GRAFT MATERIALS USED IN ORAL AND MAXILLOFACIAL SURGERY

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Abstract

Many studies have been done to get an ideal biomaterial but any materials which have features to regenerate lost tissues or provide to fill up bone defects haven't been found yet. All the materials that help to resolve the defiency which occur as a result of a factor on a living organism and turn it into a function or the ones that help to complete this deficiency in an order and quick way by the organism are called as “biomaterial”.

In this study, we aimed to present the information related to classification, using area and obtaining method of biomaterials.

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Introduction

All the materials that help to resolve the deficiency which occur as a result of a factor on a living organism and turn it into a function or the ones that help to complete this deficiency in an order and quick way by the organism are called as “biomaterial”. Biomaterial is also defined as a dead material used at clinical equipment which is aimed to interact with biological systems[1].

In contrast to other tissues bone is the tissue which has a complete regenerating capacity by itself[2]. Nevertheless; some failure may be seen during the recovery of tissue defects with bone tissues. In order to facilitate and quicken the recovery, bone graft materials are put into bone defects[3]. The recipient part is supposed to have enough vascularization for a successful osseintegration of the graft[4]. Bone graft materials provide the formation of bone with three different mechanisms such as osteogenesis, osteoinduction, osteoconduction.

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Bone graft materials that make ostoeogesis are the compound of living bone cells. Therefore; the unique graft material which has an osteogenetic character is the autogenous bone. Osteoinductive materials have the capacity to transmute undifferentiated mesenchyma cells in tissue to osteoblast and chondroblast[5].

Osteoconduction is a physical effect which provides new bone formation with border tissues' being penetrated with graft matrix's working as a skeleton shape[2].

Four healing phases which ensue each other such as integration, displacement, shape and local acceleration phenomena have to be accomplished successfully so as to a graft can be a functional part of bone tissue. In comparison with small grafts this event generally takes more time at big grafts. Failure at any of these phases results in graft's failure[6].

Biomaterials are used at the cure of defects which occur as a consequence of a trauma and at the cure of congenital deformities and bone defects which occur as a result of tumor surgery. Materials which are transplanted at organ or tissue implementation are classified according to their immunological origins.

Biomaterials are classified according to the tissues that are attained such as autogenous bone graft, homogen bone graft, heterogen bone graft and alloplastic materials (Table: 1)[5].

BIOMATERIALS	
A. Bone source biomaterials	**B. Alloplasts**
a) Autograft	a) Bioceramics
I-Cortical bone	b) Bioactive glass
II-Cansellous bone	c) Polimers
III-Cortico-cancellous bone	d) Source of tissue
b) Homograft	e) Metals
I-Isograft	f) Gelatin film
II-Allogreft	g) Calcium sulfate
1) Fresh frozen bone	h) Calcium carbonate
2) Frozen dried bone	
3)Demineralized frozen dried one all.	
c) Xenograft	
I) Demineralised bone	
II) Deproteinised bone	

Table 1: Classification of biomaterials.[1]

a) Autogenous bone gratf (Autograft)

Autogrfats are the tissues which are taken from the same organism. This group is indicated as the most advantageous graft material as for fresh autogen graft's providing osteogenetic cells and not causing immunological reaction. However; the need for the second operation at donor site, long term postoperative pain, limitation of movement and extension of curing time are the disadvantages of this group. While talking about autografts it will be suitable to make a difference between cortical and cansellous bone[5].

These gratfs can be obtained from different area in different forms. The extra oral area from which the most frequent otogen bone can be obtained are: iliac bone, mandibular simphiz, ramus, maxillar tuber or exsoztoz. The most suitable donor site depends on volume and regeneration type which is necessary according to the feature of the case[4].

I. Cortical bone: While forming a durable and hard structure they don't have any skills to increase the osteogenesis.

II. Cancellous bone: The primary advantage of marrow bone is its enhancing skills at osteogenesis explicitly.

III. Cortico- Cancellous bone: Usage of these grafts has got popularity in recent years. However, this graft doesn't have the equal characteristic of both cortical and cancellous bones' features. Cortico- cancellous bone doesn't have the feature of increasing osteogenesis as cancellous bone because it has a cortical bone layer which has got more nonporous structure.

b) Homogenous bone graft (Homograft)

I. Isograft: The graft of tissue that is obtained from a donor genetically identical to the recipient. is named as izograft or 'singenesioplastic graft[5].

II. Allograft: Allograft is the tissue wich is taken from the donor which doesn't have any similarities genetically with the recipient. Bone allografts are obtained from the bones which are taken from different genetical types of different cadavers and they are conserved in bone banks after they have been subject to some operations[7].

In order to take away immunological complication and carry disease potentials of allografts during their preparation the last techniques are freezing, desiccation by freezing methods or radiation.

Fresh Frozen Bone: The benefits of fresh frozen bones on facial skeleton are limited. Its basic usage is for osteocondral allogratfs 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 maxilofacial part. Preparation includes lifting the cohesive tissue with soft tissue. Cohesive capsules are cut. This lets intracapsuler way to freeze. Freezing causes necrosis and tissue injury at hemorrhage biologically. The freezing rate control of the tissue and its being subject to cooling operative is carried out under control[5].

Frozen Dried Bone: Bone is frozen at -76 C. It is taken under some drying process and heat is enhanced gradually. This lets retained water to go out. The output of water is supplied in time. Two weeks are necessary for dehydration. The revascularization of the applied bone is slow and there is more resorptive activity than autogenous grafts. Revascularization mechanism starts with the answer of acute inflammation and it lasts long.

The chronic inflammation is observed. The mineralization which occurs at periphery by osteodeposition is like cortical bone autografts but it is seen less and more slowly. It is

encountered with cellular immunological answer at frozen bone implementation[5]. Homogen frozen dried bone is considered as ostoeconductive materials[2]. It is only used successfully at the treatment of chronic fistula and alveol defects and the risk of transmission of the illness is rare[5].

Demineralized Frozen Dried Bone Allografts (DFDBA): The demineralization operation with hydrochloric acid provides to come off the proteins for stimulating bone formation in bone matrix. All these proteins which stimulate the bone formation may be named as “bone morphogenetic protein” (BMP)[2,3]. This process includes multipotential cells originated from natural recipient bone in which the graft has been replaced. These cells that fill the area turn into osteoblasts by undergoing a change.

Allograft is resorbed by the recipient bone with time and this regenerative process is thought of being induced by BMP and probably by other growth factors in allograft. Although it is shown that freezing graft material or its being dried by freezing doesn’t damage graft's cellular activity, some writers don't believe in the real occurrence of osteoinduction. DFDBAs are the most used allografts as a result of their easy obtainment reliability and their asserted osteoinductive features. Relative to cancellous bone allografts, the antigenic features of cortical bone allografts is less. Besides, at great concentration it includes more BMP than cancellous bone. Therefore; from DFDBA grafts the ones obtained from cortical bone must be preferred. The risk of illness transfer at allograft using is an important matter.

Being dried by freezing doesn't eradicate antigenic features of allografts totally, it minimizes. The results got by DFDBA shows differences. One of the most important reason is their having different features from each other. Commercial bone banks don't determine graft's osteoinductive capacity level or the amount of BMP at each grafts that they produce. Many factors such as the cadaver's age that the graft is taken, sex, his/her illnesses, the medicine he/she used, genetical features, the time after his/her death, keeping conditions and the graft production protocol of the tissue bank, etc... affect the graft's quality. The amount of BMP at grafts is also important. The amount of BMP of the donor must be 2mg/40 age/weight minimally and 10 µ optimally[8].

The allogenic bones prepared for frozen or frozen dried different oral surgery implementation are brought into use with various anatomical forms. Cancellous iliac bone is taken into pieces at approximately 2-10 mm size so as to be used in bone defects. Small cancellous pieces are used in periapical after küretaj, for limited alveolar corner revision.

Alloplastic bone materials (hydroxyapatite, β - tricalciumphosphate,etc.) and showing only osteocondctive effect of bone allgrafts and autogenous bone grafts cause postoperative complications at transmitting has directed researchers to get allogenic, osteoinductive and osteoconductive characterised bone grafts which has low antigenic features. For this purpose some studies have been done with autolysed and deantigenised bone graft. On the contrary to lyophilize or other allogenic human bones these researchers determine that allogenic bone is osteoconductive. As microorganisms in bone matrix are wholly damaged during preparation it is proclaimed that human allogenic bones are reliable for not to transport infectious illnesses including HIV. Lyophilized and sterilezed allogenic human bone is brought into use as pieces and powder form. Powder form of this bone is suggested for filling up cyst cavity[8].

Allogen bone grafts have many advantages such as the limitation of donor field, reduction of anesthesia and operation time, reduction of loss of blood and complications at low levels[4]. However its disadvantage is getting the tissue from a different person. Therefore, with medical history it should be well investigated whether these donors have infection, malign neoplasm, degenerative bone illnesses, contagious illnesses such as hepatitis B, C and AIDS. Besides it shouldn't be forgotten that some illnesses are concerned with bone quality[5].

c) Heterogen Bone Grafts (Xenograft)

Grafts taken from different kind of donors are named as Xenogenic (Xenografts or heterogen bone graft). Heterografts are recommended for filling up small defects at jaws. Many clinicians state that these grafts don't provide any osteogenic potential. Instead, they constitute matrix for bone. Being prepared with some organic decomposers and during this operation by losing its immunojenity mostly calf bone is the most general graft source. This bone is having been ready to use for graft by being sterilized with calcium matrix after being kept in ethylene diamine for 24 hours and separated

from its organic components. The graft prepared by this way doesn't cause any immune reaction at recipient[4].

As the bone is prepared at low degree temperature these xenografts contain more small crystals. This feature is preferred for its providing better osteintegration. Moreover; xenografts are resorbed more than alloplastic HA (7). At the studies done with calf bone, it is shown that graft give successful results in osteotomy field but it is inadequate at the improvement of posttraumatic deformity and hipoplastic field[5].

Demineralised Bone: It is obtained by demineralising the minerals existing in bone. With bone's demineralization nonkollajen proteins which exist in bone matrix come out. Wide fractions of noncollagen proteins of which bone demineralization is limited at low degree, have osteoinduction potential. Its usage is successful at 3 walled defects and at small graft fields which don't require strength. Using it by putting together with stronger materials is suitable. It is applied by tissue membranes[5].

Deproteinised Bone: The bone which is inorganic and without protein is the material that the organic part of bone is extracted and only natural calcium phosphate material has been left. This material is formed with under saturated calcium apatite crystals.

This material provides the rehabilitation by being exposed to the regenerations which are constructed by osteoclasts. At clinical researches, successful results are taken only by its combination with bone and autogenous bone. It is used at cystic cavities, alveol crest augmentations and at fields which are constituted for application. At sine enhancement operations using demineralised bone is more frequent than using unshaped biomaterials[5].

Alloplasts

Alloplastic materials are synthetic, inorganic, biocompatible and bioactive osteoconductive graft materials[3,7]. The most favorite alloplastic materials are; bioceramics, polymers and bioactive glass[3].

a) Bioceramics: They are obtained by integrating hydroxyapatite powder under pressure and high temperature with each other (synterization). They are also named as phospate of lime graft substances. Basically these substances without pore turn into porous way with some chemical processes. However, these pores are not connected with each other as calcium carbonate graft substances[8].

As it is well known located in bone and teeth's inorganic structure calcium and phosphor minerals are the basic elements. Tissue harmony of phosphate of lime graft substances is excellent. They don't cause any kind of inflamed and unknown substance reaction. Like calcium carbonate they show osteoconductive effect, they don't have osteoinductive effect[2].

The difference between tricalcium phosphate and hydroxyapatite is the containing rate of calcium for phosphate. The rate of calcium for phosphate at hydroxyapatite is 1:67. They have resorbed and unresorbed types. For the tricalcium phosphate graft substances the rate of calcium for phospate is 1:5. Tricalcium phospate graft substances are resorbed[2].

b) Bioactive glass: Basically bioactive glass consists of silicone dioxide, soda, calcium oxide and phosphor oxide. Surface reactions which occur when they come by tissue liquid provide the formation of "hydroxy-carbonate apatite" layer. Graft bits' being covered by this layer becomes true in a few hours after the application. This layer being richer than phosphate of lime increases the adsorbtion and concentration of proteins which are used for generating mineralized extracellular matrix by osteoblasts.

These bioactive features are asserted that they cause quick and new bone formation by directing and enhancing osteogenesis. Moreover, it is expressed that they provide a direct connection with the new bone formation in recipient area[2].

c) Polimers: HTR (Hard Tissue Replacement) the unique polymer based graft substance used contemporarily. It is a micro porous graft substance which consists of polimetilakrilat, polihydroetilmetakrilat and calcium hydroxide and it is not resorbed or compatible with tissue[2].

It acts as scaffolding for new bone formation when it has a close contact with alveolar bone. It shows osteoconductive effect and it is not resorbed. While particules' being charged with negative surface energy provide them to be closed to the bone, their hydrophilic feature simplifies clot formation[8].

Advantages and disadvantages of alloplastic materials;

They can be applied easily. As a second operation is not required both operation time is short and second surgical branch is not necessary.

There are commercial forms with intended size and shape. They may cause stranger body and inflammation reactions. The reaction rate is more than autogenous materials. There is a possibility for the bone to be resorbed in inflammation field and the tissue cover is supposed to have enough quality and quantity[8].

Under conditions with frequent deformity and more loss of tissue skin and soft tissue transplantation may be necessary before biomaterials are applied. If the defect at bone tissue is so wide graft must be considered absolutely and functional stress on recipient part, responsibility and trauma after implementation must be taken into consideration.

Each surgeon must determine the biomaterial and the technique he/she will use according to the prepared plan and apply it on the model. During surgery there must be an atraumatic work as possible. The suitability of the used material for defect contours, its stabilization and the aesthetic of the patient must be considered. Suitable equipment must be used during the surgery of shaping biomaterial. The equipment must be manipulated in such a way that it won't form sharp or disordered edges.

Conclusions

No matter what kind of graft material is applied, it is not possible to predict the acquired result beforehand. Since many factors have effects on this subject, factors such as patient choice, the morphology of bone defect, the type of the graft, the potential of recovery and the well-made plaque of the patient have important effects on the result.

Declaration of Interest

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