Regeneration is the reproduction of a lost or injured part of the body in such a way that the architecture and function of the lost tissue are completely restored.

Introduction to Periodontal Tissue Regeneration:

Detachment of the junctional epithelium from the tooth surface (the formation of a periodontal pocket), disconnection of periodontal ligament fiber attachment to the root surface via cementum, and bone loss, are hallmarks of periodontitis.

The aim of regenerative periodontal therapy is to restore the structure and function of the periodontium through formation of new attachment of junctional epithelium to the tooth surface and of connective tissue fibers to the root surface.

Research has provided evidence that in most situations chronic periodontal diseases can be treated. There is also evidence that periodontally involved teeth have a good chance of survival, provided that therapy, patient compliance and maintenance care are appropriate. There is a broad range of treatment options available, but only a few may be regarded as truly regenerative procedures.

According to a position paper from the American Academy of Periodontology, periodontal regenerative procedures include soft tissue grafts, bone replacement grafts, root biomodifications, guided tissue regeneration, and combinations thereof, for osseous, furcation and recession defects.

This micrograph illustrates the periodontal ligament (PL) with its collagen fiber bundles spanning the area between the root covered with cementum (C) and the alveolar bone (AB). D, dentin. (Undecalcified ground section, unstained and viewed under polarized light.)

Scaling and root planning using hand instruments:

The aim of scaling and root planning is to remove the bacterial biofilm, calculus and contaminated cementum. Numerous studies have proven the effectiveness of reducing the bacterial load, and thus controlling the subgingival microflora, by scaling and root-planning. Research in animals and in humans indicates that the formation of new connective tissue attachment following scaling and root planning or flap surgery is not predictable. Although some new connective tissue attachment may form, a long junctional
epithelium is what predictably establishes itself on the root surface. Therefore, scaling and root planning cannot be regarded as a regenerative procedure, although its efficacy in treating chronic periodontitis is beyond doubt.

While the aim of root surface debridement is to reduce the amount of bacteria and endotoxins on the root surface, treatment of the root surface with demineralizing agents such as acids or EDTA primarily aims to expose collagen fibrils. To achieve this, the smear layer must be removed and the mineralized component of the superficial layer of cementum or dentin needs to be decalcified. The biological concept behind root surface demineralization is to improve blood clot adhesion to exposed collagen fibrils. Stabilization of the coagulum may have a positive effect on wound healing and is regarded as an important contributing factor in achieving periodontal regeneration.

Mesenchymal cells may preferentially adhere to the blood clot-stabilized root surface and the apical migration of epithelial cells may be reduced. Originally, citric acid was used because of its ability to detoxify the root surface. As reports have shown that treatment with citric acid and phosphoric acid can result in root resorption and ankylosis, the chelator EDTA, which has

Bone grafts and bone substitute materials:-

Bone fillers, have all been used with the aim of achieving periodontal regeneration. A systematic review has shown that clinical parameters are improved when intrabony and Class II furcation defects are treated with bone fillers.

The rationale behind the use of bone fillers is to take advantage of one or more of the following properties of such materials, namely osteoconduction, osteoinduction and osteogenesis, induced by transferred cells that are capable of differentiating into osteoblasts. Not all three properties apply to every type of bone filler. While the contribution of transferred cells to new tissue formation may be overestimated, osteoconduction is the most powerful property of bone fillers to support new bone.

Guided tissue regeneration:-

Guided tissue regeneration is a technique that is based on a solid biologic principle. The rationale behind guided tissue regeneration is to use a physical barrier (barrier membrane or simple membrane) to selectively guide cell proliferation and tissue expansion within tissue compartments. The barrier membrane prevents gingival epithelium and connective tissue expansion and favors migration of cells from the periodontal ligament and alveolar bone into the periodontal defect.
Schematic drawing illustrating the four compartments from which cells can grow into the periodontal defect and repopulate the root surface after periodontal therapy: (1) oral gingival epithelium; (2) gingival connective tissue; (3) bone from the alveolar process; and (4) periodontal ligament.

Critical issues include:

(i) the complexity of the periodontium, which consists of four different tissues;
(ii) the use of very high doses of bone morphogenetic proteins;
(iii) the ideal carrier has still not been found;
(iv) The enormous costs that are associated with recombinant human bone morphogenetic proteins in relation to relatively small and non-life-threatening periodontal defects for which other treatment options exist.

**Growth / differentiation factors**:

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**Enamel matrix proteins**:

Subject of major interest is the biological concept behind the therapeutic use of enamel matrix proteins for periodontal regeneration. Based on the circumstantial evidence, the original idea emerged that there is a causal relationship between enamel matrix proteins and cementogenesis. However, such a cause–effect relationship has never been proven experimentally. Over a period of more than a decade, more than 100 nonclinical and non-histological studies formed a basis that allowed the development of a comprehensive picture of what appears to be responsible for supporting periodontal regeneration. Overall, this data provides evidence for enamel matrix proteins supporting wound healing and new periodontal tissue formation. However, as with any other regenerative technique, patient and defect selection and appropriate recall programs are mandatory for successful outcomes. Furthermore, the clinician’s experience and skills, and a biological understanding of periodontal wound healing and regeneration, are certainly of additional advantage.
Light micrograph illustrating periodontal regeneration, as evidenced by formation of new periodontal ligament fibers (NPLF) inserting into both new bone (NB) and new cementum (NC). Detachment of cementum from the treated root (R) surface is a common finding in paraffin sections. (Paraffin section stained with hematoxylin and eosin.)

Does periodontal tissue regeneration really work?

The Answer may be simply, “Yes, it does. As a proof of principle, many histological studies, mainly performed in animals, have provided evidence that various treatment modalities have regenerative potential. According to current human-based evidence, regenerative periodontal therapies can only restore a fraction of the original tissue volume in extent.

Thus, complete periodontal restoration may still be regarded as an illusion. When it comes to predictability and a substantial extent of new attachment formation, there are only a few regenerative techniques available. Guided tissue regeneration and enamel matrix proteins certainly have a regenerative potential. However, these regenerative techniques do not relieve the dentist from his responsibilities. As with so many other sensitive techniques, important aspects to be considered as outcome determining variables include:

(i) appropriate patient and defect selection.
(ii) correct application of a regenerative device or a technique.
(iii) The dentists experience and skills.

Finally, it should still be borne in mind that the structural and interactive complexity of periodontal tissues is probably one of the reasons why it is so difficult to regenerate the periodontium.

References:

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