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REVIEW ARTICLE

PERIODONTAL VACCINE -A RAY OF HOPE.

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Abstract

In the current era, Periodontal disease treatment is focused on the removal of Periodontal microbiota with non surgical therapy & allow growth of the beneficial microorganism. Therefore, for regulating Periodontal disease in humans, availability of a vaccine would be beneficial for the mankind. Specific etiopathogenesis of microbiota suggests that the development of target therapy for target site of microbial colony is most appropriate pathway to treat the disease. Instead of mechanical debridement Vaccination can be a target therapy. Every utmost effort of human started as a dream so also this concept of Periodontal vaccines is notion to mankind., animal studies proving without the doubt, researches are still being going on for open the mystery with humans with the validity of these vaccines. In every seconds medical science has seen recent advancements may be it take longer duration ,but after the discovery of magical vaccine it can come in limelight for welfare of mankind. With the invention of Periodontal vaccines, who knows there might not be a chance for a Periodontist.

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Introduction:-

Due to microbial, genetic, environmental and systemic factors Periodontitis has got a complex etiology, playing an important role in etiopathogenesis. In the present era. Periodontal disease treatment is focused on the removal of periodontal microbiota with non surgical therapy & allow growth of the beneficial microorganism. Therefore, availability of a vaccine for regulating Periodontal disease in humans, would be of immense benefit for the mankind.¹

Vaccination is the administration of antigenic material to stimulate an individual's immune system .The cowpox virus was the first vaccine discovered after vaccinia. The first scientific attempt to prevent an contagious disease (small pox) was done by 200 years ago by Jenner. But it was done in complete knowledge of viruses (or indeed any kind of microbe) and immunology.²

However after 100 years , It was not until the work of Pasteur that different preparations of bacteria could be used to generate increased immunity against the fully virulent microorganism this is how principle of vaccination emerged . Thus, Pasteur's dried Rabies-infected rabbit spinal cords and heated anthrax bacilli the true forerunners of today's vaccines, however there is no real successors of Jenner's animal-derived vaccinia vaccine.Even Pasteur did not have a proper immunological memory concept of the lymphocyte, which had to wait another era, & consumed too much time.²

Ultimately in 1957 clonal selections theory given by Brunet's and the discovery of T and B lymphocytes 1965, the mechanism became clear & throughout twentieth century vaccination against bacterial and viral infectious diseases has progressed. For many diseases, this has been achieved with brilliant success, but for others there is still research is going on till date.²

Bacterial etiology:-

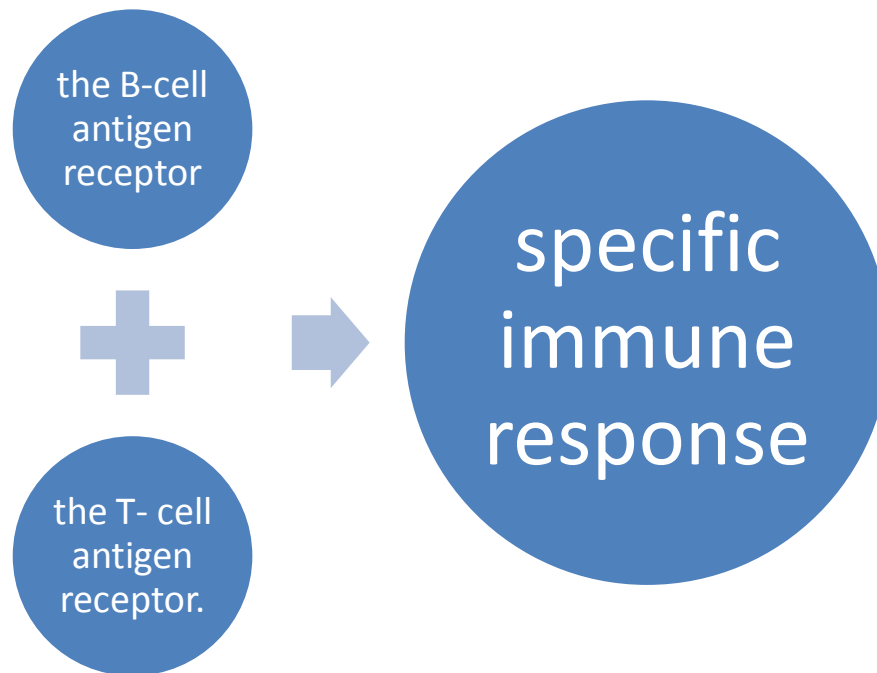
It is clearly evident the role of microbiota in the etiopathogenesis of human periodontal disease. Various studies on the microbiota revealed with wide variety in the composition of the subgingival microflora in the colonization of the plaque. Since decades the research for the etiological agent for destruction of periodontium result in destructive periodontal disease has been going on. However, recently, some key pathogen are identified.³

Main Pathogen of Periodontal disease are:-

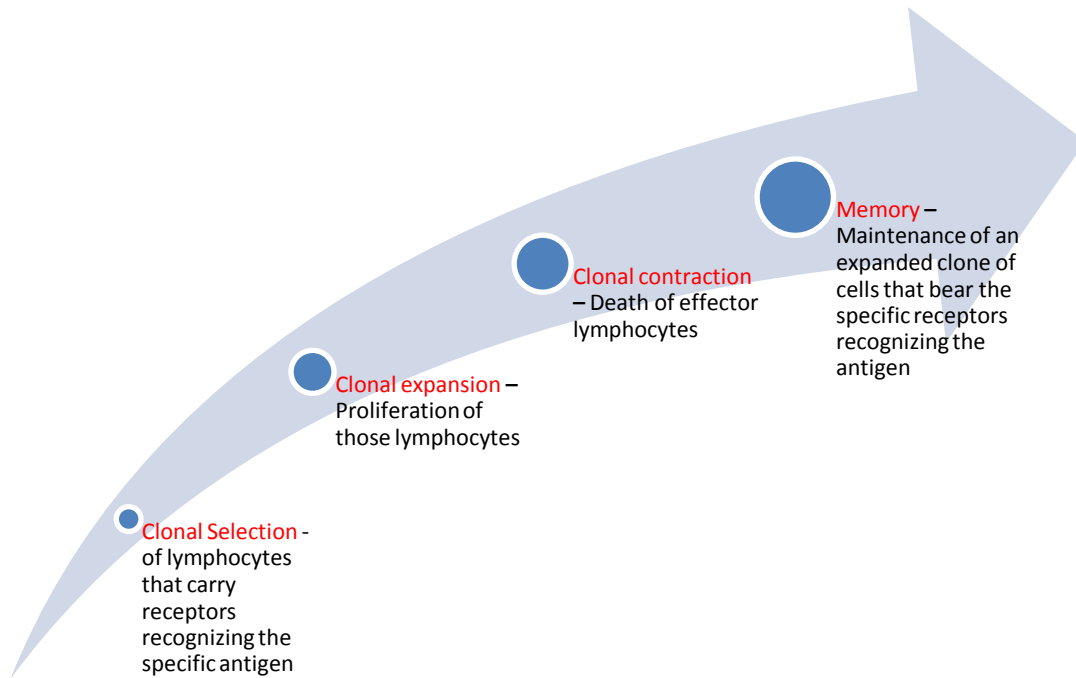
- Porphyromonas gingivalis
- A. actinomycetemcomitans
- Tannerella forsythia (Bacteroides forsythus)
- Treponema denticola
- Prevotella intermedia
- Fusobacterium nucleatum
- Eikenella corrodens
- Campylobacter rectus (Wolinella recta)
- Peptostreptococcus micros³

Mechanism of action:-

Chronic inflammation, if delayed, can result in an adaptation & accommodation called the specific immune response. Two type of receptors are responsible for generation of specific immune response are;



Four phases are involved in the generation of specific immunity:

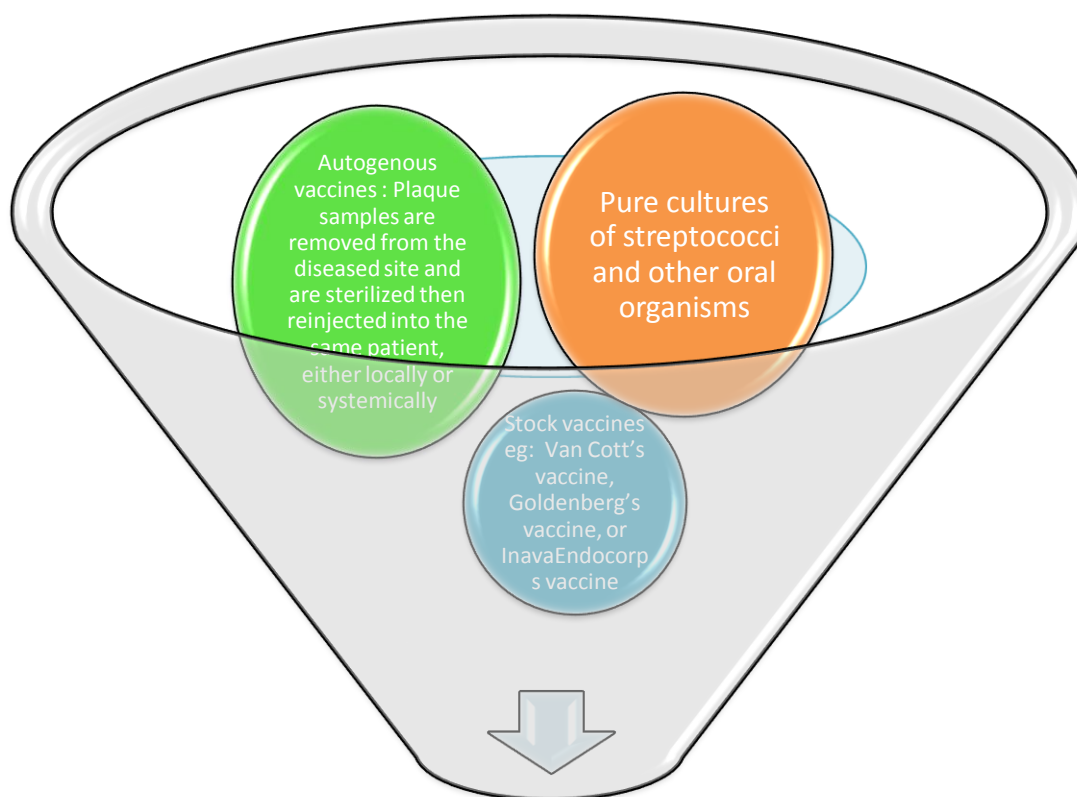


If the person get sufficient number of lymphocytes to against specific pathogen can said to be immune . Development of immunity or resistance to infection, after a secondary booster dose that is able to consider the individual immune to a subsequent infection is called as vaccination⁴

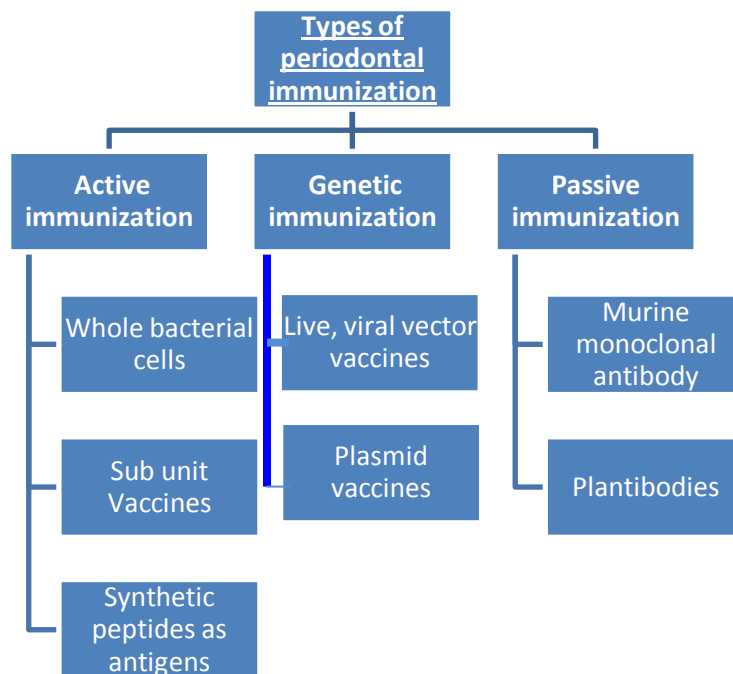
Human Periodontal Vaccine Preparation:-

Three types of vaccine include :

- Pure cultures of streptococci
- Autogenous vaccine
- Stock vaccine



human periodontal vaccine



Active immunization:-

➤ Whole cells

Here host is inoculate the entire cell with its components to bring about active immunization. For this various key organisms for vaccine preparation have been tried. *P. gingivalis* and *A. actinomycetemcomitans* are of main importance owing to their active role in the etiopathogenesis of periodontal disease.

➤ Subunit vaccine

Here the *P. gingivalis* virulence factors are used as subunits for the immunization:

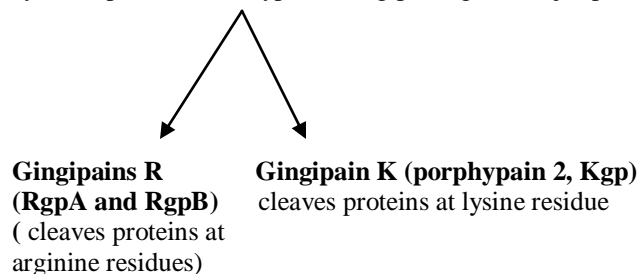
1. Outer membrane protein,
2. Gingipains,
3. Fimbriae
4. Heat shock protein⁵⁻⁶.

1. Outer component:-

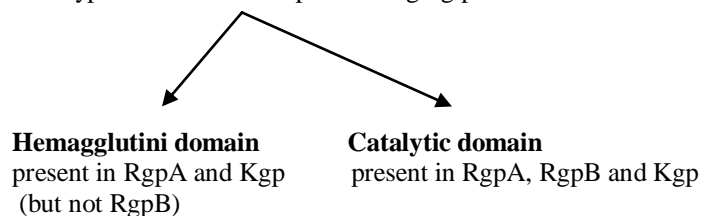
P. gingivalis outer component or the fimbriae are highly immunogenic and play an key role in adhesion to oral tissues is used for active immunization.⁷

2. Gingipains:-

cysteine proteases is a type of Gingipains gives major pathogenic capability to *P. gingivalis* and can be grouped into-



Two types of domains are present in gingipains:



3. Fimbriae as target antigens:-

P. gingivalis fimbria play major virulence factor in the etiopathogenesis of periodontal disease..through fimbriae *P. gingivalis* adhered to the host surface play a major target antigen and induce an immune response⁸

4.Heat Shock Protein:

These proteins participate in the cell function such as folding, assembly, and translocation of polypeptides across membranes and after cell damage play a role in protein repair. There is a phenomenon termed heat shock response, wherein a cell by enhanced transcription experiences increased temperature or any other stress factor, starts producing elevated amounts of heat shock protein.

Classification:-

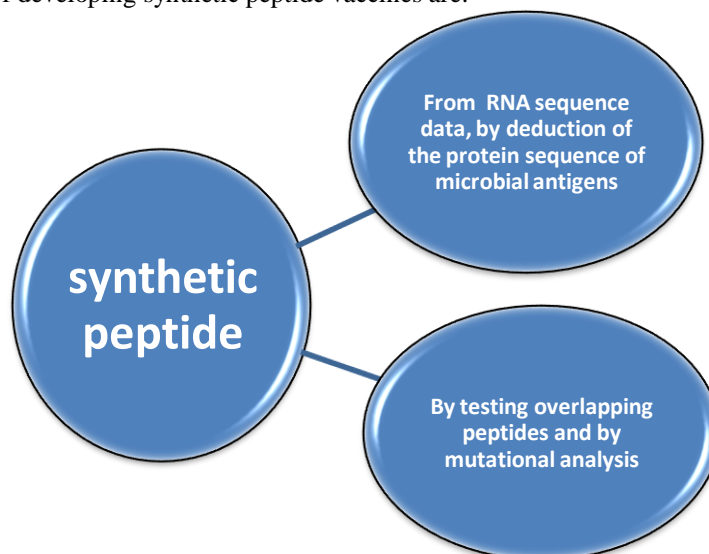
Heat Shock Proteins are classified according to their molecular weight, size, structure, & function.

- **sHsp** - act as dustmen of cells, Prevent aggregation of other proteins by collecting protein called as “garbage” of the tissue.
- **Hsp60, Hsp70** - help in protein folding and refolding

- **Hsp90** - prevent the aggregation of other proteins ,stabilize substrate proteins and maintain their active, or inactive state,
- **Hsp100** - Disaggregation of protein⁹

➤ **Synthetic peptides:-**

Such peptides are weakly immunogenic by itself, based on the microbial antigens known sequence, these require synthesis of linear and branched polymers of 3-10 amino acid and to induce antibody response need to be conjugate to large proteins 2ways of developing synthetic peptide vaccines are:



Advantages of synthetic peptide are:

- Adequately Safe
- Economic
- Ease of use
- Target vaccination for specific targeting
- Not easily develop resistance .¹⁰⁻¹¹

Passive immunization:-

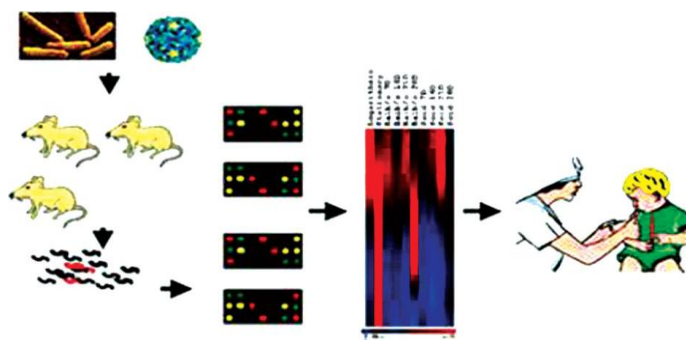
It is active for short time ,because through it host does not induce immunity against it, and covers the host as much time till injected antibody persists in the body. Here, the antigens are delivered through a vector which produces antibodies. These antibodies, when inoculated into a host create immunization.

Passive immunization can be categorised in two ways:

- **Murine monoclonal antibodies**
- **Platibodies**

Murine monoclonal antibodies:-

Antigen injected into mice → Result in antibody production → Produced antibodies inoculated into host → Result in passive immunization

**Plantibodies:-**

this is biomolecular approach to induced bacterial or viral antigens in plants, through which produced antibodies which could be used as orally administered vaccine



It's a new approach but not widely used due to less documentation.

Genetic immunization:-

In early 1990's, a new approaches to the production of vaccines through recombinant DNA technology had begun as that varies in structure from conservative ones. The strategy mainly includes :

Live, viral vector vaccines ↔ Plasmid vaccines

Conclusion:-

The present era of treatment of Periodontitis is non-specific and is centered on the removal of plaque biofilm by scaling & root planning, often following surgical procedures. This present therapy is costly, invasive and has a unpredictable prognosis due in part to poor patient cooperation.& antibiotics uses is limited by the need for long duration treatment to prevent reappear of the pathogen.

Specific bacterial etiology suggests that the development of a specific treatment modality to target site colonization is now a appropriate approach to treat the disease. Vaccination may be an target therapy to mechanical debridement. Every endeavor of human started as a dream so also this notion of periodontal vaccines. the validity of these vaccines , animal studies proving without the doubt, researches are still being going on for open the mystery with humans. Medical science has seen recent advancements in the decades again, our close proximity to success this will soon be in public eye, soon be an actuality spoken about in every part of the world. With the invention of Periodontal vaccines, who knows there might not be a chance for a Periodontist¹¹

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