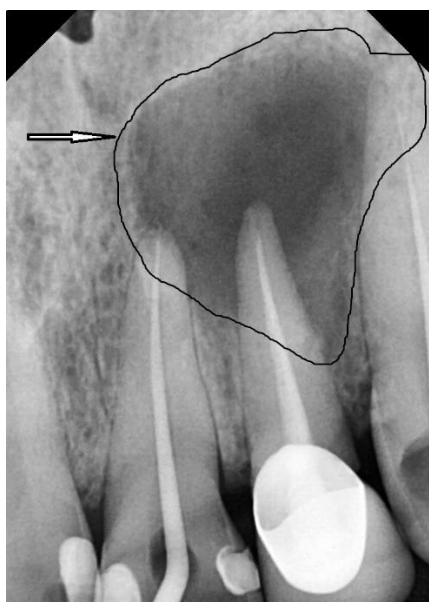


Figure 2. Patient 6. Range of the cyst on x-ray (roots 21,22,23 inside)

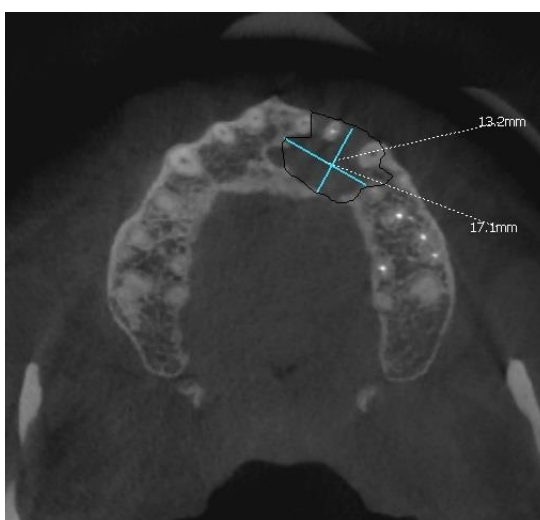


Figure 3. Patient 6. Horizontal Cone Beam Computer Tomography-range of the cyst with destruction of both cortical bone laminas

Table 1. Study group summary

Quantity of patients	N = 10
Age (years)	17–29
Mean Age (years)	24.4
Sex (F/M)	6/4
Cysts / tumors	6/4
Diameter of the lesions min-max (mm)	9.47–24.70
Mean diameter (mm)	15.1
Topography maxilla / mandible	5/5
Front side of the maxilla	4
Lateral side of the maxilla	1
Front side of the mandible	2
Lateral side of the mandible	3
Quantity of root resections	16
Teeth extractions	0
Quantity of using graft (cc – cubic centimeter)	24

Table 2. Details in the studied groups

No.	SexF/M	Age (Years)	The type of sport practiced professionally	Histopatolgy examination	Localisation (number of teeth)	Largest dimension measure in 3D (mm)	Graft usingcc	Root resection Y/N	Regeneration period of cortical lamina-months	Laesion removal: 1 – tumor, 2 – cyst
1.	F	22	Handball	Ossifying fibroma	Front mandible (32,31,41,42)	23.67	3	Y	4	1
2.	M	29	Football	Radicular cyst	Front left maxilla (21,22,23)	24.70	3	Y	6	2
3.	F	24	Football	Radicular cyst	Lateral left maxilla (27)	9.47	3	Y	6	2
4.	M	28	Boxing	Complex odontoma	Front right maxilla (13)	10.14	1	N	5	1
5.	M	18	Kickboxing	Radicular cyst	Front right maxilla (11,12)	16.25	3	Y	8	2
6.	M	29	Mixed martial arts	Radicular cyst	Front left maxilla (21,22,23)	17.10	3	Y	6	2

No.	SexF/M	Age (Years)	The type of sport practiced professionally	Histopatology examination	Localisation (number of teeth)	Largest dimension measure in 3D (mm)	Graft usingcc	Root resection Y/N	Regeneration period of cortical lamina-months	Laesion removal: 1 – tumor, 2 – cyst
7.	F	21	Rowing	Osteoid osteoma	Front mandible (41,42,43)	14.12	2	Y	6	1
8.	F	28	Basketball	Cementoma	Lateral mandible (36)	11.29	2	Y	4	1
9.	F	26	Figure skating	Radicular cyst	Lateral mandible (36)	14.47	2	Y	6	3
10.	F	19	Ice hockey	Radicular cyst	Lateral mandible (46)	10.12	2	Y	6	3

3. Results

The surgical procedure was completed successfully without intraoperative complications.

Histopathological examination confirmed the diagnosis of a benign cystic and tumor lesion of odontogenic origin.

The postoperative healing process proceeded without signs of infection or inflammatory complications. The patient reported no postoperative discomfort.

Radiological follow-up demonstrated progressive bone regeneration within the defect site. Gradual resorption of the biomaterial and replacement by newly formed bone tissue was observed.



Figure 4. Patient 1. Good regeneration of bone defect 2 years post op.



Figure 5. Patient 6. Good regeneration of the bone inside the defect after 2 years

4. Discussion

Craniofacial injuries represent a significant problem in sports medicine. Athletes participating in contact sports are particularly exposed to mechanical forces affecting the facial skeleton [13].

Previous studies have demonstrated that maxillofacial injuries are among the most common injuries observed in combat sports [14]. These injuries may include dental trauma, fractures of facial bones and soft tissue injuries.

Large epidemiological analyses also indicate that the oral cavity and facial skeleton belong to the most vulnerable anatomical regions during sports activity [15].

From a biomechanical perspective, the mandible represents one of the most vulnerable structures of the facial skeleton during sports-related trauma. The mandible is exposed to complex mechanical forces including compression, tension and bending moments generated during direct impact to the facial region. The distribution of these forces depends on the direction and magnitude of trauma as well as the structural integrity of the bone.

In the presence of pathological lesions, such as cysts or benign tumors, the mechanical resistance of bone may be significantly reduced. Consequently, even relatively low-energy trauma may result in pathological fractures of the jaw. This phenomenon may be particularly relevant in athletes participating in contact sports where repetitive mechanical loading of the craniofacial skeleton occurs.

The presence of pathological lesions of the jaw bones may further increase the risk of injury. Cystic lesions and benign tumors may weaken bone structure through progressive resorption and thinning of the cortical bone.

In athletes exposed to repeated craniofacial trauma, such structural changes may predispose to pathological fractures. Therefore, early diagnosis and appropriate surgical treatment of jaw bone lesions may be considered an important element of preventive sports medicine.

Reconstruction of bone defects following surgical removal of cystic lesions represents an important aspect of oral surgery. Various bone graft materials have been proposed for this purpose [16].

Among these materials, biphasic calcium sulfate has attracted considerable attention due to its favorable biological properties. The material demonstrates high biocompatibility and osteoconductive characteristics, allowing gradual replacement by newly formed bone tissue.

Clinical studies have confirmed effective bone regeneration following the use of biphasic calcium sulfate graft materials [17]. Comparative studies evaluating different graft materials have also demonstrated favorable outcomes in bone regeneration procedures [18].

Randomized clinical trials evaluating ridge preservation techniques further support the effectiveness of synthetic biomaterials in bone regeneration [19].

Several clinical reports have demonstrated successful reconstruction of bone defects following cyst removal using biphasic calcium sulfate biomaterials [20, 21].

In the context of sports medicine, restoration of bone integrity following surgical treatment of jaw lesions may play an important role in reducing the risk of pathological fractures and enabling safe return to sports activity.

A limitation of the present study is that it represents a single clinical case. Further studies involving larger groups of athletes are required to better understand the relationship between jaw bone lesions, craniofacial trauma and the risk of pathological fractures.

5. Practical implications for sports medicine

Early detection of pathological lesions of the jaw bones may represent an important preventive element in athletes exposed to craniofacial trauma. Diagnostic imaging performed before participation in high-risk sports disciplines may allow identification of asymptomatic lesions that could predispose to pathological fractures.

Appropriate surgical treatment combined with reconstruction of bone defects using modern biomaterials may contribute to restoration of bone strength and reduction of injury risk.

Such an approach may be particularly relevant in athletes participating in combat sports and other disciplines associated with increased exposure to craniofacial trauma.

6. Conclusions

Benign cysts and tumors of the jaw bones may significantly weaken bone structure and increase susceptibility to pathological fractures, particularly in individuals exposed to repetitive craniofacial trauma such as athletes.

Early diagnosis and appropriate surgical management are essential for preventing complications and restoring bone integrity.

Reconstruction of bone defects using biphasic calcium sulfate mineral biomaterials represents an effective method supporting bone regeneration and may contribute to improved clinical outcomes in oral and maxillofacial surgery.

References

1. Reehal P. Facial injury in sport. *Curr Sports Med Rep.* 2010;1:27–34 DOI: 10.1249/JSR.0b013e3181cd2c04
2. Viozzi CF. Maxillofacial and mandibular fractures in sports. *Clin Sport Med.* 2017;2:355–68. DOI: 10.1016/j.csm.2016.11.007
3. Audlin J, Tipirneni K, Ryan J. Facial trauma patterns among young athletes. *Craniofacial Trauma Reconstr.* 2021;3:218–23. DOI: 10.1177/1943387520966424
4. Kaczmarzyk T, Stypułkowska J, Tomaszewska R. Torbiele obszaru szczękowo-twarzowego [Cysts of the maxillofacial region]. Warszawa: Kwintesencja; 2009. Polish.
5. Omami G, Yeoh M. Cysts and benign odontogenic tumors of the jaws. *Dent Clin North Am.* 2024 Apr; 2: 277–95. DOI: 10.1016/j.cden.2023.09.004
6. Morgan PR. Cysts and cystic lesions of the jaws. *Current Diagn Pathol.* 1995;2:86–93. DOI: 10.1016/S0968-6053(00)80004-6
7. Tsuneki M et al. Combined immunohistochemistry for the differential diagnosis of cystic jaw lesions: its practical use in surgical practice. *Histopathology.* 2010;57:806–13. DOI: 10.1111/j.1365-2559.2010.03712

8. Ward JP, Magar V, Franks SJ, Landini G. A mathematical model of the dynamics of odontogenic cyst growth. *Anal Quantat Cytol Histol.* 2004;26:39–46.
9. Enislidis G, Fock N, Sulzbacher I, Ewers R. Conservative treatment of large cystic lesions of the mandible: a prospective study of the effect of decompression. *Br J Oral Maxillofac Surg.* 2004;42:546–50. DOI: 10.1016/j.bjoms.2004.06.020
10. Rao S, Rao S. Decompression as a treatment for odontogenic cystic lesions of the jaw. *J Oral Maxillofac Surg.* 2014;72:1231. DOI: 10.1016/j.joms.2014.03.035
11. Dreesman H. Ueber Knochenplombierung. *Beitr Klin Chir.* 1892;9:804.
12. Yahav A, Kurtzman GM, Katzap M, Dudek D, Baranes D. Bone Regeneration. Properties and Clinical Applications of Biphasic Calcium Sulfate. *Dent Clin N Am* 2020; 64: 453–72. DOI: 10.1016/j.cden.2019.12.006
13. Polmann H, Melo G, Conti Reus J, Domingos FL. Prevalence of dentofacial injuries among combat sports practitioners: A systematic review and meta-analysis. *Dental Traumatol.* 2019;36:124–40. DOI: 10.1111/edt.12508
14. Ansari U, Smith WP et al. Early return to sport post-maxillofacial fracture injury in the professional athlete: A systematic review. *J Craniomaxillofac Surg.* 2019;9:1323–330. DOI: 10/1016/j.jcms.2019.06.001
15. Stanbouly D, Murphy R, Murphy TX et al. Craniomaxillofacial injuries from the sport of wrestling: A query of the National Electronic Injury Surveillance System (NEISS). *Oral Maxillofac Surg.* 2022;3:393–400. DOI: 10.1007/s10006-021-01004-3
16. Baranes D, Kurtzman GM. Biphasic Calcium Sulfate as an alternative grafting material in various dental applications. *J Oral Implantol.* 2019;45(3):247–55. DOI: 10.1563/aaid-joi-D-18-00306
17. Dudek D, Reichman-Warmusz E, Kurtzman GM, Mahesh L. The use of grafting material biphasic calcium sulfate for the treatment of osseous defects resulting from radicular cysts. Clinical study and six-month follow up. *J Osteointegration.* 2020;3:1–6.
18. Machtei EE, Mayer Y, Horowitz J, Zigdon-Giladi H. Prospective randomized controlled Clinical trial to compare hard tissue changes following socket preservation using alloplasts, xenografts vs no grafting: Clinical and histological findings. *Clin Implant Dent Relat Res.* 2018;00:1–7.
19. Mayer Y, Zigdon-Giladi H, Machtei EE. Ridge preservation using composite alloplastic materials: a randomized control clinical and histological study in humans. *Clin Implant Dent Relat Res.* 2016;00:1–8. DOI: 10.1111/cid.12415
20. Dudek D, Warmusz O, Kurtzman GM, Reichman-Waqrmusz E. Treatment of a root cyst of the maxilla with endodontic microsurgery and grafting using biphasic calcium sulfate hardening cement: A case study. *Med Res Arch.* 2024;12:1–7. DOI: 10.18103/mra.v12i11.5701
21. Dudek D, Wałach K, Warmusz O, Reichman-Warmusz E. The using of biphasic calcium sulfate in two-stage treatment of odontogenic fibroma of the mandible – Case report. *Int J Clin Im Med Rev.* 2022;2:1–4. DOI: 10.55920/IJCIMR.2022.02.001075
22. Glendor U. Aetiology and risk factors related to traumatic dental injuries. *Dental Traumatol.* 2009;26(1):47–51. DOI: 10.1111/j.1600-9657.2009.00841.x
23. Boffano P, Roccia F, Zavatiero E. European Maxillofacial Trauma (EURMAT) project: A multi-centre study. *J Cranio-Maxill-Fac Surg.* 2015;43(2):254–9. DOI: 10.1016/j.jcms.2014.11.018
24. Levin L, Zadik Y. Oral and dental trauma in contact sports. *Dental Traumatol.* 2012;29(2):161–4. DOI: 10.1111/j.1600-9657.2011.01064.x

Author Contributions: Study Design, DD,AC, IP, LJ, OW, GW, and EK; Data Collection, DD,AC, IP, LJ, OW, GW, and EK; Data Interpretation, DD,AC, IP, LJ, OW, GW, and EK; Manuscript Preparation, DD,AC, IP, LJ, OW, GW, and EK; Literature Search, DD,AC, IP, LJ, OW, GW, and EK. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

Funding: Financing from own funds.

Institutional Review Board Statement: It was not necessary because it was not a research experiment.

Informed Consent Statement: After discussing the treatment plan, each patient signed an informed consent form before surgery procedure

Data Availability Statement: All data is available in the Artmedica surgery outpatient department database

Acknowledgments: Special thanks to Prof. Ewa Kłodzińska for her expert assistance in developing and writing this paper.