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# Guided Bone Regeneration

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**Abstract**
Guided bone regeneration is similar to the basic concepts of guided tissue regeneration. In guided bone regeneration, we are only dealing with two comparments: the connective tissue and the bone. Connective tissue exclusion achieved with the barrier membrane allowed for the bone regeneration to occur. The biological basis for guided bone regeneration involved fullfillment of bone growth requirement: establishing stable immobile base, allow for release of growth factors, and finally, preserving the blood supply to the area of defects. The guided bone regeneration promotes bone formation by protection against an invasion of competing, nonosteogenic tissues. GBR holds a long term promise and plays a major role in implant reconstruction.

**Key Words**
Regeneration, Osseointegration, Alveolar Bone

Developing artificial replacement for missing teeth had been an elusive goal for more than 1500 years. **Branemark** initiated the replacement of missing teeth using an implant in 1952 and the first patient was treated with implants in 1965. **Branemark** presented his research for the first time in 1982 at a conference held in Toronto. His finding have since then opened a new era in the field of dental prosthesis and oral rehabilitation.[1]

Over the past 15 years, the principles of Guided Tissue Regeneration has been successfully applied to increase the volume of the host bone at sites chosen for implant placement. The concept of bone regeneration employs same principles of specific tissue exclusion and space provision, but is not associated with the teeth. Hence the term Guided Bone Regeneration (GBR) is used for this technique.[1,2]

The principles of Guided Tissue Regeneration for bone regeneration (GBR) was first investigated in oral cavity by ***Dahlin et al*** in 1988. Transmandibular bone defects in rats were covered by barrier membranes and showed complete regeneration of bone in 9 weeks. Similar results were reported by experiments conducted by Karring et al using bioresorbable membranes. Histological analysis showed 85% of bone regeneration in over 180 day.[3]

The concept of Guided Bone Regeneration was applied to Osseo integrated dental implants by Dahlin, using ePTFE to cover Branemark dental implants. Several screw threads were left uncovered by bony housing and were draped by membrane. When stage two surgery was performed, almost all previously exposed threads were found to be covered with bone. Similar results were obtained by Becker et al, using Teflon membranes around the titanium implants.[3,9]

**GUIDED BONE REGENERATION** is similar to the basic concepts of guided tissue regeneration. In guided tissue regeneration, we are dealing with epithelial and connective tissue exclusion and space creation to allow for the cells of the periodontal ligament to repopulate the root surface and allow bone cell to grow into the area of defect. Thus, in GTR we have five compartments: the epithelium, the connective tissue, the cells of periodontal ligament, the cementum, and the bone.[4,5]

In guided bone regeneration, we are only dealing with **two comparments: the connective tissue and the bone**. Connective tissue exclusion achieved with the barrier membrane allowed for the bone regeneration to occur. The biological basis for guided bone regeneration involved fulfillment of bone growth requirement: establishing stable immobile base, allow for release of growth factors, and finally, preserving the blood supply to the area of defects. The guided bone regeneration promotes bone formation by protection against an invasion of competing, nonosteogenic tissues.[6,7]

**Murray in 1957** stated that there were three things necessary for the new growth of bone: the presence of a **blood clot, preserved osteoblast, and contact with living tissue.** The importance of clot establishment and stabilization in GBR has been investigated by Melcher and Dreyer, who studied the healing process of a penetrating defect in rat femur, where the blood clot was protected with either a plastic or organic shield during healing.[8,11,14]

The study support the role of the barrier as a)protection of the hematoma from invasion by non-osteogenic shields b)stabilization of the hematoma and prevents its distortion by the pressure of overlying tissue. Further more, the membrane seal off the bone defect from the surrounding soft connective tissue. This creates a secluded space into which cells only from the surrounding bone can migrate. This principle is referred to as the osteopromotion principle. In GBR, we are only dealing with the connective tissue (not with the epithelium like the GTR). The barrier provided an isolated environment which the osteogenic process, e.g. osteoconduction, osteoinduction, and osseointegration can occur undisturbed.

Since biochemical induction of bone formation is still in an experimental phase, and distraction osteogenesis cannot be applied in the healing of local bone defects in the jaw bones; Guided Bone Regeneration and the use of bone grafting materials are the only methods commonly applied in clinical practices. Among these, Guided Bone Regeneration has shown the best and most predictable results when employed. [10]

**Meltzer** classified the defect of the implant site into four classes. **Class I** site described the defect of which all bony walls are intact and the diameter of the site is greater than the diameter of the implant. In **Class II Site**, the three walls are intact; however, there is a fenestration or dehiscence in the fourth wall. **Class III site** has two sublass: the first described the defect which has two of four walls are intact and two walls present with either a fenestration or dehiscence, the second subclass described a knife edge ridge defect of adequate height, but less than adequate width. Finally, **Class IV** site demonstrated the inadequate ridge height. Each class effects the treatment path in term of implant placement (immediate, delayed, or staged) and the healing time. The success of the therapy lies in the ability to achieve the adequate bone height and width by guided bone regeneration techniques to allow for complete osseointegration of the implant.[15,18]

Several clinical applications of the principle of Guided Bone Regeneration, in conjunction with the treatment of oral defects prior to or concomitantly with the placement of oral implants, have been developed . These include:

1. Alveolar bone defect closure
2. Augmentation of Alveolar Ridges
3. Alveolar bone dehiscence in association with implants:
4. Alveolar bone fenestrations in association with implants:
5. Immediate implant placement following tooth extraction

In recent years, the one stage method of combining the implant placement with Guided Bone Regeneration has been preferred over the two-stage method using Guided Bone Regeneration prior to implantation.

**The rationale of this procedure is**

a) To decrease the restorative time.
b) To promote bone to implant contact.
c) To preserve alveolar bone height.

**Indications for immediate implant placement are:**

a) Failed endodontically treated teeth.
b) Teeth with advanced periodontal disease.
c) Root fractures.
d) Advanced caries beneath the gingival margin.

**Contradictions for immediate implant placement are:**

a) Teeth with suppuration.
b) Teeth with large periapical infections.

The main **disadvantage** of combining bone regeneration with implant placement is the fact that, in case of a compromised treatment outcome regarding bone formation, only the more apical part of the implant is properly osteointegrated. In such situations, long-term prognosis is impaired and the rate of soft tissue complications is increased. However, had the two-stage technique be applied, such a problem could adequately be dealt with.[12,13]

6. Treatment of Peri-Implant defects:

Peri-implant tissue destruction may be caused by bacterial infection and inflammation, similar to that in periodontal disease, or may be a consequence of occlusal overload.

Antimicrobial and regenerative therapies established for the treatment of periodontal disease, can also be applied to deal with peri-implantitis.

Studies have shown successful re-osteointegration of bacterially contaminated implant surfaces using Guided Bone Regeneration principle. Histological data has revealed varying amounts of bone regeneration and the best results were obtained with a combination of Guided Bone Regeneration and bone substitutes.

**Surgical Technique**

The surgical technique for Guided Bone Regeneration involves either a full thickness flap or a combination of split thickness and full thickness flap extending between the adjacent teeth. The steps involved are:[12,13]

1. Lateral incision technique is used. The initial incision is placed over the intact bone away from the defect. Incisions extend into the gingival sulcus of neighbouring teeth.
2. Following flap elevation, soft tissue within the defect is carefully removed.
3. Barrier membrane is adjusted and adapted to cover the bony defect and 3 to 4 mm of the surrounding intact bone. The membrane should be atleast 1 to 2 mm away from adjacent tooth.
4. In situations where there is a possible risk of collapse of the membrane barrier into the defect, miniscrews are placed to support the membrane.
5. Cortical bone lining the defect is perforated into the subjacent cancellous bone.
6. The mucoperiosteal flaps are subsequently repositioned and tightly sutured with mattress sutures.
7. Post-surgical plaque control includes twice daily rinse with chlorhexidine solutions. Sutures are removed after 14 days. In case of non-resorbable membranes, the barriers are removed 6 to 8 months after initial surgery.

**Conclusion**

Guided bone regeneration hold a long term promise and played a major role in implant reconstruction. With the advance of growth factor technology and barrier membrane, horizontal bone growth will become the area of interest. Researches and studies have provided to us the insights to all the component of GBR: the barrier, the BMPs and growth factor, the dynamics of hard and soft tissue growth. Further researches in the timing of the signal and the gene therapy will enable us to successfully predicting the outcome of the one wall defect.[17,18,19]

**References**


1. Proceeding of the world workshop in clinical periodontics, The American Academy of Periodontology, 1989.
2. The Annals of Periodontology. 1996 World Workshop in Periodontics. The American Academy of Periodontology, 1996.
3. Buser, D., Dahlin, C., Schenk, R. Guided Bone Regeneration in Implant Dentistry. Quintessence Publishing Co, Inc., 1994.
4. Periodontal Literatures Reviews. A summary of Current Knowledge. The American Academy of Periodontology, 1996.
5. Rosen, V.,Cox, K., Hattersley, G. Bone Morphogenetic Proteins. Principles of Bone Biology, Academic Press, 1996.
6. Boyne, PJ. Regeneration of alveolar bone beneath cellulose acetate filter implants. Journal of Dental Research, 43: 827, 1964.
7. Melcher, AH., Dreyer, CJ. Protection of blood clot in healing circumscribed bone defects. Jounl of Bone and Joint Surgery,

44B: 424, 1962
8. Boyne, PJ. Restoration of osseous defects in maxillofacial casualties. Journal of American Dental Association, 78:767, 1969.
9. Dahlin, C., Gotlow, J., Lindhe, A., Nyman, S. Healing of maxillary and mandibular bone defects using a membrane technique. An experimental study in monkeys. Scand Journal of Plastic Reconstruction Hand Surgery, 24:13, 1990.
10. Nyman, Lindhe, Karring. Reattachment , new attachment. Textbook of Clinical periodontology, 1989.
11. Dahlin, Linde A., Gottlow, J., Nyman S. Healing of bone defects by guided tissue regeneration, Plastic Reconstructive Surgery 81: 672, 1988.
12. Buser, D., Dula K., Belser, U., Hirt, HP., Berthold, H. Localized ridge augmentation using guided bone regeneration. Surgical procedure in the maxilla, Int J. of Periodontal Restorative Dentistry, 13: 29, 1993.
13. Schenk, RK., Buser, D., Hardwick, WR., Dahlin C. Healing pattern of bone regeneration in membrane protected defects. A histologic study in the canine mandible. Int J Oral Maxillofac Implants, 9: 13, 1994.
14. Dahlin, Linde A., Gottlow, J., Nyman, S. Healing of bone defects by guided tissue regeneration, Plastic Reconstruction Surg, 81:672, 1988.
15. Sandlin FI, Neill ME. Guided cell repopulation in periodontal therapy utilizing absorbable barrier techniques. Clinical Update, Naval Post Graduate Dental School. 2002; 24 : 6 - 9.
16. Sato N. Guided Bone Regeneration. In: Sato N. Periodontal surgery. A clinical Atlas. Quintessence: 247 - 309.
17. Scantlebury TV. 1982 –1992 : A decade of technology development for Guided Tissue Regeneration. J Periodontol 1993; 64 : 1129 - 1137.
18. Schallhorn RG, McClain PK. The use of combined periodontol regenerative techniques (Guest Editorial). J Periodontol 1999; 70 : 102.
19. Schenk RK, Buser D, Dahlin C. Healing pattern of bone regeneration in membrane protected defects. Int J Oral Maxillofac Implants 1994; 9 : 13 - 29.

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