

Drug delivery systems for periodontitis



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2.0 LITERATURE SURVEY

2.1 TECHNIQUE

Periodontitis, a disease involving supportive structures of the teeth prevails in all groups, ethnicities, races and both genders. It is a localised inflammatory response caused by bacterial infection of a periodontal pocket associated with subgingival plaque. Periodontal diseases include conditions such as chronic periodontitis, aggressive periodontitis and necrotizing periodontitis. Aggressive forms of periodontitis can be localized or generalized. Antibacterial agents have been used effectively in the management of periodontal infection. The effectiveness of mechanical debridement of plaque and repeated topical and systemic administration of antibacterial agents are limited due to the lack of accessibility to periodontopathic organisms in the periodontal pocket. Systemic administration of drugs leads to therapeutic concentrations at the site of infection, but for short periods of time, forcing repeated dosing for longer periods. Local delivery of antimicrobials has been investigated for the possibility of overcoming the limitations of conventional therapy. The use of sustained release formulations to deliver antibacterials to the site of infection (periodontal pocket) is gaining interest. These products provide a long-term, effective treatment at the site of infection at much smaller doses. (Kaplish *et al.* 2013)

Formulation and development of a gel based topical dosage form for antimicrobial drug will be proved to be worthwhile like ability to deliver drug more selectively to a specific site, avoidance of gastro-intestinal incompatibility, providing utilization of drugs with short biological half-life,

improving physiological and pharmacological response and provide suitability for self medication. (Basavaraj *et al.* 2012)

2. 1. 1 Periodontal Local Drug Delivery

Goodson *et al* in 1979 first proposed the concept of controlled delivery in the treatment of periodontitis. The effectiveness of this form of therapy is that, it reaches the base of periodontal pocket and is maintained for an adequate time for the anti-microbial effect to occur. These delivery systems are also called sustained release, controlled-release, prolonged release, timed release, slow release, sustained action, prolonged action or extended action. There are distinct phases in a periodontal treatment plan where a dental practitioner can use this sustained release device.

They are as follows:

- As an adjunct to Scaling and Root planning.
- Periodontal maintenance therapy: Recurrent periodontitis usually involves only a few teeth. These sites are ideal for the treatment with this device.
- For whom surgery is not an option or those who refuse surgical treatment
- Sustained release device is a less invasive treatment option and it requires less time compared to surgical treatment. (Kaplish *et al.* 2013)

2. 1. 1. 1 Types of local drug delivery devices

1. Sustained released devices –These are delivery systems whose action lasts less than 24 hours therefore require multiple applications. It follows the first order kinetics.
2. Controlled delivery devices –These are the devices which follows zero order kinetics and whose actions last longer than 24 hours, thereby decreasing the number applications. (Greenstein *et al.* 2000)

2. 1. 1. 2 Advantages of local drug delivery system

- Provides drug in an effective concentration that can be maintained there long enough for the desired effect to be accomplished without causing any side effect.
- It can attain upto 100 fold higher concentration of an antimicrobial agent in subgingival site compared with a systemic therapy.
- Broad spectrum antibiotics which cannot be employed systemically because of many sideeffects can be safely employed locally with minimum side effects.
- Superinfection and drug resistance are rare. It also reduces the risk of developing drug resistant microbial populations at non oral body sites.
- The potentials of daily drug placement into periodontal pockets as a part of home self care procedure can be performed by a compliant patient.
- This route may employ antimicrobial agents not suitable for systemic administration such as various broad spectrum antiseptics solutions. e. g.- chlorhexidine
- Improve the patient compliance. (Slots *et al.* 1996 and Chadha *et al.* 2012)

2. 1. 1. 3 Disadvantages of local delivery system

- Inaccessible and deeper pocket areas, furcations cannot be completely dealt with antimicrobial agents.
- Time consuming and laborious, if many sites are involved.
- Non-sustained local delivery is limited by an only brief exposure of targeted microorganisms to applied antimicrobial agent.
- Connective tissue associated plaque and extra pocket oral surfaces don't get affected by local drug delivery which may be responsible for recurrence of disease in treated areas.
- Difficulty in placing therapeutic concentration of antimicrobial agent into deeper parts of periodontal pockets and furcations lesions.
- Personal application of antimicrobial agents by patients as a part of their home self-care procedure is frequently compromised by the patient's lack of adequate manual dexterity, limited understanding of periodontal anatomy and poor compliance and performance with recommended procedures. (Axelsson 1999)

2. 1. 1. 4 Local drug delivery systems for treating periodontitis

Various local drug delivery system for treating periodontitis-Fibers, Film, Injectable systems, Gels, Strips and compacts, Vesicular systems, Microparticle system, Nanoparticle system etc.

- Injectable drug delivery systems

Injectable systems are particularly attractive for the delivery of antibiotic agents into the periodontal pocket. The application can be easily and rapidly carried out, without pain, by using a syringe. Thus, the cost of the therapy is

considerably reduced compared to devices that need time to be placed and secured. Moreover, an injectable delivery system should be able to fill the pocket, thus reaching a large proportion of pathogens. Two types of injectable drug delivery systems have been studied in periodontal diseases- biodegradable (1) microparticles and (2) gels. (Kaplish *et al.* 2013)

1. Microparticles /Microspheres

These are controlled release drug delivery system which comprises of drug-containing microparticles or microspheres, between 10 and 500 microns in size, suspended in a pharmaceutically acceptable carrier medium, and are capable of

maintaining an effective level of drug in the periodontal pocket for a period of one to thirty days. They are spherical free flowing particles consisting of proteins or synthetic polymers. Non-biodegradable as well as biodegradable materials have been investigated for the preparation of microspheres.

There are two types of microspheres;

a) Microcapsules.

b) Micromatrices.

In microcapsules entrapped substance is distinctly surrounded by distinct capsule wall and in micromatrices entrapped substance is dispersing throughout the microspheres matrix. Solid biodegradable microspheres incorporating a drug dispersed or dissolved through particle matrix have the potential for the controlled release of drug. They are made from polymeric,

waxy, or other protective materials (i. e. biodegradable synthetic polymers and modified natural products). (Chaudhari *et al.* 2010)

Advantages of microspheres

- Constant and prolonged therapeutic effect.
- Reduction in dosing frequency and thereby improve the patient compliance.
- They could be injected into the body due to the spherical shape and smaller size.
- Better drug utilization will improve the bioavailability and reduce the incidence or intensity of adverse effects.
- Microsphere morphology allows a controllable variability in degradation and drug release.