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REVIEW ARTICLE

ANIMAL MODELS AND ITS ROLE IN THE STUDY OF PERIODONTAL DISEASES

***Dr. Shashwati Paul and Dr. Kalpajyoti Bhattacharjee**

Silchar, Assam, India

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ABSTRACT

Animal models have contributed new data and findings in medical sciences, including periodontology. Selection of the ideal animal model depends on the similarity of the periodontium and the disease condition to that of humans. There is no single model which can represent periodontal tissues exactly similar to humans. The most common animal models used are dogs and non-human primates, although other animals (rats, mice, hamsters, rabbits, miniature pigs, ferrets, and sheep) have also been frequently used. Dog models have contributed significantly to the current understanding of periodontology. In this review, we have highlighted few important aspects of animal models with a brief description of models used in periodontology.

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INTRODUCTION

Periodontitis is an inflammatory disease of the periodontium, which gradually affects all the dental supporting tissues. The aim of periodontal treatment should be to regenerate the periodontal tissue by usage of both non surgical and surgical techniques, biomaterials for guided tissue regeneration, bone replacement grafts, growth factors (e.g. enamel matrix derivatives) or, as more recently proposed, mesenchymal stem cells (Tobita *et al*., 2008). Research in periodontology involves various methodologies, principally the research in the etiology of diseases of periodontium using experimental models of periodontitis, and the regeneration of lost periodontal tissues by surgically creating experimental bone defects along with experimental periodontitis. Animal models have been used greatly to the generation of new knowledge in the etiology and treatment of periodontal diseases (Li *et al.,* 1996).

Animal models used in periodontal research

It is now well established that periodontitis is triggered by pathogenic microbial communities forming on subgingival tooth surfaces while the host response is responsible for the tissue damage in periodontitis. Moreover, systemic conditions have an impact on periodontal disease by affecting pathologic mechanisms and host immune status (Lalla and Papapanou, 2011; Darveau, 2010).

Corresponding author:* **Dr. Shashwati Paul,
Silchar, Assam, India.

Animal studies have greatly contributed to these critical principles which have been reproduced across several different animal species models.

Dogs

Many experimental studies on gingival and periodontal diseases have been conducted in dogs. The beagle is one of the most commonly used due to its size and its extremely cooperative temperament. Globally, all periodontal tissues and the size of the teeth are quite similar to those observed in humans. However, some major differences exist between dogs and humans as the lack of lateral movements, no occlusal contacts for all the premolars and presence of open contacts between teeth (Sorensen *et al.,* 1980).

Non-Human Primates

Nonhuman primates have oral structures and teeth similar to those of humans and have naturally occurring dental plaque, calculus, oral microbial pathogens, and periodontal disease. In particular, rhesus monkeys *(Macaca mulatta),* cynomolgus monkeys *(Macaca fascicularis)*, and baboons *(Papio anubis)* are susceptible to naturally occurring periodontal disease (Schou *et al.,* 1993). Although periodontitis in primates most closely resembles the human disease, the expense of and special husbandry requirements for these animals limit their use in periodontal studies.

Rats

The rat is the most extensively-studied rodent for the pathogenesis of periodontal diseases.

Typical rodent dentition is I 1/1, C 0/0, Pm 0/0, M 3/3. The incisor is rootless.The structure of the dental gingival area in rats is quite similar to that observed in humans (Yamasaki *et al.,* 1979), with a shallow gingival sulcus and attachment of the junctional epithelium to the tooth surface.

Ferrets

Ferrets have a deciduous and permanent dentition. The formula is I 2/2, C 1/1, Pm 4/4, M 2/2. Ligature-induced periodontitis was obtained within 4 weeks (Harper *et al.,* 1990).

Other species

Other animal models have also been investigated for modelling periodontal diseases. Minks, Hamsters, Mice, Sheep, Miniature pigs, Rabbits are other models which have also been used for studies in periodontology (Oortgiesen *et al.,* 2010).

DISCUSSION

Non Human Primates have similar dental structure, microflora, and disease to humans, either natural or experimentally induced periodontitis. But they are very expensive, with ethical and husbandry issues. Dogs develop natural or experimental periodontitis similar to humans but are relatively expensive, need special daily care, husbandry issues and dentition is different from humans. Ferrets exhibit naturally or experimentally induced disease with similarity to humans but some husbandry issues. Rodents can be used to induce experimentally induced disease (Oortgiesen *et al.,* 2010). They are inexpensive and have similar molar structure to humans. They are naturally resistant to periodontitis and their microbiota is different from humans. Due to their small size, large number of animals is needed for the required amount of tissue for analysis. In case of Minipig, dental structure and periodontitis have some similarity to humans (Wang *et al.,* 2007). Again, these are relatively expensive, with husbandry issues and thus relatively fewer studies (Bhardwaj and Bhardwaj, 2012).

Conclusion

Experimental models for periodontal diseases are essential for understanding the origin and evolution of the pathology in humans.

The use of animal models in periodontal research is a necessary step prior to entering into clinical trials with new biomaterials and treatments.

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