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Review Article

Various materials which can be used as bone grafting materials in dentistry: A literature review

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ABSTRACT

Oral surgical procedures are one of the common procedures occurring in daily routine practice. These oral surgical procedures can be minor oral surgical procedures or major oral surgical procedures. Minor oral surgical procedures include extraction of mobile tooth, grossly carious tooth, only root stumps present, alveoloplasty, etc. and major oral surgical procedures include impactions, fracture reductions, single or multiple placements of implants, etc.These procedures might result in the formation of bone defect, while doing the oral surgical procedures. These bone defects need to be restored in to the normal anatomy, so that the normal functioning could not get hampered. Bone grafting is also one of the surgical procedure which is done for the replacement of the missing bone. These defects might occur from any general disease, accident, congenital abnormality. There are different methods which can be used to eliminate different defects and it includes guided bone regeneration therapy, Bone graft helps in maintain the normal anatomic architecture of the bone, it helps in restoring the function of the bone, helps in restoring the esthetics of the bone, helps in eliminating the space and also creating the space, so that the implant can be placed.

1. Introduction

Bone can be classified as the mineral tissue of the body, which helps in providing the structural support to the body. Bone has a capacity to regenerate but required scaffolding to do the same. A graft is a tissue which can be implanted after removal from the donor site with in a recipient, which after than can be restored, repaired and regenerated. Bone grafting can be stated as a surgical procedure, in which new bone or the replacement material can be placed in the bony defects to aid in healing.[1–7] Bone grafting can also be defined as the surgical procedures which replaces the missing bone with the help of material from patient own body or artificial or synthetic, or a natural substitute. Bone graft materials can act as fillers and can scaffold to help in formation of the bone to promote healing. Bone grafts can be placed at different locations depending upon the indication. There are different stages in the integration of the graft at the recipient site, which includes, stage of inflammation, revascularization, stage of osseoinduction, stage of osseoconduction, and finally the stage of remodeling. Literature revealed that annually, 2.2 million orthopedic procedures includes autogeneous grafts and allograft material.[8–10]

Indications of using bone graft materials:

1. To fill any of the bone defect.
2. For the placement of the implant in the esthetic region.

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3. Some times in alveolar sockets, after the extraction procedure.
4. As a filler material, in peri implant defect, occurring due to peri implantitis.
5. For augmentation of maxilla or mandible in horizontal or vertical direction.
6. Especially at the time of immediate placement of the implant.
7. In periodontal inflammation.[9–13]

2. Classification

These materials can be classified depending upon source of the graft material, depending upon the content of the graft material, depending upon the vascularity of the graft material, depending upon the method of preservation of the graft material.[11–14]

1. Depending upon the source of the graft material: it is classified as Autograft, Allograft, xenograft, synthetic bone substitutes.
2. Depending upon the content of the graft material: it is classified as cortical bone graft, cancellous bone graft, cortico cancellous bone graft.
3. Depending upon the vascularity of the bone graft: it is classified as vascular bone graft and non-vascular bone graft.
4. Depending upon method of preservation of the bone graft: it is classified as fresh or fresh frozen, freeze dried bone graft, demineralized freeze dried bone graft.
5. Based on the mode of action of the bone graft: it is classified as osteogenic bone graft, osteoconductive bone graft, osteoinductive bone graft, osteopromotive bone graft.

2.1. Auto graft

It was first used by hegedus in the year of 1923 for the reconstruction of osseous defect. This graft is shifted from one position to the other position in the same individual. Out of all autogeneous bone is found best as it shows both the properties i.e. osteogenetic and osteoconductive property. It is the gold standard grafting material of choice.[14–16]

Advantages of using auto graft are, it shows least immunological reactions, it is totally histocompatible, it shows best osteoinductive, osteoconductive and osteogenetic property, it is available in various sizes and various shapes.

Some of the disadvantages of the auto graft material are: it is very much expensive, increased impatient stay, increases the absorption rate, and it requires additional surgery.

2.2. Allograft

These are the grafts which can be shared between genetically dissimilar members of the same species. They are available in different forms such as fresh frozen, freeze dried bone graft or demineralized freeze dried bone graft. These allograft are available as cortical cancellous, cortico cancellous. They are available in different shape and different sizes.[10,11]

The main advantages of the allograft material, it shows properties of osteoconductive, osteoinductive, they are easily available in the market, does not required additional surgery for the placement of the graft. The only disadvantage of this material is immunogenicity, possibility of transmission of diseases.

2.3. Xenograft

These graft materials are taken from a donor of another species. The other name of this graft is organic bone. These grafts are available as demineralized bovine bone grafts, demineralized coral bone subsitutes which is mostly similar to human cancellous bone. It is commercially available in the market as Algipore, Bio oss.[7,8]

This bone material i.e. Bio-oss has shown successful results in bone regeneration procedures, at various sites like in periodontal defects, in sinus grafting during direct sinus lift procedures while placing the implant, it shows high osteoconductivity properties and it is very much bio compatible with no systemic immune response.

Some of the advantages of this material is, it is very economical, shows slow resorption rate, easily available in the market, show osteoconductive property. Some of the disadvantages of the material is immunogenicity.

2.4. Alloplastic materials

These are known as the synthetic materials, which can be used as bone grafting materials in the treatment of periodontal osseous defects.[7–13]

Some of the synthetic materials, used for the treatment of osseous defects are

2.4.1. Tri calcium phosphate

This is one of the most used graft material. Calcium and phosphorus are in the ratio of 1:1.5. They are crystals of beta whitlocite. They are available in two different forms as cement and in ceramics.

Advantages of using this material is, it is very much biocompatible, shows good osteoconductivity, promotes good vascularization and healing of the bone, and show resistant to compressive loads. Along with advantages some of the disadvantages of the material are, it is having low mechanical stability, shows less endurance to shear forces, it is brittle, does not show any of the osteogenic property.[5–7]

2.5. Hydroxyapatite

It is found to be the main inorganic component of the tooth and the bone, it also consists of calcium and phosphate.

The main advantages of this material are, it shows high osteoconductive properties, this material is not generally resorbable, very much good carrier for osteogenic growth. [1,2]

Some of the disadvantages of the material is, it is very much brittle and can fracture easily.

2.6. Calcium sulphate

It is also known as plaster of paris. This graft is used in tooth extraction, and dento alveolar defects. The advantages of this material are, it is highly bio compatible, prevents necrosis of the flap, it shows good handling properties, it is available in cement as well as granular form. Some of the disadvantages of the material are it is very much prone to fracture, shows high rate of resorption, and provides minimal structural support. [10–15]

2.7. Polymer

It consists of polymethyl-methacrylate and polyhydroxyl-ethylmethacrylate beads, which is coated with calcium hydroxide. It shows excellent osteoconductive property, shows good compressive strength which is equal to cortical bone itself, and the main disadvantage of this graft material is thermal bone necrosis, if high temperature is used during the process of polymerization.

2.8. Bioactive glass ceramic

It is made up of calcium oxide, sodium oxide, silicon dioxide, potassium oxide. They are amorphous materials. These material provide better strength, also provide surface for attachment of the cell.

2.8.1. Plastic material

HTR polymer has shown a totally positive effect in improving the attachment levels and filling of the defect. They are very much biocompatible material, the main disadvantage of the material is very long resorption time.

3. Discussion

In today's time, knowledge of different types of grafts is very much required for proper treatment and good prognosis of the treatment plan. For good prognosis, proper handling of the graft while transferring it from packing along with maintaining all the sterlized conditions is very much helpful in maintaing prognosis. Grafts help in maintaining the normal architecture of the bone, helps in maintaining the esthetics of the bone.

4. Conclusion

The development of various bone regenerative materials such as engineering, cells, and nanotechnology has father widen up the horizon in the field of bone regeneration. It may be concluded that a great achievement have been in bone grafting in dental field but still the wait for an ideal graft material is on.

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6. Conflict of Interest

None.

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