



RESEARCH ARTICLE

ANALYTICAL APPROACHES ON APPLICATION OF BIOMATERIALS IN PERIODONTAL DISEASES

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ABSTRACT

Nowadays, biomaterials applications could be established as a good medium/ vehicle for periodontal research and practice. Such materials based biotechnology routinely used in periodontal applications and is being continued as a very impressive tool to improve related disorders specifically in all dental research including periodontology. In this review biomaterials applications in periodontology will be elaborately discussed in detail including all applied agents.

Key words:

Biomaterials, Biotechnology research,
Periodontology.

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INTRODUCTION

Commonly biomaterial is any substance that has been worked to collaborate with normal systems for a therapeutic reason - either a medicinal (treat, amplify, repair or supplant a tissue limit of the body) or an expository one (Papaspriidakos *et al.*, 2013). As a science, biomaterials is around fifty years old. The examination of biomaterials is called biomaterials science or biomaterials planning. It has experienced immovable and strong improvement over its history (Berglundh *et al.*, 2002; Pjetursson *et al.*, 2012; Bozini *et al.*, 2011; Misch, 2007), with numerous associations putting a considerable measure of money into the headway of new things. Biomaterials science incorporates segments of medication, science, science, tissue outlining and materials science (Branemark *et al.*, 1989). Observe that a biomaterial is one of a kind in connection to a natural material, for instance, bone that is conveyed by a characteristic structure. Additionally, mind should be polished in portraying a biomaterial as biocompatible, since it is application-specific. A biomaterial that is biocompatible or suitable for one application may not be biocompatible in another. Biomaterials can be gotten either from nature or mixed in the examination focus using a grouping of blend approaches utilizing metallic sections, polymers, ceramic generation or composite materials (Jokstad, Asbjorn, 2009; Sinn *et al.*, 2011; Arcuri, 1995; Chen, 2009; Lee, 2007).

They are frequently used and in addition balanced for a helpful application, and in this manner contains whole or some part of a living structure or biomedical device which performs, grows, or replaces a trademark limit. Such limits may be for the most part standoffish, for example, being used for a heart valve, or may be bioactive with a more instinctive value, for instance, hydroxy-apatite secured hip additions. Biomaterials are moreover used every day in dental applications, surgery, and solution movement. For example, a creation with impregnated pharmaceutical things can be put into the body, which permits the drawn out entry of a drug over a widened time allotment. A biomaterial may moreover be an autograft, allograft or xenograft used as a transplant material (Ruggiero *et al.*, 2009).

Dental Implants

A dental implant or embed (generally called an end osseous insert or establishment) is a surgical fragment that interfaces with the bone of the jaw or skull to reinforce a dental prosthesis, for instance, a crown, associate, denture, facial prosthesis or to go about as an orthodontic remain (Kumar snf Honne, 2012; Branemark *et al.*, 1992; Pallaci, Patrick, 1995; Spector, 2008; Lindhe, *et al.*, 2008; McCracken *et al.*, 2010; Esposito *et al.*, 2010). The explanation behind present day dental supplements is a biologic methodology called Osseo integration, in which materials, for instance, titanium shape a comfortable join to bone. The insert establishment is at first put with the objective that it is most likely going to Osseo integrate, then a dental prosthetic is incorporated (Kumar snf Honne, 2012; Branemark *et al.*, 1992; Pallaci, Patrick, 1995;

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Spector, 2008; Lindhe, *et al.*, 2008; McCracken *et al.*, 2010; Esposito *et al.*, 2010). A variable measure of patching time is required for Osseo integration before either the dental prosthetic (a tooth, framework or denture) is joined to the implant or a projection is set which will hold a dental prosthetic (Esposito *et al.*, 2013; Atieh *et al.*, 2009; Peterson and Miloro, 2004; Esposito *et al.*, 2009; Sclar, Anthony, 2003; Branemark *et al.*, 1992). The basic usage of dental supplements is to support dental prosthetics. Introduce day dental additions make usage of Osseo integration, the biologic technique where bone breakers immovably to the surface of specific materials, for instance, titanium and a couple stoneware (Buser *et al.*, 1994).

The joining of install and bone can support physical weights for an impressive period of time without disillusionment. For individual tooth substitution, an insert projection is at first secured to the install with a projection screw. A crown (the dental prosthesis) is then connected with the projection with dental bond, a little screw, or merged with the projection as one piece in the midst of fabrication (Branemark *et al.*, 1989; Guidance for Industry and FDA Staff). Dental additions, comparatively, can moreover be used to hold a different tooth dental prosthesis either as a settled framework or removable dentures. An install reinforced associate (or settled denture) is a social affair of teeth secured to dental inserts so the prosthetic can't be cleared by the customer. Interfaces frequently interface with more than one implant and may similarly connect with teeth as catch core interests (Laskin, Daniel, 2007; Newman *et al.*, 2012; Atieh *et al.*, 2010; Patzelt *et al.*, 2013; Assunção *et al.*, 2009). Regularly the amount of teeth will overshadow the catch centers with the teeth that are direct over the additions suggested as projections and those between projections insinuated as Pontiacs. Install maintained traverses attach to implant projections in an indistinct way from a singular tooth insert substitution (Lee *et al.*, 2012). A settled framework may supplant as few as two teeth (generally called a settled inadequate denture) and may connect with supplant an entire bend of teeth (generally called a settled full denture). In both cases, the prosthesis is said to be settled in light of the way that it can't be emptied by the denture wearer (Branemark *et al.*, 1989).

A removable implant reinforced denture (furthermore an install maintained over denture (Jokstad, Asbjorn, 2009; Ruggiero *et al.*, 2009) is a sort of dental prosthesis which is not for unsurpassed settled set up. The dental prosthesis can be disengaged from the install projections with finger weight by the wearer. To engage this, the projection is shaped as a little connector (a catch, ball, bar or magnet) which can be related with nearly taking after connectors in the underside of the dental prosthesis. Facial prosthetics, used to right facial misshapeness (e.g. from danger treatment or wounds) can utilize relationship with supplements put in the facial bones (Sinn *et al.*, 2011). Depending on the condition the install may be used to hold either a settled or removable prosthetic that replaces some part of the face (McCracken *et al.*, 2010). In orthodontics, little estimation dental additions, implied as Temporary Anchorage Devices (or TADs) can help tooth improvement by making stay centers from which forces can be generated (Chen *et al.*, 2009). For teeth to move, an oblige must be associated with them toward the pined for advancement. The drive engages cells in the periodontal ligament to realize bone modifying, removing bone toward go of the tooth and adding it to the space made. In order to deliver

constrain on a tooth, a stay point (something that won't move) is required. Since supplements don't have a periodontal ligament, and bone redesigning won't be sustained when weight is associated, they are flawless stay centers in orthodontics. Normally, embeds expected for orthodontic advancement are close to nothing and don't totally Osseo integrate, allowing basic removal taking after treatment.

Biomaterials Applications in Periodontological Research and Practice

In spite of the way that introduce Osseo integration happens a while, the bone embed contact midpoints 70-80% with least of 60% notwithstanding for gainful embed that proceeded for a long time which incite more territories of control for development on surfaces for better Osseo integration (Jokstad, Asbjorn, 2009; Susan Wingrove; Greenstein *et al.*, 2008; Ferguson, 2014; Zhu *et al.*, 2015; Esposito *et al.*, 2010; Papaspyridakos *et al.*, 2011). As of now introduces had full scale anomalies like typically clear strings, fenestrations, pores, grooves, steps, strings, or other surface variations from the norm that were discernible. The consideration was to make mechanical interlocking among introduce and bone at the full scale level. Regardless, burden in getting done with beginning reliability, post implantation relative advancement, antagonistic interfacial bone patching up all prompt scan for development of the surface method for a titanium dental introduce like the rate and nature of its Osseo integration (Javed and Romanos, 2010). At the little level, surface irregularities are at that level, perhaps in conjunction with significant scale peculiarities. This would bear the cost of the likelihood of microscopic interlocking of bone and embed, which may improve the heap transmitting limits of the interface.

Minuscule level consolidates surface coatings and similarity of surface coatings and change of surface geography to improve bone embed joining. These days, the change of the bone shaping action at the interface is based on nanoscale highlights that can instigate the parcel of foundational microorganisms along the osteogenic pathway and help cell intrigue and association with extracellular framework acknowledging gathering of integrin's into central bond structures (FA), and begin intracellular hailing course all inducing an unrivaled Osseo integration (Papaspyridakos *et al.*, 2011) Particular methods have been utilized to make nanosized features on dental embed. Nanomaterials are in a general sense polymers fortified by nanoparticles accomplishing novel materials which can be utilized as light weight substitutes for metals. Precisely when brought into a mass material, nanoparticle can unequivocally influence the mechanical properties of the materials. Compound frameworks combine anodic oxidation in which nanostructure with partition transversely over of <100 nm is made on Ti embeds through electrolytic response that happens at the Ti anode, accomplishing the headway of an oxide film. This outcomes in a surface with micropores which indicate expanded cell affiliation (Arcuri, 1995). Influencing supplement surfaces with particles of different detachments transversely over is one of the an awesome piece of the time utilized strategies for surface change in which aluminum oxide, titanium oxide and calcium phosphate with molecule evaluate going from near nothing, medium to boundless (150-350 μm) coarseness are utilized. Clinical reviews have shown higher minor bone levels and survival rates for influenced embed than machine turned supplements (Chen *et al.*, 2009).

Considerations have familiar blended outcome with concession with aluminum oxide left in the wake of influencing. Couple of producers have detailed catalization of Osseo integration while others have indicated impeded bone strategy by a conceivable strong activity with calcium particles (Lee, 2007). Drawing with solid dangerous produces micropits (0.5-2 μm) in width. Twofold damaging scratching with HCl and H₂SO₄ warmed more than 100°C has made surface topography arranged to interface with fibrin organize and drive commitment of osteogenic cells. Sandblasting and damaging scratching (SLA-sandblasted, tremendous coarseness, ruinous cut surface) is made by clearing coarseness (250-500 μm) influencing carried after by drawing with acids which besides passes on severe surface, micro texturing and cleaning and better bone union (Ruggiero *et al.*, 2009). Plasma sprinkling gives a vulnerable surface that bone can enter all the more quickly and upgrade Osseo integration. Titanium plasma showering contains embedding titanium powder into a plasma devour at high temperature where particles are predicted on to the surface of supplements where they collect and circuit together embellishment a film around 100 nm (Kumar and Honne, 2012; Renouard, Frank, 2009).

It has been displayed that this 3 dimensional geography broadened unyielding nature at the bone embed interface and have routinely been supported for districts with low bone thickness. Fluoride (F) treatment-Titanium is to an awesome degree open to fluoride framing dissolvable titanium fluoride in F strategy. This treatment upgrades Osseo integration and osteoplastic differentiations with augmented articulation of Cbfa1, osterix and bone sialoprotein (Branemark *et al.*, 1992). Fluoridated unforgiving introduces moreover withstood more vital push-out strengths and showed an essentially higher takeoff torque than control installs. Regardless, threatening impact of F on the breaking down resistance of titanium and titanium blends has been for the most part revealed. Fluorides are to an incredible degree capable anxious oxide encompassed on titanium and titanium blends. Antibacterial coatings at first look have been investigated as a conceivable approach to manage check surgical site diseases. Gentamycin near to the layer of HA can be secured onto the embed surface which may go about as a region prophylactic director close-by the systemic against tainting masters in dental introduce surgery. Study was done to research if unmistakable pH, air and surface properties could control bacterial handle to titanium surfaces utilized as a bit of dental augmentations. Titanium floats with machined or anodized (TiUnite™) surface were hatched with a co-culture of *Streptococcus mitis* and *Actinomyces oris* (early colonizers of oral surfaces) at pH 5.0, 7.0 and 9.0 at high-effect or anaerobic condition. The bond was assessed by numbering settlement shaping units (CFU) on agar and by confocal laser filtering microscopy (CLSM). The outcomes found that bacterial association by *S. mitis* and *A. oris* can be confined by acidic pH and oxygen exhausting air. The anodized surface lessened the commitment of *S. mitis* showed up contrastingly in connection to the machined surface; while *A. oris* clung likewise well to the pores of the anodized surface and to the torments of the machined surface (McCracken *et al.*, 2010; De Brandão *et al.*, 2013). Polymeric embeds as polymethylmethacrylate and polytetrafluoroethylene were at initially utilized as a bit of 1930s. All things considered, low mechanical nature of polymers has thwarted their utilization as embed materials. Mix of polymers and different portrayals of constructed biomaterials (HA, Al₂O₃, Glass earthenware production) have been utilized as a bit of permeable or strong

structures for tissue affiliation, substitution and augmentation as coatings to exchange force to delicate and hard tissue district. Biodegradable polymers, for example, Polyvinyl liquor, polylactides or glycosides, cyanoacrylates or other hydrated structures have been joined with biodegradable CaPO₄ for use, for example, dealt with frameworks, plates, screws or other such applications, for example, bone advancement and periimplant bone deformity repairs. The utilization of polymers for osseointegrated embed will without a doubt pieces among prosthesis and introduce for deaden ingestion and better copies the biomechanical furthest reaches of trademark tooth work. The IMZ increases are either titanium plasma sprinkled or hydroxyapatite secured and join a polymethyleneintramobile part (IME) which goes about as an inside ensure and is set between the introduce and prosthesis through IMC (intamobile connector) to start conveyability and affirmation a more uniform pressure allotment along bone embed interface. Considerations have shown this trance connecting with fragment in like way helpers in lessening occlusal loads (De Brandão *et al.*, 2013; Fritzscheier, 2007).

Results of Literature Analysis

Based on scientific analysis of more than 250 original research articles published during 2002-2016 covered by PubMed as well as Scopus databases with keywords of periodontal disease and biomaterials it was analyzed that it's a big demand on the use of such nanomaterials applications in 2004 since now. In figure 1 it is illustrated that during within years 2002-2003 it's a little application for biomaterial sciences in periodontology but after 2006 such biomaterials has been widely used.

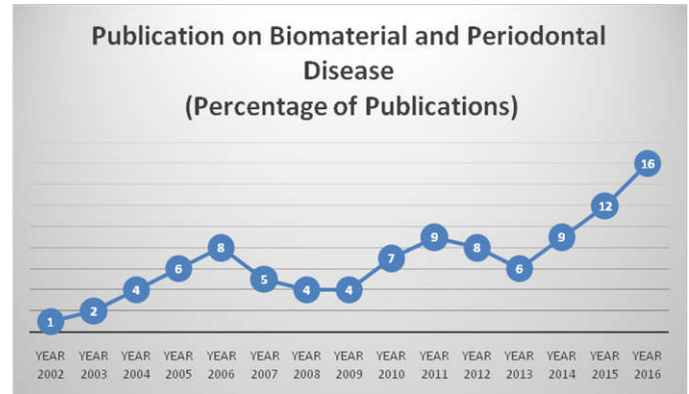


Figure 1. Demonstration of universal application of biomaterials applications in periodontological research during within 2002-2016

REFERENCES

- Arcuri, M.R. 1995. "Titanium implants in maxillofacial reconstruction". *Otolaryngol Clin North Am.*, 28 (2): 351–63. PMID 7596615.
- Assunção, W. G. A., Barão, V. A. R., Delben, J. A., Gomes, É. A., Tabata, L. F. 2009. "A comparison of patient satisfaction between treatment with conventional complete dentures and overdentures in the elderly: A literature review". *Gerodontology*, 27 (2): 154–162. doi:10.1111/j.1741-2358.2009.00299.x. PMID 19467020.
- Atieh, M. A., Atieh, A. H., Payne, A. G., Duncan, W. J. 2009. "Immediate loading with single implant crowns: A systematic review and meta-analysis". *The International Journal of Prosthodontics*, 22 (4): 378–387.

- Atieh, M. A., Ibrahim, H. M., Atieh, A. H. 2010. "Platform Switching for Marginal Bone Preservation Around Dental Implants: A Systematic Review and Meta-Analysis". *Journal of Periodontology*, 81 (10): 1350–66. doi:10.1902/jop.2010.100232. PMID 20575657.
- Berglundh, T., Persson, L., Klinge, B. 2002. "A systematic review of the incidence of biological and technical complications in implant dentistry reported in prospective longitudinal studies of at least 5 years". *Journal of clinical periodontology*, 29 (Suppl 3): 197–212. doi:10.1034/j.1600-051X.29.s3.12.x. PMID 12787220.
- Bozini, T., Petridis, H., Garefis, K., Garefis, P. 2011. "A meta-analysis of prosthodontic complication rates of implant-supported fixed dental prostheses in edentulous patients after an observation period of at least 5 years". *The International journal of oral & maxillofacial implants*, 26 (2): 304–318.
- Branemark, Per-Ingvar Worthington, Philip, ed 1992. *Advanced osseointegration surgery: applications in the maxillofacial region* (in English). Carol Stream, Illinois: Quintessence Books. ISBN 0867152427.
- Branemark, Per-Ingvar; Zarb, George 1989. *Tissue-integrated prostheses* (in English). Berlin, German: Quintessence Books. ISBN 0867151293.
- Buser, Daniel, Schenk, Robert, K. 1994. *Guided bone regeneration in implant dentistry* (in english). Hong Kong: Quintessence Books. ISBN 0867152494.
- Chen, Y., Kyung, H. M., Zhao, W. T., Yu, W. J. 2009. "Critical factors for the success of orthodontic mini-implants: A systematic review". *American Journal of Orthodontics and Dentofacial Orthopedics*, 135 (3): 284–291. doi:10.1016/j.jado.2007.08.017. PMID 19268825.
- Misch, Carl, E. 2007. *Contemporary Implant Dentistry*. St. Louis, Missouri: Mosby Elsevier.
- De Brandão, M. L., Vettore, M. V., Vidigal Júnior, G. M. 2013. "Peri-implant bone loss in cement- and screw-retained prostheses: Systematic review and meta-analysis". *Journal of Clinical Periodontology*, 40 (3): 287–295. doi:10.1111/jcpe.12041. PMID 23297703.
- Esposito, M., Grusovin, M. G., Chew, Y. S., Coulthard, P., Worthington, H. V. 2009. "One-stage versus two-stage implant placement. A Cochrane systematic review of randomised controlled clinical trials". *European Journal of Oral Implantology*, 2 (2): 91–99.
- Esposito, M., Grusovin, M. G., Maghaireh, H., Worthington, H. V. 2013. "Interventions for replacing missing teeth: Different times for loading dental implants". *The Cochrane database of systematic reviews*. 3 (CD003878): CD003878. doi:10.1002/14651858.CD003878.pub5. PMID 23543525.
- Esposito, M., Grusovin, M. G., Polyzos, I. P., Felice, P., Worthington, H. V. 2010. "Timing of implant placement after tooth extraction: Immediate, immediate-delayed or delayed implants? A Cochrane systematic review"(PDF). *European Journal of oral Implantology*, 3 (3): 189–205. PMID 20847990.
- Esposito, Marco; Worthington, Helen V., Loli, Vassiliki; Coulthard, Paul; Grusovin, Maria Gabriella, 2010. "Interventions for replacing missing teeth: antibiotics at dental implant placement to prevent complications". *The Cochrane Database of Systematic Reviews*, (7): CD004152. doi:10.1002/14651858.CD004152.pub3. ISSN 1469-493X. PMID 20614437.
- Ferguson, M. 2014. "Rhinosinusitis in oral medicine and dentistry.". *Australian Dental Journal*, 59 (3): 289–95. doi:10.1111/adj.12193. PMID 24861778.
- Fritzscheier, C. U., W. Schmüdderich, 2007. *Periimplantitis prophylaxes durch Versiegelung der Implantatinnenräume*, *Implantologie*, 15(1):71-80
- "Guidance for Industry and FDA Staff - Class II Special Controls Guidance Document: Root-form Endosseous Dental Implants and Endosseous Dental Abutments". FDA. 2004-05-12. Retrieved 2013-11-11.
- Greenstein, G., Cavallaro, J., Romanos, G., Tarnow, D. 2008. "Clinical recommendations for avoiding and managing surgical complications associated with implant dentistry: a review". *J Periodontol.*, 79 (8): 1317–29. doi:10.1902/jop.2008.070067.
- Javed, F., Romanos, G. E. 2010. "The role of primary stability for successful immediate loading of dental implants. A literature review". *Journal of Dentistry*, 38 (8): 612–620. doi:10.1016/j.jdent.2010.05.013. PMID 20546821.
- Jokstad, Asbjorn, ed. 2009. *Osseointegration and Dental Implants* (in English). John Wiley & Sons. ISBN 9780813804743.
- Kumar, M. N., Honne, T. 2012. "Survival of dental implants in bisphosphonate users versus non-users: A systematic review". *The European Journal of Prosthodontics and Restorative Dentistry*, 20 (4): 159–162. PMID 23495556.
- Laskin, Daniel, 2007. *Decision making in oral and maxillofacial surgery*. Chicago, IL: Quintessence Pub. Co. ISBN 9780867154634.
- Lee, J. Y., Kim, H. Y., Shin, S. W., Bryant, S. R. 2012. "Number of implants for mandibular implant overdentures: A systematic review". *The Journal of Advanced Prosthodontics*, 4 (4): 204–9. doi:10.4047/jap.2012.4.4. 204.PMC 3517958. PMID 23236572.
- Lee, S.L. 2007. *Applications of orthodontic mini implants*. Hanover Park, IL: Quintessence Publishing Co, Inc. pp. 1–11. ISBN 9780867154658.
- Lindhe, Jan, Lang, Niklaus P., Karring, Thorkild, eds. 2008. *Clinical Periodontology and Implant Dentistry 5th edition* (in English). Oxford, UK: Blackwell Munksgaard. ISBN 9781405160995.
- McCracken, Michael S., Mitchell, Lillian; Hegde, Rashmi; Mavalli, Mahendra D. 2010. "Variability of Mechanical Torque-Limiting Devices in Clinical Service at a US Dental School". *Journal of Prosthodontics*, 19 (1): 20–24. doi:10.1111/j.1532-849X.2009.00524.x. ISSN 1059-941X. PMID 19765196.
- Newman, Michael, Takei, Henry, Klokkevold, Perry, eds. 2012. *Carranza's Clinical Periodontology* (in English). St. Louis, Missouri: Elsevier Saunders. ISBN 9781437704167.
- Pallaci, Patrick, 1995. *Optimal implant positioning and soft tissue management for the Branemark system* (in english). Germany: Quintessence Books. pp. 21–33. ISBN 086 7153083.
- Papaspyridakos, P., Chen, C. - J., Singh, M., Weber, H. - P., Gallucci, G. O. 2011. "Success Criteria in Implant Dentistry: A Systematic Review". *Journal of Dental Research*, 91 (3): 242–248. doi:10.1177/002203451143 1252. PMID 22157097.
- Papaspyridakos, P., Mokti, M., Chen, C. J., Benic, G. I., Gallucci, G. O., Chronopoulos, V. 2013. "Implant and Prosthodontic Survival Rates with Implant Fixed Complete Dental Prostheses in the Edentulous Mandible after at Least 5 Years: A Systematic Review". *Clinical Implant Dentistry and Related Research*, 16 (5): 705–717. doi:10.1111/cid.12036. PMID 23311617.
- Patzelt, S. B. M., Bahat, O., Reynolds, M. A., Strub, J. R. 2013. "The All-on-Four Treatment Concept: A Systematic

- Review". *Clinical Implant Dentistry and Related Research*, 16: 836–855. doi:10.1111/cid.12068. PMID 23560986.
- Peterson, L.J. Miloro, M. 2004. *Peterson's Principles of Oral and Maxillofacial Surgery*, 2nd Edition. PMPH-USA.
- Pjetursson, B. E., Thoma, D., Jung, R., Zwahlen, M., Zembic, A. 2012. "A systematic review of the survival and complication rates of implant-supported fixed dental prostheses (FDPs) after a mean observation period of at least 5 years". *Clinical Oral Implants Research*, 23: 22–38. doi:10.1111/j.1600-0501.2012.02546.x. PMID 23062125.
- Renouard, Frank, 1999. *Risk Factors in Implant Dentistry: Simplified Clinical Analysis for Predictable Treatment*. Paris, France: *Quintessence International*, ISBN 0867 153555.
- Ruggiero, S. L., Dodson, T. B., Assael, L. A., Landesberg, R., Marx, R. E., Mehrotra, B. 2009. "American Association of Oral and Maxillofacial Surgeons Position Paper on Bisphosphonate-Related Osteonecrosis of the Jaws—2009 Update". *J Oral and Maxillofac Surg.*, 67 (5): 2–12. doi:10.1016/j.joms.2009.01.009. PMID 19371809.
- Sclar, Anthony, 2003. *Soft tissue and esthetic considerations in implant dentistry (in English)*. Carol Stream, IL: Quintessence Books. ISBN 0867153547.
- Sinn, D. P., Bedrossian, E., Vest, A. K., Bedrossian, Vest 2011. "Craniofacial Implant Surgery". *Oral and Maxillofacial Surgery Clinics of North America*. 23 (2): 321–335. doi:10.1016/j.coms.2011.01.005. PMID 2149 2804.
- Spector, L. 2008. "Computer-Aided Dental Implant Planning". *Dental Clinics of N Amer.*, 52 (4): 761–775. doi:10.1016/j.cden.2008.05.004. PMID 18805228.
- Susan Wingrove. ?. "Focus on implant home care Before, during, and after restoration". *RDH MAGAZINE*. 33 (9).
- Zhu, Yanfei. Zheng, Xinyi, Zeng, Guanqi, Xu, Yi, Qu, Xinhua, Zhu, Min, Lu, Eryi, 2015. "Clinical efficacy of early loading versus conventional loading of dental implants". *Scientific Reports*, 5: 15995. doi:10.1038/srep15995. ISSN 2045-2322. PMC 4635353 PMID 26542097.
