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Review Article

Various materials used for the repair of bone defects: A review

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ABSTRACT

Now a days most commonly used material to treat the defects in the bone after trauma or after any pathology are bone grafts. Bone grafting is a procedure which is performed surgically to join any defect which is surrounding the bone or for the union of the bone. It was found that the graft material which are allogenic in nature as well as other bioactive synthetic substitutes of the bone graft material shows good integration with the remaining bone. To increase the chances of acceptance of these allogenic bone graft materials and others synthetic bioactive graft materials addition of different growth factors for e.g. such as bone morphogenic proteins, platelet rich plasma, platelet rich fibrin have been considered very well. Bone is found to be the second commonly transplanted tissue after the blood. There are various methods present in the treatment of the bone defects such as guided regeneration of bone, use of stem cells and bone grafts, but bone graft shows promising results in the terms of maintaining the normal outline structure of the bone, bone grafts helps in maintaining the aesthetic restoration, helps in eliminating the space or defect which is surrounding the bone due to trauma or due to any pathological condition, helps in providing the width or height for the ease of placement of implant in the oral cavity.

1. Introduction

The procedure of bone grafting is one of the surgical method which is used to augment the bone regeneration in all the orthopedic procedure. Grafting of bone is found to be the second commonly transplanted tissue after the blood transfusion. Literature stated that over two million procedures of bone grafting done every year. From all the grafts available in the market, autologous bone graft is found to be the most satisfactory bone graft material, as it shows all the properties of osteoinduction along with osteoconduction and osteogenesis. It has the potential for regeneration of bone where it has been transplanted in the oral cavity. United states food and drug administration define bone grafting as, grafting is a surgical procedure in which a new bone or a replacement material is placed in to the fracture site of the bone or in to the bone defect to promote or to help in healing. Bone grafting can also be defined as a surgical procedure that helps in replacement of the missing bone with the help of bone which is taken from the own body of the patient or with an artificial or synthetic material transplanted from the bone from the outside. Bone graft materials helps in the formation of the bone along with it helps in the healing process. [1–3]

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1.1. Classification of different materials can be used as bone grafts

1.1.1. According to source

1. Allograft material
2. Autograft material
3. Xenograft material
4. Synthetic substitute of the bone

1.1.2. According to the content

1. Cortical bone graft: - it helps in stimulating the stability
2. Cancellous bone graft: - it helps in stimulating the process of osteogenesis
3. Cortico cancellous graft: - it helps in stimulating both i.e. the stability as well as the process of osteogenesis.

1.2. According to the vascularity of the graft

1. Vascular graft: - expensive graft and more chances of morbidity at the donor site.
2. Non vascular graft: - this graft is less expensive as compared to the vascular graft and shows less morbidity at the donor site.

1.3. According to the preservation method of the graft

1. Dried demineralized freeze graft: - this graft undergoes the process of dehydration and this graft constitute only the organic part of the bone.
2. Dried freezed graft: - this graft underwent the process of dehydration along with freezing that too without the process of demineralization which results in less antigenicity.
3. Fresh frozen: - to avoid the dehydration of the graft by the enzymes, this graft is freezed at – 80 degrees centigrade, this graft materials shows the highest property of osteoinduction as well as osteoconduction.

1.4. According to the mode of action of the graft

1. Osteogenic graft material: Formation of bone is done with the osteoblast cells, that too with in the graft.
2. Osteo inductive graft material: - formation of bone is done in the near by surrounding tissue which is present adjacent to the graft material.
3. Osteo conductive graft material: - graft material itself does not contribute to the formation of the bone, it only act as scaffold.
4. Osteo promotive graft material: - Increases the potential of osteoinduction without possessing the property of osteoinduction.[4–7]

The rationale of the bone graft material should be, the bone graft material should have the capacity to regenerate the generating capacity of the bone, it should helps in promoting as well as achieving the new attachment, it should be able to provide sufficient volume of the bone.

2. Indications for Using Bone Graft Material

1. To maintain the normal bone architecture, to fill any pathological or traumatic gap of the alveolar bone that results from any trauma, or from cyst or from any other pathological condition.
2. During the placement of the implant, where adequate bone width or height is not present or during the placement of the implant in the esthetic region.
3. In extraction sockets after the extraction of the tooth, to maintain the normal architecture of the alveolar bone.
4. In different bone augmentation procedure of the alveolar bone.
5. During the process of immediate implant placement, to achieve adequate osseointegration with the alveolar bone.

2.1. Autologous bone graft material

An autologous bone graft is a graft which has been taken from the anatomic site and the graft material is transplanted in to the other anatomic site of the same individual where it has been required is known as autologous bone graft. An autologous bone graft shows the properties of osteoinduction, along with osteoconduction as well as osteogenic, that's why an autologous bone graft material integrated more rapidly. Along with it autologous bone graft material shows some of the disadvantages like pain at the donor site from where the graft has been harvested, increased loss of blood at the site from where the graft has been taken, increased healing time post operatively at the donor site, chances of development of infection post operatively at the donor site, and the volume of the material is limited also shows higher rate of morbidity. Different sites from where the graft can be harvested are iliac crest, fibula, tibia, maxillary tuberosity in the maxilla, from the retro molar pad area, from the palate, ascending pat of the ramus, from the coronoid process.

2.2. Allograft

The graft which is taken or harvested from one individual and is transplanted in to the other genetically different individual but having the same species. This allograft is the most likely alternative to the autograft. This allograft material can be used in patients showing poor potential to the healing process, most commonly in the non union of the bone and to make the communication after the fracture. The allograft bone material is available in variety of shapes and sizes as it can be machined or customized. So they are available in different forms which includes cortical, cancelleous and highly processed derivative of the bone. It

has been found that allografts are more immunogenic than the autograft and on the other hand it also shows more rate of failure as compared to the auto graft material. Allograft material shows more chances of transmission of disease as compared to the autograft material.

2.3. Xenografts

These are the bone grafts which has been taken from the donor of the different species. This xenograft is available as demineralized bovine bone graft and demineralize coral substitute of bone which is quite similar to human cancellous bone. Xenograft material shows the advantages of slow process of resorption, ease of availability, shows the property of osteoconductivity, along with that some of the disadvantages also been shown by a xenograft material for e.g. immunogenicity.

2.4. Alloplastic material

2.4.1. Tri calcium phosphate

It is one of the most commonly used alloplastic material, in this graft material calcium and phosphate are present in the ratio of 1: 1.5. It is available in two different forms one is paste form which when applied over the defect become hardened at the site of the defect and the second form is the ceramic form. These alloplastic graft material are totally biocompatible and shows the property of osteoconductivity and also permits and promotes the process of bone regeneration. Along with it some of the disadvantages of the alloplastic materials are they are brittle also shows the property of low stability, and they are least resorbable.

2.4.2. Calcium sulphate

Otherwise known as plaster of paris, most commonly used during the process of tooth extraction, or during the treatment of the defects in the periodontal and dentoalveolar region. This graft is totally bio compatible material, shows the property of osteoconductivity shows better handling properties and they are present in both cement as well as in powdered form along with it is this material is brittle so it is more prone to fracture, and rapid resorption of the material also occurs.

2.5. Hydroxyapatite

It consists of calcium and phosphate in the ratio of 1:1.67.

This material posses the property of osteoinduction along with osteoconduction and also promotes the process of osteogenesis. The only disadvantage of the material is, it is very much brittle and chances of fracture is more.

2.6. Bioactive glass ceramic

Comprised of calcium oxide, sodium oxide, potassium oxide and silicone dioxide. They provide better strength, provide surface area for the attachment of the osteoblasts, shows the phenomenon of bio activity.

2.7. Plastic material

Plastic material like HTR polymers shows better results in the attachment level and also shows better results in the filling of the defect. They are highly biocompatible materials but only disadvantage of the material is long resorption period.[7–10]

3. Conclusion

In todays time there are variety of materials are present to treat the bone defect. One should know the different types of bone grafts materials, must have a thorough knowledge of their advantages as well as disadvantages of the material.

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5. Conflict of Interest

None.

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