LITERATURE REVIEW

THE USE OF AUTOGRAFT IN PERIODONTAL SURGERY

A THESIS

Submitted as Partial Fulfillment of the Requirements for

the Attainment of the Degree of Bachelor of Dentistry

ADITYA REYNALDI LOMO

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DEPARTMENT OF PERIODONTIA

FACULTY OF DENTISTRY

HASANUDDIN UNIVERSITY

MAKASSAR

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KATA PENGANTAR

Segala puji syukur penulis panjatkan kepada Allah SWT yang telah melimpahkan berkat rahmat, taufik dan hidayah-Nya sehingga penulis dapat menyelesaikan penulisan dan penyusunan skripsi dengan judul "THE USE OF AUTOGRAFT IN PERIODONTAL SURGERY". Shalawat dan salam juga penulis haturkan kepada junjungan Nabi besar Rasulullah Muhammad SAW sebagai teladan yang membawa manusia dari jalan yang gelap menuju jalan serba pengetahuan. Penulisan skripsi ini bertujuan sebagai salah satu syarat penyelesain studi dalam mencapai gelar sarjana kedokteran gigi pada Fakultas Kedokteran Gigi Universitas Hasanuddin. Selain itu, skripsi ini diharapkan dapat memberikan manfaat tidak hanya untuk penulis tetapi bagi pembaca dan peneliti lainnya.

Berbagai hambatan penulis alami selama penyusunan skripsi ini, tetapi berkat doa, dukungan, dan bimbingan dari berbagai pihak, skripsi ini dapat terselesaikan dengan tepat waktu. Oleh karena itu, pada kesempatan ini penulis pertama-tama ingin mengucapkan terima kasih serta penghormatan dan penghargaan kepada orang tua penulis yakni, Ayahanda **Alm. Ir. Julianus H. Lomo,** Ayahanda **Ir. Arman Razak** dan Ibunda **Asfawati,** karena doa dan restunyalah sehingga rahmat Allah tercurah, serta kasih sayang dan kesabaranya dalam memberikan dukungan baik material maupun moril sehingga skripsi ini dapat terselesaikan.

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Makassar, 11 Oktober 2022

Penulis

ABSTRAK

Penggunaan Autograft dalam Bedah Periodontal

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Latar Belakang: Penyakit periodontal terdiri dari berbagai kondisi inflamasi yang menyebabkan degenerasi periodonsium dan mempengaruhi semua struktur pendukung gigi seperti gingiva, ligamen periodontal, sementum, tulang alveolar dan lain-lain. Penyakit periodontal juga dapat diartikan sebagai penyakit yang ditandai dengan inflamasi gingiva, resesi gingiva, dan poket periodontal pada jaringan pendukung gigi. Berdasarkan hasil Riset Kesehatan Dasar (RISKESDAS) tahun 2018, sebanyak 57,6% penduduk Indonesia memiliki masalah pada gigi dan mulut. RISKESDAS menyatakan bahwa proporsi terbesar masalah gigi di Indonesia adalah gigi rusak/gigi berlubang/sakit (45,3%). Sedangkan masalah kesehatan gigi dan mulut yang paling banyak dialami oleh penduduk Indonesia adalah gusi bengkak dan/atau bisul (abses) sebesar 14%. Penyebab utama penyakit periodontal adalah plak, akumulasi kalkulus dan bakteri. Faktor predisposisinya adalah stres, merokok, dan konsumsi alkohol. Dengan banyaknya kerusakan yang dapat ditimbulkan ketika menderita penyakit periodontal, misalnya dapat menyebabkan kerusakan tulang, maka perlu dilakukan pencangkokan tulang itu sendiri. **Tujuan:** Mampu memahami tentang, kerusakan tulang akibat kerusakan periodontal, penyembuhan setelah perawatan periodontal, regenerasi jaringan periodontal, fungsi dan klasifikasi cangkok tulang, sejarah, definisi dan metode *autograft*, kombinasi *autograft* dengan bahan regenerasi lainnya. **Metode:** *Literature Review.* Adapun langkahnya yaitu mengumpulkan informasi dari beberapa sumber, melakukan kompilasi data menggunakan metode sintesis informasi dari literatur/jurnal, dan tinjauan literatur. **Tinjauan Pustaka:** Cangkok tulang adalah prosedur pembedahan untuk mengganti tulang yang hilang dengan bahan tubuh pasien sendiri, pengganti buatan, sintetis, atau alami. Ada berbagai macam jenis cangkok tulang, salah satunya adalah autograft. *Autograft* adalah pencangkokan tulang yang melibatkan pemanfaatan tulang yang diperoleh dari individu yang sama yang menerima cangkok. **Hasil:** Dalam tinjauan *literature review* ini didapatkan hasil bahwa autograft dapat memberikan hasil yang baik untuk pencangkokan tulang dalam bedah periodontal. **Kesimpulan:** *Autograft* adalah "standar emas" karena mereka adalah cangkok yang diambil dari bagian donor di tempat yang sama dari individu dan ditransplantasikan ke bagian lain dari individu. Cangkok autogenous dianggap sebagai standar emas karena mereka mempertahankan viabilitas sel dan tidak menimbulkan respon imunologi pada pasien.

Kata Kunci: *Autograft*, cangkok tulang, kerusakan tulang, bedah periodontal.

ABSTRACT

The Use of Autograft in Periodontal Surgery

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Background: Periodontal diseases consists of a wide range of inflammatory conditions which causes degeneration of Periodontium and affects all supporting structures of teeth such as gingiva, periodontal ligament, cementum, alveolar bone and etc. Periodontal disease also can be interpreted a disease characterized by gingival inflammation, gingival recession, and periodontal pockets in the supporting tissues of the teeth. Based on the results of the Basic Health Research (RISKESDAS) in 2018, as much as 57.6% of the population of Indonesia have problems with their teeth and mouth. RISKESDAS stated that the largest proportion of dental problems in Indonesia was damaged/cavities/sick teeth (45.3%). Meanwhile, the majority of oral health problems experienced by the Indonesian population are swollen gums and/or ulcers (abscesses) by 14%. The main causes of periodontal disease are plaque, calculus accumulation, and bacteria. The predisposing factors are stress, smoking, and alcohol consumption. With the amount of damage that can be caused when suffering from periodontal disease, for example, it can cause bone damage, it is necessary to have a bone graft itself. **Objectives:** Be able to understand about, bone damage due to periodontal breakdown, healing after periodontal treatment, periodontal tissue regeneration, function and classification of bone graft, history, definitions and methods of autograft, combination of autograft with other regeneration material. **Method:** Literature Review. The steps are collecting information from several sources, and compiling data using information synthesis methods from literature/journals, and literature. **Literature Review:** A bone graft is a surgical procedure to replace lost bone with the patient's own body material, artificial, synthetic, or natural substitutes. There are various types of bone grafts, one of them is autograft. Autograft is bone grafting that involves the utilization of bone obtained from the same individual who received the graft. Results: In this literature review, it was found that autograft can provide good results for bone grafting in the periodontal surgery. Conclusions: Autografts are the “gold standard” because they are grafts that are harvested from a part of the donor at the same site of the individual and transplanted into another part of the individual. Autograft are considered the gold standard because they maintain cell viability and do not elicit an immunologic response in the patient.

Keywords: Autograft, bone graft, bone damage, periodontal surgery.

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CHAPTER I

INTRODUCTION

1.1 Background

Periodontal diseases consists of a wide range of inflammatory conditions which causes degeneration of Periodontium and affects all supporting structures of teeth such as gingiva, periodontal ligament, cementum, alveolar bone and etc.[1] Periodontal disease also can be interpreted a disease characterized by gingival inflammation, gingival recession, and periodontal pockets in the supporting tissues of the teeth. The main causes of periodontal disease are plaque, calculus accumulation and bacteria. The predisposing factors are stress, smoking, and alcohol consumption.[2] With the amount of damage that can be caused when suffering from periodontal disease, for example, it can cause bone damage, it is necessary to have a bone graft itself.

A bone graft is a surgical procedure to replace lost bone with the patient's own body material, artificial, synthetic, or natural substitutes. Bone grafting is possible, as bone tissue has the ability to fully regenerate if space is provided to grow. When natural bone grows, it generally replaces the graft material completely, and results in a fully integrated area.[3] One of the types of bone graft used is autograft.

Autograft, autologous, autogenous bone grafting involves the utilization of bone obtained from the same individual who received the graft. Bone can be taken from nonessential bones, such as from the iliac crest, mandibular symphysis (chin area), and mandibular anterior ramus (coronoid process).When a block graft is to be performed, autogenous bone is the most preferred because there is less risk of rejection, since the graft originates from the patient'sown body. It will be osteoinductive and osteogenic, as well as osteoconductive.The disadvantage of autologous grafts is that an additional surgical site is required, another potential site for postoperative pain and complications. All bones require a blood supply at the transplant site. Depending on where the transplant site is and the size of the graft, additional blood supply may be required. For this type of graft, extraction of the periosteum and accompanyingblood vessels along with the donor bone is required.[3]

1.2. Problem Formulation

How is autograft used in periodontal destruction

1.3. Writing Purpose

1. Understanding periodontal tissue regeneration
2. Understanding the function and classification of bone graft
3. Understanding about autograft
4. Understanding the results of bonegraft treatment
5. Understanding the combination of autograft with other regeneration materials

1.4. The Benefits of Writing

The theoretical and practical benefits of this Literature review are expected to provide information or knowledge about:

1. Bone damage due to periodontal breakdown
2. Healing after periodontal treatment
3. Periodontal tissue regeneration
4. Function and classification of bone graft
5. History, definitions and methods of autograft
6. Combination of autograft with other regeneration material

CHAPTER II
LITERATURE STUDIES

2.1. Bone Damage due to Periodontal Breakdown[4]

Periodontal disease changes bone morphology, namely reducingbone height, bone thickness, changing the shape of the alveolar process, butalso changing the histological structure of the bone, including bone density.For accurate diagnosis and therapy, a thorough understanding of the nature and pathophysiology of these changes is required.

a. Horizontal bone damage

The most common pattern of bone loss in periodontal disease is horizontal bone loss. The height of the bone is reduced, but the edges of the bone remain perpendicular to the tooth surface. The interdental septa, as well as the facial and lingual plates, are all damaged, though not to the same degree, around the same teeth.

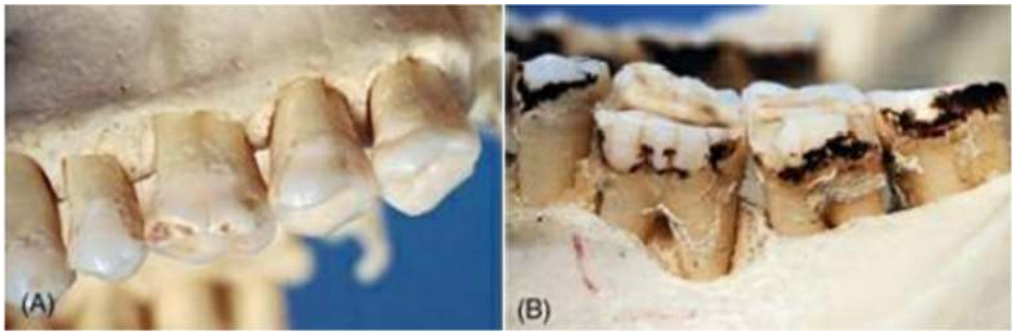


Figure 2.1: A, Horizontal bone loss. Note the reduction in the height of the marginal bone exposing the cancellous bone and reaching the furcation of the second molar. B, Vertical (angular) bone loss at the distal root of the first molar.

(Newmann MG, Takei HH, Klokkevold PR, Carranza FA. Newman and Carranza's Clinical Periodontology Third South Asia Edition. Elsevier. India)

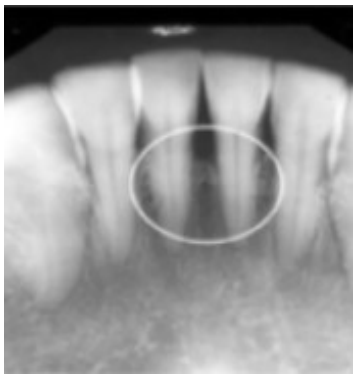
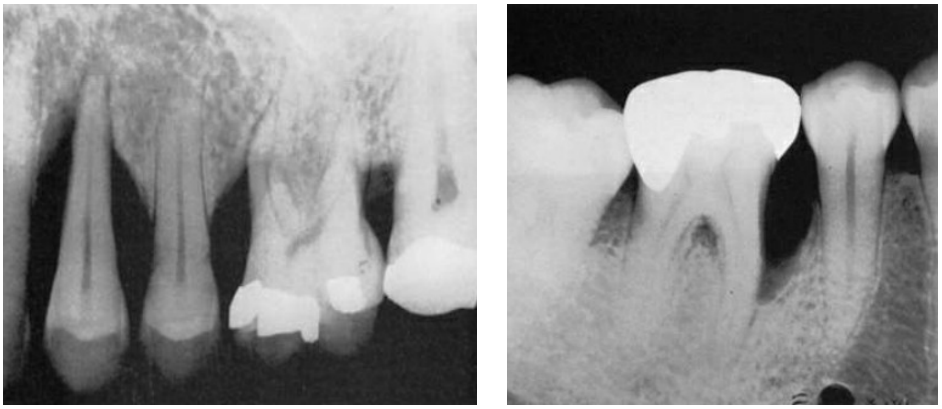


Figure 2.2: Radiological picture of horizontal bone damage.[5]

(Desyaningrum H, Epsilawati L, Rusyanti Y. Padjadjaran J Dent Res Student; 1(2). Oktober 2017. P. 140)

b. Vertical/angular damage

Vertical damage is that which occurs in an oblique direction, leaving a hollow trough in the bone beside the root, the base of the defect being apically to the surrounding bone. In most cases, the angular bone destruction is in the accompanying infrabony periodontal pocket or infrabony pocket.



A B

Figure 2.3: A. Angular (vertical) defects of different depths. B. Angular defect on the mesial surface of the first molar. Note also furcation involvement.

(Newmann MG, Takei HH, Klokkevold PR, Carranza FA. Newman and Carranza's Clinical Periodontology Third South Asia Edition. Elsevier. India)

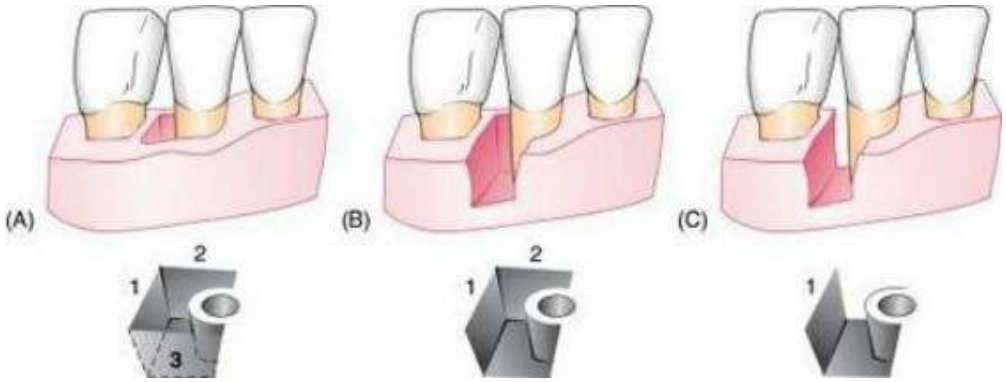


Figure 2.4: Vertical defects of one, two, and three walls of the right lateral incisor. A, Three bony walls: distal (1), lingual (2), and facial (3). B, Two-wall defects: distal (1) and lingual (2). (C), One-wall defect: distal wall only (1).

(Newmann MG, Takei HH, Klokkevold PR, Carranza FA. Newman and Carranza's Clinical Periodontology Third South Asia Edition. Elsevier. India)

Goldman and Cohen[4] classify angular defects based on the amount of bone wall. Angular defects may have one, two, or three walls. A continuing defect involving more than one tooth surface, in a shape similar to a trough, is known as a circular defect. The amount of wall on the apical portion of the defect is often greater than that on the occlusal portion, for which the term is used, i.e., combined bony defect.

c. Osseous craters

Osseous craters are depressions at the apex of the interdental bone bounded by the facial and lingual walls. Crater has been found to make up about one third (35.2%) of all defects and about two thirds (62%) of all mandibular defects and occurs twice as often in the posterior segment as in the anterior segment.

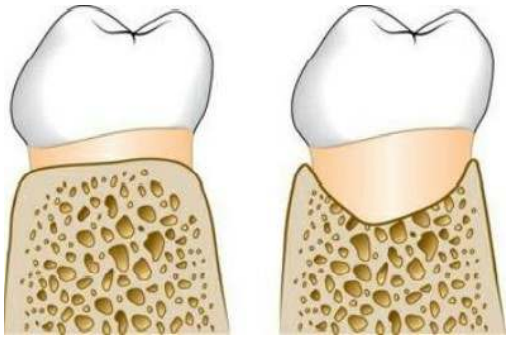


Figure 2.5: Crater damage to the faciolingual area between the two lower molars. Left, Normal bone contour. Right, bone crater.
(Newmann MG, Takei HH, Klokkevold PR, Carranza FA. Newman and Carranza's Clinical Periodontology Third South Asia Edition. Elsevier. India)

The height of the facial and lingual crater crests was found in 85% of cases, with the remaining 15% being nearly equally divided between the higher facial crest and the higher lingual crest.

Here are some reasons for the high frequency of suggested interdental craters:

- The interdental areas collect plaque and are difficult to clean.
- The normal plain or even a slightly concave fasiolingual shape of the interdental septum in the lower molars may favor crater formation.
- The vascular pattern from the gingiva to the center of the crest may provide a pathway for inflammation.

d. Furcation involvement

The term furcation involvement refers to the invasion of the bifurcation and trifurcation of multirooted teeth by periodontal disease. The prevalence of furcation-involved molars is unclear. Although some reports indicate that mandibular first molars are the most common site and that maxillary premolars are the least common, other studies have found a higher prevalence in upper molars. The amount of furcation involvement increases with age.

Figure 2.6: An illustration showing gum disease causing bone loss in the furcation of a lower molar.

(Dr. Laureen Langer)

2.2. Healing After Periodontal Treatment

The healing process is influenced by local factors and systemic factors in the periodontal tissue.

Healing and repair process after periodontal therapy

- Local Factor[6]

  Systemic conditions that impede the repair process can reduce the effectiveness of local periodontal treatments and must be addressed before or during local procedures. However, local factors, such as plaque micro-organisms, are the most common factors that hinder the healing process after periodontal treatment. Healing can be delayed by:

  - Excessive tissue manipulation during treatment
  - Trauma to the tissue
  - Presence of foreign bodies in the body and,
  - The existence of repeated treatment mechanisms that can inhibit cellular activities in the healing process.

  An adequate blood supply is needed to enhance cellular activity during the healing process. If the blood supply is interrupted or insufficient then areas of necrosis will develop and will delay the healing process.

- Systemic Factor[6]

  The effects of systemic conditions on the healing process have been observed in animal experiments but are poorly defined in humans. Healing

capacity decreases with age, possibly due to the vascular changes that are common in the aging process resulting in reduced blood circulation. Healing is also delayed in patients with generalized infections as well as in patients with diabetes and other debilitating diseases. The healing process is also disrupted by insufficient food intake; condition of the body that lacks nutrients and lacks vitamin C, protein and other nutrients. however, the nutritional requirements of healing tissue in small wounds, such as those occurring in periodontal surgical procedures, can be addressed with a balanced diet. Healing is also influenced by hormones. Systematically administered glucocorticoids such as cortisone inhibit the repair process by suppressing the inflammatory reaction or by inhibiting fibroblast growth, collagen production, and endothelial cell formation. Systemic stress, thryoidectomy, testosterone, and adrenocorticotropic (ACTH) as well as large doses of estrogen can suppress the formation of granulation tissue and interfere with the healing process.

Healing after periodontal treatment

1. Regeneration

According to Melcher[6,7] regeneration is a healing process that occurs in a biological process in which the structure and function of the bones return to normal. Regeneration is the natural renewal of structure, produced by the growth and differentiation of new cells and intercellular substances to form new tissues. Regeneration occurs through the growth oftissue of the same type using tissue that has been and is being damaged or from its precursors. In periodontal tissues, the gingival epithelium is replaced by epithelium, and the underlying connective tissue andperiodontal ligament are replaced by connective tissue.

Bone and cementum are replaced by connective tissue, which is the precursor of both. Meanwhile, undifferentiated connective tissue cells will develop into osteoblasts and cementoblasts which will form bone and cementum.

The regeneration of the periodontal tissue is a continuous physiological process. If under normal conditions, new cells and tissues will directly form to replace mature and dead cells, this can be called wear and tear repair. Examples are:

- Mitotic activity in the gingival epithelium and periodontal ligament connective tissue
- New bone formation
- Continuous deposition of cementum. Permanent regeneration also takes place during destructive periodontal disease.

This means that regeneration is part of healing, but bacteria and bacterial products can prolong the disease process, as long as an inflammatory exudate is produced, then this is injury to regenerated cells and tissues, which can prevent the completion of the healing process. By removing bacterial plaque and creating conditions to prevent new build-up of plaque from forming, periodontal treatment can remove any barriers or barriers to regeneration.

2. Repair

Repair is healing that is characterized by the presence of new tissue in which structure and function do not return to normal and it is accordance to Melcher[6,7]. The repair process simply restores the continuity of the damaged marginal gingiva and re-establishes the normal gingival sulcus at a level parallel to the root to form the basis of the pre-existing periodontal pocket.This process, known as healing by scar, stops bone breakdown but does notform gingival attachment and bone elevation. This process involves regeneration and mobilization of the epithelium and connective tissue to the damaged area and increasing local mitotic division to provide a relative number of cells for regeneration and repair. To regain the attachment of the gingiva or attachment of the apparatus that is parallel to the root, treatment using special materials and techniques is needed. If these are not used or are not successful, then the tissue only undergoes a repair process that involves tissue regeneration to regenerate the attachment apparatus but no re-attachment of gingival origin or formation of normal bone height occurs.

Sourced from Amler[7], wound healing after extraction, the first 24 hours will occur in the form of a blood clot in the socket. The clot will be replaced with granulation tissue in 2-3 days. Then after 4-5 days, the epithelium of the soft tissue margin begins to proliferate which is nothing but to cover the granulation tissue in the socket. The socket containing granulation tissue, young connective tissue, and osteoid formation towards the apical portion of the socket occurred one week after extraction. Then after 2 weeks, this socket will form immature woven bone in the apical and lateral parts. After 3 weeks, even this socket is filled with connective tissue and osteoid mineralization also occurs. Then what covers the wound is the epithelium. In week 4, The woven bone will migrate to the center and be replaced by mature bone (bone marrow, trabecular bone and lamellar bone). And radiographically, bone formation in the socket and trabeculae can only be seen after 6 weeks of healing.

3. New Attachment

According to Isidor[6,7] new attachment is a healing that is characterized by new attachment of connective tissue to the root surface that begins with periodontal disease. New attachment is the process of attachment of new periodontal ligament fibers into the new cementum and the attachment of the gingival epithelium to the top of a tooth that was previously denuded by disease. The attachment of the gingiva or periodontal ligament to an area of a tooth that was lost during tooth preparation is a re-attachment and not a new attachment.

Reattachment refers to the repair process in a root area where a pocket was not previously formed, for example during surgery, trauma to cementum, root fracture, or in periodontal treatment. Meanwhile, epithelial adaptations must be distinguished from new attachments. Epithelial adaptation is the closed apposition of the gingival epithelium to the tooth surface, in the absence of gingival fiber attachment. Pockets are not completely lost, although probe access is no longer possible.

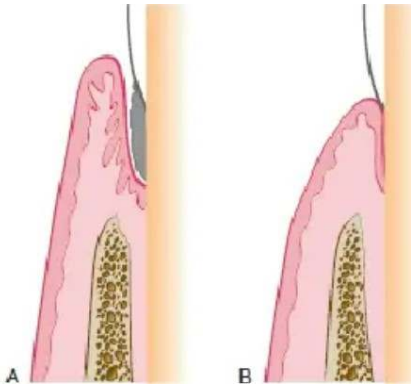


Figure 2.7: Epithelial adaptation after periodontal treatment. A, Periodontal pocket. B, After treatment. Pocket epithelium is highly adapted but not attached to roots.

(Newman, Carranza. Carranza's Clinical Periodontology. 11th Ed. Chapter 35. Saunders)

However, studies have shown that the sulcus, which is lined by this long and thin epithelium, can be resistant to diseases similar to true connective tissue attachment. The absence of bleeding and secretions on probing, the absence of clinical signs of inflammation, the absence of visible plaque on the root surface suggest that the deep sulcus is in an inactive state and will not cause further attachment loss. Under these conditions, a pocket depth of 4-5 mm after treatment is acceptable.

4. Periodontal Reconstruction

Periodontal reconstruction leads to a process of cell and fiber regeneration and re-establishment of lost periodontal structures resulting in:

1. Attachment level reached
2. Formation of new periodontal ligament fibers
3. The position of the alveolar bone was significantly more coronal when compared to before treatment.

This technique to achieve these results has been the goal and dream of the ideal periodontal treatment for centuries. Since the 1970s the research

conducted has brought us closer to the ideal result. Melcher[6,7] stated that the regeneration of the periodontal ligament is the key to the success of periodontal reconstruction, because it provides a link between the alveolar bone and cementum, and because the regeneration of the periodontal ligament contains cells that can generate and remodel the three alveolar connective tissues that are part of the periodontium. During the healing phase of the periodontal pocket, the area is invaded by cells from four dissimilar sources: oral epithelium, gingival connective tissue, bone and periodontal ligament.

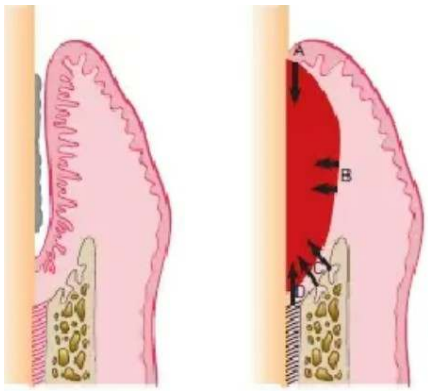


Figure 2.8: Source of regenerating cells in the healing phase of periodontal pockets. Left, Infrabony pocket. Right, After therapy, the clot formed was invaded by cells from A, the marginal epithelium; B, gingival connective tissue; C, bone marrow, and D, periodontal ligament

(Newman, Carranza. Carranza's Clinical Periodontology. 11th Ed. Chapter 35. Saunders)

The final outcome of periodontal pocket healing depends on the sequence of steps that occur during healing. If the epithelium proliferates along the tooth surface before other tissues arrive, the result will be a long junctional epithelium. If cells derived from the gingival connective tissue are the first to fill the area, then what is formed is a network of fibers parallel to the tooth surface and remodeling or remodeling of the alveolar bone without attachment to cementum. If the bone cells come first, then what is formed is root resorption and ankylosis. Finally, only when cells from the

periodontal ligament proliferate coronally will new periodontal ligament and cementum be formed.

In general, the tissue response and clinical outcome after periodontal treatment can be seen in the following chart:

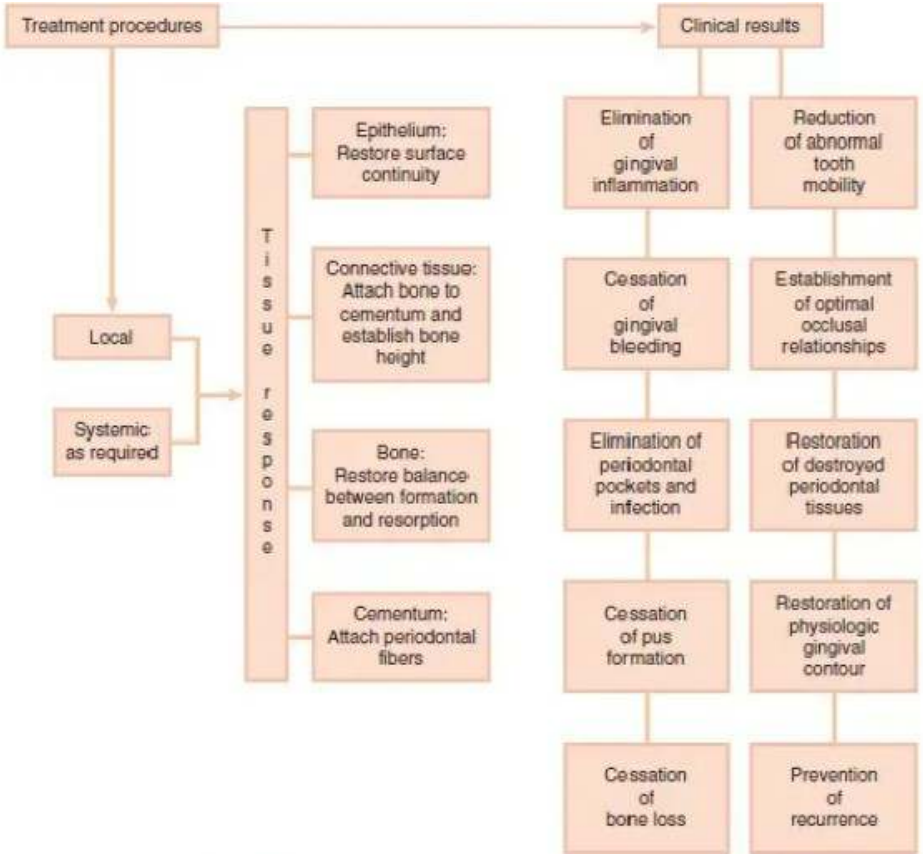


Chart 2.1: Tissue response and clinical outcome after periodontal Treatment

The response of the tissue after the periodontal treatment is that on the epithelium it restores surface continuity, then on the connective tissue the effect is that the bone attaches to the cementum and builds up bone height, then on the bone the effect is to restore the balance between formation and resorption, then also on the cementum, the periodontal fibers is attached. About the clinical results is divided into two, for the first is elimination of gingival inflammation, and then, cessation of gingival bleeding, after that,

elimination of periodontal pockets and infection, cessation of pus formation, and then is cessation of bone loss.

The second is reduction of abnormal tooth mobility, the establishment of optimal occlusal relationships, and then, restoration of destroyed periodontal tissues, after that, restoration of physiologic contour, and the last is the prevention of recurrence.

2.3. Periodontal Tissue Regeneration

Based on a study, histological analysis of a human model and showing three levels of histopathology of the apically positioned coronal layer: epithelium, connective tissue, and cementum-bone interface. Given the limited number of cementum-bone interfaces, defined as “periodontal attachments”, this study demonstrates that periodontal surgical techniques without regenerative strategies are limited in their capacity to restore lost tissue.

These observations led to a major paradigm shift in periodontology. Studies in the 1980s demonstrated periodontal regeneration as a viable outcome in periodontal treatment using innovative techniques. Most importantly, however, the regenerative approach leads to a deeper understanding of biology-based treatment strategies to restore periodontal tissue to pre-disease levels. Every form of wound healing includes regeneration.

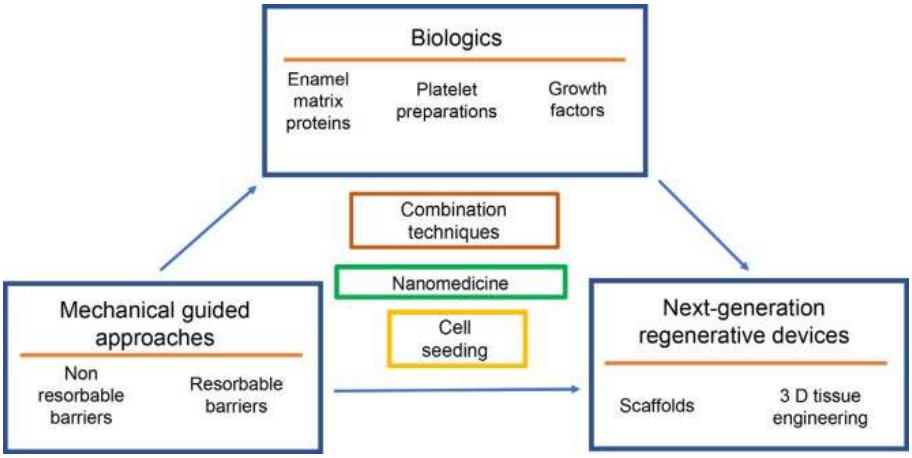


Figure 2.9: Periodontal regeneration as a process that combines mechanical and biological devices.[8]

(Kantarci A. Biological Basis of Periodontal Regeneration. Dent Clin N Am, Elsevier. Cambridge, USA. Pp. 2-3)

The difference between "repair" and "regeneration" is conceptual as compared to biological. Repair has been used to refer to incomplete or lack of regeneration in which cellular elements fill the wound area depending on their rate of proliferation and activity after injury inflicted by periodontal surgery. Therefore, cells with a higher capacity for multiplication, growth, and proliferation will be the first to arrive at the injured site. Not surprisingly, similar to other wound models elsewhere in mammals, gingival-derived epithelial cells have the highest migratory and proliferative capacities. Thus, wound healing by repair begins with the epithelial cells covering the wound area.

The process of regeneration of periodontal tissue requires local progenitor cells. These progenitor cells will differentiate into periodontal ligament-forming cells, cementoblasts, and osteoblasts. So, the key to the success of periodontal tissue regeneration is to stimulate progenitor cells to fill in defects or damage. The growth factor is an important regulator in the process of periodontal tissue regeneration, including migration, attachment, proliferation, and differentiation of periodontal progenitor cells.

Growth factors,especially platelet-derived growth factor (PDGF) and transforming growth factor-β (TGF-β) have been shown to stimulate periodontal regeneration in vitro.

Platelet-rich plasma (PRP) is autologous platelets in plasma that are concentrated by centrifugation. PRP contains growth factors such as PDGF, TGF-β, vascular endothelial growth factor and so on. Polypeptide growth factors act as biological mediators in periodontal regeneration, are agents that stimulate regeneration because they regulate the adhesion, migration, proliferation and differentiation of bone and connective tissue cells.

The growth factors found in PRP play a role in the bone healing process, such as platelet derived growth factor, transforming growth factor , vascular endothelial growth factor, epithelial growth factor, insulin growth factor-1 and basic fibroblast growth factor. Blood proteins, namely fibrin, fibronectin and vitronectin, function in adhesion molecules in osteoconduction.[9]

2.4. Bone Graft

2.4.1 Bone graft function

Bone graft material affects the formation of new bone at the defect site in many ways. The material may induce bone formation via cellular signaling or via osteocompetent cell transfer, or it may simply provide a scaffold and have a space-maintenance function for the host to grow new bone. Therefore, graft materials can be classified according to their function and interaction with the host.

A graft that transfers the osteocompetent cells that initiate the bone formation process is called an osteogenic graft. New bone in that section is formed from cells transferred in the graft and not just from osteocompetent cells at the site of the defect. The only osteogenic graft is an autogenous bone graft. A graft that stimulates mesenchymal stem cells to differentiate and initiate bone formation is called an osteoinductive graft. This process occurs via transfer of proteins in the graft which initiates a signaling cascade for the host to form bone. A graft that only provides a scaffold for the host to make new bone and has no biological influence on the host is an osteoconductive

graft. There are no proteins or cells present in the graft material to affect the host and affect bone formation.[10]

2.4.2 Classification of bone graft

Classification of bone grafts by material group:[3]

a. Allograft-based bone grafts involve allograft bone, used alone or in combination with other materials (eg, Grafton, OrthoBlast).
b. Factor-based bone grafts are natural and recombinant growth factors, used alone or in combination with other ingredients such as transforming growth factor-beta (TGF-beta), platelet-derived growth factor (PDGF), fibroblast growth factor (FGF), and proteins. bone morphogenetics (BMP).
c. Cell-based bone grafts use cells to generate new tissue on their own or added to a supporting matrix, for example, mesenchymal stem cells.

d. Ceramic-based bone graft substitutes including calcium phosphate, calcium sulfate, and bioglass used alone or in combination; for example, OsteoGraf, ProOsteon, OsteoSet.
e. Polymer-based bone grafts use degradable and nondegradable polymers alone or in combination with other materials, for example, open porosity polylactic acid polymers.

Graft classification based on source:[10]

a. Autograft, taken from the host, is the gold standard in bone grafting, the only graft source being osteogenic.
b. Allograft, graft taken from a similar genetic donor, cadaveric graft.
c. Xenograft, a graft taken from a different genetic donor, the source is most often a cow or pig.
d. Synthetic Graft, the graft is not taken from a living donor, there are no cellular or protein products in this graft.

Table 2.1: Weaknesses and advantages by type or source.[11]

Types of Grafts	Advantage	Disadvantage
Autograft	Osteogenesis: containing live cells Osteoinductive: having BMP and other growth factors Osteoconductive Lack of immunity No disease transmission Cost-effective	Donor site morbidity due to harvesting Pain Limited donor site: limited amount
Allograft	No morbidity of donor site Unlimited amount Osteoinductive, osteoconductive Various mineral composition: cortical, cortico-cancellous, cancellous Various form: powder, cancellous cubes, cortical chips/fresh, fresh-frozen, freeze-dried/mineralized, demineralized	No osteogenesis: no live cell inclusion Disease transmission: viral or bacterial, 12.9–13.3% High cost Dependent on donor's bone state: age Ethical problem
Xenograft	No morbidity of donor site Unlimited amount Osteoconductive	No osteogenesis No osteoinduction Disease transmission Non-resorbable in vivo Ethical problem

2.4.3 Bone Healing Process

The formation of new bone matrix secreted by osteoblasts which will then ossify is a sign of the success rate of the bone healing process. Osteoblasts are bone-forming cells that are responsible for a process, namely the process of mineralizing the bone matrix by secreting type I collagen and releasing calcium, magnesium, and phosphate ions. These cells are known to be derived from osteoprogenitor cells of bone marrow-derived mesenchymal tissue whose differentiation is influenced by parathyroid hormone (PTH), by producing osteocalcin, bone sialoprotein as well as bone-specific extracellular matrix proteins.[12]

The process of attachment of osteoblasts to the surface of the bone graft matrix takes place slowly (usually within hours) then the cells will spread to the surface of the bone graft matrix. The process of attachment of osteoblasts to the entire surface of the bone graft material depends on the compatibility of the surface of the bone graft material, and the expression of the biological components of the adhesive, including the secretion of ECM

(extra cellular matrix) and the results of the attachment of cells to the surface of the material. This process is mediated by the formation of focus adhesion and formation of plaques composed of transmembrane integrins that link the cytoskeleton to the ECM secreted between the material and the cell. This adhesion phase involves ECM proteins, cell membrane proteins and cytoskeleton proteins which then interact together to induce signal transduction and promote transcription factors and regulate gene expression. The osteoprogenitor cells will easily occupy suitable media and are analogous to the actual bone conditions to be able to proliferate and differentiate to stimulate the process of osteogenesis.[12]

2.5. Autograft

2.5.1 History of Autograft

Autograft, the first known bone graft material in modern medicine, has been documented since the early 19th century and is still considered the gold standard of grafting today. The first report was for a maxillofacial application to fill a hole in the skull with a native bone plug after the hole was drilled to release the pressure. In the late 1800s, Bergmann reported using a fibular graft to close a tibial defect.

2.5.2 Definition of autograft

Autologous bone graft (ABG) has long been considered the standard method for grafting because it contains all three grafting components. It contains osteoprogenitor cells in the bone marrow, the morcelized surface of the bone chip acts as a scaffold, and osteoinductive factors reside within the bone fragments. Many papers in the last 2 decades have described methods of harvesting autografts. Today, most autografts are usually taken from the iliac crest because of the cancellous structure and cell volume.[13]

Autografts are taken from the same person's donor site and transplanted to a new location. Autografts provide the most osteogenic organic material for grafting, but they have drawbacks such as donor site morbidity and limited graft volume. Extraoral or intraoral autografts can be employed in periodontal regeneration. In the maxilla’s, spina nasalis, tuberosity, and crista zygomatico-alveolaris, in the mandible's, ramus, retromolar region, and symphysis region, as well as bony exostoses and bone collected from

various places using bone scrapers, are all intraoral autograft harvest sites. Autografts from the mandible are frequently used as bone chips.[14]

Autogenous bone is often removed intraoral, often from the same quadrant as regenerative surgery. Intraoral donor placement, however, usually results in a relatively limited graft volume. Harvesting sufficient donor bone, therefore, as a coagulum of cortical bone or cortical-cancellous bone, may require the creation of additional intraoral surgical sections, thereby increasing the potential for surgical morbidity and discomfort.[15]

Autografts have great osteoconductive potential and there is no risk of rejection. If the graft is deployed immediately or enriched, some osteogenic properties may be generated. These characteristics make this type of graft considered the "gold standard" and widely used in clinical practice, especially for the reconstruction of small bone defects, due to quantity limitations. However, the disadvantage is increased morbidity requiring additional surgery.[16]

2.5.3 Autograft method

When the ABG is inserted into the graft site, the initial response by the surrounding tissue is similar to that of a convoluted fracture. Most of the transplanted cells die due to ischemia. Fortunately, mesenchymal cells are the most resistant to ischemia and may survive to initiate differentiation and proliferation. The efficacy of ABG is closely related to the viability of these cells and is considered to be the most vital component of the graft.

Cell signaling is required for the osteoclastic response to break down fragmented bone. As osteoclasts begin to digest surface mineralized fragments, collagenous and noncollagenous proteins and signaling molecules are exposed and signal for osteoblastic activity. Oversimplified, the reaction for ABG is to consolidate, delete, and rebuild. Resorption initially exceeds formation. However, even with long-term follow-up, some devitalized autogenous bone will remain unremodeled.[13]

Bone allografts that have been frozen (FDBA), the freeze-drying technique used to prepare these grafts for use alters the 3D presentation of human leukocyte antigens on the surface of the graft particles, that affect immune recognition. FDBA are osteoconductive and can be used with

autografts to boost osteogenic potential. These graft tissues have been calcified and are used to treat periodontal problems.[14]

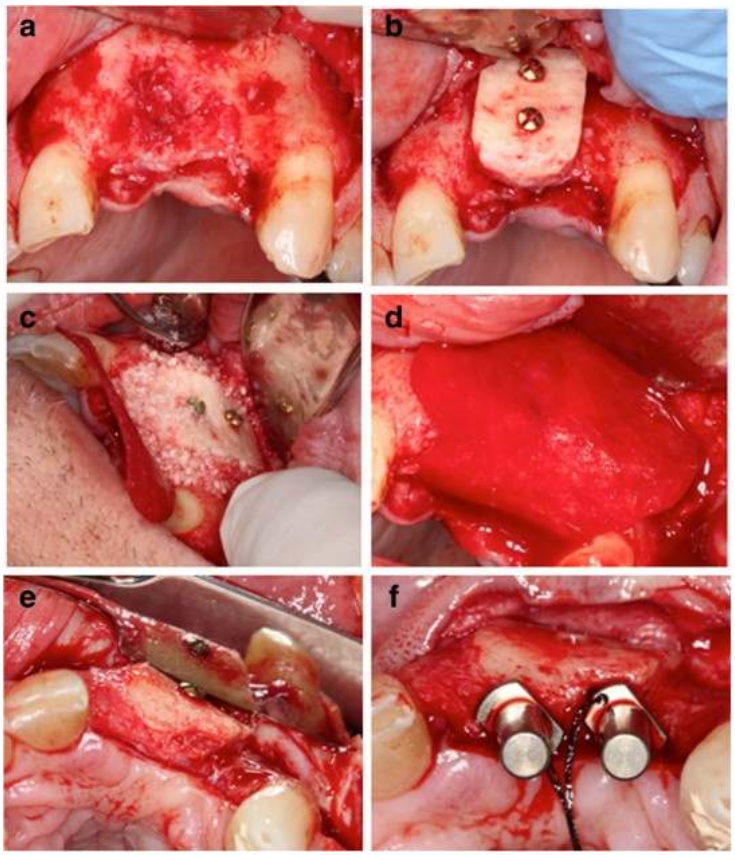


Figure 2.10: Autogenous block grafting in a clinical setting.
(Dr. Aditya Patel)

The methods in periodontology, this is in implant procedure. For picture A, Advanced bone loss, both vertically and horizontally. B, Autogenous block graft fixed with screws. C, FDBA particles are added to fill any gaps that remain. D, Bio-Gide, a porcine degradable collagen membrane used to enclose and cover bone transplants. E, Six-month results show that the bone augmentation procedure was successful. F, Successful placement of dental implants in enhanced bone. (Dr. Aditya Patel)[14]

2.6. Combination of Autograft with Other Regenerating Materials[17]

The Guided Tissue Regeneration (GTR) technique was introduced by Nyman et al[17] in 1982. The term GTR was used by Gottlow in 1986, and slowly became accepted as a regenerative therapy. The World Workshop in

Periodontics in 1996 defined GTR as "An experimental procedure for regenerating lost periodontal structures through different tissue responses" by creating barriers to keep the epithelium and gingival corium away from the root surface. Barriers also help achieve primary wound healing, isolate defects from the gingiva, and stabilize blood clots.

During the last decade, various regenerative operations have been proposed and studied to regenerate certain periodontal tissues such as alveolar bone, cementum, periodontal ligament, and gingiva. These treatments are derived from different surgical approaches, membranes, different bone grafts, different bone conductive/inducing materials or protein combinations, exogenous growth factors, cell-based techniques, andrecombinant techniques, including the use of genes. The results obtained depend on the patient's age, size of the defect, genetic and demographic effects, and lifestyle, but the periodontal tissue regeneration approach was successful and the GTR/GBR (Bone Regeneration Induction) strategy was successful.

Various therapeutic approaches have been proposed for the regeneration of damaged periodontal tissues in gingival recession and periodontitis. To treat gingival recession, traditional surgical procedures useautologous transplanted tissue (eg, from the roof of the mouth). Tissue-derived collagen-based membranes can replace the procedure, avoidingrepeat operations and reducing patient pain and discomfort. Great attention is paid to the restoration of the function of periodontal tissues that are damaged or have pathological effects.