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RESEARCH ARTICLE

ALVEOLAR DISTRACTION OSTEOGENESIS AND IMPLANTOLOGY

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Abstract

Congenital or acquired alveolar abnormalities are the indications for alveolar ridge augmentation. Periodontal disease, traumatic avulsions, post-extraction abnormalities, and/or protracted denture use with ensuing disuse atrophy can all contribute to acquiredalveolar bone loss. The horizontal dimension has suffered the most loss in the majority of these instances. The loss of the buccal bone plate following a traumatised tooth avulsion is a common scenario that results in a horizontal defect. The goal of current implant dentistry standards is to produce natural-looking prosthetic restorations with the best possible functional and aesthetic results. In order to attain gold-standard outcomes, a number of factors have been proposed, including sufficient bone height, width, and anteroposterior projection; sufficient amount and quality of soft tissue; preservation of the buccal sulcus; and sufficient papillae and gingival contour. In the modern practice of dentistry, the preservation and rebuilding of the alveolar bone and surrounding soft tissues for the implantation of dental implants has become essential. An alternate technique for repairing alveolar atrophy is alveolar widening by distraction osteogenesis (DO), which is comparable to alveolar split grafting but does not require the graft. The alveolar bone and associated mucosa have undergone a durable, aesthetically pleasing restoration thanks to the combination of vertical DO and osseointegration.

Introduction:-

Definition

Distraction osteogenesis is a biologic process of new bone formation between the surfaces of bone segments that are gradually separated by incremental traction.The process is initiated when a traction force is applied to bone segments and continues till the callus tissue is stretched.Distraction forces applied to bone also create tension in the surrounding soft tissues, initiating a sequence of adaptive changes termed distraction histiogenesis. [1]

Indications

1. Severe maxillary deficiency in the transverse, vertical and antero-posterior planes
2. Severe mandibular deficiency in the transverse, vertical and antero-posterior planes
3. Temporomandibular joint ankylosis
4. Condylar hypoplasia

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5. Obstructive sleep apnea
6. Mandibular segmental defects after tumor ablation or trauma
7. Vertical and horizontal alveolar ridge deficiency
8. Clefts

Contra- Indications
1. Geriatric patients due to delayed healing
2. Irradiated bone
3. Osteoporotic bone
4. Any systemic disease which effects bone metabolism

Phases Of Distraction
Clinically, distraction osteogenesis consists of five sequential periods:

Osteotomy
Latency, the duration from bone division to the onset of traction;
Distraction, the time when gradual traction is applied and distraction regenerate is formed;
Consolidation, the period that allows maturation and corticalization of the regenerate after traction forces are discontinued and
Remodeling which extends from the initial application of full functional loading to the completion of regenerate bone remodeling

Steps
Osteotomy Phase
An osteotomy divides a bone into two segments, resulting in a loss of continuity and mechanical integrity; this is also referred to as a fracture.[5,6,7] Discontinuity of a skeletal segment triggers an evolutionary process of bone repair known as fracture healing. This process involves recruitment of osteoprogenitor cells, followed by cellular modulation or osteoinduction, and establishment of an environmental template (osteoconduction).

As a result, a reparative callus is formed within and around the ends of the fractured bone segments; under normal conditions, the callus undergoes gradual replacement by lamellar bone, which is mechanically more resistant. Osteotomy for distraction osteogenesis should aim for maximum preservation of periosteum and endosteum to maintain an intact blood supply, good venous flow and viable source of cell required in order to initiate and perpetuate the distraction osteogenesis process.

Latency Phase
It is characterised by initial inflammation followed by formation of soft callus, hard callus and calcification leading to bony union. If distraction is begun too early, the result is decreased bone formation, often with cartilaginous elements present and decreased mechanical strength of the newly created bone.

If distraction is begun too long (i.e., if hard callus formation has begun) the distraction device may be unable to further separate the bone segments. The soft tissue callus phase begins 3 to 7 days after injury and lasts 2 to 3 weeks; this time frame set the boundaries of latency period. Distraction in the maxillofacial skeleton has been reported with immediate activation and with latency phases of up to 12 day.[6]

Consolidation Phase
The consolidation period is that time between of the distraction device.

This period represents the time required for complete mineralization of the distraction regenerate. After distraction ceases, the fibrous inter zone gradually ossifies and one distinct zone of fibre bone completely bridges the gap.

Remodeling Phase
The remodeling period is the period from the application of full functional loading to the complete remodeling of the newly formed bone.It takes a year or more before the structure of newly formed bony tissue is comparable to that of the pre-existing bone.

Distraction Devices
Distraction appliances of the maxillofacial region can be divided into:
Extra-oral appliances
Unidirectional devices
Bi-directional devices
Multidirectional devices

Intra-oral devices
Tooth-borne devices
Tissue-borne devices
Hybrid (tooth and tissue borne)
Devices

Distraction Osteogenesis And Implant Surgery
Vertical Alveolar Distraction Osteogenesis
The general indication or vertical alveolar distraction osteogenesis is a vertical defect greater than 5mm.
Osteotomy is performed. The stabilizing plate is fixed to the jaw bone and the transport plate is secured to the transport fragment.The activation key is slightly turned to ensure the mobility of the transport fragment.The distractor is activated with the key by the patient or a family member.The transport segment is slowly mobilized in a coronal direction.

A consolidation period in static mode allows the calcification of the regeneration chamber.

The distractor is removed.The implants are inserted at the same time.The flap is secured around the implants neck. A two-stage procedure can be also performed.A complicating factor to consider in the use of vertical distraction osteogenesis is the bone level of adjacent teeth.

Bone distracted significantly beyond the bone support of adjacent teeth will not persist.

Therefore, the distraction occasionally may require the inclusion of adjacent teeth to displace the defect adequately in order to move the overall bone level crestally.The transport bone fragment being distracted should be of sufficient size to maintain blood supply and avoid sequestration or late resorption.A bone fragment that is too small, such as a one-tooth segment, or too narrow can easily be compromised by manipulation during the fixation process or by an aggressive distraction protocol.

Horizontal Alveolar Split Distraction Osteogenesis
The indication for alveolar widening by distraction osteogenesis is an alveolus that is too narrow for implant placement. Usually interpreted as less than 4 mm in crestal width, or situated too far lingually or palatally.An alveolar split bone-grafting approach is also used; this technique requires interpositioning of a structural graft or simultaneous placement of an implant to maintain width. A delayed placement approach is frequently used for all of these techniques, requiring a 4-month bone graft incorporation period prior to implant placement.

One of the major advantages of the split alveolar graft is the ability to obtain a mature lamellar plate of bone (both facially and lingually).

The use of alveolar crest widening by distraction oste- ogenesis not only has the advantage of avoiding a bone graft but also is favorable for early implant placement.Implants are typically placed 6 weeks after osteotomy, which is about 3 to 4 weeks after distraction, into a woven matrix that is highly conducive to osseointegration..Excess periosteal reflection will lead to vascular embarrassment and subsequent plate loss from late bone resorption.

Conclusion:-

Alveolar distraction is a technique in constant development. Review of the literature in the last 14 years shows that there are clear indications for its use with results similar to a sometimes even more predictable than traditional bone grafting techniques in preparation for implantation location. Although there are complications with alveolar distraction, most appear to be minor and easy to control. Appropriate patient selection and a better understanding of technology most important for successful bone regeneration with alveolar distraction osteogenesis

Although distraction osteogenesis is often less invasive or more reliable than bone grafting in achieving the desired bone augmentation, physicians are still hesitant to prescribe its use.

Currently, treatment plans for augmentation of deficient sites in the jaws often favor conventional bone grafting strategies, and the use of distraction osteogenesis is relegated to ablated sites where bone grafts have failed or where the defect is completely unmanageable with conventional grafting.

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