REVIEW ON: DENTAL CONE DRUG DELIVERY SYSTEM TO TREAT THE PERIODONTAL DISEASE

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Abstract

One of the most prevalent diseases affecting humans are those which affect the oral cavity. Periodontal diseases comprise a wide range of inflammatory conditions that affect the supporting structures of the teeth (the gingiva, bone and periodontal ligament), which could lead to tooth loss and contribute to systemic inflammation. Chronic periodontitis predominantly affects adults, but aggressive periodontitis may occasionally occur in children.The severity of the periodontal disease depends on environmental and host risk factors, both modifiable (for example, smoking) and non-modifiable (for example, genetic susceptibility). Periodontitis is when the periodontal condition has progressed beyond gingivitis into a chronic, destructive, irreversible inflammatory disease state. The bacteria then can penetrate deeper into the tissues and surrounding periodontium. This triggers a host response in an attempt to defend against the invading bacteria. However, during the process of protecting against the bacteria, the host defence also lead to the destruction of the periodontium. Prevention is achieved with daily self-performed oral hygiene and professional removal of the microbial biofilm on a quarterly or bi-annual basis. New treatment modalities that are actively explored include antimicrobial therapy, host modulation therapy, laser therapy and tissue engineering for tissue repair and regeneration.

KEYWORDS: *Periodontitis, Systemic Inflammation, gingivitis*

INTRODUCTION

Dental problem are a serious public health concern in every country, affecting people of all ages, and races, and genders. In recent years the prevalence of oral illness has regions dramatically. Dental disorders affect over 70% of the population. Major oral disorders such as tooth caries, dental decay, periodontal infections, and dry socket impact the human population.

Periodontitis is a localized inflammation response caused by bacterial infection of a periodontal pockets associated with subgingival plaque. It is an infection of periodontium. Periodontal disease is a general term encompassing a group inflammation pathology that mainly include gingivitis and periodontitis. The periodontium being itself an umbrella term that comprise a number of different structure. In periodontal disease there is a formation of gap between gums and teeth which called as '**pockets**. This pocket provides an ideal habitat for anaerobic pathogenic bacteria to develop and multiply. Clinically, the periodontal pocket which slightly deeper than the sulcus of healthy tooth deepens as the condition advance resulting in addition al damage of the tooth's supporting tissue and, In many cases, tooth loss. Periodontal ligament, alveolar bone and dental

cementum. According to who it is widely spreadable chronic disease around the world.it begins with accumulation of plaque around teeth which form microbial biofilm with bacterial followed by localized inflammation og gingiva [1]

The inflammation in the periodontal tissue is initiated by microbial plaque and bacterial infection. In the periodontal pocket the bacteria form a highly structured and complex biofilm. As this continues, the biofilm reach far subgingival and it becomes difficult for the patient to 1 reach it during oral hygiene practices. Traditional treatment options for such conditions includes mechanical debridement aimed at removing the subgingival flora and providing a clean, smooth and compatible root surface. But, in several instances, the complex anatomy of the root and the location of the lesion may hamper the treatment and prevent sufficient 2 reduction of the bacterial load. [1,2,3]

Periodontitis is an infection-driven inflammatory disease in tooth-supporting tissues (i.e., the periodontium). Moreover, genetics and environmental and behavioural factors are involved in the development of the disease, the exposure of susceptible individuals to its initiation, and the speed of progression. The structure of the periodontium is diverse; it is composed of the gingiva, the underlying connective tissue, cement on the root surface, alveolar bone, and the periodontal ligament between the cementum and alveolar bone (**Figure 1**A,B). The junctional epithelium of the gingiva is a unique structure, located at the bottom of the gingival sulcus, which controls the constant presence of bacteria at this site. The most characteristic feature of periodontitis is the activation of osteoclast genesis and the destruction of alveolar bone as its consequence, which is irreversible and leads to loss of tooth support [3,4]

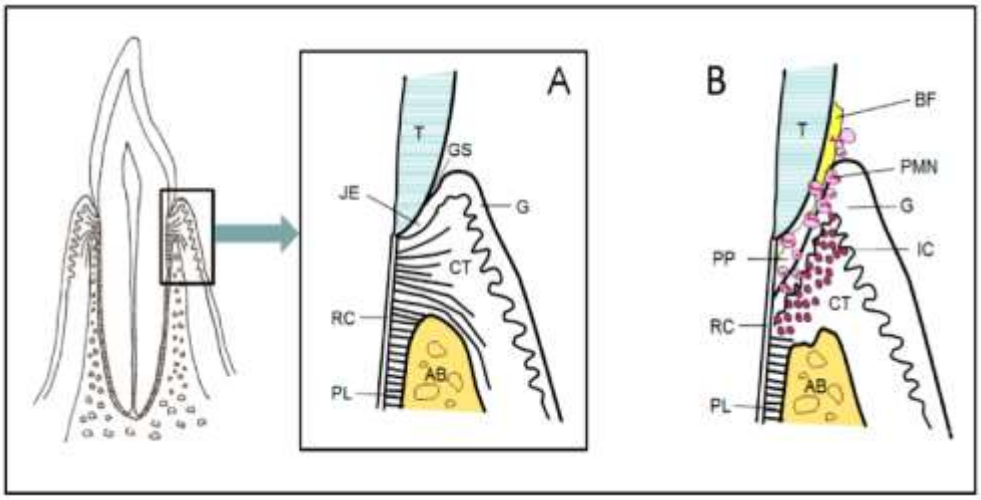

Fig.No. 1 The structure of the periodontium[4]

The complex structure of the periodontal biofilm, consisting of multiple bacterial communities residing in a glycocalyx matrix, has been well described by Marsh (2). It has been demonstrated that once bacteria attach to a tooth surface and reside within a mature biofilm structure, they have reduced susceptibility to antimicrobials compared with planktonic or free-floating bacteria (3). Therefore, mechanical debridement is considered critical to disrupt the biofilm when using systemic antibiotics to treat periodontitis. The rationale for use of adjunctive systemic antimicrobials is to further reduce the bacterial load, enabling resolution of the inflammation in the periodontal pocket.Antibiotics may be prescribed for periodontal patients who do not respond to conventional mechanical therapy, for patients with acute periodontal infections associated with systemic manifestations, for prophylaxis in medically compromised patients, and as an adjunct to surgical and non-surgical periodontal therapy. Application of antibiotic periodontal therapy focuses on the pathogenic microbiota, the patient, and the choice of drug [4,5,6]

2. Stages

There are mainly four stages in periodontal diseases which includes different clinical sign & symptoms and radiological screening are given as follows: 10–12

2.1. Gingivitis It is the only stage when periodontitis can be reversible. At this stage the plaque formation around teeth occurs. There are mainly few painless symptoms seen at this stage such as bad breath, swollen reddish gums and bleeding while brushing and flossing. It can be reversed by maintaining good oral hygiene and

regular checkups. Generally, 1-2 mm clinical attachment loss, less than 15% of bone loss around root, probing depth 4mm or less occurs.

2.2. Early stage It is the second stage of periodontal disease. It is manageable by oral hygiene but not reversible. At this stage, the infection starts spreading to surrounding tissues and starts degrading it. Symptoms at this stage include inflammation of gums, severe bad breath, and bleeding during brushing or flossing, spacing between teeth become evident and will gradually increase. Here, 3-4 mm clinical attachment loss, less than 15-33% of bone loss around root, probing depth 5mm or less occurs [6,7]

2.3. Moderate stage Like second stage moderate stage cannot be reversed. Same symptoms as moderate stage occurs but space between teeth and recessions of gums are more evident. Treatment like deep cleaning, scaling and flap surgeries can be done at this stage. Around5 mm or more clinical attachment loss, 33% of tooth loss of four teeth or less, with complex issues such as probing depth 6 mm or more, Class II-III furcations, and/or moderate ridge defects.

2.4. Advanced stage Last stage of periodontal disease; wherein 50-90% of loss of periodontal tissues occurs. Also other symptoms like swollen gums that ooze of pus, cold sensitivity, loosening of teeth, painful chewing and severe halitosis occurs. If left untreated it causes more spaces or gaps between teeth and gums, gum recession, patient needling dentures, and other health problems that can be worst. Treatment includes regular checkups, cleaning and maintaining good oral hygiene can help halt the progression of Periodontitis. Secondary Occlusal trauma, severe ridge defects, bite collapse, pathologic migration of teeth, less than 20 remaining teeth (10 opposing pairs) seen.

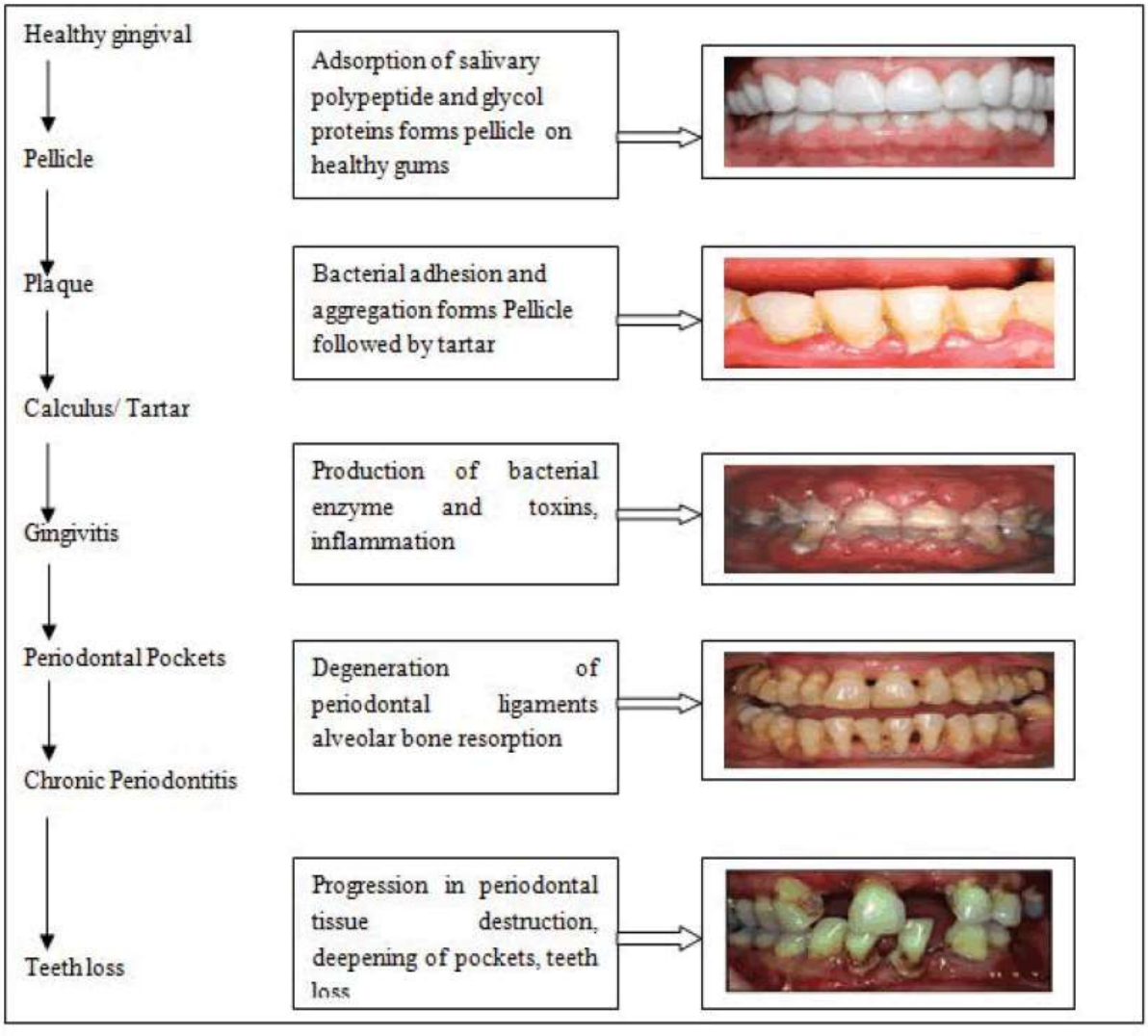

Figure 1: Various phases of periodontal disease.

Treatments:

1.Include mechanical method: Scaling and root planning

2.Antimicrobial therapy:Systemic antibiotics are used

3.Local drug delivery system (models of LDDS)

2. Types of Periodonti 2tis

2.1. Gingivitis: As described above, gingivitis is inflammation of gums and can be reversed by maintaining oral hygiene.[7,8]

2.2 Chronic periodontitis: In this type of periodontal disease, symptoms may include chronic inflammation of gums, severe bad breath, and bleeding during brushing or flossing occurs. Loss of epithelial tissue, bone and ligaments which is not reversible [8]

2.3 Aggressive periodontitis It can be present in localized or generalized forms, both are early onset form of chronic periodontal inflammatory disease, typical manifesting between puberty and early third decade of life. The symptoms are same as chronic periodontitis. [9]

2**.4. Necrotizing ulcerative gingivitis** It is mainly occurring in people who are suffering from malnutrition, immune suppressive and HIV. Necrosis means death of cell or living tissue. It mainly occurs due to deficiency of nourishment need [10]

2.4.1. Peri-implant mucositis It is associated with inflammation of soft tissue surrounding dental implants with no sign of bone loss. Symptoms included red or tender gums around implants, bleeding while brushing [11]

2.5. Systemic chronic periodontitis This type of chronic periodontal disease happens in patient who have systemic syndrome. Inflammation of gums occurs due to systemic disease such as as Diabetes, Heart disease, Respiratory disease,

Etiology and pathogenesis of periodontal disease

Periodontal disease refers to the inflammatory processes that occur in the tissues surrounding the teeth in response to bacterial accumulations, or dental plaque, on the teeth. The bacterial accumulations cause an inflammatory response from the body. The chronic and progressive bacterial infection of the gums leads to alveolar bone destruction and loss of tissue attachment to the teeth. Periodontal disease has many states or stages, ranging from easily treatable gingivitis to irreversible severe periodontitis. Periodontal disease is increased by several risk factors: cigarette smoking; systemic diseases; medications such as steroids, anti-epilepsy drugs and cancer therapy drugs; ill-fitting bridges; crooked teeth and loose fillings; pregnancy; and oral contraceptive use. In addition to these variables, any medical condition that triggers host antibacterial defense mechanisms, such as human immunodeficiency virus (HIV) infection, diabetes, and neutrophil disorders, will likely promote periodontal disease. The most prevalent form of periodontal disease is a mild form called gingivitis. Gingivitis affects 75% of adults in the United States and is characterized by inflammation of the gums, redness, swelling, and frequent bleeding. More advanced forms of periodontitis are also prevalent, affecting approximately 30% (moderate disease) and 10% (advanced disease) of the adult population in the United States. The symptoms are similar to those of gingivitis, but are more severe due to higher accumulations of bacteria and stronger inflammatory responses [11,12]

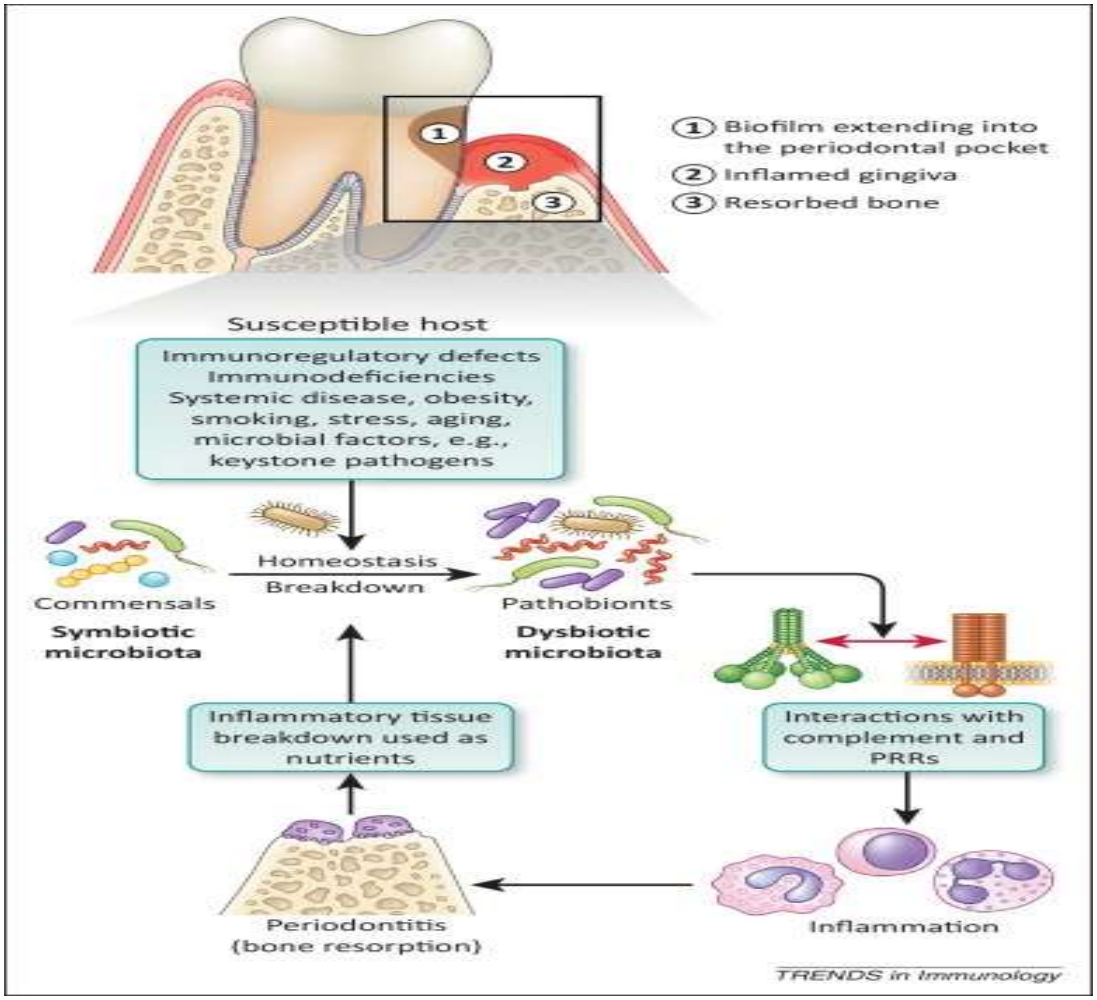

Fig No.2 Etiology and pathogenesis of periodontal disease [12]

In diagnosing the extent of periodontal disease, the probing depth is a good indicator of the advance of the disease. In a healthy periodontium, there is no loss of epithelial attachment or pocket formation, and the periodontal pocket is less than 2 mm deep. Periodontal pockets can extend between 4 and 12 mm. Clinically, patients with periodontal pockets of 4 mm or more are diagnosed with periodontitis. Patients with periodontal pockets of 6 mm or more are diagnosed with advanced or severe periodontitis. Due the minimal symptoms of gingival bleeding and attachment loss, many individuals neglect to treat their disease. Left untreated, gingivitis may progress to irreversible periodontitis, resulting in tooth loss [12,13]

Once diagnosed, most periodontal diseases can be treated successfully. The therapeutic goals in periodontal disease are: first, to alter or eliminate the origin of the microbes as well as contributing risk factors, thereby preventing the progression of the disease and preserving the healthy state of the periodontium. Second, the recurrence of periodontitis must be prevented. Finally, in severe cases, regeneration of the periodontal attachments must be attempted.[8] The first nonsurgical step involves special cleaning called scaling and root planning. Supplemental treatment may include an antiseptic mouth rinse and medication, either to aid the healing process or to further control the bacterial infection. Often, antibiotics may be administered, which may offer an effective alternative to scaling and root planning. Tetracycline or a combination of amoxicillin and metronidazole may be used in order to kill a broad range of bacteria. However, if overused, these agents may not kill the bacteria. Another drawback to antibiotic therapy lies in the difficulty of identifying and targeting a specific pathogen, due to the numerous species residing in the plaque. Surgical treatment along with antibiotic therapy may therefore be beneficial to periodontal disease patients. If the periodontal pockets are not reduced, or if further loss of alveolar bone is observed, then surgical intervention is clearly needed to try to prevent tooth loss [13]

Surgical treatment of periodontal disease by a periodontist consists of removing inflamed tissues to reduce the damage to the alveolar bone around the area of infection. Furthermore, surgery allows dentists to access areas where scaling and root planning cannot remove tartar and plaque. The elimination of bacterial accumulations helps regenerate bone and tissue, to help reduce pockets. Additional procedures, such as bone grafts, target bone regeneration and growth. If the periodontal disease has caused excessive loss of gum tissue, then soft-tissue grafts may be performed to reduce further gum recession and bone loss [14]

The oral cavity is an open system exposed to the environment. Furthermore, the possibilities of foreign material entering the system from the oral cavity are heightened due to the constant intake of food and liquids through the mouth. The presence of the large numbers of bacteria can induce tissue destruction indirectly by activating host defense cells, which in turn, produce and release mediators that stimulate the effectors of connective tissue breakdown. Components of microbial plaque have the capacity to induce an initial infiltrate of inflammatory cells, including lymphocytes, macrophages, and polymorphonuclear leukocytes (PMNs) [15]

The Periodontal Disease Index (PDI)

Objectives of the PDI Index

The following objectives were incorporated into the design of the index:

1. To assess prevalence and severity of gingivitis and Periodontitis within the individual dentitions and in population groups.

2. To provide an accurate basis for incidence and longitudinal studies of periodontal disease.

3. To provide a meaningful basis for estimate of need for periodontal therapy in selected population groups.

4. To provide accurate recordings for clinical trials of preventive and therapeutic procedures in periodontics.

5. To provide measurable reference data for assessment of correlations with factors of potential significance in the etiology of periodontal disease.

LOCAL DRUG DELIVERY SYSTEM

Controlled delivery was first proposed in the treatment of periodontitis by Goodson et al.1979.when compared to a systemic medication regimen, the local route of drug delivery can achieve a higher amount of antibiotics in the infected area. The main requirement for this type of therapy to be effective is that the drug enters the bottom of the infected area and be held there by some mechanism, such as a reservoir, for long enough that the antimicrobial action to occur. These can be used successfully in those individuals for whom the surgery is not an alternative,but they are not suitable for those having known allergyto the antibiotics, asthmatics, and other immunodeficiency diseases. The purpose of local delivery, which comprises a drug carrier and regulating factors that control the release of the drug, and retains effective therapeutic drug level at the area of action [15,16]

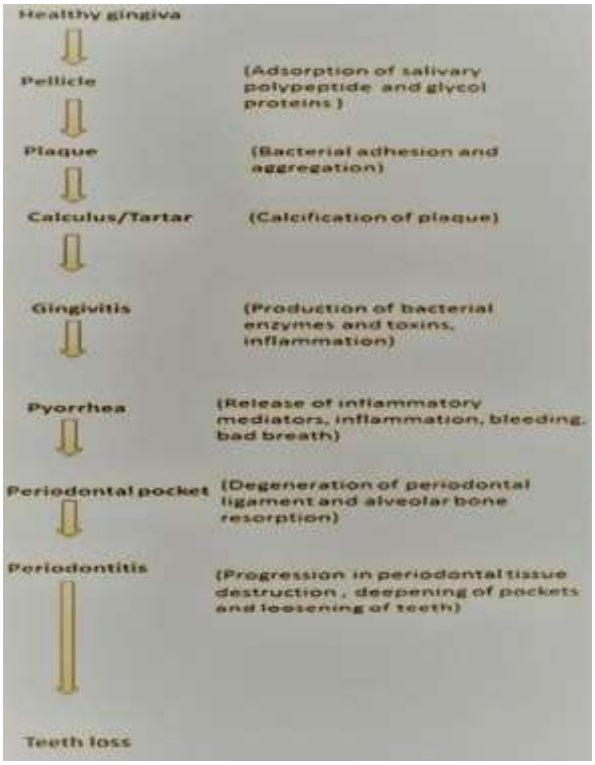

Figure 2: Flow chart shows various phases of periodontal diseases

Use of local delivery systems in dental practices –

1. Scaling and root planning is extremely effective treatment modality for controlling early to moderate periodontitis. Although all sites treated do not respond totally, the majority do. This would then leave a minority of sites requiring more aggressive treatment, which would include locally delivered antimicrobials

2. Recurrent pockets in the periodontal maintenance patient are an excellent place in a dental practice to use any controlled local delivery system.

3. Not all types of inflammatory periodontitis are amenable for controlled local delivery of antimicrobials. When conventional treatment is not totally effective, additional and usually more aggressive treatment is necessary. If after scaling and root planning or scaling and root planning with controlled local delivery there are localized sites that did not respond, controlled local local delivery of antimicrobials may be appropriate.[18]

4. The ailing or failing implant may be an appropriate situation for local delivery of an antimicrobials

.5. Periodontal abscess.

6. In periodontal pockets before regenerative surgery is done.

Ideal characteristics of local drug delivery systems:

1. Inhibit or kill the putative pathogens [18]

2. It should reach the site.

3. Should have adequate concentration.

4. Be there long enough 5. Do no harm

Table 2: Types of risk factor in periodontitis [19,20]

Modifiable risk factor	**Non-modifiable risk factor**
Microorganisms (specific pathogen)	Osteoporosis
Smoking	Some hematological disorders
Poorly controlled diabetes mellitus	History of periodontitis
Stress	Age
Poor self-care	Gender
Untreated human immunodeficiency virus or acquired immunodeficiency syndrome	Race
Oral effects of some metabolism	Genetic disorders
Local factors	Bone level
Obesity	Drug-induced disorders
Improper diet	Some host response
Chronic inflammation	Bone level
Some host responses	Normal hormonal variations (e.g. pregnancy)

Selection of antimicrobials:

The periodontal clinical status, the composition of the periodontopathic microbiota, the patient's medical status, potential adverse drug reactions and possible drug interactions determine the choice of antimicrobial agent6 . Bactericidal rather than bacteriostatic drugs are preferred because their effectiveness is independent of a functioning host defences in the periodontal site. A combination of antibiotics is indicated in patients harbouring several pathogens that, combined, fail to show sensitivity to any single antibiotic. Before any antimicrobial agent can be recommended for periodontal therapy a number of basic and important conditions have to be fulfilled – 1. Drug must show in vitro activity against the organisms considered most important in the etiologic [20,21]

2. It should be demonstrated that a dose sufficient to kill the target organism can be reached within the subgingival environment. 3. At that dose the drug should not have major local or systemic adverse effects. 4. Organisms should not be resistant to the antimicrobial agents. 5. Antibiotic should be specific for periodontal pathogens and not in general use for treatment of other diseases and should be inexpensive. There are two major routes of drug delivery of antibiotics: i) Systemic antibiotic therapy and ii) local drug delivery with its respective advantages and disadvantages. Antimicrobial agent may be delivered by direct placement into the periodontal pocket or via systemic route. Local drug delivery allows the application of antimicrobial agents at levels that cannot be reached by systemic route7 Local drug delivery may be particularly successful if the presence of target organism is confined to clinically visible lesions. On the other hand, systemically administered antibiotics may reach widely distributed microorganisms 6 .Disadvantages of systemic therapy relates to the fact that the drug is dissolved by dispersal over the whole body, and a small portion of the total dose actually reaches the subgingival microflora in the periodontal pocket. Local drug delivery systems are means of drug application to confined areas. For the treatment of periodontal diseases, local ends at levels that cannot be reached by systemic route7. Local drug delivery may be particularly successful if the presence of target organism is confined to clinically visible lesions [21,22]

***In vitro* and *in vivo* models of local drug delivery system**

For evaluating the efficacy of periodontal dosage forms, a variety of approaches have been explored. *In vitro*, *in vivo*, and microbiological models are the most common types of models. The selection of an appropriate *in vitro* model should be done with care to closely imitate *in vivo* behavior. The results of *in vitro*

release for various parameters may be dependable and predetermined. The periodontal pockets serve as a reservoir for intra-pocket fluid, whereas gingival crevicular fluid (GCF) serves as a leaching surface for medication release and dispersionthroughout the pocket. The dissolving profile of drug delivery systems can be influenced by the parameters ofthe GCF, such as pH, volume, flow rate, and composition.In healthy pockets, small amounts of GCF (0.04 mL) and flow rates (0.03 mL/min) were found. It displays similarity with extracellular protein concentrations in terms of protein concentrations. It resembles extracellular fluid in terms of protein concentrations, and it is assumed to reflecta normal extracellular transudate. Inflamed sites producemore fluid and have a higher flow rate than healthy sites. The amount and volume of fluid flow, on the other hand,are determined by the degree of inflammation at each site. Hitting and Ho and Goodson reported volumesof roughly 0.5 mL and flow rates of 0.33 mL/min and 0.33 mL/min, respectively [21]

***In vivo* models**

There are a variety of animals that can and have been used to study the pathology of periodontal diseases and their management. However, because various species do not respond equally or even similarly to humans, the data collected from animal studies may be beneficial or problematic to humans. Furthermore, the results of animal studies can be used as a reference for human application.

Human studies have numerous limitations to analyse the etiologic and treatment methods in human research, such as determining the severity of the disease, individual risk factors, and susceptibility to disease progression, critical investigations must be conducted. As a result, animal models are needed. The human anatomy, as well as the stage of periodontal disease, should be taken into account when using animal models. Nonhuman primates, rats,dogs, ferrets, and hamsters can all be used to research various aspects of periodontal disease and therapy, with some advantages and drawbacks. Some advantages and disadvantages of LDDSs are given below [22,23]

Advantages:

1.Patient acceptance and compliance have improved

2.Direct access to diseases of interest

3.Lower the entire cost of health-care treatment

4.Problems with the gastrointestinal tract can be prevented

5.It has the ability to provide longer-lasting effects

6.It has the potential to improve the drug's therapeutic efficacy

7. It is feasible to apply in a painless and straightforward manner.

Disadvantages:

1. This path is not suited for irritants in the area
2. Because of the narrow region, the dose is limited
3. Peptidase and esterase enzymes may be involved pre-systemic metabolism.
4. Due to peptidase, peptide administration is not possible

Following local drug delivery system are used in Periodontitis[23,24]

1)Film

2)Fiber

3)Injectable system

4)Strip

5)Lipososmes

6)Microparticles

Reason for Tooth Extraction

Severe periodontitis can be localized or generalized. In localized aggressive periodontitis, tissue loss usually begins on the permanent teeth (first molar and incisors), and the disease can proceed to involve adjacent teeth asthe patient becomes older. Most or all of the permanent teeth are affected by the generalized form of aggressive periodontitis[24,25] Secondary clinical symptoms include incisor dentilabial migration with the development oftooth gap, motility of the affected teeth, irritation of theeroded root, profound jaw pain, and parietal abscesslymphadenopathy.[25] The alveolar bone around the teethand the periodontal ligaments are destroyed as a result of this damage. Other dental infections, such as dental caries, the combination of gum diseases, accident damages, orthodontic causes, compromised teeth (e.g., canines and lateral incisors), and unsuccessful therapies, can occur alongside periodontal disease. All of these factors play role in tooth extraction.

The key factors that signal the extraction of periodontally afflicted teeth were tooth motility, detachment of root surface and furcation. Tooth extraction causes major masticatory system difficulties and dysfunction. According to so me prior studies, tooth decay and periodontal infection are the primary causes of tooth removal in avariety of countries, with percentages ranging from 31.8% to 94.4%.[27,28] The alveolar process will undergo atrophy after periodontally affected teeth are extracted. The site's bundle bone will obviously lose its function and eventually disappear. The most significant amount of bone loss occurs in the horizontal dimension, primarily on the ridge's face side. There is also reduction of vertical ridge height,which is particularly noticeable on the buccal aspect, according to reports. After extraction of the infected tooth, the specific dental formulation is used for regeneration of soft tissues, bone formation, and wound healing in the form of bioresorbable dental cones [26]

Dental Cones

They are intended to be gently placed into the empty cavity left behind after the removal of teeth. The primary goal of these dental cones is to inhibit bacterial proliferation or bleeding [27]

There are two types of dental cones available:

1. Dental cones with antibacterial agents.
2. Astringent/coagulants containing dental cones

Dental Cones with antibacterial agents Using a slow-release antibacterial compound, these are utilized to prevent bacteria from multiplying in the socket [28,29]

1. Astringent/coagulants-containing dental cones They serve as a hemostasis, preventing bleeding, and promoting wound healing. It has astringents or coagulants in it, for example, collagen cones sponge [30]

Recent Therapies Used in Periodontitis

There are number of new treatment approaches are used in periodontitis which includes NPs and host modulatory therapy (HMT). NPs are atom clusters that have a range of therapeutic applications, including cancer therapy, medication transport, tissue engineering, regenerative medicine biomolecule detection, and antibacterial agents. Because of its physicochemical and biological features, NPs are gaining popularity in dentistry. NPs are ultra-distributed nanostructures entities with sizes ranging from 10 to 1000 micrometer drugs can be encapsulated, dissolved, trapped, or linked to the structure of NPs, which has potential use in dentistry. To boost fluoride levels, NPs with sufficient amounts of fluoride can be administered in the oral cavity. This application enables for tooth remineralization and prevents the formation of cavities [34,35]

Host Modulatory Therapy

HMT is a therapy approach aimed at reducing tissue death and regulating or even regenerating the periodontium by altering or downregulating destructive parts of the host response while upregulating protective or regenerative processes [36,37]

Uses of HMT:

- To improve therapeutic efficacy
- To allow for more predictable patient treatment and to reduce the advancement of the disease
- They could even act as preventative measures to the development of gum diseases.

Evaluation of Dental Formulations:

Most of the dental formulations of LDDS have some common evaluation parameters which include:

Surface pH

The pH of the surface is thought to be the most important factor in pharmacological action. Because an acidic or basic pH might irritate the gingival surface, the formulation's surface pH was chosen to study any potential adverse effects caused by pH variations *in vivo*. The pH is determined by placing the dental film in a petri-plate containing replicated fluid for 1 h. And after that, the pH of film is measured using the pH meter [38,39]

Swelling Index: - Dental cone were weighed (W1) and allowed to swell on a Petridis in phosphate buffer, pH 6.8 at 37± 0.5°C 10 ml for 30 mins. Then cone was taken out and excess fluid was removed with filter paper. Then the weight (wet weight) of the formulation was taken and recorded. When the weight became constant. (W2), the weight taken was used for calculating the swelling index (S.I) [40,41]

Swelling index was calculated from following equation.

$$\text{Swelling index} = (W2 - W1 / W1) \times 100$$

Where

SI (%) is percent swelling.

W2 is the final swollen cone weight.W1 is the initial weight of the cone.

Drug Content Estimation: - Drug content uniformity was determined by dissolving the dental cone in 10 ml of phosphate buffer (pH 6.8) for 1h under occasional shaking. The 1 ml solution was withdrawn and diluted with phosphate buffer pH 6.8 up to 10 ml, and the resultant solution was filtered through a Whatman filter paper. The drug content was then determined after appropriate dilution at 208 nm using a UV spectrophotometer (Shimadzu, 1800, Japan) [34,35]

In vitro Drug Release: The pH of gingival fluid varies from 6.5 – 6.8, so 6.8 phosphate buffer is used as simulated gingival fluid. In addition, because the dental cones should be immobile in the periodontal pocket, and in oral cavity there is a continuous flow of saliva is occurred. So, to maintain the flow a peristaltic dissolution model is adopted for in vitro drug releases studies. This method is closely related to flow through method USP 4 apparatus operated in open-loop mode is capable of maintaining a continuous flow of fresh dissolution medium Ph 6.8, thus, maintaining infinite sink conditions.[45,] By peristaltic pump the dissolution fluid is flow at 4ml/mins, $37^0.5^0$C directly on dental cone which are placed on glass slide in beaker. Samples were taken at predetermined intervals, filtered, and analyzed by UV

Conclusion

Local drug administration into the periodontal pockets can enhance dental health according to existing data. The limitations of the systemic use of antibacterial for periodontitis, where the antibiotic is reduced several times before reaching the site of action, can thus be solvedby LDDS. The dental formulations, their advantages and evaluations, and the use of dental cones containing antimicrobial and biodegradable

polymers in the treatment of dental bone regeneration, alveolar ridge preservation, soft-tissue healing, and periodontal diseases are discussedin this review.

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