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BONE GRAFTS IN IMPLANTOLOGY

Dental Science

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ABSTRACT

Rehabilitation of the incomplete dentition by means of osseointegrated implants represents a highly predictable and widespread therapy. Implant placement necessitates sufficient bone quantity as well as bone quality that may be compromised following tooth loss or trauma. Three-dimensional bone morphology, however, may not permit favorable implant positioning. In the age of prosthetic-driven implant treatment, bone grafting procedures may be indicated not exclusively due to lack of bone volume, but to ensure favorable biomechanics and long-term esthetic outcome. A vast Variety of treatment modalities have been suggested to increase alveolar bone volume and thus overcome the intrinsic limitations of oral implantology.

KEYWORDS

Allograft, Cortical Bone Chip Freeze Dried Bone Allograft, Demineralized freeze dried Allograft, Synthetic Bone Graft, Polymethylmethacrylate Demineralized Bone Matrix, Synthetic Hydroxyapatite, Calcium Phosphate Cement Calcium Sulphate, Bioactive Glass, Composite Graft, Homograft, Xenograft.

INTRODUCTION

Maxillofacial surgery deals with major surgery of jaw bone tumors, oral cancers, temporomandibular joint, congenital facial defects, jaw bone fracture etc. This branch of surgery has come up more recently with advanced surgical technique and bone grafting has become a regular job for surgeons in the reconstruction of acquired or congenital jaw defect. The term grafts applies to the transplantation of living tissues and implant means transplantation of non-viable tissues1. An adequate bone volume is needed in order to guarantee the long term success of dental implant placement2. Bone grafts are necessary to provide support, fill voids and enhance biologic repair of skeletal defects.

Today, Bone replacement grafts are widely used to promote new bone formation and periodontal regeneration in periodontal therapy especially in intrabony defects.

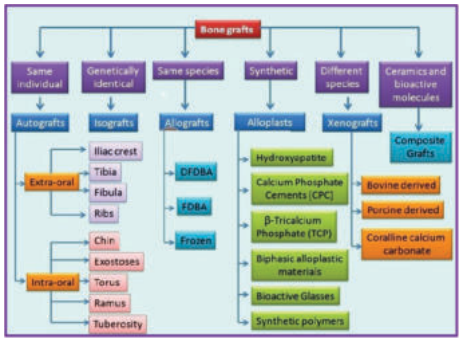
Reconstructive surgery or the ability to make a patient ,,,,whole"" again, is a basic principle of any surgical specialty. Oral and maxillofacial surgeons have had a long history of providing hard and soft tissue reconstruction procedures in the maxillofacial regions to improve patients" lives.".

CLASSIFICATION

There are various bone graft materials are available in different ways but on the basis of their sources, contents and immunology, they are following types-

Classification of bone grafts based on material groups

a. Allograft-based bone graft involves allograft bone, used alone or in combination with other materials (e.g., Grafton, OrthoBlast).
b. Factor-based bone graft are natural and recombinant growth factors, used alone or in combination with other materials such as transforming growth factor-beta (TGF-beta), platelet-derived growth factor (PDGF), fibroblast growth factors (FGF), and bone morphogeneic protein (BMP).
c. Cell-based bone grafts use cells to generate new tissue alone or are added onto a support matrix, for example, mesenchymal stem cells.
d. Ceramic-based bone graft substitutes include calcium phosphate, calcium sulphate, and bioglass used alone or in combination; for example, OsteoGraf, ProOsteon, OsteoSet.
e. Polymer-based bone graft uses degradable and nondegradable polymers alone or in combination with other materials, for example, open porosity polylactic acid polymer



Autogenous Grafts

Autogenous Bone has Been Adopted as the Gold Standard Because:

- Autograft bone includes cells participating in osteogenesis.
- There is a minimal inflammatory reaction.
- There is rapid revascularization around the graft particles.
- A potential, release of growth and differentiation factors sequestered with

In the Graft

A: Intra-oral Autografts:

Intra-oral autogenous bone grafts harvested from the maxillary tuberosity, edentulous alveolar areas, healing bony wound, extraction sites and mental and retro-molar areas.Several types of autogenous bone grafts can be used:

(a) Cortical Bone Chips: These are not used today because they are generally much longer particles 1,559.6× 183 mm and have a higher potential for sequestration.
(b) Osseous coagulum: This is made by harvesting intraoral bone with round burns, and then mixing it with blood.
(c) Blend of cortical and cancellous.

B. Extra-oral Autografts:

Extra-oral autografts from iliac cancellous bone and marrow provide a great osteogenic potential, being able to induce cementogenesis, bone regeneration and Sharpey"s fibers reattachment

Allografts:

Allogenic graft composed of tissue taken from an individual of the same species who is not genetically related to the patient.

They include:

-Freeze- Dried Bone Allograft

Mineralized cortical freeze-dried bone allograft was introduced to periodontal therapy in 1976 and is the only dental bone graft material that has been extensively field tested for the treatment of adult periodontitis. Freeze drying is the application of a natural phenomenon of sublimation of water.

The benefits of fresh frozen bones on facial skeleton are limited. Its basic usage is for osteocondral allografts under orthopedic rehabilitation. Allografts must be taken from donor in a sterilized way in twelve hours after death. With multiple bacteriological studies the bone must be subjected to peripheral and bone marrow culture before and after operation. Generally it takes part in renovation and it limits the function of renovation at maxillofacial part. Preparation includes lifting the cohesive tissue with soft tissue. Cohesive capsules are cut.

-Demineralized Freeze-dried Allograft

It's First Use in Dentistry and Medicine in 1965 by Urist[24]. Demineralization of a bone allograft exposes bone morphogenetic protiens within the bone matrix. These inductive protiens induce cellular differentiation and the formation of bone through Osteoinduction by inducing pluripotential stem cell to differentiate into osteoblast

These two types of allografts elicits mesenchymal cell migration, attachment and osteogenesis when implanted in well vascularized bone, and it induces endochondral bone formation when implanted in tissues that would otherwise not form bone .Both FDBA and DFDBA materials are widely used in periodontal therapy and there are no reports of disease transmission during the 30- year history of using freezedried bone allografts.

Alloplast:

Alloplastic materials are synthetic, inorganic, biocompatible
And bioactive osteoconductive graft materials.

The Most Favorite Alloplastic Materials are;
-Bioceramics polymers
-Bioactive glass.

1. Polymethylmethacrylate and Polyhydroxylethylmethacrylate (PMMA-PHEMA)Polymers:
2. This composite is prepared from a core of PMMA and PHEMA with a coating of calcium hydroxide. It forms calcium carbonate apatite when introduced into the body and interfaces with bleeding marrow.

1. Demineralized Dentin Matrix (DDM):

The organic component of dentin, which accounts for approximately 20% of dentin weight, is mainly type I collagen, a component of bone. Dentin also contains bone morphogenetic proteins (BMPs), which promote the differentiation of mesenchymal stem cells into chondrocytes, and thus enhance bone formation, non- collagen proteins such as osteocalcin and osteonectin, which have been implicated in calcification and dentin- specific proteins including dentin phosphoprotein, also known as phosphophoryn, and dentin sialoprotein.

3. Hydroxylapatite (HA):

Synthetichydroxyapatite, Ca_{1o} $(PO_4)6(OH)_2$, has been available for more than 30 years. It is the primary mineral found in bone. Synthetic hydroxyapatite can be found as porous or nonporous and in ceramic or non-ceramic forms.

The advantages of using hydroxyapatite are:
(1) Immunoreaction can be ignored
(2) Post-operative morphologic changes and volume decreases do
(3) not occur if Small blocks and chips are adequately packed during surgery.
(4) Post-operative adsorption of hydroxyapatite, if any, is slight and slow and is replaced by bone.

Cement fixation performed on a layer of hydroxyapatite particles prevents the harmful influence of polyethylene wear particles of cement interface

4. Calcium Phosphate Cement (CPC):

Among the materials used for bone and tissue regeneration, calcium phosphate cements are gaining special interest due to their biomimetic nature and potential use as controlled release systems.

5.b-Tricalcium Phosphate (TCP):

Tricalcium phosphate is a porous calcium phosphate compounds. Alpha and beta tricalcium phosphate are produced similarly, although they display different resorption properties. The crystal structure of alpha tricalcium phosphate (a- $Ca3(PO_4)_2$is monoclinic and consists of columns of cations, while the beta tricalcium phosphate has a rhombohedral structure. The former is formed by heating the latter above 1,180°C and quenching in air to retain its structure. Alpha form is less stable than beta and forms the stiffer material calcium-deficient hydroxyapatite when mixed with water.

6. Calcium Sulfate

Calcium sulfate, generally known as plaster of Paris, or gypsum, is perhaps, the oldest ceramic bone substitute material. first internal use to fill bony defects was reported in 1892 by Dressmann.The relatively simple chemistry of calcium sulfate, there is less latitude for formulation variation than is the case in the calcium phosphate domain.Traditionally, calcium sulfate hemihydrate ($CaSO_4 \times 1/2H_2O$) powder is hydrated to form calcium sulfate dihydrate ($CaSO_4 \times 2H_2O$), undergoing a slight exothermic reaction to set to a solid form

7. Bioactive Glasses (BG):

Among the different alloplastic materials used in periodontal therapy, hydroxyapatite, calcium phosphates and bioactive glass ceramics share a common factor,the concept of "bioactivity." Since their invention three decades ago by Hench et al(1971) bioactive glasses have clinically gained wide acceptance in restorative orthopedics and dentistry. The original composition of bioactive glass approved by the FDA, designated 45 S5, was composed of 46.1 mol% SiO, 26.9 mol% CaO, 24.4 mol% Na_2O, and 2.5 mol% P_20_5. The original composition and fine structurehas been extensively modified in an attempt to further enhance bioactive glass as a bone replacement graft.

8. Oily CaOH

Suspension: Recently, a non-setting oily $CaOH_2$ suspension has been introduced into the market for application in jawbone surgery. This formulation contains, apart from $CaOH_2$, liquid and solid carbohydrate chains and various fatty acids (e.g., oleic, palmitoleinic, gadoleinic, margarine, pentadecane, myristic, linolenic, stearic, arachidic, lauric) esterified with glycerol, while the oily part consists of a natural product of porcine origin, oleum pedum and vaselinum album.

9. Porous Titanium Granules:

Tigran™ PTG (Natix, Tigran Technologies AB,Malmo,Sweden) is irregularly shaped and porous granules manufactured using commercially pure titanium. The granules are between 0.7 mm and 1.0 mm. When they are mixed with the patient"s blood or with a saline solution, the granules attach to each other due to the capillary force. The titanium surface is very thrombogenic, which facilitates the formation of stabilizing blood clots around the granules. The granules that have a porosity of about 80% and an osteoconductive surface structure, imitate properties of human bone, and create scaffolding for bone generation that stimulates osteoblast colonization and Osseo integration.

Homograft

It is very much similar to autograft. An immune response will be elicited by the graft and vast majority of the original cells withinthe graft die. Then there will be invasion of the cancellous bone spaces by granulation tissue and necrotic soft tissue is removed. Here the calcified matrix of the graft will not be destroyed by the host's response. Furthermore, this matrix is capable of exerting an inductive influence on the invading granulation tissue resulting in osteogenesis.

Xenograft (Pronounces "Zeeno" – Graft)
Oral surgeons have started using bone crystals of bovine source to strengthen loose teeth. However the ultimate success of the Xenograft remains unpredictable.

Calf bone (Bioplant), treated by detergent extraction, sterilized and freeze dried, has been used for the treatment of osseous defects. Kiel bone is calf or ox bone denaturized with 20%H_2O_2 dried with acetone and sterilized with ethylene oxide inorganic bone is ox bone from which the organic material have been extracted by means of ethylene diamine, it is then sterilized by autoclaving. These materials have been tried and discarded because following a first transfer of tissue there is

initial acceptance followed by rejection within a few days by acute inflammatory reaction. If a second same transplant is done it will be rejected more rapidly. It elicited the highest refusal rates among patient.

Ideal Characteristics Of Bone Graft

An ideal bone substitute (BS) material should provide a variety of shapes and sizes with suitable mechanical properties to be used in sites where there are impact loading; moreover,

- It should be nontoxic.
- It should be resistance to infection.
- It should not cause any root resorption or ankylosis.
- It should be strong and resilient.
- It should be easily adaptable and available.
- It should require minimal surgical intervention.
- It should stimulate new attachment and be able to trigger osteogenesis, cementogenesis and formation of a functional periodontal ligament.

Bone Graft Applications

The most common use of bone grafting is in the application of dental implants to restore the edentulous area of a missing tooth. Dental implants require bones underneath them for support and proper integration into the mouth so we can apply bone grafts in-

- Socket preservation
- Periodontal defects.
- 3rd molar extraction sites to support 2ndmolars.
- Ridge Augmentation
- Defects following cyst removal/apicoectomies
- Sinus lift
- Distraction Osteogenesis
- Nerve Repositioning
- Impalnt dentistry

Bone Healing

Recovery time depends on the injury or defect being treated and the size of the bone graft. Recovery may take 2 weeks to 3 months. The bone graft itself will take up to 3 months or longer to heal.

There are various phases of bone healing:

A) Phase I (Steady –state phase) Activity-preosteoclast formation to osteoclast

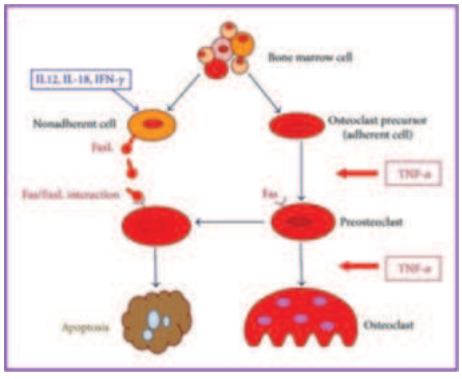


Fig (Steady – State Phase)

B) Phase ii (Resorption phase) Activity-Resorption of graft (8 days)

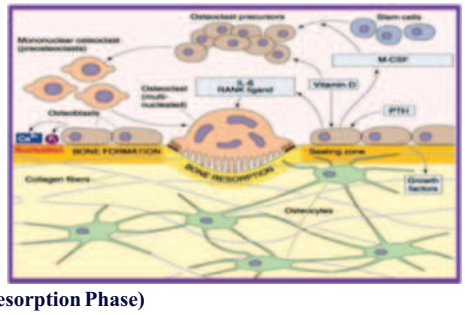


Fig (Resorption Phase)

C).Phase iii (Inversion phase) Activity-Macrophagic debriment

D)Phase iv (Formation phase) Activity-Osteoblast bone synthesis (80 days)

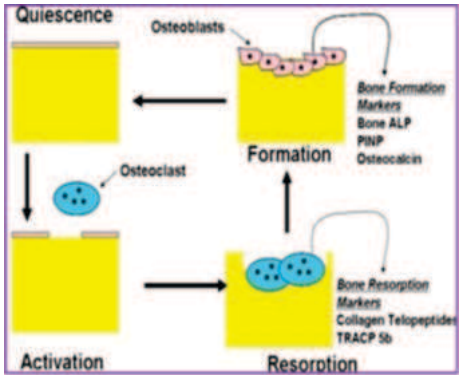


Fig (Formation Phase)

E) Phase v(Quiescence phase) Activity-Bone remodeling, maturation After that bone graft vascularization and remodeling completed in 90 days.

Mechanism

Bone is a tough supporting tissue and functions in both movement and the maintenance of postural stability by working cooperatively with muscles as well as play a role in calcium metabolism. Despite its hard structure it exist in a dynamic turnover known as bone remodeling. There are two types of bone structures that naturally remodel during a year.

Cortical bone (~3%/year)

Cancellous bone (~30%/year)

There are three classes of bone grafting materials based upon the mode of action

Osseo induction

Osseo conduction

Osseo integration

Osteoinduction

Involves stimulation of osteoprogenitor cells to differentiate into osteoblasts and then begins formation of new bone. The most widely studied type of osteoinductive cell mediators are BMPs. A bone graft material that is osteoconductive and osteoinductive will not only serve as a scaffold for currently existing osteoblasts but will also trigger formation of new osteoblasts, promoting faster integration of the graft for proper bone healing or anchorage of an implant, since they can be recruited to form osteoprogenitor cells and with time, develop into differentiated bone cells With the correct stimulus (the inductive agent), an undifferentiated mesenchymal cell can be transformed into a preosteoblast, a process which constitutes bone induction. In addition to the differentiated bone cells, i.e. osteoblasts, osteoclasts and osteocytes, bone and adjacent tissues contain a number of less differentiated cells. These undifferentiated cells are of utmost importance for proper bone healing or anchorage of an implant, since they can be recruited to form osteoprogenitor cells and with time, develop into differentiated bone cells With the correct stimulus (the inductive agent), an undifferentiated mesenchymal cell can be transformed into a preosteoblast, a process which constitutes bone induction.

Inductive agents naturally function in bone surroundings too, but it is difficult to differentiate between bone induction and bone conduction in an ortho- topic site. More modern research into osteoinduction dates back to Urist's experiment in the mid-1960s . Demineralised bone was used as an osteoinductive agent. Later, Urist et al isolated a soluble glycoprotein called BMP as the inductive agent. The BMP belong to the transforming growth factor (TGF)-β-family of growth factors. There are at least 15 different BMP of which BMP-2 and BMP-7 seem to be particularly interesting. To date, a great number of research projects involving various types of BMP are being conducted .BMP are naturally released in response to trauma or at bone remodelling and are the only known inducive agents. However, physical stimuli such as stress or types of electrical signals otherwise applied have been regarded as, directly or indirectly, influencing bone induction.

Osteoconduction

Occurs when bone graft material serves as a scaffold for new bone growth, which is perpetuated by the native bone. Osteoblasts from the

margin of defect that is being grafted, utilize the bone graft material as a framework upon which to spread and generate new bone. In the very least, a bone graft material should be osteoconductive.

Bone growth on an implant surface depends on the action of differentiated bone cells. These cells may originate either in pre-existing preosteoblasts/osteoblasts that are activated by trauma or in cells recruited from primitive mes- enchymal cells by osteoinduction. In the practical situation, therefore, osteoconduction depends to a fairly large extent on previous osteoinduction. The debate concerning whether or not a particular biomaterial acts as an osteoinductor may be slightly academic, since the injury at placement is sufficient to recruit previously undifferentiated bone cells. Various types of bone growth factors are necessary for bone formation. Furthermore, bone growth, including bone conduction, does not occur without a proper blood supply. Albrektsson studied bone conduction and remodelling in vivo and came to the conclusion that so-called full vas-cularisation was necessary for bone formation. It is therefore not surprising that the principal action of many growth factors is both mitogenic and angiogenic. Growth factors that regulate bone tissue in one way or another include insulin-like growth factor (IGF I, II), fibroblast growth factor (FGF), TGF-β and platelet-derived growth factor (PDGF). The IGF are also called somatomedins. The growth factors are small proteins that serve as signaling agents for cells However, in the case of implants, bone conduction is not only dependent on conditions for bone repair, but also on the biomaterial used and its reactions. Bone conduction is not possible on certain materials such as copper and silver. However, bone conduction is seen with biomaterials not regarded as ideal from the point of view of bio- compatibility, such as stainless steel and obviously materials of high biocompatibility such as commercially pure (c.p.) titanium. Bone conduction on implants may be quantified. There is a significant difference in the amount of bone that grows on seemingly similar materials such as c.p. titanium and titanium 6-aluminum 4-vanadium. However, the clinical implications of this difference remain unknown.

Osseointegration

Brånemark, who introduced this term, suggested the spelling "osseointegration" instead of "osteointegration", and the Osseointegration is not an isolated phenomenon, but instead depends on previous osteoinduction and osteoconduction. Thus materials that are too toxic to allow osteoconduction will not be osseointegrated either. However, many materials show at least some bone attachment, which has inspired bone pathologists to regard osseointegration as a simple foreign body reaction,whereas more clinically oriented scientists have rejected such a view. Osseointegrated implants have undergone a real breakthrough in oral and craniofacial implantology, yielding excellent functional results, in contrast to alternatively anchored implants, which have generally shown very poor success rates. Even if initial osseointegration is dependent on bone induction and conduction, the term implies that the bone anchorage is maintained over time. Cylindrical implant designs (without threads), rough plasma-sprayed surfaces and overloading represent factors that may lead to secondary failure of osseointegration. The ultrastructure of the bone–titanium interface in osseointegration demonstrates an amorphous layer from 20– 40 to 500 nm thick. Some investigators have described collagen and calcified tissue in this zone, whereas others have failed to verify these findings. This zone is too narrow to be seen at the light microscope level of resolution. At the light microscope level, direct bone contact, osteogenesis and bone resorption occur simultaneously. From a purely biomechanical viewpoint, Skalak and Zhao have demonstrated that when a hole slightly smaller than the implant diameter is prepared for implant placement, force-fitting stress increases installation torque and initial stability can be induced at a similar magnitude as seen with roughened implants. Oral implants retrieved from patients despite remaining stability have shown that there does not seem to be 100% bone attachment. Implants retrieved after clinical function for up to 17 years showed an average of 70–80% bone contact with an absolute minimum of 60%. Functioning osseointegrated implants demonstrate interfacial bone density similar to that of the bone in which the implant was implanted. Even if long-term functioning osseointegrated implants show what seems to be similar bone tissue reactions, osseointegration might be able to be achieved more rapidly than otherwise observed. Such potentially accelerated osseointegration has been indicated by results from experiments with hydroxyapatite coating,using intermediary roughened implants after hyperbaric oxygen treatment or by using anodised c.p. titanium with artificially enhanced oxide layers. Acceleration of osseointegration may depend on the removal of negative tissue conditions or optimisation of the biomaterial rather than on an actual increase in the rate of bone response.

Much less attention has been paid to the possibility of establishing osseointegration in orthopaedic surgery than in oral and craniofacial surgery. The original notion that polymerised bone cement may be histologically osseoin- tegrated has not been confirmed in more recent investigations. Histological sections to reveal true bone to implant contact need to be quite thin (of the order of 10– 20 μm) to really reveal osseointegration. Thicker sections have a shadow effect that make it impossible to state whether or not true direct bone contact has been achieved. Apart from poor resolution, this is the reason why common radiographs are of little value in the diagnosis of osseointegration. The question is whether it is really possible to establish osseointegration of conventional orthopaedic arthroplasties with the combined use of less biocompatible materials, interfacial heat due to curing bone cement, drilling or reaming without a cooling agent and too rapid loading. It is known that interfacial implant movement of more than 150 μm will inevitably lead to soft tissue formation instead of bone, for instance, Even if one or two-point bone contact can be demonstrated, this need not represent actual osseointegration of the entire implants.

Current Clinical Approaches To Enhance Bone Grafting:

For all the cases, in which the normal process of bone regeneration is either impaired or simply insufficient, there are currently a number of treatment methods available in the surgeon's armamentarium, which can be used either alone or in combination for the enhancement or management of these complex clinical situations, which can often be recalcitrant to treatment, representing a medical and socioeconomic challenge. Standard approaches widely used in clinical practice to stimulate or augment bone regeneration include distraction osteogenesis and bone transport, and the use of a number of different bone-grafting methods, such as autologous bone grafts, allografts, and bone-graft substitutes or growth factors. An alternative method for bone regeneration and reconstruction of long-bone defects is a two-stage procedure, known as the Masquelet technique. It is based on the concept of a "biological" membrane, which is induced after application of a cement spacer at the first stage and acts as a 'chamber' for the insertion of non-vascularised autograft at the second stage .There are even non-invasive methods of biophysical stimulation, such as low-intensity pulsed ultrasound (LIPUS) and pulsed electromagnetic fields (PEMF), which are used as adjuncts to enhance bone regeneration.

During distraction osteogenesis and bone transport, bone regeneration is induced between the gradually distracted osseous surfaces. A variety of methods are currently used to treat bone loss or limb-length discrepancies and deformities, including external fixators and the Ilizarov technique,combined unreamed intramedullary nails with external monorail distraction devices or intramedullary lengthening devices However, these methods are technically demanding and have several disadvantages, including associated complications, requirement for lengthy treatment for both the distraction (1 mm per day) and the consolidation period (usually twice the distraction phase), and effects on the patient's psychology and well-being.

Bone grafting is a commonly performed surgical procedure to augment bone regeneration in a variety of orthopaedic and maxillofacial procedures, with autologous bone being considered as the 'gold standard' bone-grafting material, as it combines all properties required in a bone-graft material: osteoinduction (bone morphogenetic proteins (BMPs) and other growth factors), osteogenesis (osteoprogenitor cells) and osteoconduction (scaffold).

It can also be harvested as a tricortical graft for structural support, or as a vascularised bone graft for restoration of large bone defects or avascular necrosis. A variety of sites can be used for bone-graft harvesting, with the anterior and posterior iliac crests of the pelvis being the commonly used donor sites. Recently, with the development of a new reaming system, the reamer-irrigator-aspirator (RIA), initially developed to minimize the adverse effects of reaming during nailing of long-bone fractures, the intramedullary canal of long bones has been used as an alternative harvesting site, providing a large volume of autologous bone graft. Furthermore, because it is the patient's own tissue, autologous bone is histocompatible and non-immunogenic, reducing to a minimum the likelihood of immunoreactions and transmission of infections. Nevertheless, harvesting requires an additional surgical procedure, with well-

documented complications and discomfort for the patient, and has the additional disadvantages of quantity restrictions and substantial costs.

An alternative is allogeneic bone grafting, obtained from human cadavers or living donors, which bypasses the problems associated with harvesting and quantity of graft material. Allogeneic bone is available in many preparations, including demineralized bone matrix (DBM), morcellised and cancellous chips, corticocancellous and cortical grafts, and osteocondral and whole-bone segments, depending on the recipient site requirements. Their biological properties vary, but overall, they possess reduced osteoinductive properties and no cellular component, because donor grafts are devitalized via irradiation or freeze-drying processing. There are issues of immunogenicity and rejection reactions, possibility of infection transmission, and cost.

Bone-graft substitutes have also been developed as alternatives to autologous or allogeneic bone grafts. They consist of scaffolds made of synthetic or natural biomaterials that promote the migration, proliferation and differentiation of bone cells for bone regeneration. A wide range of biomaterials and synthetic bone substitutes are currently used as scaffolds, including collagen, hydroxyapatite (HA), β-tricalcium phosphate (β-TCP) and calcium-phosphate cements, and glass ceramics, and the research into this field is ongoing. Especially for reconstruction of large bone defects, for which there is a need for a substantial structural scaffold, an alternative to massive cortical auto- or allografts is the use of cylindrical metallic or titanium mesh cages as a scaffold combined with cancellous bone allograft, DBM or autologous bone.

Factors Influencing Graft Success

1) The patient
2) The morphology of the defect
3) The graft material,
4) The surgical procedure
5) The healing period

1) Patient Factors:

The scientific literature clearly shows that plaque control residual periodontal infection, tobacco smoking and the patient's compliance are important prognostic factors in regenerative periodontal therapy. Other factors include conditions such as diabetes, hyper-parathyroidism, thyrotoxicosis, osteomalacia, osteoporosis, Paget's disease and some medications may all affect the healing process.

Factors that interfere with bone healing include failure of vessels to proliferate into the wound, improper stabilization of the coagulum and granulation tissue into the defect, ingrowth of "non-osseous" or fibrous tissues with a high proliferative activity, and bacterial contamination.

2) The Morphology of the Defect:

Among the defect anatomy-associated factors, depth of the intrabony component of the defect and/or probing depth is consistently found to be relevant.

The number of residual bony walls defining the defect seems to affect outcomes. Defects with two and three bony walls respond more favorably to treatment than do one-wall defects.

3) Graft Materials

When bony reconstruction is presented to the surgeon, many choices must be weighed before the proper graft material is chosen.Selection of graft material is guided by:

1. Biologic acceptability
2. Predictability
3. Resorbability
4. Clinical feasibility
5. Minimal operative hazards
6. Minimal postoperative sequelae
7. Patient acceptance

A range of 125–1,000 mm is acceptable with 250–750 mm most commonly available for particle size of grafts used in periodontal treatment. A minimal pore size of 100 mm is needed between particles to allow vascularization and bone formation. Particles less than 100 mm in size elicit a macrophage response and are rapidly resorbed with little or no new bone formation.

4) The Surgical Procedure:

The surgical technique for the treatment of periodontal intrabony defects with bone replacement grafts is essentially the same regardless of the type of graft material being used. Incisions are designed to allow for primary closure of flaps to protect the graft site from infection and the graft material from displacement.

Intrasulcular incisions are the common choice, with emphasis on preserving interdental tissue. Flaps are reflected full thickness to expose the underlying osseous defects and allow access for thorough debridement of the defects and meticulous root planning. New surgical techniques have been developed to optimize primary closure as well as to minimize the surgical trauma in the reconstructive procedures of periodontal intraosseous defects. The basic principle of the Single flap approaches is the elevation of a flap to access the defect only on one side (buccal or oral), leaving the opposite side intact.

Once the defect has been debrided of soft tissue and the tooth root surfaces thoroughly planned to remove all deposits of dental plaque and calculus, the bone replacement graft material is packed into the defect to fill the defect to the level of the remaining alveolar bone. Space maintenance is paramount to bone formation. If the graft material resorbs too rapidly, compared with the time required for bone formation, the site may fill with connective tissue rather than bone. Therefore the space or contour and size of the augmentation should be maintained until the graft has formed enough bone to maintain the space itself. Absolute graft immobility is paramount to its union to the recipient bone. If pieces of bone graft are mobile, they cannot receive a blood supply, become encapsulated in fibrous tissue and often sequestrate. Flaps are closed and sutured for primary closure and complete coverage of the bone replacement graft. Sutures should be removed in 7–10 days.

5) The Postsurgical Healing Period:

Postsurgical care should include twice-daily rinsing with 0.12% chlorhexidine gluconate for 2 weeks and gentle tooth brushing starting 1 week after the surgery.

Systemic antibiotics may be prescribed for 7–10 days after the surgical procedure. Patients should be seen at intervals of 1 week, 2 weeks and 4 weeks after surgery for supragingival plaque removal and then should be placed on a periodontal maintenance schedule at 3-month intervals. Adequate healing time must be provided to allow regeneration of the new bone volume. The amount of time required is variable and depends on local factors such as the number of remaining walls of bone, the amount of autogenous bone in the graft and the size of the defect. Larger grafts, less autogenous bone in the graft and fewer bony walls increase the amount of healing time.

DISCUSSION

Appropriate selection of bone graft or bone graft substitute requires an understanding of Patients problem, Specific biological needs and Graft properties. There are several clinical conditions that require enhancement of bone regeneration either locally or systemically, and various methods are currently used to augment or accelerate bone repair, depending on the healing potential and the specific requirements of each case.

CONCLUSION

Knowledge of bone biology has vastly expanded with the increased understanding at the molecular level, resulting in development of many new treatment methods, with many others (or improvements to current ones) anticipated in the years to come. However, there are still gaps; in particular, there is still surprisingly little information available about the bone regeneration in humans. In the future, control of bone regeneration with strategies that mimic the normal cascade of bone formation will offer successful management of conditions requiring enhancement of bone regeneration, and reduce their morbidity and cost in the long term. Research is ongoing within all relevant fields, and it is hoped that many bone-disease processes secondary to trauma, bone resection due to ablative surgery, ageing, and metabolic or genetic skeletal disorders will be successfully treated with novel bone-regeneration protocols that may address both local and systemic enhancement to optimize outcome.

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