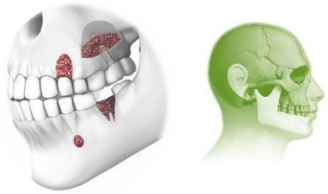
NORAKER®

THE BIOGLASS® COMPANY

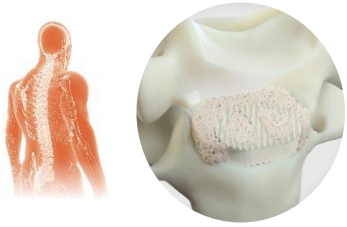
Summary of Safety and Clinical Performance (SSCP)

Surgeons version

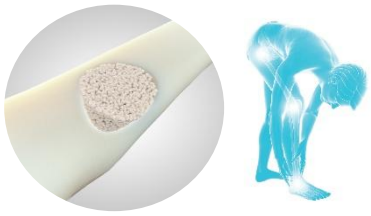
Granules Range



BiologicGlass
Bioactive Bone Substitute



GlassBone®
Bioactive Bone Substitute



AktiBone®
Bioactive Bone Substitute

This summary of safety and clinical performance is intended to provide public access to the main aspects of the safety and clinical performance of the device.

The summary of safety and clinical performance is not intended to replace the Instructions for Use as the main document to ensure the safe use of the device, nor is it intended to provide diagnostic or therapeutic suggestions to intended users or patients.

Version C.1 (EN) of this summary of safety and clinical performance has been validated by a notified body.

The following information is intended for users/healthcare professionals.

I. Device identification and general information

1. Brand name

GlassBone™ Granules

It is available in different volumes: 0.5cc, 1cc, 5cc, 10cc and 16cc and different granule sizes: 0.5-1 mm and 1-3 mm.

There are several other trade names (brands) under which the GlassBone™ Granules (GB) device is marketed: these devices are identical, only the name changes.

These brands are: AktiBone™ Granules (XAK-G), BiologicGlass™ Granules (XBG-G), MectaGlass™ (XMG), BioActys™ Granules (XBA), CicaGlass™ Granules (CIG-G), CareGlass™ Granules (CAG-G).

The volumes and granule sizes available are the same as GlassBone™ Granules.

GlassBone™ Granules (GB-G)	AktiBone™ Granules (XAK-G)	BiologicGlass™ Granules (XBG-G)	MectaGlass™ Granules (XMG-G)	BioActys ™ Granules (XBA-G)	CicaGlass ™ Granules (CIG-G)	CareGlass™ Granules (CAG-G)	Granule size	Volume
GB05.1/05-U	XAK-GM0.5	XBG-GM0.5	XMG-GM0.5	XBA-GM0.5	CIG-GM0.5	CAG-GM0.5	0.5-1 mm	0.5 cc
GB05.1/1-U	XAK-GM1.0	XBG-GM1.0	XMG-GM1.0	XBA-GM1.0	CIG-GM1.0	CAG-GM1.0		1 cc
GB05.1/5	XAK-GM5	XBG-GM5	XMG-GM5	XBA-GM5	CIG-GM5	CAG-GM5		5 cc
GB1.3/1-U	XAK-GL1.0	XBG-GL1.0	XMG-GL1.0	XBA-GL1.0	CIG-GL1.0	CAG-GL1.0	1-3 mm	1 cc
GB1.3/5	XAK-GL5	XBG-GL5	XMG-GL5	XBA-GL5	CIG-GL5	CAG-GL5		5 cc
GB1.3/10	XAK-GL10	XBG-GL10	XMG-GL10	XBA-GL10	CIG-GL10	CAG-GL10		10 cc
GB1.3/16	XAK-GL16	XBG-GL16	XMG-GL16	XBA-GL16	CIG-GL16	CAG-GL16		16 cc

When "GlassBone™ Granules" is cited in the document, this includes all the brands mentioned above.

2. Name and address of the manufacturer

Name: NORAKER®

Address: 60 avenue Rockefeller – 69008 LYON - France

Phone: +33 4 78 93 30 92

SAS CAPITAL 300 000 €

N° RCS Lyon 483 190 518

SIRET: 483 190 518 000 41

Intra-community T.V.A: FR74 483 190 518

Contact address for vigilance: vigilance@noraker.com

3. Unique manufacturer registration number

FR-MF-000000325

4. Unique Device Identifier (UDI-DI)

Basic UDI-DI for GlassBone™ Granules range of products is: 0376019113DT731M2 (control key: M2).

5. Nomenclature

GMDN: 16966 - Prosthesis, internal, bone, synthetic

EMDN: P900402 – IMPLANTABLE PROSTHETICS AND OSTEOSYNTHESIS DEVICES; ABSORBABLE FILLING AND RECONSTRUCTION DEVICES

Regulation 2017/2185 codes are: MDN 1102, MDT 2003, MDT 2006, MDT 2008, MDT 2011, MDS 1005 irradiation and MDS 1008.

6. Device class

This product is a medical device in accordance with Article 2 of Regulation 2017/745, class III according to the applicable classification rule 8 of Annex VIII to Regulation 2017/745.

7. Year of affixing of the first CE marking

The first affixing of the CE marking and placing on the market dates from 2008.

8. Agent, name and unique registration number

Not applicable

9. Notified Body, name and unique identifier number

Name: GMED

Unique Identifier Number: 0459

II. Destination of the device

1. Intended use of the device

GlassBone™ Granules is a synthetic and biocompatible bone substitute device (bioactive glass 45S5), intended for the filling, reconstruction and/or fusion of bone defects or gaps in the skeletal system, in orthopaedic, neurosurgery, cranio maxillo facial and otorhinolaryngology surgery.

2. Indications and target population

Loss or lack of bone substance for bone defects of traumatic, pathological or surgical origin when autologous solutions are not applicable or sufficient in orthopedics, neurosurgery, cranio maxillo facial and otorhinolaryngology surgery in adult and pediatric population (more than 10 kg):

- Fusion or reconstruction of deformities and degenerative diseases in spine
- Fusion or reconstruction of deformities and degenerative bone pathologies in orthopedic
- Filling and reconstruction of bone defects due to resection of tumors, cyst or infection and in case of prosthetic revision
- Filling after surgical bone defect (donor sites after removal of autograft, …)
- Filling after removal of cholesteatoma
- Filling and reconstruction due to maxilla and periodontium pathologies

*Note: GlassBone™ Granules can be used for filling any bone cavity after **surgical procedure** without direct indication and without having a direct therapeutic or diagnostic function themselves.*

Destination	Granular size		Population	Lifetime
	0.5 – 1 mm	1 -3 mm		
Spine		x	Adult & Child	12 months
Ortho		x	Adult	12 months
CMF	x		Adult & Child	12 months (pediatric population 9 months (adult population)
ENT	x		Adult	10 months

Table 1 : GlassBone™ Granules destinations

3. Contraindications and limits

GlassBone™ Granules must not be used:

- In case of chronic or acute infection not treated with appropriate therapy.
- In patients who have suffered severe trauma with external wounds open near the defect, which could become infected.
- In patients with a known allergy to bioactive glass or its constituents (Ca^{2+}, PO_4^{3-}, Na^+ and $Si(OH)_4$),
- In patients with pre-existing conditions or disease that may interfere with the good healing of tissues.
- In patients who have undergone or will undergo chemotherapy or radiation therapy at or near the site of implantation.
- In the irradiated bone (according to radiological criteria indicating osteonecrosis).
- To replace structures subjected to high mechanical stress.
- During severe renal and hepatic infections.
- In conjunction with a treatment known to affect the skeleton.
- In case of unsutured meningeal breach in cranio-spinal surgery.
- In neonatology service.

To date, we do not have any studies conducted in pregnant women or data related to use during breastfeeding. As a safety measure, the implantation of GlassBone™ Granules is not recommended during the periods of pregnancy and lactation.

III. Device description

1. Description

GlassBone™ Granules is a synthetic, resorbable and bioactive bone substitute with osteoconduction properties for filling bone defects in the skeletal system in adult and pediatric population (more than 10 kg).

- Composition: 45S5 bioactive glass granules

45S5 bioactive glass granules are only composed of elements naturally present in bone tissue (Calcium, Phosphate, Sodium, Silicon). The release of these ions during the resorption of bioactive glass will allow the formation on the surface of a layer of carbonate hydroxyapatite whose composition and structure are similar to the mineral phase of the bone. This layer provides GlassBone™ Granules an osteoconduction property and creates a strong link between granules and living tissues.

This medical device does not contain any medicinal substance or tissues of human origin.

The radio-opacity of GlassBone™ Granules makes it possible to discern bone substitute granules following their implantation. As the granule's resorption, the radio-opacity of the bone defect approaches that of the surrounding bone.

It is a single-use device.

Bone defects are consolidated in about 9 - 12 months (see table 1) and the bioactive glass granules are gradually resorbed. It should be considered that after 12 months; the device no longer fulfils its function even if the device is not totally degraded.

The current expiration date is 5 years after gamma sterilization.

The device is MR safe and sterile.

- Operating principles and mode of action

Implantation of GlassBone™ Granules is done after elimination of all soft and/or pathological tissue from the implantation site. Once the surgical site has been prepared, the blister is open as explained in instruction for use. GlassBone™ Granules can be mix with another constituent in sterile cup (saline serum, autologous bone from the implantation site and/or from another operating site, bone marrow, and/or patient blood). To perform the application of GlassBone™ Granules, the defect must have sufficient bone wall. The defect is completely fill using a sterile instrument without material compression (not apply excessive pressure to the defect) in the site nor blotting the blood/moisture in the positioned graft. GlassBone™ Granules maintains its volume it does not shrink or expand. It is recommended to avoid placing granules outside of the bone defect. It is necessary to remove them if it happens. Finally, it is recommended to avoid direct contact of GlassBone™ Granules with the skin.

After placement of GlassBone™ Granules, ensure the primary closure of the soft tissues at the graft site. Resorbable or non-resorbable membranes can also be used for the closure. The closure of the operative site depends on the surgery performed and the surgical site (membrane, sutures, etc.). An adequate closure of the graft site is mandatory (e.g., with cortical bone window, collagen membrane, mucosal-periosteum flap, fascia or muscle flap).

To note GlassBone™ Granules does not have sufficient mechanical strength to withstand load bearing before hard tissue is formed. When used in load bearing areas, standard internal or external stabilization techniques should be followed to achieve rigid stabilization in all planes. It is necessary to follow the usual post-operative treatment and rehabilitation procedures associated with bone grafts.

After implantation the interstitial spaces between the granules allow fluid circulation and cellular and vascular colonization. The resorption of bioactive glass will allow the formation on the surface of a layer of carbonate hydroxyapatite, which composition and structure are similar to the mineral phase of bone, preventing graft rejection. This layer gives the granules their osteoconduction property and makes it possible to create a link between the granules and the living tissues. Following the carbonate hydroxyapatite layer reactions, bone growth continues, and bioactive glass continues to degrade and serves as a scaffold for bone regeneration.

2. Reference to previous model(s) and description of changes

There is no previous model for this device.

3. Description of accessories intended for use with the device

No accessories are used with our device.

4. Description of other devices intended for use in combination with the device

No accessories or compatible devices are sold with GlassBone™ Granules.

However, when implanted GlassBone™ Granules can be mix with another constituent in sterile cup (saline serum, autologous bone from the implantation site and/or from another operating site, bone marrow, and/or patient blood[1]).

[1] Based on clinical data

IV. Risks and warnings

1. Residual risks and adverse effects

The residual risks of the device itself, i.e., the risks remaining after the implementation of the risk management measures, concern the allergic risks, 0.001% have been found since the launch on the market. To date, no adverse effects directly related to the device are reported or detected.

Post-surgical symptoms (pain, redness, inflammation, oedema, hematomas, seroma, swelling, bleeding, ...), postoperative infection, recurrence/residual disease, otorrhea, pulmonary embolism, vein thrombosis, wound leakage, nerve palsy or paresthesia, mechanical failure, delay in consolidation, loss of fracture reduction, fusion failure, fracture, loss of bone graft, protrusion of the graft. These complications are the same as those that can occur with autologous bone grafting (see part 6. Other therapeutic solutions).

Possible adverse event is not more severe than those expected of similar products if the instructions are followed correctly by a qualified surgeon familiar with bone grafting techniques.

Device-related complications	Frequency of occurrence	Source
Allergy to the constituents of the device	Not detected to date out of 47,926 sales	PMS and available clinical data
Surgical adverse event	Not more than those expected of similar products	

The profit/risk ratio is positive since the benefit is greater than the risk with an acceptable residual risk.

2. Warnings and Precautions

GlassBone™ Granules should be used by qualified surgeons (orthopaedists, neurosurgeons, maxillofacial surgeons, stomatologists and otorhinolaryngologists) trained in bone grafting and fixation techniques who have read these instructions for use.

Regarding the surgical procedure

- The general principles of asepsis and patient medication must be observed when using GlassBone™ Granules.
- GlassBone™ Granules does not substitute antibiotic therapy treatment during infection.
- The combination of any drug substance with GlassBone™ Granules during implantation is the responsibility of the surgeon.
- Manipulate GlassBone™ Granules with a surgical instrument to avoid piercing surgical gloves.
- It is advisable to revive the recipient site before implantation.
- Completely fill the defect with GlassBone™ Granules. It is possible to perform the application of GlassBone™ Granules if the defect has sufficient bone wall.
- Avoid placing granules outside of the bone defect. Remove them if necessary.
- Avoid direct contact of GlassBone™ Granules with the skin.
- If it moves/migrates, the bioactive glass can cause wear of the joints and interfere with movement. Prevention of movement and granule migration is essential for proper bone formation.
- Do not apply excessive pressure to the defect. Excessive pressure may cause embolization of fat in the bloodstream.
- GlassBone™ Granules maintains its volume that is to say it does not shrink or expand.
- GlassBone™ Granules does not have sufficient mechanical strength to withstand load bearing before hard tissue is formed. When used in load bearing areas such as mandible fractures, standard internal or external stabilization techniques should be followed to achieve rigid stabilization in all planes.
- It is necessary to follow the usual post-operative treatment and rehabilitation procedures associated with bone grafts.
- The closure of the operative site depends on the surgery performed and the surgical site (membrane, sutures, etc).
- An adequate closure of the graft site is mandatory (e.g., with cortical bone window, collagen membrane, mucosal-periosteum flap, fascia or muscle flap).

Regarding the medical device

- GlassBone™ Granules is a device that resorbs over time to make way for regenerated bone. There is currently no clinical study available that demonstrates complete resorption of the granules.
- This device does not harden like cement.
- GlassBone™ Granules is a sterile disposable device and must never be re-sterilized or reused. Reuse may cause contamination and impairment of bone substitute performance.

3. Other aspect of security, if applicable

GlassBone™ Granules has been subject to one FSCA in July 2020 (registered in ANSM under reference: R2010145)

NORAKER® launched a voluntary recall to withdraw lot GB1906004 of synthetic bone substitute GlassBone™ Granules GB05.1/5 (0.5-1mm-5cc) from the market, following an error in packaging. Indeed, the labels of the devices indicated GlassBone™ Granules 0.5-1mm (GB05.1/5) but the blister packs contained larger granules GlassBone™ Granules 1-3mm (GB1.3/5).

27 boxes have been recalled, 8 boxes have been destroyed and 10 devices had been already implanted.

No health risk has been identified because GlassBone™ Granules GB1.3/5 (1-3mm- 5cc) can be used in the same indications as GlassBone™ Granules GB05.1/5 (0.5-1mm- 5cc) i.e. in orthopedic surgery, spine and CMF/ENT to fill, reconstruct and/or fuse bone defects.

So, no additional action had been required for practitioners who had used this batch of bone substitutes, other than the usual post-operative follow-up.

This FSCA have been closed on the 30, July 2020.

V. Summary of Clinical evaluation and Post-Market Clinical Follow-up (PMCF)

1. Summary of clinical data on equivalent devices, if applicable

GlassBone Granule™ – Gamma irradiation sterilized is claimed equivalent to GlassBone Granule™ – Ethylene oxide sterilized, produced by the same manufacturer: NORAKER® with only a change of sterilization mode, and an intended use for the same indications.

A. PMCF Follow-up

Following the implementation of a post-market clinical follow-up study, 6 studies have been completed with GlassBone Granules™ (EtO sterilized):

a) Spine

i. **Indications – Spinal pathologies**

- Surgery

GlassBone Granules™ were used in spinal pathologies. The procedure was aimed at promoting fusion and improving patient outcomes in degenerative disc diseases and other spinal conditions.

- Method

This is a retrospective study conducted at CHU St Etienne, involving 127 patients, representing 130 cases. The study aimed to confirm the safety and tolerability of GlassBone Granules™ under its normal conditions of use in spinal pathologies. The follow-up period ranged to 6 to 12 months.

- Results

The majority of patients had degenerative disc disease and in 42% of cases, GB-G was used mainly for posterior fusion.

- Performance - Pain was thus improved for 90% of patients and fusion was acquired for 91% of patients, partial fusion for 5% and 5% of non-union.
- Safety - Immediate post-surgery complications during the hospital stay were noted: 1 infection (0,8%), 3 mechanical (2,4%) and 2 neurological (1,6%). Complications during clinical follow-up were identified: 4 surgical site infection and 3 mechanical complications (material expansion/replacement) at 2 months and only 1 mechanical complication at 6 months. These complications were not related to the substitute. No adverse event was noted at 12 months.

- Conclusion

The study demonstrates the safety and tolerability of GBG in spinal pathologies. The material showed no direct association with complications, and favorable outcomes were observed with a high fusion success rate (91%) and significant pain improvement in 90% of patients.

ii. **Indications – Spine deformities: Adolescent idiopathic and non-idiopathic scoliosis**

- Surgery

Surgical treatment of idiopathic scoliosis in children and adolescents by posterior vertebral instrumentation, arthrodesis and fusion of the instrumented segments with the GlassBone Granules™ (GlassBone-G). Pr Courvoisier: Published.

- Method

A retrospective and monocentric study (grade C) was to conduct at CHU Grenoble (France) to confirm the performance and tolerability of the GlassBone G device in posterior thoracolumbar spinal fusion for the

treatment of pediatric scoliosis. GlassBone G is used for fusion of the instrumented vertebrae allowing consolidation of the instrumentation after surgery. The safety and bone fusion are evaluated.

- Results

23 pediatric patients, all operated by Prof. Courvoisier, were included in the study. The average age was 14.9 ± 3.1 years [3 - 19] with a distribution of 12 women (52.2%) and 11 men (47.8%).

- Performance - At the last postoperative follow-up [12-24 months], all patients (n=23) had an acquired fusion. No pseudoarthrosis was found during follow-ups. The reduction in Cobb angle for the included patients is significant ($p<0.05$). The loss of correction is 1,7 ± 4,9° and 2 ± 4,4° for the 3-6-, 12/24-months postoperative follow-ups compared to the immediate postoperative radiograph measurements (no significant difference).
- Safety - Before 6 months, there were two surgical site infections that required surgical revision for lavage (at 2 months post-op) and there was 1 internal bleeding. At the final follow-up, 1 patient had PJK with kyphosis at the top of the highest instrumented level. GlassBone G was well in place during revision. All these adverse events are related to the surgical practice and not to the device.

- Conclusion

The results of this study showed that the use of bioactive glass in posterior fusion, when combined with proper surgical planning, hardware placement and correction, is effective in providing good clinical and radiological outcomes. The performance and safety of GlassBone Granules™ are demonstrated.

iii. Indications – Degenerative diseases, trauma, or spinal deformities in the lumbar or cervical spine

- Surgery

Spinal surgery of degenerative painful segments is a valuable treatment option in the management of chronic cervical and low back pain. The surgery consists in stabilizing and fusing painful vertebral segment(s).

- Method

A post market, retrospective, observational and monocentric clinical study was conduct in Hospital Pierre Wertheimer (69) to confirm the performance and tolerance of the GlassBone Granules™ device. This study assesses GlassBone Granules™ (GB-G) synthetic bone substitute in real life and aims to provide sufficient evidence of the device's clinical performance and safety.

- Results

100 patients who had undergone spine surgery with GlassBone Granules™ bioactive glass between September 2019 and September 2021 for reconstruction of deformities and degenerative diseases were included. The population represented 48 women (48%) and 52 men (52%). 19% of patients underwent surgery for cervical pathology and 81% for lumbar pathology. The pathologies concerned are 45% discopathies, 40% deformations, 11% traumas and 4% tumors.

- Performance - Pain was improved at 12 months in 85.6% of patients and bone fusion at 12 months in 96% of patients. Performance was confirmed with a good fusion rate.
- Safety - A total of 24% of complications were found in a population of 24 patients of which only 6 were under 65 years of age. Safety was confirmed because no serious adverse events occurred and adverse events which was detected were not related to the device.

- Conclusion

The results of this retrospective study suggest that the 45S5 BAG may be an interesting alternative option to autologous graft, in terms of safety and bone fusion efficiency. The performance and safety of GlassBone G were confirmed.

b) ENT

i. Indications – Mastoid obliteration after cholesteatoma resection

- Surgery

The surgical technique involved mastoid obliteration using GlassBone Granules™ after cholesteatoma resection. This approach aims to fill the mastoid cavity and support proper healing, ensuring stability and minimizing the risk of recurrence.

- Method

This was a clinical study conducted at Clinique Causse (42) designed to confirm the safety and performance of GlassBone Granules™ (GB-G) under its normal conditions of use. Patients were monitored over 10-month follow-up period.

- Results

A total of 87 patients were enrolled in this study; the average age is 49.8 years with a distribution of 37 women and 50 men.

- Performance - During the follow-up period cholesteatoma recidivism was observed in 2% of the patients (2 patients). Overall, both air conduction thresholds and air bone gap were slightly lowered when comparing post-operative values to pre-operative values.
- Safety - There was no extrusion of bioactive glass material no complications occurred due to the bioactive glass material. 65% of patients had none post-operative complications. Complications were vertigo, intermittent Otorrhea, persistent Otorrhea, EAC healing delay, EAC stenosis, infection with retroauricular fistula, secondary facial paresis, cerebrospinal fluid in perioperative time. No allergy was noted. All these adverse events are related to the surgical practice and not to the device GlassBone Granules™.

- Conclusion

The study confirmed the safety and performance of GlassBone Granules™ for mastoid obliteration following cholesteatoma resection. Complications observed were associated with surgical practice rather than the material itself. The low recurrence rate of cholesteatoma and the absence of material extrusion or allergies highlight the reliability and effectiveness of GB-G.

c) Orthopaedic

i. Indications – Filling after tumor resection

- Surgery

GBG were used to fill bone defects following tumor resections. The material was applied post-resection to support healing and consolidation of the affected area.

- Method

This is a retrospective study that was conducted in June 2022 including 36 patients who undergone tumor resection. The mean follow-up period was 22 months (ranging from 6 to 58 months). The study aimed to evaluate the performance and safety of GlassBone Granules™ in promoting consolidation and healing.

- Results

- Performance – 78% of patents achieved consolidation or showed partial progress accord the Neer classification. The healing rate was 100%, meeting performance criteria.
- Safety – No fractures were reported during the follow-up period and no complications occurred after surgery.

- Conclusion

The study confirmed the safety and performance of GB-G in bone defect management after tumor resection. The absence of complications and the 100% healing rate demonstrate the material's reliability and effectiveness in promoting consolidation.

ii. Indications – Osteomyelitis

- Surgery

AktiBone bioactive glass granules (45S5) were used to fill bone defects after debridement of osteomyelitis, mainly localized in the femur (48.3%) and tibia (12.6%). The procedure was performed as a one-stage surgery without the need for a second operation or autologous graft harvesting from the iliac crest, making it a cost-effective and efficient approach for osteomyelitis management.

- Method

This is a retrospective study with 87 patients who underwent osteomyelitis surgery and grafted with AktiBone bioactive glass granules between January and December 2021. Data from clinical follow ups including bone remodeling, maintenance of bone volume and side effects (complications and recurrence) were analyzed. The safety and performance of bioactive glass have been evaluated. Patients were also treated with antibiotics until 4 months post-surgery.

- Results

The population represented 39 women (77.8%) and 48 men (55.2%). The average age at the time of surgery was 52.4 years old. The main isolated pathogen is *Staphylococcus aureus* (64.4%). According to Cierny–Mader classification, anatomic osteomyelitis is type 3 (localized osteomyelitis- 62.1%) and 4 (diffuse osteomyelitis- 37.9%).

- Performance – All patients are safe of their osteomyelitis at 4 months and 12 months. Bone remodeling and defect healing were successful for all patients. AktiBone G provided an effective alternative to autografts and allografts for reconstructive procedures following curettage of infected bone.
- Safety - No immediate post-surgery complications during the hospital stay were noted. No recurrence of osteomyelitis occurred during clinical follow-up. No extrusion of bone substitute occurred. The procedure was well tolerated by all patients.

- Conclusion

The study demonstrated that AktiBone bioactive glass granules are safe and effective solution for managing osteomyelitis. The one-stage procedure eliminates the need for autologous graft harvesting or secondary operations, offering a cost-effective and rapid treatment method. AktiBone G supports successful bone remodeling and provides a long-term solution for reconstructive procedures, making it a well-tolerated and reliable option for patients with osteomyelitis.

B. Data from literature

Currently, the device GlassBone Granules™ (EtO sterilized) is found in 18 publications:

a) Orthopaedic

(Aytekin et al., 2020). Comparison of the Results of GlassBone and Tricalcium Phosphate Graft Used in Bone Tumors. AOT Journal (2020) 53(2):pp 332-336.

- **Surgery**

Patients with benign bone tumors, primarily simple bone systs (SBC) and aneurysmal bone cysts (ABC), were treated with either 45S5 bioactive glass or tricalcium phosphate (TCP) grafts. The procedure involved filling bone defects created after tumor excision, and no graft harvesting from a donor site was required.

- Methods

This retrospective study analyzed 41 patients with benign bone tumors treated between 2013 and 2015. Patients were divided into two groups as those treated with BG (45S5 bioactive glass) and TCP grafts. Graft consolidation was evaluated radiologically with x-rays monthly. The study focused on evaluating consolidation time, residual cyst occurrence, infections and the need for revision surgery.

- Results (performance and safety)

For GlassBone group:

- ⇨ **Residual cysts:** 2/22 patients (9.09%) had residual cyst and required revision surgery.
- ⇨ **Infections:** None observed
- ⇨ **Consolidation:** Faster radiological consolidation compared to TCP group, observed between 14-16 months (p=0.0001)

For TCP group:

- ⇨ **Residual cysts:** 1/19 patients (5.26%) required revision surgery with the same graft
- ⇨ **Infections:** 1-19 patients (5.26) experienced infection.

- Conclusion

The study highlights the superior performance of 45S5 bioactive glass compared to tricalcium phosphate in treating bone tumors. GlassBone demonstrated faster radiological consolidation and no cases of infection, making it a safe and effective alternative. Additionally, the absence of the need for graft harvesting further supports its use as a reliable and efficient option for bone defect management in tumor surgeries.

(Tetzel & Guyard, 2021) – Saving the lower limb with GlassBone - Successful surgical revision of pseudarthrosis after infected open proximal tibia fracture type IIIC with bioactive glass grafting - A case report. Trauma Case Rep (2021)31.

- Surgery

The patient, a 51-year-old male who suffered an open proximal tibia fracture (type IIIC) of the left leg after a motorcycle accident. Patient was admitted in January of 2013 to a general orthopedic department for a series of surgical surgeries:

- Immediate surgery consisted of an open reduction and internal plate fixation (lateral LCP, antero-lateral approach) along with vascular bypass of the popliteal artery. The postoperative phase was complicated by severe wound healing disorder, leading to septic osteitis with skin necrosis and bone exposition in March 2013. This necessitated several additional surgeries
- The final treatment consisted of a two-step Masquelet therapy followed by auto- and GlassBone-grafting and plate fixation. The bone defect was filled with extensive auto- and allograft (Iliac crest, GlassBone) within the borders of induced membrane and fixed via medial LCP (locking compression plate).

- Methods

This case report involved clinical and radiological follow-up at 1, 3, 4, 6, 10 and 27 months postoperatively to assess bone consolidation, graft integration (autograft and GlassBone), functional recovery (weight-bearing progression and pain assessment) and signs of infection or material loosening.

- Results

- Performance – Progressive weight-bearing was initiated at 15 kg and increased by 10 kg weekly. During the following clinical controls, (3, 4, 6, and 10 months postoperatively) the patient showed an excellent clinical evolution. Radiological findings showed progressive graft homogenization and bone consolidation beginning at 1 month postoperatively.
  At 10 months radiographs showed successful consolidation without pain or restriction in daily activities.
  At 27 months radiographs and CT scans revealed complete transformation of GlassBone into native bone, with perfect consolidation and no signs of material loosening.
- Safety – No postoperative infections and bacteriological samples and PCR analysis were consistently negative. Radiographically there was no material loosening or secondary displacement observed. There was no deformity or axial misalignment.

- Conclusion

This case report highlights the successful use of GlassBone Granules™ in combination with autografts for treating a severe open tibia fracture complicated by septic osteitis. The patient experienced good clinical evolution with pain-free mobility ad full consolidation achieved by 27 months. GB-G demonstrated effective integration, providing a reliable and durable solution for reconstructive procedures in complex cases.

Mora-Zúñiga A, Cárdenas-Arellano F, Cruz-Munguía JD, Hernández-Carrillo JE. Osteomielitis crónica de tibia; uso de vidrio biactivo como complemento de tratamiento. Acta Ortopédica Mexicana, 2021 Oct.

- Surgery

The patient a 42-year-old male with chronic tibia osteomyelitis (classified as type IV B by Cierny-Mader), underwent a two-stage surgical treatment:

- First stage: Extensive bone and soft tissue debridement, placement of cement beads medicated with amikacin in the medullary cavity and osteoclast system for irrigation with vancomycin.
- Second stage: Free fibular bone grafting, fixation and stabilization with screws, bioactive glass placement in areas of interface between stabilized fibula and posterior tibial cortex

- Method

This case report focuses on the surgical management of chronic tibia osteomyelitis, with sequalae of previous surgical interventions and multiple antibiotic treatments. The patient was evaluated at multiple stages post-surgery. At one month to check the wound healing, infection signs and graft integration, 3 months to evaluate weight-bearing capacity and functional recovery and 12 months to assess long-term outcomes and functional recovery.

- Results

- Performance – At 1 month the patient showed complete movement range, with muscle hypotrophy and no infection signs. The graft was in the integration phases without material instability.
  At 3 months, the patient was able to walk without support. Radiography showed successful osseointegration of the fibula into the tibia and laboratory tests returned to normal.
  At 12 months, the patient had no evidence of infection and regained 90% of the function in the affected limb.
- Safety – No signs of infection were observed at any follow-up stage. Surgical wounds healed cleanly with no complications. The fistulas closed, and no signs of instability in the osteosynthesis material were found at 1-month radiography.

- Conclusion

This case highlights the effective use of bioactive glass in combination with free fibular bone grafting to treat chronic tibia osteomyelitis. The two-stage surgical approach allowed for the successful integration of the graft and the restoration of limb function. The patient showed excellent recovery with no infection and regained most of the function in the affected limb by 12 months.

(Gravina_2022) Gravina P, De Francesco F, Pangrazi PP, Marchesini A, Neuendorf AD, Campodonico A, Gigante A, Riccio M. A case report of upper limb loss of substance: Use of functional gracilis free flap, brachioradialis transposition and bioglass for bone regeneration. Trauma Case Rep. 2022 Jan 31

- Surgery

The patient a 27-year-old male with complex upper limb trauma and loss of a proximal third of the posterior forearm structure as well as loss of active finger extension, ulnar and radial nerve territory anesthesia and ulnar fracture. The patient underwent several surgeries:

- Initial surgery: A fixation of the ulnar bone by external fixator.
- 6 days later: A debridement, fasciotomy of dorsal hand was performed, and Negative Pressure Therapy was applied on the wound at the distal third of forearm.
- 45 days later: A composite nerve-tendon-muscle-skin gracilis free flap was harvested from the contralateral leg, related to tendon transfer, to supply active hand extension.
- 6 months after surgery: The ulnar fracture was affected by pseudoarthrosis. Bioactive glass was implanted in the site of the bone defect previously prepared with a biologic camera.

- Method

This case report evaluates the outcomes of a multi-stage surgical intervention in a patient with complex upper limb trauma, including nerve, tendon, muscle and bone damage. The follow-up periods were 3 months and 5 months to monitor the patient and 12 months to measure the functional recovery and clinical outcomes.

- Results

- Performance – At 3 and 5 months, satisfactory outcomes in the injury site. After one-year follow-up, there were optimal clinical outcomes including significant recovery in finger, thumb and wrist flexion.
- Safety – The surgeries were performed without complications at the surgical sites. There were no signs of infection observed at any follow-up stage.

- Conclusion

This case report demonstrates the successful use of bioactive glass to treat a complex upper limb injury with pseudoarthrosis after ulnar fracture. The multistage approach, including tendon transfer and bioactive glass implantation, led to satisfactory functional recovery and significant improvements in limb mobility, particulary finger and wrist flexion. The patient achieved clinical optimal outcomes after one year.

(Gravina_2022) Gravina P, De Francesco F, Pangrazi PP, Gigante A, Riccio M. A Large Osteoid Osteoma of Trapezium: A Regenerative Approach and a Review of Literature. Journal of Hand Surgery Global Online. 2022 Sept

- Surgery

The patient, a 19-year-old male, presented with a rare large osteoid osteoma (1.3 cm) in the trapezium of the right hand causing persistent and dull pain localized at the thumb basal joint for one year. The patient underwent filling and reconstruction surgery: enucleation of the nidus (curettage) and filling the bone defect with bioactive glass mixed with fresh blood.

- Method

This case describes the surgical treatment and follow-up of a large osteoid osteoma in the trapezium of a young patient. The patient was evaluated using various clinical examination tests, including VAS score, Pinch test, Kapanji scores and Michigan Hand Outcomes Questionnaire. Follow-up periods were at 60 days and 12 months after surgery.

- Results

- Performance – At 60 days post-surgery all clinical examination tests improved significantly ($P < 0.05$) with VAS score at 0 (no pain) Pinch test improved at 20 kg, Kapanji scores at 9 and the brief Michigan Hand Outcomes Questionnaire global score (showed subjective evaluation of the functional and aesthetic outcomes) was slightly significantly better at 60 days after surgery (70.83%).
  At 12 months post-surgery, there were no recurrence of osteoid osteoma, and continued improvement in clinical outcomes.
- Safety – The surgery was performed without complications and no recurrence of the osteoid osteoma was observed. No adverse events were noted during the follow-up period.

- Conclusion

The patient achieved excellent clinical outcomes with complete pain relief, improved hand function, and no recurrence after 12 months. This regenerative approach proved to be an effective treatment for this condition.

(Cuvillier at al., 2022) Masquelet's induced membrane technique associated with Reamer Irrigation Aspiration grafting and intramedullary Nailing (MaRIAN) for chronic diaphyseal osteomyelitis of the lower limb. *Orthopaedics and Traumatology: Surgery and Research* (2022).

- Surgery

The first surgical stage consisted of bone resection in the healthy zone and use of a gentamicin cement spacer to fill the bone defect. The second stage consisted of the placement of a statically locked intramedullary nail associated with a bone autograft using the RIA technique.

- Methods

This case series evaluates the outcomes of 12 patients (9 with tibial osteomyelitis, 2 with femoral osteomyelitis and 1 with knee non-union), all of whom underwent surgery for chronic diaphyseal osteomyelitis. 8 patients had a transplant by RIA alone. In 4 patients, the graft was associated with an osteoinductive protein (Osigraft, Olympus, USA), or mixed with a bone substitute (GlassBone™, Noraker®, Lyon, France) in a patient. The mean bone defect was 7.3 cm (± 6.7). The follow-up was a minimum of 18 months with an average of 5 years.

- Results

- Performance – Corticalization appeared on average after 1.6 months (range, 1–3 months) and complete callus was obtained after 9.1 months postoperatively (range, 3–36 months). Complete consolidation of the bone defect was achieved. Despite the statistical weakness related to the size of the cohort, the resumption of early weight bearing and nail dynamization seemed to have an impact on the formation of complete consolidation.
- Safety – No infectious recurrence was observed at follow-up. All patients underwent successful bone stabilization and autograft integration without complications

- Conclusion

This short series, compared to the literature, demonstrated that the proposed technical modifications improved the overall management of this rare and challenging condition while maintaining the reliability of the original technique.

(Ilyas, 2022) İlyas G, Kaya A, İncesu M. Is a Bioceramic Glass Bone Graft Superior to Spongious Allografts in Femoral and Tibial Benign Bone Lesions? J Tepecik Educ Res Hosp 2022;32(1):122-30

- Surgery

The treatment consisted in curettage-grafting surgery for patients with benign tumor in long bones whose measurements are between 7 and 150 cm and average volume of 43.15 cm^3. The main follow-up was 16 months [6-48]. No additional graft harvesting was required for either group.

- Method

47 patients (19 men and 28 women) were randomized to receive either human-induced cancellous graft (29 patients) or bio ceramic glass graft (18 patients). The main follow-up period lasted 16 months with a range of 6 to 48 months.

- Results

- Performance - At the end of follow-up, the average pain score, according to VAS, over 10, was found as 1.07 ± 0.96 in human-induced cancellous graft group while the GlassBone group was 1.0 ± 0.84. The average lower extremity function score percentage (LEFS score) was 93.75% ± 3.67% in human-induced cancellous graft group while it was 94.51% ± 3 in GlassBone group. The average consolidation ratio at the end of follow-up was found as 82.58% ± 15.55 (35-98) in human-induced cancellous graft group, while 93.78% ± 3.67 was found in GlassBone group (87-99).
- Safety – No complications were noted for either group

- Conclusion

The results of this study suggest that GlassBone provides superior bone consolidation compared to human-induced cancellous graft for benign bone lesions in the femur and tibia. Both grafts demonstrated similar outcomes in terms of pain relief and lower extremity function, but GlassBone showed a significantly higher consolidation ratio at the end of the follow-up period. Additionally, no graft harvesting was needed for either group, ensuring a more straightforward procedure for patients.

(Mathieu,2025) Mathieu L. Masquelet technique including a multiperforated non-vascularized fibula graft for the reconstruction of massive post-traumatic bone defects in military practice. European Journal of Trauma and Emergency Surgery. (2025)

- Surgery

Reconstruction of massive post-traumatic long-bone defects (femur, tibia, humerus) using the Induced Membrane Technique (Masquelet technique) combined with a multiporated non-vascularized fibula graft (NVFG). The membrane cavity was filled with autologous cancellous bone graft supplemented with either allograft or bioactive glass (GlassBone™ Granules). Procedures were performed either in optimal military medical facilities or in austere forward surgical units.

- Method

This retrospective case series included 9 patients (8 men and 1 woman; mean age 37 years) with massive post-traumatic long-bone defects involving more than one-third of the bone length.
Treatment followed the standard IMT protocol:

1. T0: initial debridement and temporary stabilization
2. T1: PMMA spacer placement and soft-tissue management if needed.
3. T2: performed after an average interval of 15 weeks, consisting of definitive internal fixation, implantation of multiperfored NVFG and filling of the membrane cavity with autograft + allograft (Biobank®) or GlassBone™ Granules (mean substitute proportion 31%)

Outcomes measures included bone union, time to union, healing index and functional scores (LEFS or Quick-DASH). The mean follow-up was 20 months.

- Results

- Performance – At final follow-up, bone union was achieved in 8 out of 9 patients (89%), with a mean time to union of 8.1 months. The healing index averaged 0.58 months/cm, indicating efficient progression of consolidation despite the large defect sizes (mean 14 cm, 190 cm^3). Functional outcomes were favorable with a mean LEFS score of 68% and all patients were able to return to work, although some required reassignment due to joint fusion.
- Safety – No recurrent infections were reported at the end of follow-up, including among the five patients who initially presented with infected defects. Only one complication was observed: a persistent nonunion in a humeral defect with a positive intraoperative culture at T2. No safety concerns were associated with the use of the bone substitute, including GlassBone™ Granules.

- Conclusion

This study suggests that the Masquelet technique combined with a muliporated non-vascularized fibular graft provides effective reconstruction of massive long-bone defects, even in austere military environments provided that infection control is achieved. The use of autograft supplemented with GlassBone™ Granules was shown to be safe and supported successful bone healing in these complex reconstructive cases.

b) Spine

(Barrey et al., 2019) Barrey 2019: Clinical and radiographic evaluation of bioactive glass in posterolateral cervical or lumbar spinal fusion. European Journal of Orthopedic Surgery & Traumatology. (2019).

- Surgery

All patients underwent posterior spinal fusion in either the cervical or the thoraco-lumbar spine. The procedure included appropriate decompressive surgery was performed with subsequent fixation using posterior instrumentation as appropriate and filled with bioactive glass. GlassBone Granules™ (1 – 3 mm) were mixed with local autograft harvested from the surgical site and blood.

- Method

This study included 30 consecutive patients with indications for a posterolateral spinal fusion procedure were operated by the author and consecutively included in the study. Multi-level fusions represented most of the cohort with 43% of patients with more than seven levels treated.

- Results

- Performance - Radiographic imaging demonstrated excellent fusion rates (93%) at final follow-up, equivalent to the outcomes reported in the literature for autogenous bone, with excellent bone bridging and no spinal implant loosening. Additionally, 90% of the patients demonstrated recovery at 1 year after surgery with a pain reduction of 60%.
- Safety – No implant loosening was observed. Only two cases of non-union were encountered and resorption was observed on all CT-Scan.

- Conclusion

This study confirms that the use of bioactive glass mixed with local autograft is an excellent alternative to autologous graft. No changes were required to the standard surgical techniques for either approach or fixation method, and the results at 6 and 12 months from this treatment of degenerative or trauma spine disorders with respect to pain, neurological status and function were highly encouraging.

(Courvoisier et al. 2023) Courvoisier A, Maximin M-C, Baroncini A. Safety and Efficacy of Stand-Alone Bioactive Glass Injectable Putty or Granules in Posterior Vertebral Fusion for Adolescent Idiopathic and Non-Idiopathic Scoliosis. Children 2023, 10, 398.

- Surgery

43 patients with scoliosis underwent posterior fusion with posterior instrumentation. Two groups were included one receiving GlassBone Granules™ and one GlassBone Injectable Putty.

- Method

18 patients underwent surgery using GlassBone Granules™ (1-3mm) and 25 using GlassBone Injectable Putty. Each patient's last follow-up was performed at 24 months and included clinical and radiological evaluations.

- Results

For GlassBone Granules™ group:

- ⇨ The mean aged is 15.7 ± 1.7 [13–19].
- ⇨ 9 patients had adolescent idiopathic scoliosis, 7 patients had neurologic scoliosis and 2 had neuromuscular scoliosis.
- ⇨ 78% received 10 cc of GB-G (1-3 mm) and 22% received 20 cc.

- Performance - At the latest follow-up, bony fusion was documented in all patients (100%). Cobb angle measurements reflected a significant reduction in spinal deformity. No significant loss of correction occurred between the immediate post-operative examination and the 24-months. There was no sign of non-union, screw loosening, implant displacement or rod breakage.
- Safety - Four of all operated patients (GB-G and Putty) experienced adverse events. 2 patients (4.7%) had surgical site infection which was treated with revision and cleaning, and 1 patient had an extended stay in the intensive care unit (2.3%). All these adverse events were due to surgical intervention. No other causes were identified. 1 case (2.3%) of late mechanical complications was observed 24 months after surgery. Surgical revision was performed, and the instrumentation was removed.

- Conclusion

The results show that the massive use of bioactive glass in posterior fusion, when combined with proper surgical planning, hardware placement and correction, is effective in providing good clinical and radiological outcomes.

c) CMF

(Adam et al. 2016). Adam S, Sama HD, Dégardin N, Gallucci A, Bellot-Samson V, Bardot J. The gingivo periosto plastic surgery with osseous substitute: technique and first results. Annales Chirurgie Plastique Esthetique (2016). Vol 61, numéro 4, 257-62.

- Surgery

This study included 23 cases of gingivoperioplastic surgery using GlassBone Granules™ (0.5-1mm) for cleft patients.

- Methods

This retrospective study was conducted since January 2012 to December 2012. The follow-up duration was 18 months.

- Results

Age distribution:

- ⇨ 4-6 years: 6 patients
- ⇨ 7-9 years: 9 patients
- ⇨ ≥10 years: 8 patients

Cleft lip:

- ⇨ Unilateral clefts: 17 cases
- ⇨ Bilateral clefts: 6 cases
- ⇨ Narrow clefts: 18 cases
- ⇨ Wide clefts: 5 cases

GlassBone volume used:

- ⇨ ≤ 1 cc: 20 patients
- ⇨ ≥ 1 cc: 3 patients

- Performance – The surgical technique was described as simple and effective. We observed less morbidity of the operating site. Globally satisfactory outcomes were observed.
- Safety - At 18 months, no adverse effects were observed: neither inflammation nor infection. One case of bleeding was noted 2 days after surgery, but it was due to lack of respect of instructions.

- Conclusion

Gingivoperioplastic surgery with GlassBone Granules™ proved to be safe and effective, with no major complications and low morbidity. The results support its use as a viable alternative for bone grafting in cleft patients.

Bahammam, MA. Effectiveness of bovine-derived xenograft versus bioactive glass with periodontally accelerated osteogenic orthodontics in adults: a randomized, controlled clinical trial. BMC Oral Health. 2016, 30;16(1):126.

- Surgery

Group 1 underwent a modified corticotomy technique on the labial side only, whereas group 2 was treated with the same technique combined with periodontally accelerated osteogenic orthodontics (PAOO) using a bovine-derived xenograft and group 3 was treated in the same way but combining PAOO with bioactive glass (0.5-1mm).

- Method

In this prospective, single-masked clinical trial, 33 orthodontic patients (20 women, 13 men; mean age 21.2), were randomly allocated to one of three groups.

- Group 1: Modified corticotomy techniques (labial side only)
- Groupe2: Same technique + PAOO with bovine-derived xenograft
- Group 3: Same technique + PAOO with bioactive glass (0.5-1mm)

- Results

- Performance - At the end of the study period, there was a significantly greater increase in bone density in the two groups that had been treated with bone grafting when compared with the group that had been treated with a modified CAOT alone. Moreover, patients who were treated with the bovine derived xenograft showed a greater (albeit not statistically significant) increase in bone density than those who were treated with bioactive glass.
- Safety – No adverse events were reported in any of the groups

- Conclusion

The study confirms that PAOO combined with bone grafting (either bovine-derived xenograft or bioactive glass) is more effective in increasing bone density than corticotomy alone.

Graillon N 2018. Graillon N, Degardin N, Foletti JM, Seiler M, Alessandrini M, Gallucci A. Bioactive glass 45S5 ceramic for alveolar cleft reconstruction, about 58 cases. J Craniomaxillofac Surg. 2018 Oct;46(10):1772-1776.

- Surgery

The surgery involved grafting of a unilateral or bilateral alveolar cleft using GlassBone (0.5-1mm size). Depending on the volume needed, patients received 0.5 to 2 cc of GlassBone.

- Method

In this clinical case series, 58 patients aged 3 to 15 years (7.6 years on average) were included who have undergone a unilateral or bilateral alveolar cleft. In 11 patients, one side was grafted with bioactive glass while the other side was grafted with iliac bone before the beginning of the study.

- Results

- Performance - Bone continuity was achieved in 63.8% of the cases. Bilateral cleft and dental agenesia increased grafting failure. In the subgroup of 25 patients with isolated unilateral cleft without dental agenesis, 80% had bone continuity at one year.
- Safety - We noted 10.3% of alveolar fistula recurrence. They are two cases (3.4%) of mucosal dehiscence. Hospitalization, social eviction and antalgic consumption were reduced and no significant complications such as infection or graft rejection were reported.

- Conclusion

The use of bioactive glass in the treatment of alveolar clefts resulted in a high rate of bone continuity, especially in patients with isolated unilateral clefts. While complications like alveolar fistula recurrence and mucosal dehiscence occurred, the overall safety and effectiveness of the procedure suggest it is a viable option for alveolar cleft repair.

El Hawary 2021. El-Hawary HE, Shawky M. Assessment of the sticky bone preparation of bioactive bone glass in grafting critical-sized surgical bony defects. Egyptian Dental Journal. 2021 Jul; 67: 1899-1908.

- Surgery

This study involved 24 patients with cystic bony lesions larger than 2 x 2 cm, who were randomy allocated into two equal groups. The cysts were enucleated, and the bone defects were then filled with different bioactive glass-based materials.

- Group 1: the defects were filled with bioactive bone glass particles
- Group 2: the defects were filled with bioactive glass sticky bone, a combination of bioactive glass granules and platelet-rich fibrin.

- Method

This was a randomized clinical controlled trial comparing two different bone grafting materials for the treatment of large cystic bony lesions. The primary focus was to compare the bone healing process and the outcomes in terms of bone density and defect filling. The patients were monitored over the course of the study, with assessments made at three-month and six-month intervals.

- Results

- Performance - In group 1, the percentage of decrease in the bone density during the first three months is higher in group 1 than group 2 that was then increased by nearly the same percentage at the six months interval, although statistically there is no significant difference between the two groups throughout the study period. The defects were completely filled in the 2 groups without loss of substitute. The healing went uneventful through all the cases.
- Safety - The surgically reconstructed defects did not show postoperative infection nor wound dehiscence or graft rejection throughout the healing phase. After resolving the postsurgical phase's signs, none of the patients exhibited any complaint during the whole study interval. The defect was reconstructed.

- Conclusion

The use of bioactive glass particles and bioactive glass sticky bone in the treatment of large cystic bony lesions proved to be effective in reconstructing the defects.

Hassan 2022. Hassan C-H, Malheiro E, Béquignon E, Coste A, Bartier S. Sublabial bioactive glass implantation for the management of primary atrophic rhinitis and empty nose syndrome: Operative technique. Laryngoscope Investigative Otolaryngology. 2022;7(1):6-11.

- Surgery

Two patients were operated for nasal obstruction: empty nose syndrome (ENS) and atrophic rhinitis (AR) are two chronic and socially disabling nasal diseases. The surgery involved the use of submucoperiosteal bilateral GlassBone Granules™ bioactive glass to fill the nasal cavities.

- Method

This is a case report in which the objective of the current study was to describe an innovative technique of a sub mucoperiosteal bilateral GlassBone Granule bioactive glass.

- Results

- Performance - Results demonstrated a postoperative satisfying endoscopic and sinus CT-scan results with filling of the nasal cavities, with less crusts and a complete wound healing.
- Safety - They had no short-term complications.

- Conclusion

The use of GlassBone in alveolar grafts simplifies the surgery procedure and the postoperative management. a novel and original technique of surgical management of primary AR and ENS with GlassBone implant in a submucoperiosteal approach in two patients. Short-term endoscopic and radiologic images provided promising results with an improvement of nasal symptoms. Long term results of this technique in terms of long-lasting volume, tolerance and symptoms scores must be evaluated in larger series.

Philip-Alliez, C., Fievet, L., Serratrice, N., Seiler, M., Le Gall, M., Charavet, C., & Catherine, J.H.(2024, Apr). Cone Beam-CT-Based Bone Volume Assessments of Alveolar Synthetic Bone graft GlassBone™ in Cleft Lip and Palate Patients: A Retrospective Study. J Maxillofac Oral Surg, 23(2), 342-352.

- Surgery

The children underwent early secondary alveolar grafting (ESBG) for clefts of the lip and palate using GlassBone (0.5 mm).

- Method

This retrospective monocentric study included 17 children aged 4 to 10 years with Clefts of the lip and palate (CLP). The objective was to assess the effectiveness of bioactive glass 45S5 in reducing cleft volume and improving clinical and physiological outcomes.

- Results

- Performance - The surgical success rate was about 68%, defined as A and C scores according to Chelsea's classification. The mean filling of the cleft was about 57.6 ± 27.7% at 1 year, corresponding to a mean remaining cleft about 42.4 ± 27.7% of its initial volume, which is a significant relative reduction
- Safety – 7 patients with unsatisfactory gingival scar (37%), 5 absences of germs' evolution through the graft (27%), 2 recurrences of oro-nasal fistula (10.5%). No complication with GlassBone Granules™ were noted.

- Conclusion

GlassBone Granules™ is associated with an absence of donor site harvesting, and an absence of associated morbidity. On top of that, this substitute is available in an unlimited quantity compared to autologous bone graft. Its use simplifies the surgical process and is associated with a reduction in surgical time, pain, and duration of school exclusion. GlassBone Granules™ presents good performance and safety outcomes providing satisfactory clinical and radiological results; it represents a convincing alternative to autologous bone graft. Its use might be particularly accurate in cases of small clefts, bilateral clefts, and dental agenesis with poor prognosis for grafting.

d) ENT

Verdier, E. F., Saloux, A. L., Azzis, O. M., Lebullenger, R. M., Dabit-Beal, T. A., & Brezulier, D.Y. (2024, Jan). Bioglass 45S5, a relevant alternative to autogenous harvesting for secondary alveolar bone grafts in clefts? Retrospective study of one hundred surgeries. J Craniomaxillofac Surg, 52(1), 85-92

- Surgery

Secondary alveolar bone grafting (SABG) with bioactive glass 45S55 was performed in patients with unilateral cleft lip and palate.

- Method

The primary objective of this retrospective observational study was to evaluate the success rate of secondary alveolar bone grafting (SABG) with the addition of bioactive glass 45S5 and to highlight the prognostic factors. Patients who underwent operation between 2015 and 2021 and had follow-up cone-beam computed tomography (CBCT) were analyzed. The follow-up was 12 months. Multivariate analysis was performed to determine factors influencing radiographic success.

- Results

A total of 102 SABG was analyzed. They were unilateral total cleft lip and palate (49, 48.0%). The mean age at surgery was 9.32 ± 3.09 years.
- Performance – The radiographic success rate was about 80.4% (82/102) at 1 year.
- Safety – 3 post-operative infections were reported (2.9%)

- Conclusion

GlassBone G is associated with an absence of donor site harvesting, and so an absence of associated morbidity. On top of that, this substitute is available in an unlimited quantity compared to autologous bone graft. It also allows teeth eruption and movements through the graft without any particular complication. GlassBone G presents good performance and safety outcomes, while allowing teeth movements, so it can be an alternative to autologous bone graft.

Verdier_2025. Verdier E.F, Azzis O.M, Marchand M. Jeanne S, Lebullenger R.M, Gatibelza ME, Dabit-Béal T., Brézulier D.Y. Secondary alveolar bone grafting of clefts using bioactive glass 45S5: Long-term dental and periodontal status: official publication of the American Journal of Orthodontics and Dentofacial Orthopedics. 2025

- Surgery

Secondary alveolar bone grafting (SABG) was performed in patients with cleft lip and/or palate using 45S5 bioactive glass as the grafting material. The procedure aims to restore alveolar continuity, support tooth eruption and improve periodontal stability in the cleft region.

- Method

This retrospective study evaluated 45 secondary alveolar bone grafts performed in 35 cleft patients using 45S5 bioactive glass, with a mean follow-up of 5.75 years. The mean age at surgery was 9.32 years. Clinical success was determined using a composite outcome combining periodontal volume at the graft site and recession classification of adjacent teeth. Additional analyses assessed the influence of adjacent tooth presence and orthodontic strategy (space closure vs. space opening).

- Results

- Performance – A 71.1% clinical success rate was observed at long-term follow-up. The presence or absence of adjacent teeth did not significantly affect clinical outcomes (P = 0.845), and orthodontic strategy also showed no significant impact (P = 0.325). A significant association between radiographic and clinical success was identified only in patients with a complete dental formula (P = 0.035), suggesting more predictable graft performance when all teeth are present.
- Safety – No adverse effects related to the use of 45S5 bioactive glass were reported during the follow-up period. Material resorption was not evaluated in this study. Overall, the treatment was well tolerated, with no complications attributable to the graft material.

- Conclusion

This study indicates that 45S5 bioactive glass is a relevant and effective alternative to autograft for secondary alveolar bone grafting, achieving a 71% long-term clinical success rate. Outcomes appear more predictable in patients with a complete dentition adjacent to the graft site. Despite the low evidence level due to the retrospective design, the findings support the bone regeneration performance and favorable safety profile of GlassBone Granules in the context of SABG.

2. Summary of clinical data relating to investigations of the device prior to CE marking, if applicable

Not applicable.

3. Summary of clinical data and the main findings pertaining to the device itself

Not applicable.

4. Overall Summary of Clinical Performance and Safety

The clinical claimed clinical performance is the filling, reconstruction and / or fusion of bone defects allowing the regeneration of the bone. The claimed performance is consistent with the results we currently have:

Reference	Population	GlassBone™ Granules	Destination	Indication	Performance (%)	Follow-up (months)
Graillon et al.,2018	Child	Sterilized EtO Granular size: 0.5-1 mm	CMF	Alveolar cleft	80% reconstruction	12
Barrey, 2019	Adult	Sterilized EtO Granular size: 1-3 mm	Spine	Cervical and lumbar degenerative diseases	93% fusion	12
Aytekin et al., 2020	Adult and Child	Sterilized EtO Granular size: 1-3 mm	Ortho	Benign bone cyst	100% filling and consolidation	16
Ilyas, 2022	Adult	Sterilized EtO Granular size: 1-3 mm	Ortho	Benign bone lesions	95% reconstruction	16.5
Courvoisier et al, 2023	Child	Sterilized EtO Granular size: 1-3 mm	Spine	Spine deformities	100% fusion	24
RETRO_StEtienne	Adult	Sterilized EtO Granular size: 1-3 mm	Spine	Cervical and lumbar degenerative diseases	91% fusion	12
SCOGRAPE	Child	Sterilized EtO Granular size: 1-3 mm	Spine	Lumbar deformative diseases	100% fusion	12
CAUSSE	Adult	Sterilized EtO Granular size: 0.5-1 mm	ENT	Cholesteatoma	100% filling	10
TUGRA	Adult	Sterilized EtO Granular size: 1-3 mm	Ortho	Benign bone tumor	100% filling and consolidation	22
Bresil_TRAUMA	Adult	Sterilized EtO Granular size: 1-3 mm	Ortho	Osteomyelitis	100% filling and consolidation	12
DEFGRAD	Adult and Child	Sterilized EtO Granular size: 1-3 mm	Spine	Lumbar and cervical spine disease	100% fusion	12

Current clinical results indicate that the benefits far outweigh the risks since the only risk associated with the identified device would be allergy.

	Benefits	Risk
Manufacturer's claim	- Reduction of graft site morbidity and/or no other bone harvesting site - Limited recurrent / residual disease - Quality of life improvement	Serious adverse event: none Device risk: No allergy Surgical risk: possible complications but not more severe than those expected of similar products.
Available performance data	- Orthopaedic, spine, CMF: Reduction of and complication associated with other harvesting graft or absence of morbidity (no harvest graft) - ENT: Limited recidivism and recurrence rate - Spine: Pain and deformity reduction - Orthopaedic: Reduction of fracture rate, tumor rate and bone infection recurrence - CMF: Pain reduction - ENT: Hearing improvement All results in accordance with literature research.	- No complications related to GlassBone Granules substitute. No allergy. - Surgical complications not more severe than those expected of similar products. (average 18 % and up to 22%)

5. Ongoing or planned post marketing clinical follow-up

The table below lists all ongoing and planned studies or registers concerning this medical device.

Destination	Indication	Statue	Grade	Objective
Register				
Spine	Pathologies of the spine	Finished	-	Confirm indications and safety per operatively.
Ortho	Trauma	Ongoing	-	Confirm indications and safety per operatively.
ENT	Cholesteatoma	To be started	-	Confirm indications and safety per operatively.
Studies in progress				
PUGRA - ENT	Cholesteatoma	Forthcoming 14/50	B	- Evaluation of tolerance through complication rate analysis - and performance through filling analysis
TUGRA_LONG - Ortho	Benign Bone tumor	0/40	C	- Evaluation of tolerance through complication rate analysis - and performance through consolidation analysis

Osteomyel_Ita – Ortho	Osteomyelitis	13/25	C	- Evaluation of tolerance through complication rate analysis - and performance through filling analysis
Upcoming clinical investigations				
ALGRAPE - CMF	Cleft palate	TBD	B	- Evaluation of performance with bone reconstruction - Evaluation of tolerance
OSTEOMYELITIS - Ortho	Osteomyelitis	TBD	C	- Evaluation of tolerance through complication rate analysis - and performance through consolidation analysis after infection
PACPTHAGLASS – Ortho	Total hip arthroplasty	TBD	B	- Evaluation of tolerance through complication rate analysis - and performance through bone remodelling and implant stability analysis

For each study, a follow-up of complications is planned throughout the duration of the study. Events should be reported to NORAKER® at any time. In addition, post-market surveillance data and other clinical data that will be collected will be incorporated as part of the annual updates of the clinical assessment.

VI. Other therapeutic solutions

Grafts are used when conservative treatments (first line approaches when pathologies are not severe) have failed and when surgery is required. In this case, they are mainly used in combination with others implants such as rods, screws, plates and prothesis. They can also be used alone or not at all. Their mains functions (prevent progression of disease, mechanical support etc.) are different as bone grafts functions. Thus, these alternative treatments cannot be compared with bone grafts. They are considered as complementary implants.

Likewise, drug treatments, chemotherapy, radiotherapy, physiotherapy… are complementary and can't be considered as a total alternative solution.

Therapeutic alternatives to GlassBone™ Granules are autologous bone, allograft, xenograft, and other families of synthetic substitutes.

The gold standard remains the autologous bone but involves a sampling site on the patient and therefore a second surgical site that can cause additional complications: pain, infection, fracture, loss of sensation or hematomas. These complications, the lengthening of the operating time, the limited quantity and the variable quality of the available material are the main limitations of autologous transplantation, leading professionals to resort to bone substitutes. The most common options for replacing autograft are: allogeneics, xenografts and synthetic bone substitutes.

Allografts are tissues of human origin and are distributed by tissue banks and are subject to authorization. Xenografts are made from non-viable tissues of animal origin, stripped of their bone marrow, or derivatives made non-viable. They are of various origins: coral, cuttlefish, mammals. Most bone substitutes of animal origin come from cattle. The risk of pathogen transmission is not excluded.

As regards synthetic substitutes, they do not contain any derivative or tissue of biological origin and are not derived from such derivatives. Their composition varies (calcium phosphate, calcium sulfate, bioactive glass...) and can be absorbable or non-absorbable.

GlassBone™ Granules, like other synthetic bone substitutes, makes it possible to overcome the constraints of the sampling site (morbidity of the donor site) and to achieve the expected performance of the gold standard.

This summary table shows the advantages (+) and disadvantages (-) of other available solutions.

	Manipulation	Bioactivity	Transmission of possible pathogens	Availability	Osteoconduction	Osteoinducteur	Bioresorbable
Autograft	-	-	+	-	+	+	-
Allograft	+	-	-	-	+	-	-
Xenograft	+	-	-	+	+	-	-
Synthetic substitute	+	+	+	+	+	-	+ / -
BMP	+	-	-	+	+	+	+
Bioactive glass	+	+	+	+	+	-	+

VII. Suggested profile and training for users

Users are experienced surgeons (orthopaedists, neurosurgeons, cranio-maxillofacial surgeons, stomatologists and ENT surgeons) with bone graft techniques. There is no specific training on the use of the device.

VIII. Reference to harmonized standards and common specifications applied

At the moment of writing this document, no common specification is published on our product, and only a few standards are harmonized according to Regulation 2017/745.

The list of harmonized standards applied is as follows for this device:

Number	Year	Title of standard
EN ISO 11137-1 + A2 (2019)	2015	Sterilization of health care products - Radiation - Part 1 : requirements for development, validation and routine control of a sterilization process for medical devices
EN ISO 13485 + A11 (2021)	2016	Medical devices, Quality management systems, Requirements for regulatory purposes
EN ISO 14971 + A11 (2021)	2019	Medical devices - Applications of risk management to medical devices
EN ISO 11137-2 + A1 (2023)	2015	Sterilization of health care products - Radiation - Part 2: Establishing the sterilization dose
EN ISO 11737-1 + A1 (2021)	2018	Sterilization of medical devices - Microbiological methods Part 1: Determination of the population of microorganisms on products
EN ISO 11737-2	2020	Sterilization of medical devices - Microbiological methods - Part 2 : tests of sterility performed in the definition, validation and maintenance of a sterilization process
EN ISO 10993-9	2020	Biological evaluation of medical devices - Part 9: Framework for identification and quantification of potential degradation products
EN ISO 10993-10	2023	Biological evaluation of medical devices - Part 10: Tests for skin sensitization
EN ISO 10993-12	2021	Biological evaluation of medical devices - Part 12: Sample preparation and reference materials
EN ISO 10993-18	2020	Biological evaluation of medical devices - Part 18: Chemical characterization of medical device materials within a risk management process
EN ISO 10993-23	2021	Biological evaluation of medical devices - Part 23: Tests for irritation
EN ISO 11607-1 + A1 (2023)	2020	Packaging for terminally sterilized medical devices — Part 1: Requirements for materials, sterile barrier systems and packaging systems
EN ISO 11607-2 + A1 (2023)	2020	Packaging for terminally sterilized medical devices — Part 2: Validation requirements for forming, sealing and assembly processes
EN ISO 15223-1	2021	Medical devices - Symbols to be used with medical device labels, labelling, and information to be supplied - Part 1: General requirements
NF EN 556-1	2024	Sterilization of medical devices - Requirements for medical devices to be labeled “STERILE” - Part 1: Requirements for terminally sterilized medical devices