bonalive

Smart Healing™

Literature references
Electronic

Bonalive is a smart biomaterials company, transforming healthcare at the intersection of biology and technology. With over 30 years of clinical history, and one of the most evidence-based technologies in the industry, we are re-imagining a smarter future for healthcare.

Content

Important literature references are marked with this symbol.

See the indicated page for extra material relating to the article.

ELECTRONIC REFERENCE LIST

Preclinical and clinical research publications are an authoritative and valuable resource for healthcare professionals interested in Bonalive technologies and their use.

The electronic reference list also contains:
- a link to each article's abstract
- surgeons' video presentations of their research

BIOACTIVE GLASS TECHNOLOGY

At the core of our technology is S53P4 bioactive glass – a smart biomaterial consisting solely of elements that exist naturally in the human body.

Characterized by its ability to firmly attach to living tissue and chemically bond with surrounding bone, S53P4 bioactive glass naturally facilitates the formation of new bone. Thus, it is a unique material for filling defects and replacing damaged bone tissue because S53P4 bioactive glass functions as naturally as your biology.

Smart Healing™ solutions are osteostimulative (non-osteoinductive) and come with a range of benefits for filling, reconstructing and regenerating bone defects as well as for filling bone cavities, voids and gaps in both adult and pediatric patients.

THE LEVEL OF EVIDENCE IN CLINICAL STUDIES

The Level of Clinical Evidence provides a guide to describe the strength of the results measured in a clinical trial or research study. It is developed from USPSTF and Oxford (UK) CEBM Levels of Evidence.[1]

Type of evidence	Level of evidence
Data derived from meta-analyses or systematic reviews of randomized studies or multiple randomized trials.	**L1a**
Data derived from at least one well-designed randomized trial.	**L1b**
Data derived from at least one well-designed non-randomized trial (e.g. cohort studies, case-control studies) or from at least one low-quality randomized trial.	**L2**
Data derived from case reports or low-quality non-randomized trials.	**L3**
Data derived from expert opinions without explicit clinical appraisal.	**L4**

According to this hierarchy, we provide the following list of level L1a, L1b and L2 clinical research publications to support the use of our products.

[1] Burns PB, Rohrich RJ, Chung KC. The levels of evidence and their role in evidence-based medicine. Plast reconstr surg. 2011;128(1):305-10.

THE LEVEL OF EVIDENCE IN CLINICAL STUDIES

L1A LEVEL OF EVIDENCE CLINICAL STUDIES

Bone infection surgery

- **Clinical applications of Bioactive glass S53P4 in bone infections: a systematic review.**
  Bigoni M, Turati M, Zanchi N, Lombardo AS, Graci J, Omeljaniuk RJ, Zatti G, Gaddi D.
  Eur Rev Med Pharmacol Sci. 2019;23(2 Suppl):240-51.[2]

- **Clinical application of antimicrobial bone graft substitute in osteomyelitis treatment: A systematic review of different bone graft substitutes available in clinical treatment of osteomyelitis.**
  van Vugt T, Geurts J, Arts J. Biomed Res Int. 2016;2016:6984656.[2]

Trauma surgery

- **Autologous versus synthetic bone grafts for the surgical management of tibial plateau fractures: a systematic review and meta-analysis of randomized controlled trials.**
  Cooper G, Kennedy M, Jamal B, Shields D. Bone Jt Open 2022 Mar;3(3):218-228.

L1B LEVEL OF EVIDENCE CLINICAL STUDIES

Trauma surgery

- **Bioactive glass granules: a suitable bone substitute material in the operative treatment of depressed lateral tibial plateau fractures: a prospective, randomized 1 year follow-up study.**
  Heikkilä JT, Kukkonen J, Aho AJ, Moisander S, Kyyrönen T, Mattila K.
  J Mater Sci: Mater Med. 2011;22(4):1073-80.[3]

- **Bioactive glass S53P4 and autograft bone in treatment of depressed tibial plateau fractures. A prospective randomized 11-year follow-up.**
  Pernaa K, Koski I, Mattila K, Gullichsen E, Heikkilä J, Aho A, Lindfors N.
  J Long Term Eff Med Impl. 2011;21(2):139-48.[3]

Benign bone tumor surgery

- **Biodegradable biomaterials in orthopedic surgery: a narrative review of the current evidence.**
  Raitio A, Saarinen A, Sinikumpu J-J, Helenius I. Scandinavian Journal of Surgery 2024,113(1):62-70.

- **Allograft versus bioactive glass (BG-S53P4) in pediatric benign bone lesions: a randomized clinical trial.**
  Syvänen J, Serlo W, Jalkanen J, Kohonen I, Raitio A, Nietosvaara Y, Helenius I.
  J Bone Joint Surg Am. 2023 May;105(9):659-666.

- **Bioactive glass granules versus standard autologous and allogeneic bone grafts: a randomized trial of 49 adult bone tumor patients with a 10-year follow-up.**
  Aro H. Välimäki V-V. Stranberg N. Lankinen P. Löyttyniemi E. Saunavaara V. Seppänen M. Acta Orthopaedica 2022; 93:519-527.

- **A prospective randomized 14-year follow- up study of bioactive glass and autogenous bone as bone graft substitutes in benign bone tumours.**
  Lindfors NC, Koski I, Heikkilä JT, Mattila K, Aho AJ. J Biomed Mater Res. 2010(a);94B(1):157-64.[4]

[2] Review article
[3] Publications are from the same clinical study
[4] Publications are from the same clinical study

- **Bioactive glass and autogenous bone as bone graft substitutes in benign tumors.**
  Lindfors NC, Heikkilä JT, Koski I, Mattila K, Aho AJ. J Biomed Mater Res 2009;90(1):131-6.[4]

- **Long-term evaluation of blood silicon and osteocalcin in operatively treated patients with benign bone tumors using bioactive glass and autogenous bone.**
  Lindfors NC, Heikkilä JT, Aho AJ. J Biomed Mater Res 2008;87(1):73-6.[4]

Spine Surgery

- **The effect of bioactive glasses on spinal fusion: a cross-disciplinary systematic review and meta-analysis of the preclinical and clinical data.**
  Cottrill E, Pennington Z, Lankipalle N, Ehresman J, Valencia C, Schilling A, Feghali J, Perdomo-Pantoja A, Theodore N, Sciubba D, Witham T. J. Clin. Neurosci. 2020;78:34-46.[2]

L2 LEVEL OF EVIDENCE CLINICAL STUDIES

Bone infection surgery

- **Dead space management strategies in the treatment of chronic osteomyelitis: a retrospective review.**
  Epstein G, Ferreira N. Eur J Orthop Surg Traumatol 2023 Sep;33:565-570.

- **The role of bioceramics in the management of osteomyelitic voids.**
  Ferreira N, Epstein G. SA orthop. j. 2023 Sep;22(3):152-156.

- **Bioactive glass S53P4 vs autologous bone graft for filling defects in patients with chronic osteomyelitis and infected non-unions - a single center experience.**
  Steinhausen E, Lefering R, Glombitza M, Brinkmann N, Vogel C, Mester B, Dudda M.
  J. Bone Joint Infect., 6, 73-83, 2021.

- **The role of bioactive glass in the management of chronic osteomyelitis: a systematic review of literature and current evidence.**
  Tanwar Y, Ferreira N. Infect Dis (Lond). 2020 Apr;52(4):219-26.

- **Treatment of cavitary bone defects in chronic osteomyelitis: Bioactive glass S53P4 vs. calcium sulphate antibiotic beads.**
  Ferrando A, Part J, Baeza J. J. Bone Jt. Infect. 2017;2(4):194-201.

- **Clinical applications of S53P4 bioactive glass in bone healing and osteomyelitic treatment: A literature review.**
  van Gestel NA, Geurts J, Hulsen DJ, van Rietbergen B, Hofmann S, Arts JJ.
  Biomed Res Int. 2015;2015: 684826.[2]

- **Bioactive glass for long bone infection: a systematic review.**
  Aurégan JC, Bégué T. Injury, Int. J. Care Injured. 2015;46(8):3-7.[2]

- **A comparative study of the use of bioactive glass S53P4 and antibiotic-loaded calcium based bone substitutes in the treatment of chronic osteomyelitis: a retrospective comparative study.**
  Romano CL, Logoluso N, Meani E, Romano D, De Vecchi E, Vassena C, Drago L.
  The British Editorial Society of Bone Joint J. 2014;96B(5):845-50.

THE LEVEL OF EVIDENCE IN CLINICAL STUDIES

Benign bone tumor surgery

- **Enchondromas of the Hand: Curettage With Autogenous Bone vs. Bioactive Glass S53P4 for Void Augmentation.**
  Lindfors N, Kukkonen E, Stenroos A, Nordback P, Anttila T, Aspinen S. in vivo 36: 1267-1273 (2022).

- **Clinical experience on bioactive glass S53P4 in reconstructive surgery in the upper extremity showing bone remodelling, vascularization, cartilage repair and antibacterial properties of S53P4.**
  Lindfors NC. J Biotechnol Biomaterial. 2011;1(5).

Mastoid surgery

- **Mid-term outcomes of mastoid obliteration with biological hydroxyapatite versus bioglass: a radiological and clinical study.**
  Sahli-Vivicorsi S, Alavi Z, William Bran W, Cadieu R, Meriot P, Leclere J-C, Marianowski R.
  Eur Arch Otorhinolaryngol. 2022 Sep;279(9):4379-88.

- **Mastoid Obliteration: A Comparison of Two Techniques.**
  Shree N, Ravikumar A, Sarvanam P. Indian J Otolaryngol Head Neck Surg 2022 Aug;74(Suppl 1):692-698.

- **Mastoid cavity obliteration using bone pâté versus bioactive glass granules in the management of chronic otitis media (squamous disease): a prospective comparative study.**
  Mishra A, Mallick A, Galagali J, Gupta A, Sethi A, Ghotra A. J Laryngol Otol . 2021 Jun;135(6):492-500.

- **Mastoid obliteration with synthetic materials: a review of the literature.**
  Skoulakis C, Koltsidopoulos P, Iyer A, Kontorinis G.
  The Journal of International Advanced Otology. 2019;15(3):400-4.

- **Bioactive glass obliteration of the mastoid significantly improves surgical outcome in non-cholesteatomatous chronic otitis media patients.**
  Vos J, de Vey Mestdagh P, Colnot D, Borggreven P, Orelio C, Quak J.
  Eur Arch Otorhinolaryngol. 2017;274(12):4121-6.

Oral and cranio maxillofacial

- **Bioactive glass granules S53P4 in osteotomy Le Fort I.**
  De Souza Cruz E, Souza Jr F, de Menezes L, Tuji F, Carneiro Jr C. Sci Rep. 2020 Jul;10(1):12690.

GUIDELINES

- **Fracture-related infection: current methods for prevention and treatment.**
  Foster A, Moriarty F, Trampuz A, Jaiprakash A, Burch M, Crawford R, Paterson D, Metsemakers W-J, Schuetz M, Richards RG. Expert Review of Anti-infective Therapy. 2020;18:307-21.

- **Evidence-based recommendations for local antimicrobial strategies and dead space management in fracture-related infection.**
  Metsemakers W-J, Fragomen A, Moriarty F, Morgenstern M, Egol K, Zalavras C, Obremskey W, Raschke M, McNally M. J Orthop Trauma 2020;34:18-29.

CLINICAL STUDIES

Bone infection

Clinical outcomes and complications of S53P4 bioactive glass in chronic osteomyelitis and septic non-unions: a retrospective single-center study.
Gatti S, Gaddi D, Turati M, Leone G, Arts J, Pessina F, Carminati M, Zatti G, De Rosa L, Bigoni M. Eur J Clin Microbiol Infect Dis 2024 Mar;43(3):489-499.

A rare case of calcaneal bone osteomyelitis resulting from local paracoccidioidomycosis in an immunosuppressed patient: a case report.
Dos Santos E, Freitas C, Romanholi P, Silva D, Katayama M, Pires E. J Foot Ankle. 2023 Dec;17(3):191-5.

Outcome and predictors of treatment failure in chronic osteomyelitis using bioactive glass granules and putty formulations.
Dell'Aquila A, Reis G, Guba G, Targa W, Bongiovanni J, Durigon T, Salles M, Reis F. Antibiotics 2023 Dec;12(12):1720.

Use of autologous bone graft with bioactive glass as a bone substitute in the treatment of large-sized bone defects of the femur and tibia.
Findeisen S, Gräfe N, Schwilk M, Ferbert T, Helbig L, Haubruck P, Schmidmaier G, Tanner M. J Pers Med. 2023 Nov;13(12):1644.

Dead space management strategies in the treatment of chronic osteomyelitis: a retrospective review.
Epstein G, Ferreira N. Eur J Orthop Surg Traumatol 2023 Sep;33:565-570.

The role of bioceramics in the management of osteomyelitic voids.
Ferreira N, Epstein G. SA orthop. j. 2023 Sep;22(3):152-6.

S53P4 bioactive glass putty in the local treatment of cavitary chronic osteomyelitis.
Reis G, Cuba G, de Gastro Targa W, Miras P, Bongiovanni J, Salles M, Reis F, Dell´Aquila A. Acta Ortop Bras. 2023 Feb;31(1):e258453.

Utilization of bioactive glass S53P4 inside an induced membrane for severe bone defect with high risk of infection: a multi-center preliminary experience.
Aurégan J, Villaina B, Glombitzac M, Blokhuis T, Heinänen M, Bégué T. Injury 2022 Oct;53 Suppl 2:S13-S19.

Bioactive glass in the treatment of chronic osteomyelitis in children: Description of four consecutive cases and literature review.
Lazzeri S, Montagnani C, Zanardi A, Beltrami G, Galli L. Injury 2022 Oct;53(10) 3317-21.

Management of chronic osteomyelitis of the femur and tibia: a scoping review.
Arshad Z, Lau E, Aslam A, ThahirA, Krkovic M. EOR 2021 Sep 14;6(9):704-15.

Bioactive Glass Applications: A Literature Review of Human Clinical Trials.
Cannio M, Bellucci D, Roether J, Boccaccini D, Cannillo V. Materials 2021, 14(18), 5440.

Bioactive glass S53P4 to fill-up large cavitary bone defect after acute and chronic osteomyelitis treated with antibiotic-loaded cement beads: a prospective case series with a minimum 2-year follow-up.
Kojima K, MD, Silva F, Leonhardt M, Carvalho V, Oliveira P, Lima A, Reis P, Silva J. Injury. 2021 Jul;52 Suppl 3:S23-S28.

Bioactive glass S53P4 vs autologous bone graft for filling defects in patients with chronic osteomyelitis and infected non-unions? a single center experience.
Steinhausen E, Lefering R, Glombitza M, Brinkmann N, Vogel C, Mester B, Dudda M. J. Bone Joint Infect. 2021;6:73-83.

CLINICAL STUDIES

Use of contemporary biomaterials in chronic osteomyelitis treatment: clinical lessons learned and literature review.
Geurts J, van Vugt T, Arts J. J Orthop Res. 2021;39:258-64.

The management of chronic osteomyelitis in adults: outcomes of an integrated approach.
Venter R, Tanwar S, Grey J-P, Ferreira N. SA orthop. j. 2021 Feb;20(1):33-38.

Treatment of infected tibial non-unions using a BMAC and S53P4 BAG combination for reconstruction of segmental bone defects: a clinical case series.
Van Vugt T, Geurts J, Blokhuis T. Injury October 7, 2020;8:37.

The role of bioactive glass in the management of chronic osteomyelitis: a systematic review of literature and current evidence.
Tanwar Y, Ferreira N. Infect Dis (Lond). 2020 Apr;52(4):219-26.

Bioactive glass in a rare case of osteomyelitis of the heel in a guillain-barré syndrome: a case report.
Iacopi E, Ferranti S, Riitano N, Abbruzzese L,Pieruzzi L, Goretti C, Zampa V, Piaggesi A.
Int J Low Extrem Wounds. 2021 Mar;20(1):60-66.

Results after using bioactive glass S53P4 in reconstructive orthopaedic surgery - a 36-month follow-up clinical study.
Bataga T, Trambitas C, Solyom A, Fodor R, Bataga S, Abageru S, Miron A, Halmaciu I, Ivanescu A.
Revista de Chimie 2019;70(7):2703-6.

Bioactive glass as dead space management following debridement of type 3 chronic osteomyelitis.
Oosthuysen W, Venter R, Tanwar Y, Ferreira N. Int Orthop. 2019;44(3):421-8.

A retrospective case-series on the use of S53P4 bioactive glass for the adjunctive treatment of septic diaphyseal non-union.
Gaiarsa G, Dos Reis P, Kojima K, Silva J, Lima A. Acta Ortop Bras. 2019;27(5):273-5.

33 **Cost-effectiveness study of one-stage treatment of chronic osteomyelitis with bioactive glass S53P4.**
Geurts J, van Vugt T, Thijssen E, Arts J. Materials. 2019;30;12(19).

Bilateral tibial brodie's abscess in young patient treated with BAG-S53P4: case report.
Cossio A, Graci J, Lombardo A, Turati M, Melzi M, Bigoni M, Zatti G. Ital J Pediatr 2019;45:91.

Clinical applications of Bioactive glass S53P4 in bone infections: a systematic review.
Bigoni M, Turati M, Zanchi N, Lombardo AS, Graci J, Omeljaniuk RJ, Zatti G, Gaddi D.
Eur Rev Med Pharmacol Sci. 2019;23(2 Suppl):240-51.

34 **The use of bioactive glass S53P4 as bone graft substitute in the treatment of chronic osteomyelitis and infected non-unions – a retrospective study of 50 patients.**
Al Malat TA, Glombitza M, Dahmen J, Hax P-M, Steinhausen E. Z Orthop Unfall 2018;156:152-9.

Contemporary treatment of chronic osteomyelitis: implementation in low- and middle-income countries.
Geurts J, Vranken T, Gabriels F, Arts JJ, Moh P. SA Orthop J. 2018;17(2):40-3.

Evaluation of the clinical effectiveness of bioactive glass (S53P4) in the treatment of non-unions of the tibia and femur: study protocol of a randomized controlled non-inferiority trial.
Tanner MC, Heller R, Westhauser F, Miska M, Ferbert T, Fischer C, Gantz S, Schmidmaier G, Haubruck P.
Trials. 2018;19(1):299.

Bioactive glasses in treating bone infections.
Lupescu O, Nagea M, Dimitriu AL, Antoniac IV. Key Eng. Mater. 2017;758:245-9.

Treatment of cavitary bone defects in chronic osteomyelitis: Biogactive glass S53P4 vs. calcium sulphate antibiotic beads.
Ferrando A, Part J, Baeza J. J. Bone Jt. Infect. 2017;2(4):194-201.

Il trattamento delle pseudoartrosi settiche di tibia con la tecnica di Ilizarov isolata o associata a biovetro attivo. *Treatment of infected tibial nonunions with Ilizarov technique and bioactive glass.*
Testa G, Aloj DC, Pavone V, Massè A, Avondo S, Sessa G. G. ital. ortop. traumatol. 2017;43:251-7.

Antibacterial bioactive glass, S53P4, for chronic bone infections - a multinational study.
Lindfors N, Geurts J, Drago L, Arts JJ, Juutilainen V, Hyvönen P. et al. Adv Exp Med Biol 2017;971:81-92.

Treatment of osteomyelitis by means of bioactive glass – initial experience in the Netherlands.
Geurts J, Vranken T, Arts CJJ. Nederlands Tijdschrift voor Orthopaedie. 2016;23(2):37-41.

Two-stage treatment for infected nonunion of the humerus: a case report.
Puma Pagliarello C, Testa G, Lombardini A, Condorelli G, Pavone V.
Infec Dis Trop Med 2016;3(2):E390.

Clinical application of antimicrobial bone graft substitute in osteomyelitis treatment: A systematic review of different bone graft substitutes available in clinical treatment of osteomyelitis.
van Vugt T, Geurts J, Arts J. Biomed Res Int. 2016;2016:6984656.

Optimal management of chronic osteomyelitis: current perspectives.
Pande K. Orthopedic Research and Reviews 2015;7:71-81.

Bioactive glass for long bone infection: a systematic review.
Aurégan JC, Bégué T. Injury, Int. J. Care Injured. 2015;46(8):3-7.

New trends in surgical treatment of chronic osteomyelitis.
Juutilainen V, Lindfors NC. Suomen Ortopedia ja Traumatologia. 2015;38:59-61.

Clinical applications of S53P4 bioactive glass in bone healing and osteomyelitic treatment: A literature review.
van Gestel NA, Geurts J, Hulsen DJ, van Rietbergen B, Hofmann S, Arts JJ.
Biomed Res Int. 2015:2015:684826.

Review: Emerging developments in the use of bioactive glasses for treating infected prosthetic joints.
Rahaman M, Bal BS, Huang W. Mater Sci Eng C Mater Biol Appl. 2014;C41:224-31.

A comparative study of the use of bioactive glass S53P4 and antibiotic-loaded calcium-based bone substitutes in the treatment of chronic osteomyelitis: a retrospective comparative study.
Romanò CL, Logoluso N, Meani E, Romanò D, De Vecchi E, Vassena C, Drago L.
Bone Joint J 2014;96-B:845-50.

Bioactive glass BAG-S53P4 for the adjunctive-treatment of chronic osteomyelitis of the long bones: An in vitro and prospective clinical study.
Drago L, Vassena C, Fenu S, De Vecchi E. BMC Infectious Diseases. 2013;13:584.

Through the looking glass; bioactive glass S53P4 (BonAlive®) in the treatment of chronic osteomyelitis.
McAndrew J, Efrimescu C, Sheehan E, Niall D. Ir J Med Sci. 2013;182(3):509-11.

Posttraumatic osteomyelitis.
Juutilainen V. Suomen Ortopedia ja Traumatologia 2011;34:38-41.

Bioactive glass S53P4 as bone graft substitute in treatment of osteomyelitis.
Lindfors NC, Hyvönen P, Nyyssönen M, Kirjavainen M, Kankare J, Gullichsen E, Salo J.
Bone. 2010;47:212-18.

CLINICAL STUDIES

Trauma

Autologous versus synthetic bone grafts for the surgical management of tibial plateau fractures: a systematic review and meta-analysis of randomized controlled trials.
Cooper G, Kennedy M, Jamal B, Shields D. Bone Jt Open 2022 Mar;3(3):218-228.

Our short-term experience with the use of S53P4 (BonAlive®) bioactive glass as a bone graft substitute.
Gergely I, Zazgyva A, Man A, Zuh SG, Pop TS. Acta Medica Marisiensis. 2011;57(6):627-30.

Bioactive glass granules: a suitable bone substitute material in the operative treatment of depressed lateral tibial plateau fractures: a prospective, randomized 1 year follow-up study.
Heikkilä JT, Kukkonen J, Aho AJ, Moisander S, Kyyrönen T, Mattila K. J Mater Sci: Mater Med. 2011;22(4):1073-80.

Bioactive glass S53P4 and autograft bone in treatment of depressed tibial plateau fractures. A prospective randomized 11- year follow-up.
Pernaa K, Koski I, Mattila K, Gullichsen E, Heikkilä J, Aho A. Lindfors N.
J Long Term Eff Med Impl. 2011;21(2):139-48.

Diabetic foot osteomyelitis

Treatment of cuboid bone osteomyelitis in diabetic patient with bioactive glass S53P4 - case report.
Janežič L, Križaj J, Frangež I. Acta Scientific Clinical Case Reports 2024 Mar;5(3):37-41.

Preservation surgery of septic osteoarthritis and osteomyelitis in the Diabetic Foot Using S53P4 bioactive glass—A case series.
Korpar I, Frangež I. Appl. Sci. 2023 Mar, 13(5), 3310.

Bioactive Glass in a Multi Drug Resistance Osteomyelitis in Diabetic Foot: Case Report.
Panunzi A, Giurato L, Meloni M, Luigi Uccioli I.
Int J Low Extrem Wounds . 2022 May 18;15347346221102643.

Bioactive glass, a new tool for the treatment in the diabetic foot recalcitrant osteomyelitis: A case series with 24-month follow-up.
Rodrígue Á, Parra G, Guervas-Mons M. Foot (Edinb). 2021 Sep;48:101831.

Possible advantages of S53P4 bioactive glass in the treatment of septic osteoarthritis of the first metatarsophalangeal joint in the diabetic foot.
Kastrin M, Rovan V, Frangež I. J. Clin. Med. 2021, 10(6), 1208.

Efficacy and safety of bioactive glass S53P4 as a treatment for diabetic foot osteomyelitis.
De Giglio R, Di Vieste G, Mondello T, Balduzzi G, Masserini B, Formenti I, Lodigiani S, Pallavicini D, Pintaudi B, Mazzone A. J Foot Ankle Surg. 2021 Mar-Apr;60(2):292-296

Pilot experience on the use of S53P4 bioactive glass in the surgical management of diabetic foot osteomyelitis.
Iacopi E, Pieruzzi L, Goretti C, Piaggesi A. The Int J Low Extrem Wounds 2020; 1 –8.

Bioactive glass in a rare case of osteomyelitis of the heel in a guillain-barré syndrome: a case report.
Iacopi E, Ferranti S, Riitano N, Abbruzzese L,Pieruzzi L, Goretti C, Zampa V, Piaggesi A. The Int J Lower Extremity Wounds 2020;1-7.

The use of bioactive glass S53P4 in the treatment of an infected Charcot foot: a case report.
Godoy-Santos AL, Rosemberg LA, de Cesar-Netto C, Armstrong DG.
J Wound Care. 2019;1;28(Sup1):14-7.

Bioactive glass S53P4: A new opportunity for the treatment in the diabetic foot osteomyelitis.
De Giglio R, Stefani I, Mondello T, De Filippis G, Mazzone A.
Eur J Intern Med. 2018 Aug;54:e15-e16.

Benign bone tumor

Biodegradable biomaterials in orthopedic surgery: a narrative review of the current evidence.
Raitio A, Saarinen A, Sinikumpu J-J, Helenius I. Scand J Surg. 2024 Mar;113(1):62-70.

Allograft versus bioactive glass (BG-S53P4) in pediatric benign bone lesions: a randomized clinical trial. Syvänen J, Serlo W, Jalkanen J, Kohonen I, Raitio A, Nietosvaara Y, Helenius I.
J Bone Joint Surg Am. 2023 May;105(9):659-666.

Bioactive glass granules versus standard autologous and allogeneic bone grafts: a randomized trial of 49 adult bone tumor patients with a 10-year follow-up.
Aro H. Välimäki V-V. Stranberg N. Lankinen P. Löyttyniemi E. Saunavaara V. Seppänen M.
Acta Orthopaedica 2022; 93:519-527.

Enchondromas of the Hand: Curettage With Autogenous Bone vs. Bioactive Glass S53P4 for Void Augmentation.
Lindfors N, Kukkonen E, Stenroos A, Nordback P, Anttila T, Aspinen S.
in vivo 2022 May-Jun; 36(3): 1267–1273.

Treatment of aneurysmal bone cysts with bioactive glass in children.
Syvänen J, Nietosvaara Y, Kohonen I, Koskimies E, Haara M, Korhonen J, Pajulo O, Helenius I. Scand J Surg. 2018 Mar;107(1):76-81.

S53P4 bioactive glass - an alternative treatment of bone defects.
Trambitas C, Pop TS, Miron ADT, Dorobantu DC, Brinzaniuc K. Revista De Chimie 2017;68(2):387-9.

Clinical experience on bioactive glass S53P4 in reconstructive surgery in the upper extremity showing bone remodelling, vascularization, cartilage repair and antibacterial properties of S53P4.
Lindfors NC. J Biotech Biomat. 2011;1(5).

A prospective randomized 14-year follow- up study of bioactive glass and autogenous bone as bone graft substitutes in benign bone tumours.
Lindfors NC, Koski I, Heikkilä JT, Mattila K, Aho AJ. J Biomed Mater Res. 2010(a);94B(1):157-64.

Treatment of a recurrent aneurysmal bone cyst with bioactive glass in a child allows for good bone remodeling and growth.
Lindfors NC, Aho A. Bone. 2009;45:398-400.

Bioactive glass and autogenous bone as bone graft substitutes in benign bone tumors.
Lindfors NC, Heikkilä JT, Koski I, Mattila K, Aho AJ. J Biomed Mater Res. 2009,90B(1),131-6.

Long-term evaluation of blood silicon and ostecalcin in operatively treated patients with benign bone tumors using bioactive glass and autogenous bone.
Lindfors NC, Heikkilä JT, Aho AJ. J Biomed Mater Res. 2008,87B(1):73-6.

Behavior of bioactive glass in human bone.
Heikkilä J, Salonen H-R, Yli-Urpo A, Aho A. Bioceramics. 1995;8:35-40.

CLINICAL STUDIES

Spine

The effect of bioactive glasses on spinal fusion: a cross-disciplinary systematic review and meta-analysis of the preclinical and clinical data.
Cottrill E, Pennington Z, Lankipalle N, Ehresman J, Valencia C, Schilling A, Feghali J, Perdomo-Pantoja A, Theodore N, Sciubba D, Witham T. J. Clin. Neurosci. 2020;78:34-46.

The use of bioactive glass as a posterolateral graft in patients with infected spondylodesis.
Voorde P, Geurts J. J Case Rep Images Orthop Rheum 2019;4:100019Z14PV2019.

Novel bioactive glass putty (S53P4) as bone graft expander in minimally invasive lumbosacral interbody fusion.
Saarenpää I, Hirvonen J, Frantzén J. J Minim Invasive Spine Surg Tech. 2018;3(2):52-58.

Reconstruction of vertebral bone defects using an expandable replacement device and bioactive glass S53P4 in the treatment of vertebral osteomyelitis: Three patients and three pathogens.
Kankare J, Lindfors NC. Scan J Surg. 2016;105(4):248-53.

Posterolateral spondylodesis using bioactive glass S53P4 and autogenous bone in instrumented unstable lumbar spine burst fractures. A prospective 10-year follow-up study.
Rantakokko J, Frantzén J, Heinänen J, Kajander S, Kotilainen E, Gullichsen E, Lindfors NC.
Scan J Surg. 2012;101(1):66-71.

Instrumented spondylodesis in degenerative spondylolisthesis with bioactive glass and autologous bone. A prospective 11-year follow-up.
Frantzén J, Rantakokko J, Aro H, Heinänen J, Kajander S, Gullichsen E, Kotilainen E, Lindfors NC.
J Spinal Disorder Tech. 2011;24(7):455-61.

Mastoid

Efficacy of S53P4 bioactive glass for the secondary obliteration of chronically discharging radical cavities.
Kroon V, Mes S, Borggreven P, van de Langenberg R, Colnot D, Quak J. OTO Open 2023 Nov;7(4):e96.

Use of Bonalive in obliterative mastoidectomy: anatomical results and clinical outcome.
Fassone E, Fabiano B, Caracciolo A, Sapino S, Ferrero V. Eur Arch Otorhinolaryngol 2023 Mar;280:3577-3583.

Antibiotics in mastoid and epitympanic obliteration with S53P4 bioactive glass: a retrospective study.
Alciato L, Bernardeschi D, Pourcher V, Mkrtchyan N, Tankéré F, Sterkers O, Lahlou G. Laryngoscope Investig Otolaryngol. 2022 Sep;7:1584-94.

Cholesteatoma surgery in the pediatric population: remaining challenges in the era of mastoid obliteration.
Kroon V, Mes S, Borggreven P, van de Langenberg R, Colnot D, Quak J.
Eur Arch Otorhinolaryngol. 2023 Apr;280(4):1713-1722.

Bioactive glass (S53P4) as obliteration material in subtotal petrosectomy: initial experience.
Lindeboom J, Colnot D, Buwalda J. J Laryngol Otol. 2023 Jan;137(1):105-107.

Mastoid Obliteration Using S53P4 Bioactive Glass in Cholesteatoma Surgery: A 10-Year Single-Center Experience in 173 Adult Patients with Long-Term Magnetic Resonance Imaging Controlled Follow-up.
Kroon, Mes S, Borggreven P, van de Langenberg R, Colnot D, Quak J. Otol Neurotol. 2022 Dec 1;43(10):1181-8.

Mid-term outcomes of mastoid obliteration with biological hydroxyapatite versus bioglass: a radiological and clinical study.
Sahli-Vivicorsi S, Alavi Z, William Bran W, Cadieu R, Meriot P, Leclere J-C, Marianowski R. Eur Arch Otorhinolaryngol. 2022 Sep;279(9):4379-88.

Mastoid Obliteration: A Comparison of Two Techniques.
Shree N, Ravikumar A, Sarvanam P. Indian J Otolaryngol Head Neck Surg 2022 Aug;74(Suppl 1):692-698.

Postoperative surgical site infection in cholesteatoma surgery with and without mastoid obliteration, what can we learn?
Cals F, van der Toom H, Metselaar R, van Linge A, van der Schroeff M, Pauw R. J Otol. 2022 Jan;17(1):25-30.

Mastoid Obliteration Using Bioactive Glasss—Our Experience.
Velusamy A, Hameed N, Anand A. Annals of Otology and Neurotology 2021 Sep; 4(02): 057-061.

Implantation of the Bonebridge BCI 602 after Mastoid Obliteration with S53P4 Bioactive Glass: A Safe Method of Treating Difficult Anatomical Conditions-Preliminary Results.
Król B, Cywka K, Skarzy´nska M, Skarzy´nski P. Life (Basel) 2021 Apr 22;11(5):374.

Cochlear Implantation and Mastoid Obliteration with Bioactive Glass after Canal Wall Down Mastoidectomy.
Hädicke J, Bernardeschi D, Langer J. Ann Otolaryngol Rhinol 2021; 8(3): 1267.

A Multicenter Retrospective Case Review of Outcomes and Complications of S53P4 Bioactive Glass.
Leonard C, McNally S, Adams M, Hampton S, McNaboe E, Reddy C, Bailie N. J Int Adv Otol 2021; 17(3):234-238.

Mastoid cavity obliteration using bone pâté versus bioactive glass granules in the management of chronic otitis media (squamous disease): a prospective comparative study.
Mishra A, Mallick A, Galagali J, Gupta A, Sethi A, Ghotra A. J Laryngol Otol. 2021 Jun;135(6):492-500.

Mastoid obliteration with S53P4 bioactive glass after canal wall down mastoidectomy: preliminary results.
Król B, Porowski M,Cywka K, Skarżyńska M, Skarżyńska P. Am J Otolaryngol. Mar-Apr 2021;42(2):102895.

Mastoid obliteration with S53P4 Bioactive glass can make bonebridge implantation feasible: a case report.
Król B, Porowski M,Cywka K, Skarżyńska M, Skarżyński P. Am J Case Rep, 2020; 21: e925914.

Management of tegmen defects with mastoid and epitympanic obliteration using S53P4 bioactive glass.
Remangeon F, Lahlou G, Alciato L, Tankere F, Mosnier I, Sterkers O, Pyatigorskaya N, Bernardeschi D. Laryngoscope Investigative Otolaryngology. 2020;5(2):297-304.

18F-NaF PET/CT imaging of bone formation induced by bioactive glass S53P4 after mastoid obliteration.
Timmermans A, Quak J, Hagen P, Colnot D. European J Hybrid Imaging. 2019;3:18.

Mastoid obliteration with synthetic materials: a review of the literature.
Skoulakis C, Koltsidopoulos P, Iyer A, Kontorinis G. J Int Adv Otol. 2019 Dec;15(3):400-4.

CLINICAL STUDIES

Bioactive glass granules for mastoid and epitympanic surgical obliteration: CT and MRI appearance.
Bernardeschi D, Law-ye B, Bielle F, Hochet B, Sterkers O, Dormont D, Pyatigorskaya N.
Eur Radiol. 2019 Mar 19. doi: 10.1007/s00330-019-06120-z.

Anatomical, functional and quality-of-life results for mastoid and epitympanic obliteration with bioactive glass S53P4: a prospective clinical study.
Bernardeschi D, Pyatigorskaya N, Russo FY, De Seta D, Corallo G, Ferrary E, Nguyen Y, Sterkers O.
Clin Otolaryngol. 2017;42(2):387-96.

Mastoid obliteration with S53P4 bioactive glass in cholesteatoma surgery.
de Veij Mestdagh P, Colnot D, Borggreven P, Orelio C, Quak J.
Acta Oto-Laryngologica 2017;137(7):690-94.

Bioactive glass obliteration of the mastoid significantly improves surgical outcome in non-cholesteatomatous chronic otitis media patients.
Vos J, de Vey Mestdagh P, Colnot D, Borggreven P, Orelio C, Quak J.
Eur Arch Otorhinolaryngol. 2017;274(12):4121-6.

Cutaneous and labyrinthine tolerance of bioactive glass S53P4 in mastoid and epitympanic obliteration surgery: prospective clinical study.
Bernardeschi D, Nguyen Y, Mosnier I, Smail M, Sterkers O. BioMed Research International. 2015:1-6.

Obliteration von Mastoidhöhlen.
Schimanski G, Schimanski E. HNO. 2015;63(8):538-45.

Bioactive glass S53P4 in mastoid obliteration surgery for chronic otitis media and cerebrospinal fluid leakage.
Sarin J, Grénman R, Aitasalo K, Pulkkinen J. Annals of Otology, Rhinology & Laryngology. 2012;121(9):563-9.

Mastoidectomy cavity obliteration with bioactive glass: a pilot study.
Silvola JT. Otolaryngology - Head and Neck Surgery. 2012;147(I):119-26.

Bioactive glass S53P4 in the filling of cavities in the mastoid cell area in surgery for chronic otitis media.
Stoor P, Pulkkinen J, Grénman R. Annals of Otology, Rhinology & Laryngology. 2010;119(6):377-82.

Oral and cranio maxillofacial

Bioactive glass granules S53P4 in osteotomy Le Fort I.
De Souza Cruz E, Souza Jr F, de Menezes L, Tuji F, Carneiro Jr C. Sci Rep. 2020 Jul;10(1):12690.

Osteotomy site grafting in bilateral sagittal split surgery with bioactive glass S53P4 for skeletal stability.
Stoor P, Apajalahti S, Kontio R.J Craniofac Surg. 2017 Oct;28(7):1709-16.

Regeneration of cystic bone cavities and bone defects with bioactive glass S53P4 in the upper and lower jaws.
Stoor P, Apajalahti S, Kontio R. J Craniofac Surg. 2017 Jul;28(5):1197-205.

Bioactive-glass in oral and maxillofacial surgery.
Profeta AC, Huppa C. Craniomaxillofac Trauma Reconstr. 2016;9(1):1-14.

The use of anatomically drop-shaped bioactive glass S53P4 implants in the reconstruction of orbital floor fractures. A prospective longterm follow-up study.
Stoor P, Mesimäki K, Lindqvist C, Kontio R. J Craniomaxillofac Surg. 2015;43(6):969-75.

Adipose stem cells used to reconstruct 13 cases with cranio-maxillofacial hard-tissue defects.
Sándor G, Numminen J, Wolff J, Thesleff T, Miettinen A, Tuovinen V. et al.
Stem Cells Trans Med. 2014;3(4):530-40.

Craniofacial bone reconstruction with bioactive fiber-reinforced composite implant.
Aitasalo K, Piitulainen J, Rekola J, Vallittu P. Head Neck. 2014;36(5):722-8.

Novel composite implant in craniofacial bone reconstruction.
Peltola M, Vallittu P, Vuorinen V, Aho A, Puntala A, Aitasalo K.
Eur Arch Otorhinolaryngol. 2012;269(2):623-8.

Reconstruction of orbital wall defects with bioactive glass plates.
Peltola M, Kinnunen I, Aitasalo K. J Oral Maxillofac Surg. 2008;66(4):639-46.

Long-term tissue reactions of three biomaterials in craniofacial surgery.
Peltola M, Aitasalo K, Tirri T, Rekola J, Puntala A. Key Engineering Materials. 2008;361-3:1343-6.

Bioactive glass hydroxyapatite in fronto-orbital defect reconstruction.
Aitasalo K, Peltola M. Plast Reconstr Surg. 2007;120(7):1963-72.

Bioaktiivinen lasi - suomalaista tutkimusta ja tuotekehitystä.
Peltola M. Erikoislääkäri. 2007;5:211-4.

Bioactive glass granules as a bone adjunctive material in maxillary sinus floor augmentation.
Turunen T, Peltola J, Yli-Urpo A, Happonen R. Clin Oral Impl Res. 2004;15(2):135-41.

Bioaktiivinen lasi pään ja kaulan alueen kirurgiassa.
Aitasalo K, Peltola M. Duodecim. 2004;120:1986-93.

Bioactive glass and turbinate flaps in the repair of nasal septal perforations.
Stoor P, Grénman R. Ann Otol Rhinol. 2004;113(8):655-61.

Repair of orbital floor fractures with bioactive glass implants.
Aitasalo K, Kinnunen I, Palmgren J, Varpula M. J Oral Maxillofac Surg. 2001;59:1390-5.

Bioactive glass S53P4 in repair of septal perforations and Its interactions with the respiratory infection-associated microorganisms Heamophilus influenzae and Streptococcus pneumoniae.
Stoor P, Söderling E, Grénman R. J Biomed Mater Res. 2001;58:113-20.

CLINICAL STUDIES

Reconstruction of orbital floor fractures using bioactive glass.
Kinnunen I, Aitasalo K, Pöllönen M, Varpula M. J CranioMaxillofac Surg. 2000;28, 229-34.

Bioactive glass granules and plates in the reconstruction of defects of the facial bones.
Suominen E, Kinnunen J. Scand J Plast Reconstr Surg Hand Surg. 1996;30(4):281-9.

Augmentation of the maxillary sinus wall using bioactive glass and autologous bone.
Turunen T, Peltola J, Kangasniemi I, Jussila J, Uusipaikka E, Yli-Urpo A, Happonen R-P.
Bioceramics. 1995;8:259-64.

Frontal sinus

Long-term microscopic and tissue analytical findings for 2 frontal sinus obliteration materials.
Peltola M, Aitasalo K, Aho AJ, Tirri T, Suonpää J. J Oral Maxillofac Surg. 2008;66(8):1699-707.

Bioactive glass S53P4 in frontal sinus obliteration: a long-term clinical experience.
Peltola M, Aitasalo K, Suonpää J, Varpula M, Yli-Urpo A. Head and Neck. 2006;28(9):834-41.

Bioactive glass S53P4 in frontal sinus obliteration. A 9-year experience.
Aitasalo K, Peltola M, Suonpää J, Yli-Urpo A. Key Engineering Materials. 2001;192-195:877-80.

Clinical follow-up method for frontal sinus obliteration with bioactive glass S53P4.
Peltola M, Suonpää J, Määttänen H, Varpula M, Aitasalo K, Yli-Urpo A, Laippala P.
J Biomed Mater Res. 2001;58(1):54-60.

Experimental follow-up model for clinical frontal sinus obliteration with bioactive glass (S53P4).
Peltola M, Suonpää J, Aitasalo K, Määttänen H, Andersson Ö, Yli-Urpo A, Laippala P.
Acta Otolaryngol. 2000;543:167-9.

Obliteration of the frontal sinus cavity with bioactive glass.
Peltola M, Suonpää J, Aitasalo K, Varpula M, Yli-Urpo A, Happonen R. Head and Neck. 1998;20(4):315-9.

Behaviour of bioactive glass (S53P4) in human frontal sinus obliteration.
Aitasalo K, Suonpää J, Peltola M, Yli-Urpo A. Bioceramics. 1997;10:429-32.

Obliteration of frontal sinuses with bioactive glass after chronic suppurative sinusitis. One year follow up.
Aitasalo K, Peltola M, Suonpää J, Yli-Urpo A, Andersson Ö, Varpula M, Happonen R.
Bioceramics. 1994;7:409-14.

Other studies

Bioglass and Bioactive Glasses and Their Impact on Healthcare.
Jones J, Brauer D, Hupa L, Greenspan D. Int J Appl Glass Sci 7 2016 Nov;7(4):423–34.

PRECLINICAL STUDIES

Effect of S53P4 bioactive glass and low-level laser therapy on calvarial bone repair in rats submitted to zoledronic acid therapy.
Bellato C, Oliveira D, Kasaya M, Moreira D, Cini M, Saraiva P, Gulinelli J, Santos P. Acta Cir Bras. 2021;36(6):e360603.

S53P4 bioactive glass scaffolds induce BMP expression and integrative bone formation in a critical-sized diaphysis defect treated with a single-staged induced membrane technique.
Eriksson E, Björkenheim R, Strömbergb G, Ainola M, Uppstud P, Aalto-Setälä L, Leino V-M, Hupa L, Pajarinen J, Lindfors N. Acta Biomater 2021;126:463-76.

The obliteration of noncritical size bone defects with bone dust or bone replacement material (Bioactive glass S53P4).
Kluge A, Neudert M, Kunert-Keil C, Lailach S, Zahnert T, Kemper M. Otolo Neurotol 2019;40(4):e415-e423.

Bone morphogenic protein expression and bone formation are induced by bioactive glass S53P4 scaffolds in vivo.
Björkenheim R, Strömberg G, Ainola M, Uppstu P, Aalto-Setälä L, Hupa L, Pajarinen J, Lindfors NC. J Biomed Mater Res B Appl Biomater. 2019;107(3):847-857.

Effect of osteoplasty with bioactive glass (S53P4) in bone healing - in vivo experiment on common European Rabbits (Oryctolagus cuniculus).
Arpad S, Trambitas C, Matei E, Vasile E, Pal F, Antoniac IV, Voicu SI, Bataga T, Fodor R. Rev. Chim. (Bucharest, Rom.). 2018;69(2):429-33.

Polymer-coated bioactive glass S53P4 increases VEGF and TNF expression in an induced membrane model in vivo.
Björkenheim R, Strömberg G, Pajarinen J, Ainola M, Uppstu P, Hupa L, Böhling TO, Lindfors NC. J Mater Sci 2017;52(15):9055-65.

BAG S53P4 putty as bone graft substitute – a rabbit model.
Saarenpää I, Stoor P, Frantzén J. Biomed Glasses. 2017;3(1):30-40.

Bioactive glass in cavitary bone defects: a comparative experimental study in rabbits.
Camargo AFF, Baptista AM, Natalino R, Camargo OP. Acta Ortop Bras. 2015;23(4):202-7.

S53P4 bioactive glass and fibrin glue for the treatment of osteochondral lesions of the knee – a preliminary in vivo study in rabbits.
Zazgyva A, Gurzu S, Jung I, Nagy Ö, Mühlfay G, Pop T. Rom. J Morphol Embryol. 2015;56(3):1085-90.

Comparison of the osteoconductive properties of three particulate bone fillers in a rabbit model: Allograft, calcium carbonate (Biocoral®) and S53P4 bioactive glass.
Gunn J.M, Rekola J, Hirvonen J, Aho A. Acta Odontolologica Scandinavica. 2013;71(5):1238-42.

Hydroxyapatite coating of cellulose sponges attracts bone-marrow-derived stem cells in rat subcutaneous tissue.
Tommila M, Jokilammi A, Terho P, Wilson T, Penttinen R, Ekholm E. J R Soc Interface. 2009;6:873-80.

Bioactive glass-derived hydroxyapatite-coating promotes granulation tissue growth in subcutaneous cellulose implants in rats.
Tommila M, Jokinen J, Wilson T, Forsback A-P, Saukko P, Penttinen R, Ekholm E. Acta Biomaterialia. 2008;4:354-61.

Mechanical verification of soft-tissue attachment on bioactive glasses and titanium implants.
Zhao D, Mortiz N, Vedel E, Hupa L, Aro H. Acta Biomaterialia. 2008;4(4):1118-22.

PRECLINICAL STUDIES

Bioactive glass granules as extender of autogenous bone grafting in cementless intercalary implant of the canine femur.
Keränen P, Itälä A, Koort J, Kohonen I, Dalstra M, Kommonen B, Aro H. Scand J Surg. 2007;96(3):243-51.

In vivo behavior of poly/bioactive glass composites in rat.
Ranne T, Tirri T, Yli-Urpo A, Närhi T, Laine V, Rich J, Seppälä J, Aho A.
J Bioactive Compatible Polymers. 2007;22(3):249-64.

Frontal bone defect repair with experimental glass-fiber-reinforced composite with bioactive glass granule coating.
Tuusa S, Peltola M, Tirri T, Lassila L, Vallittu P. J Biomed Mater Res. 2007;82B:149-55.

Injectable bioactive glass biodegradable polymer composite for bone and cartilage reconstruction: Concept and experimental outcome with thermoplastic composites of poly and bioactive glass.
Aho A, Tirri T, Kukkonen J, Strandberg N, Rich J, Seppälä J, Yli-Urpo A.
J Mater Sci: Mater Med. 2004;15(10):1165-73.

Granule size and composition of bioactive glasses affect osteoconduction in rabbit.
Lindfors NC, Aho AJ. J Mater Sci: Mater Med. 2003;14(4):265-372.

Bone response to degradable thermoplastic composite in rabbits.
Närhi T, Jansen J, Jaakkola T, de Ruijter A, Rich J, Seppälä J, Yli-Urpo A.
Biomaterials. 2003;24(10):1697-704.

Frontal sinus and skull bone defect obliteration with three synthetic bioactive materials. A comparative study.
Peltola M, Aitasalo KM, Suonpää JT, Yli-Urpo A, Laippala PJ, Forsback A.
J Biomed Mater Res B Appl Biomater. 2003;66(1):364-72.

Comparison of bioactive glass, mineral trioxide aggregate, ferric sulfate, and formocresol as pulpotomy agents in rat molar.
Salako N, Joseph B, Ritwik P, Salonen J, John P, Junaid TA. Dental Traumatology. 2003;19(6):314-20.

Bioactive glass as bone-graft substitute for posterior spinal fusion in rabbit.
Lindfors NC, Tallroth K, Aho AJ. J Biomed Mater Res. 2002;63(2):237-44.

Bioactive glass in frontal sinus and skull bone defect obliteration.
Peltola M, Aitasalo K, Suonpää J, Yli-Urpo A. Key Eng Mat. 2001;192-195:937-40.

In vivo model for frontal sinus and calvarial bone defect obliteration with bioactive glass S53P4 and hydroxyapatite.
Peltola MJ, Aitasalo KM, Suonpää JT, Yli-Yrpo A, Laippala PJ. J Biomed Mater Res. 2001;58(3):261-9.

Pre-treated bioactive composite in rat soft tissue.
Tirri T, Jaakkola T, Närhi T, Rich J, Seppälä J, Yli-Urpo A. Key Eng Mat. 2001;192-195:653-6.

Tissue response to bioactive glass and autogenous bone in the rabbit spine.
Lindfors NC, Aho AJ. Eur Spine J. 2000;9(1):30-5.

Bioactive glass granules and polytetrafluoroethylene membrane in the repair of bone defects adjacent to titanium and bioactive glass implants.
Turunen T, Peltola J, Makkonen T, Helenius H, Yli-Urpo A, Happonen R-P.
J Mater Sci: Mater Med. 1998;9(7):403-7.

Bioactive glass and calcium carbonate granules as filler material around titanium and bioactive glass implants in the medullar space of the rabbit tibia.
Turunen T, Peltola J, Helenius H, Yli-Urpo A, Happonen, R. Clin Oral Impl Res. 1997;8(2):96-102.

Transmission electron microscopy at the interface between S53P4 and bone.
Aho AJ, Heikkilä JT, Aho HJ, Yli-Urpo A. Bioceramics. 1996;9:41-4.

Long-term behaviour of bioactive glass cone and granules in rabbit bone.
Heikkilä JT, Salonen H, Yli-Urpo A, Aho AJ. Bioceramics. 1996;9:123-6.

Protein adsorption properties of bioactive glasses compared to their behaviour in rabbit tibia.
Brink M, Söderling E, Turunen T, Karlsson KH. Bioceramics. 1995;8:471-6.

Influence of granule size on the reactions of a bioactive glass for repair of bone defects.
Gatti A, Andersson Ö, Valdre G, Chiarini L, Tanza D, Bulgarelli S, Monari E.
Materials in Clinical Applications. 1995:409-16.

Bone formation in rabbit cancellous bone defects filled with bioactive glass granules.
Heikkilä J, Aho H, Yli-Urpo A, Happonen R, Aho A. Acta Orthop Scand. 1995;66(5):463-7.

Bone growth into surgically created cavities implanted with glass granules.
Lindfors NC, Slätis P, Karlsson K, Andersson Ö. Bioceramics. 1995;8:107-11.

Effect of bioactive glass granules and polytetrafluoroethylene membrane on repair of cortical bone defect.
Turunen T, Peltola J, Happonen R-P, Yli-Urpo A. J Mater Sci Mater Med. 1995;6:639-41.

Augmentation of the maxillary sinus wall using bioactive glass and autologous bone.
Turunen T, Peltola J, Kangasniemi I, Jussila J, Uusipaikka E, Yli-Urpo A, Happonen R-P.
Bioceramics. 1995;8:259-64.

Short term reaction kinetics of bioactive glass in simulated body fluid and in subcutaneous tissue.
Andersson Ö, Vähätalo K, Yli-Urpo A, Happonen R-P, Karlsson K. Bioceramics. 1994;7:67-72.

Analysis of the in vivo reactions of a bioactive glass in soft and hard tissue.
Gatti A, Valdrè G, Andersson Ö. Biomaterials. 1994;15(3):208-12.

Effect of glass bioactivity on new bone development induced by demineralized bone matrix in a rat ex-traskeletal site.
Pajamäki K, Andersson Ö, Lindholm T, Karlsson K, Yli-Urpo A, Laippala P, Happonen R-P.
Acta Orthop Trauma Surg. 1994;113(4):210-4.

In-vivo reactions in some bioactive glasses and glass-ceramics granules.
Gatti A, Yamamuro T, Hench L, Andersson Ö. Cells and Materials. 1993;3(3):283-91.

Induction of new bone by allogeneic remineralized bone matrix compined to bioactive glass composite in the rat.
Pajamäki K, Andersson Ö, Lindholm T, Karlsson K, Yli-Urpo A, Happonen R-P.
Annales Chirurgiae et Gynecologiae. 1993;82:137-44.

Effect of bovine bone morphogenetic protein and bioactive glass on demineralized bone matrix grafts in the rat muscular pouch.
Pajamäki K, Andersson Ö, Lindholm T, Karlsson K, Yli-Urpo A, Happonen R-P.
Ann Chir Gynecol Suppl. 1993;82:155-61.

Short term surface reactions of a bioactive glass implanted subcutaneously in rat.
Happonen R-P, Vähätalo K, Yli-Urpo A, Andersson Ö. Bioceramics. 1992;5:185-90.

In vivo behaviour of glasses in the SiO2-Na2O-CaO-P2O5-Al2O3-B2O3 system.
Andersson Ö, Liu G, Karlsson K, Niemi L, Miettinen J, Juhanoja J.
Journal of Materials Science: Materials in Medicine. 1990;1(4):219-27.

IN VITRO STUDIES

Inhibition of bacterial growth

Comparison of antibacterial and antibiofilm activity of bioactive glass compounds S53P4 and 45S5.
Zhou P, Garcia B, Kotsakis G. BMC Microbiology volume 22, Article number: 212 (2022).

Bioactive glass S53P4 eradicates staphylococcus aureus in biofilm/planktonic states in vitro.
Grønseth T, Vestby L, Nesse L, von Unge M, Silvola J. Ups J Med Sci. 2020 Aug;125(3):217-25.

Imaging studies of bacterial biofilms on cochlear implants – Bioactive glass (BAG) inhibits mature biofilm.
Kirchhoff L, Arweiler-Harbeck D, Arnolds J, Hussain T, Hansen S, Bertram R, Buer J, Lang S, Steinmann J, Höing B. PLoS ONE 2020;15(2):e0229198.

Antimicrobial activity of bioactive glass S53P4 against representative microorganisms causing osteomyelitis – Real-time assessment by isothermal microcalorimetry.
Moreno M, Butini M, Maiolo E, Sessa L, Trampuz A. Colloids and Surfaces B: Biointerfaces. 2020;189:110853.

Assessment of growth reduction of five clinical pathogens by injectable S53P4 bioactive glass material formulations.
Thijssen E, van Gestel N, Bevers R, Hofmann S, Geurts J, van Loo I, Arts J. Front. Bioeng. Biotechnol. 2020 Jun 26:8:634.

Antibiotic-loaded; Polymethylmethacrylate beads and spacers in treatment of orthopedic infections and role of biofilm formation.
van Vugt T, Arts J, Geurts J. Front Microbiol. 2019;10:1626.

Bioactive glass granules inhibit mature bacterial biofilms on the surfaces of cochlear implants.
Höing B, Kirchhoff L, Arnolds J, Hussain T, Buer J, Lang S, Arweiler-Harbeck D, Steinmann J. Otol Neurotol. 2018;39(10):e985-91.

BAG-S53P4 as bone graft extender and antimicrobial activity against gentamicin- and vancomycin-resistant bacteria.
Bortolin M, Romanò CL, Bidossi A, De Vecchi E, Mattina R, Drago L. Future Microbiology. 2018 Apr;13(5):525-33.

In vitro antibacterial activity of bioactive glass S53P4 on multiresistant pathogens causing osteomyelitis and prosthetic joint infection.
Cunha TM, Murça MA, Nigro S, Klautau GB, Salles MJC. BMC Infectious Diseases. 2018;18:157.

Recent evidence on bioactive glass antimicrobial and antibiofilm activity: a mini-review.
Drago L, Toscano M, Bottagisio M. Materials. 2018;11(2):326.

Influence of bioactive glass S53P4 granules and putty on osteomyelitis associated bacteria in vitro.
Stoor P, Frantzen F. Biomed Glasses. 2017;3(1).

Antibiofilm agents against MDR bacterial strains: is bioactive glass BAG-S53P4 also effective?
Bortolin M, De Vecchi E, Romanò CL, Toscano M, Mattina R and Drago L.
J Antimicrob Chemother 2016 Jan;71(1):123-7.

Bioactive glass combined with bisphosphonate provides protection against biofilms formed by the periodontal pathogen Aggregatibacter actinomycetemcomitans.
Hiltunen AK, Skogman ME, Rosenqvist K, Juvone H, Ihalainen P, Peltonen J, Juppo A, Fallalero A. Int J Pharm 2016;501:211-20.

The anti-bacterial activity of bioactive glass.
Trishala A, Jacob C. International Journal of Advanced Research. 2016;4(6):1070-7.

Antimicrobial activity and resistance selection of different bioglass S53P4 formulations against multidrug resistant strains.
Drago L, De Vecchi E, Bortolin M, Toscano M, Mattina R and Romanò CL.
Future Microbiol. 2015;10(8):1293-9.

Efficacy of antibacterial bioactive glass S53P4 against *S. aureus* biofilms grown on titanium discs in vitro.
Coraça-Huber DC, Fille M, Hausdorfer J, Putzer D, Noglen M. J Orthop Res. 2014;32(1):175-7.

In vitro antibiofilm activity of bioactive glass S53P4.
Drago L, Vassena C, Fenu S, De Vecchi E, Signori V, De Francesco R, Romanò CL.
Future Microbiol. 2014;9(5):593-601.

The in vitro antibacterial effect of S53P4 bioactive glass and gentamicin impregnated polymethylmethacrylate beads.
Gergely I, Zazgyva A, Man A, Zuh SG, Pop TS. Acta Microbiol Immunol Hung. 2014;61(2):145-60.

Antibacterial effects and dissolution behavior of six bioactive glasses.
Zhang D, Leppäranta O, Munukka E, Ylänen H, Viljanen MK, Eerola E, et al.
J Biomed Mater Res. 2010;93A(2):475-83.

Antibacterial effect of bioactive glasses on clinically important anaerobic bacteria in vitro.
Leppäranta O, Vaahtio M, Peltola T, Zhang D, Hupa L, Ylänen H, et al.
J Mater Sci: Mater Med. 2008;19:547-51.

Bactericidal effects of bioactive glasses on clinically important aerobic bacteria.
Munukka E, Leppäranta O, Korkeamäki M, Vaahtio M, Peltola T, Zhang D. et al.
J Mater Sci: Mater Med. 2008;19:27-32.

Factors controlling antibacterial properties of bioactive glasses.
Zhang D, Munukka E, Hupa L, Ylänen H, Viljanen MK, Hupa M. Key Eng Mat. 2007;330-2:173-6.

Effect of ion release on antibacterial activity of melt-derived and sol-gel-derived reactive ceramics.
Vaahtio M, Munukka E, Leppäranta O, Zhang D, Eerola E, Ylänen H, Peltola T.
Key Eng Mat. 2006;309-311:349-52.

Comparison of antibacterial effect on three bioactive glasses.
Zhang D, Munukka E, Leppäranta O, Hupa L, Ylänen H, Salonen J, et al.
Key Eng Mat. 2006;309-311:345-8.

A comparative study on the disinfection potentials of bioactive glass S53P4 and calcium hydroxide in contra-lateral human premolars ex vivo.
Zehnder M, Luder H, Schätzle M, Kerosuo E, Waltimo T. International Endodontic J. 2006;39(12):952-8.

Interactions between the bioactive glass S53P4 and the atrophic rhinitis-associated microorganism Klebsiella ozaenae.
Stoor P, Söderling E, Grenman R. J Biomed Mater Res. 1999;48:869-74.

Antibacterial effects of a bioactive glass paste on oral micro-organisms.
Stoor P, Söderling E, Salonen JI. Acta Odontol Scand. 1998;56:161-5.

Interactions between bioactive glass and periodontal pathogens.
Stoor P, Kirstilä V, Söderling E, Kangasniemi I, Herbst K, Yli-Urpo A. Microb Ecol Health Dis. 1996;9:109-14.

Interactions between the frontal sinusitis-associated pathogen Heamophilus Influenzae and the bioactive glass S53P4.
Stoor P, Söderling E, Andersson OH, Yli-Urpo A. Bioceramics. 1995;8:253-8.

IN VITRO STUDIES

Bone regeneration

Sintered S53P4 bioactive glass scaffolds have anti-inflammatory properties and stimulate osteogenesis in vitro.
Björkenheim R, Jämsen E, Eriksson E, Uppstu P, Aalto-Setälä L, Hupa L, Eklund K, Ainola M, Lindfors N, Pajarinen J. European Cells and Materials Vol. 40 2020, pages 15-30.

Acellular dense collagen-S53P4 bioactive glass hybrid gel scaffolds form more bone than stem cell delivered constructs.
Park H, Collignon A, Lepry W, Ramirez-GarciaLuna J, Rosenzweigef D, Chaussain C, Nazhata S. Mater Sci Eng C Mater Biol Appl. 2021 Jan:120:111743.

Biomaterial and implant induced ossification: in vitro and in vivo findings.
Vallittu P, Posti J, Piitulainen J, Serlo W, Määttä J, Heino T, Pagliari S, Syrjänen S, Forte G. J Tissue Eng Regen Med. 2020;1-12.

S53P4 Bioactive glass inorganic ions for vascularized bone tissue engineering by dental pulp pluripotent-like stem cell cocultures.
Núñez-Toldrà, Montori S, Bosch B, Hupa L, Atari M, Miettinen S.
Tissue Eng Part A. 2019 Feb 27. doi:10.1089/ten.

Repair of critical size defects using bioactive glass seeded with adipose-derived mesenchymal stem cells.
Sacak B, Cetel F, Akdeniz Z, Karademir B, Ercan F, Özkan N, Akpinar I, Celebiler Ö.
J Biomed Mater Res B Appl Biomater. 2017;105(5):1002–8.

Increase in VEGF secretion from human fibroblast cells by bioactive glass S53P4 to stimulate angiogenesis in bone.
Detsch R, Stoor P, Grünewald A, Roether JA, Lindfors NC, Boccaccini AR.
J Biomed Mater Res 2014;102(11):4055-61.

Enhanced osteogenicity of bioactive composites with biomimetic treatment.
Meretoja V, Tirri T, Malin M, Seppälä J, Närhi T. Biomed Res Int. 2014;2014:207676. **[Open access]**

Evaluating optimal combination of clodronate and bioactive glass for dental application.
Rosenqvist K, Airaksinen S, Vehkamäki M, Juppo AM. Int J Pharm. 2014;1;468(1-2):112-20.

Interaction of bioactive glass with clodronate.
Rosenqvist K, Airaksinen S, Fraser S, Gordon K, Juppo AM. Int J Pharm. 2013;452:102-7.

Effects of bioactive glass S53P4 or beta-tricalcium phosphate and bone morphogenetic protein-2 and bone morphogenetic protein-7 on osteogenic differentiation of human adipose stem cells.
Waselau M, Patrikoski M, Juntunen M, Kujala K, Kääriäinen M, Kuokkanen H. et al.
J Tissue Eng. 2012;3(1):1-14.

Osteoblast response to continuous phase macroporous scaffolds under static and dynamic culture conditions.
Meretoja VV, Malin M, Seppälä JV, Närhi TO. J Biomed Mater Res. 2008;89A(2):317-25.

Bioactive glass induced in vitro apatite formation on composite GBR membranes.
Tirri T, Rich J, Wolke J, Seppälä J, Yli-Urpo A, Närhi T. J Mater Sci: Mater Med. 2008;19:2919-23.

Molecular basis for action of bioactive glasses as bone graft substitute.
Välimäki VV, Aro HT. Scand J Surg. 2006;95(2):95-102.

Intact surface of bioactive glass S53P4 is resistant to osteoclastic activity.
Wilson T, Parikka V, Holmbom J, Ylänen H, Penttinen R. J Biomed Mater Res. 2005;77A:67-74.

Surface porous fibre-reinforced composite bulk bone substitute - In vitro studies and in vivo evaluation in segment defect.
Aho A, Hautamäki M, Mattila R, Alander P, Strandberg N, Rekola J. et al. Cell Tissue Bank 2004;5:213-21.

Osteoblast differentiation of bone marrow stromal cells cultured on silica gel and sol-gel-derived titania.
Dieudonné SC, van den Dolder J, de Ruijter JE, Paldan H, Peltola T, van 't Hof MA. et al. Biomaterials. 2002;23(14):3041-51.

Experimental follow-up model for clinical frontal sinus obliteration with bioactive glass (S53P4).
Peltola M, Suonpää J, Aitasalo K, Varpula M, Yli-Urpo A, Happonen R-P.
Acta Otolaryngol Suppl. 2000;543:167-9.

In vitro model for frontal sinus obliteration with bioactive glass S53P4.
Peltola M, Suonpää J, Andersson Ö, Määttänen H, Aitasalo K, Yli-Urpo A, Laippala P.
J Biomed Mater Res. 2000;53:161-6.

Histomorphometric and molecular biologic comparison of bioactive glass granules and autogenous bone grafts in augmentation of bone defect healing.
Virolainen P, Heikkilä J, Yli-Urpo A, Vuorio E, Aro HT. J Biomed Mater Res. 1997;35A(1):9-17.

Other studies

A comparative analysis of the cytocompatibility, protein adsorption, osteogenic and angiogenic properties of the 45S5- and S53P4-bioactive glass compositions.
Westhauser F, Arango-Ospina M, Hupa L, Renkawitz T, Boccaccini A, Kunisch E. Biomed. Mater. 2024 Feb;19(2).

Anti-inflammatory properties of S53P4 bioactive glass implant material.
Barrak F, Li S, Mohammed A, Myant C, Jones J. J Dent. 2022 Dec;127:104296.

The viability and growth of HaCaT cells after exposure to bioactive glass S53P4-containing cell culture media.
Sarin J, Vuorenmaa M, Vallittu P, Grenman R, Boström P, Riihilä P, Nissinen L, Kähäri V-M, Pulkkinen J. Otol Neurotol. 2021 Jun 1;42(5):e559-e67.

Primary stability of a press-fit cup in combination with impaction grafting in an acetabular defect model.
Schierjott R, Hettich G, Baxmann M, Morosato F, Cristofolini L, Grupp T. J Orthop Res. 2020;1–12.

The implantation of bioactive glass granules can contribute the load-bearing capacity of bones weakened by large cortical defects.
van Gestel N, Gabriels F, Geurts J, Hulsen D, Wyers C, van de Bergh J, Ito K, Hofmann S, Arts J, van Rietbergen B. Materials. 2019;12:3481.

Resorption of the calcium phosphate layer on S53P4 bioactive glass by osteoclasts.
van Gestel N, Schuiringa G, Hennissen J, Delsing A, Ito K, Rietbergen B, Arts J, Hofmann S.
J Mater Sci Mater Med. 2019;30:94.

IN VITRO STUDIES

Composition dependent mechanical behaviour of S53P4 bioactive glass putty for bone defect grafting.
van Gestel N, Hulsen D, Geurts J, Hofmann S, Ito K, Arts J, van Rietbergen B. J Mech Behav Biomed Mater. 2017;69:301-6.

Mechanical behaviour of bioactive glass granules and morselized cancellous bone allograft in load bearing defects.
Hulsen DJW, Geurts J, van Gestel NAP, van Rietbergen B, Arts JJ. J Biomech. 2016;49:1121-7.

Compression properties and dissolution of bioactive glass S53P4 and n-butyl-2 cyanoacrylate tissue adhesive-composite.
Sarin J, Hiltunen M, Hupa L, Pulkkinen J, Vallittu PK. Biomed Mater Eng. 2016 Sep 28;27(4):425-36.

The effect of fibrin sealant on bioactive glass S53P4 particles — pH impact and dissolution characteristics in vitro.
Sarin J, Björkvik L, Hiltunen M, Hupa L, Pulkkinen J, Vallittu PK. J Sci: Adv Mater Dev. 2016;482-87.

BAG-S53P4 as an additive to bone allografts: A laboratory study using an uniaxial compression test.
Putzer D, Coraça-Huber D, Ammann C, Liebensteiner M, Nogler M. J Orthop Res. 2015;33(12):1875-9.

Dissolution patterns of biocompatible glasses in 2-amino-2-hydroxymethyl-propane-1,3-diol (Tris) buffer.
Fagerlund S, Hupa L, Hupa M. Acta Biomater. 2013;9:5400-10.

Review of bioactive glass: From Hench to hybrids.
Jones J. Acta Biomater. 2013;9(1):4457-86.

Crystallization mechanism of the bioactive glasses, 45S5 and S53P4.
Massera J, Fagerlund S, Hupa L, Hupa M. J Am Ceram Soc. 2012;95(2):607-13.

Surface reactions of bioactive glasses in buffered solutions.
Varila L, Fagerlund S, Lehtonen T, Tuominen J, Hupa L. J Europ Cer Soc. 2012;32:2757-63.

In situ pH within particle beds of bioactive glasses.
Zhang D, Hupa M, Hupa L. Acta Biomaterialia. 2008;4(5):1498-505.

Load bearing capacity of bone anchored fiber-reinforced composite device.
Ballo AM, Lassila L, Vallittu P, Närhi T. J Mater Sci: Mater Med. 2007;18: 2025-31.

Immunoglobulin enhances the bioactive-glass-induced chemiluminescence response of human polymorphonuclear leukocytes.
Lindfors N.C. Klockars M. J Biomed Mater Res. 2001 Jun 15;55(4):613-7.

Protein adsorbption to bioactive glasses with special reference to precorrosion.
Söderling E, Herbst K, Larmas E, Yli-Urpo A. J Biomed Mater Res. 1996;31:525-31.

BOOKS

Thesis

Investigation of Bacterial Biofilms on Clinically Relevant Materials and Effects of Antimicrobials.
Hiltunen A. Division of Pharmaceutical Biosciences Faculty of Pharmacy University of Helsinki Finland. Thesis 2021.

Bioactive glass as bone graft substitute: in vitro assessment of the mechanical and biological properties.
Nicole van Gestel. Eindhoven University of Technology. Thesis 2019.

Factors affecting accuracy and fusion rate in lumbosacral fusion surgery – A preclinical and clinical study.
Saarenpää I. University of Turku. Turku, Finland. Thesis 2018.

Biomaterials in infection treatment.
Geurts J. Maastricht University. Maastricht, the Netherlands. Thesis 2018.

Bioactive glass S53P4 and tissue adhesives in the surgical treatment of chronic middle ear and mastoidal infections.
Sarin J. University of Turku. Turku, Finland. Thesis 2017.

The anti-biofilm effects of bisphosphonates and bioactive glass on periodontopathogen Aggregatibacter Actinomycetemcomitans.
Hiltunen AK. University of Helsinki. Thesis 2015.

Bioactive glass granules as bone graft substitute in load-bearing defects.
Dennis J.W. Hulsen. Thesis 2013.

Bioactive glass granules as bone graft substitute in load-bearing defects.
Hulsen D. Eindhoven University of Technology. Thesis 2013.

Understanding the in vitro dissolution rate of glasses with respect to future clinical applications.
Fagerlund S. Åbo Akademi University, Finland. Thesis 2012.

Bioactive glass in lumbar spondylodesis. A preclinical and clinical study.
Frantzén J. University of Turku. Turku, Finland. Thesis 2012.

Self-reinforced poly (desamino tyrosyl-tyrosine ethyl ester carbonate) and poly (LDL) lactide rods alone and with bioactive glass in the fixation of distal femoral osteotomies. An experimental study on rats and rabbits.
Pyhältö T. University of Helsinki and Helsinki University Central Hospital and from the Institute of Biomaterials, Tampere University of Technology. Helsinki, Finland. Thesis 2005.

Interactions between oral and nasal microorganisms and the bioactive glass S53P4 with special reference to nasal cavity surgery.
Stoor P. University of Turku. Turku, Finland. Thesis 2001.

BOOKS

Books

S53P4 bioactive glass.
Westhauser F, Arango-Ospina M, Hupa L, Renkawitz T, Boccaccini A, Kunisch E. 2017.
Woodhead Publishing 2017.

Management of Periprosthetic Joint Infections (PJIs)
Arts JJC, Geurts J. Woodhead Publishing Series in Biomaterials. 2017.

Bioactive glasses - materials, properties and applications.
Ylänen H. Bioactive Glasses, 2nd Edition. Woodhead Publishing Limited, UK. 2017.

Bioactive glasses in Infection treatment.
Lindfors N, Romanò C, Scarponi S, Lorenzo D, Bortolin M, Frantzén J, de Veij Mestdagh P, Colnot D, Borggreven P, Quak J. In: Boccaccini A, Brauer D, Hupa L.

Mastoid cavity obliteration with bioactive glass granules.
Schimanski G, Schimanski E. In: Recent advances in otolaryngology - head and neck surgery.
Lalwani A, Pfister M. 2016;5:249-81.

Bone substitutes and related materials in clinical orthopaedics.
Aho A, Heikkilä J. In: Phillips GO. Clinical applications of bone allografts and substitutes biology and clinical applications. World Scientific Publishing. 2005;3:139-74.

Advances in tissue banking.
Aho AJ, Heikkilä JT. Advances in Tissue Banking. 1997;1:73-108.

CONTACT

Bonalive headquarters

Bonalive Biomaterials Ltd
Tel. +358 401 77 44 00
Biolinja 12, 20750 Turku, Finland
contact@bonalive.com
www.bonalive.com

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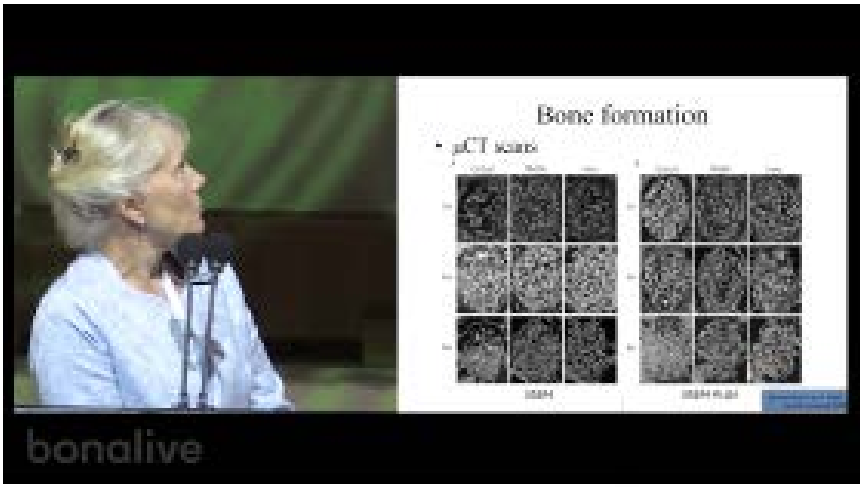


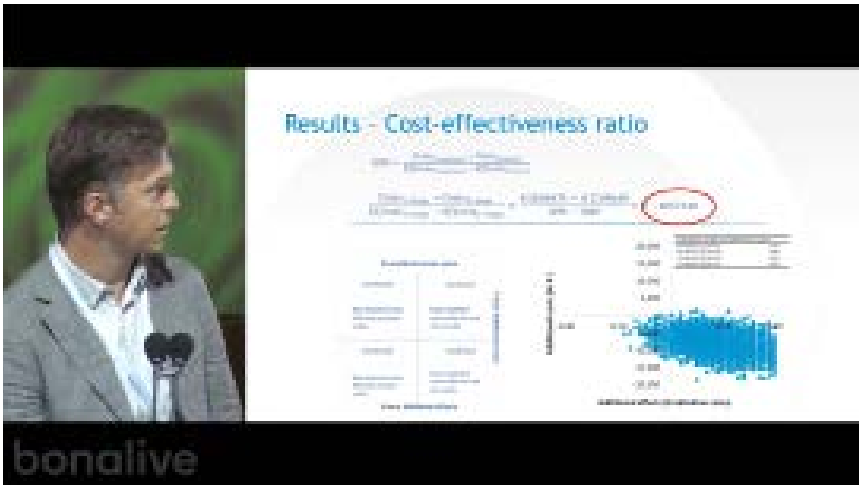
Stimulating our own biological machinery – can this be done?

Assoc. Prof. Nina Lindfors

Assoc. Prof. Lindfors presents some promising new results of applying bioactive glass to stimulate new bone growth.

Video (13:29)

Article Polymer-coated bioactive glass S53P4 increases VEGF and TNF expression in an induced membrane model in vivo. Björkenheim R, Strömberg G, Pajarinen J, Ainola M, Uppstu P, Hupa L, Böhling TO, Lindfors NC. 2017.



S53P4 bioactive glass – a highly cost-effective solution

MD Dr. Jan Geurts

MD Dr. Geurts shares an eye-opening study of the cost-savings a 1-step compared to a 2-step procedure might imply when treating infected bone.

Video (8:42)

Article Cost-effectiveness study of one-stage treatment of chronic osteomyelitis with bioactive glass S53P4. Geurts J, van Vugt T, Thijssen E, Arts J. Materials. 2019;30;12(19).

EXTRA MATERIALS

The role of S53P4 bioactive glass in septic non-union surgery

Dr. Martin Glombitza

Dr. Glombitza shares his experiences of treating septic non-unions with bioactive glass.

Video (10:58)

Article The use of bioactive glass S53P4 as bone graft substitute in the treatment of chronic osteomyelitis and Infected non-unions – a retrospective study of 50 patients. Al Malat TA, Glombitza M, Dahmen J, Hax P-M, Eva Steinhausen E. 2018.

Antibacterial bioactive glass, S53P4, for chronic bone infections – a multinational study

Assoc. Prof. Nina Lindfors

Assoc. Prof. Lindfors presents results from the multinational study using S53P4 for the resolution of bone infections and dead space management.

Video (23:59)

Article Antibacterial bioactive glass, S53P4, for chronic bone infections - a multinational study. Lindfors N, Geurts J, Drago L, Arts JJ, Juutilainen V, Hyvönen P, Suda A, Domenico A, Artiaco S, Alizadeh C, Brychcy A, Bialecki J, Romano C. 2017.

EXTRA MATERIALS

What is the role of S53P4 bioactive glass in diabetic foot treatment?

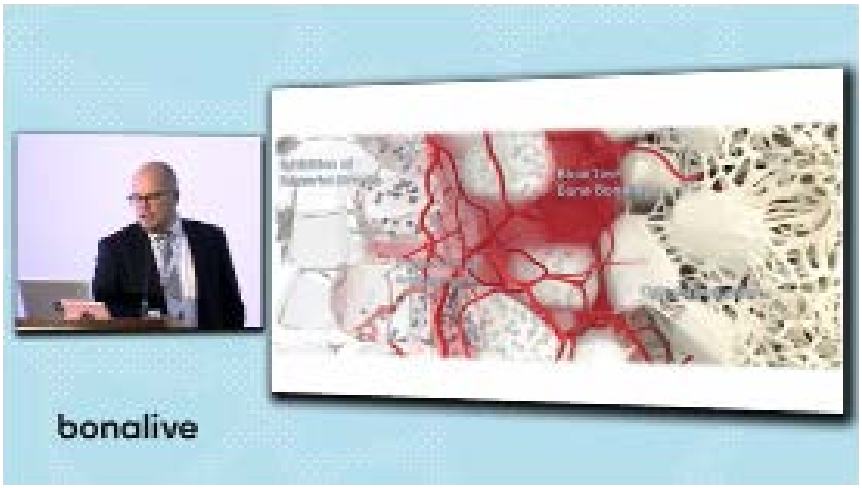
Dr. Roberto De Gigilio

Dr. De Gigilio talks about his experiences from using bioactive glass in the treatment of chronic osteomyelitis for

patients with diabetes mellitus. Dr. De Giglio is a diabetologist and talks about the promising results of his research, where bioactive glass S53P4 has been compared with current standard of care in treating diabetic foot complications.

Video (6:26)

Article Bioactive glass S53P4: a new opportunity for the treatment in the diabetic foot osteomyelitis. De Giglio R, Stefani I, Mondello T, De Filippis G, Mazzone A. Eur J Intern Med. 2018 Aug;54:e15-e16.



S53P4 bioactive glass putty in MIS spine surgery

Adjunct Prof. Janek Frantzén

Adjunct Prof. Janek Frantzén shares his experience of using S53P4 bioactive glass putty in minimal invasive spine surgery.

Video (12:42)

Article Novel bioactive glass putty (S53P4) as bone graft expander in minimally invasive lumbosacral interbody fusion. Saarenpää I, Hirvonen J, Frantzén J. J Minim Invasive Spine Surg Tech. 2018;3(2):52-58.

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9-100908