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REVIEW ARTICLE

NON-HUMAN PRIMATES AS RESEARCH MODELS IN THE FIELD OF PERIODONTICS: A REVIEW

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ABSTRACT

This review article emphasizes the role of non-human primates in periodontal research. It has been used widely to investigate the pathogenesis of periodontal disease and various treatment modalities like regenerative procedure, bone grafts, LASER, micro surgery, GTR, osseous surgeries, implant surgical procedure. The close phylogenetic relation of non-human primates to humans have opened a way to test the potential of new drugs and treatment procedures.

INTRODUCTION

Animal models are used for studying human biology and disease. They are also used as test subjects for the development and testing of drugs, vaccines, and other biologicals (i.e. antibodies, hormones, ingredients in vaccines, etc.) to improve and advance human health (Ashwini Ashok Apine, 2014). The use of animal models on periodontal research has been extensively used for more than a century to understand the pathogenesis of disease and to assess the success of various treatment modalities. In the field of periodontology it was Talbott in 1899 who described periodontitis in mongrel dogs (ShaluChandna, 2011). These data provide us the models of biologic trends before proceeding to human application (ShaluChandna, 2011). Experimental studies conducted in non human primates (NHP) are highly relevant for human clinical practice. They are phylogenetically similar, anatomically comparable and develops similar periodontal disease with similar clinical symptoms (Ebersole, 1999). Human longitudinal studies of periodontal diseases pose many problems such as determining the level of disease activity, individuals at risk and susceptibility to disease progression. In relatively new era of periodontics like regenerative procedure, bone grafts, LASER, micro surgery, GTR, osseous surgeries, implant surgical procedure have shown promising results in animal studies.

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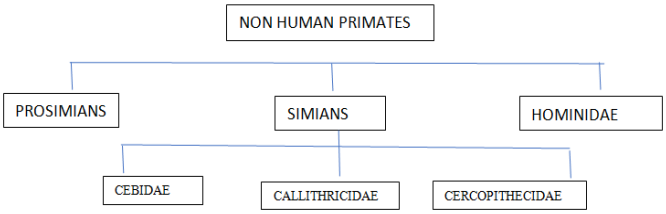
Major disadvantage of NHP is that they are expensive to obtain and house, hard to handle and may be infectious (ShaluChandna, 2011). This review article focuses on the relevancy of various NHP models used in periodontal health and disease.

General Characterstics of NHP

Criteria for Selection of a NHP

Periodontitis causesdestruction of tooth supporting structures due to inflammation induced by bacterial plaque. The treatment includes both mechanicaland chemical means which will reduce or eliminate the disease (Polson, 1986).

Classification



Source and Considerations of Non-Human Primates

Acquiring laboratory primates has evolved significantly over several decades. In the olden days importation was the method

largely used to meet the needs of the research community. As countries adopted more rigid regulations and prohibition on exportation of certain species, it was necessary to meet the problem of supplying enough animals in ways that did not threaten their future existence (Louis, 2001). It is of great importance to select an appropriate animal species that is specific for the study. The experimental animals must meet several rather stringent requirements like dental apparatus analogous to that of man (Barnet, 1971).

disease. These animals exhibit very limited numbers of lymphocytes and plasma cells (Shalu Chandna, 2011). According to weight, size of dentition, number of each tooth type, and food, the characteristics range fromvery similar to human to vastly different (Soren Schou, 1993). Apart from these factors, the unknown medical history of the animal and the risks to animal handlers for the communicable disease have to been considered. Age is considered to be an important factor.

Prosimians:	Weight	Dental Component	
Bushbaby (Galago Senegalensis	200-250 g.	I2/2, Cl/1, Pm3/3, M3/3	Spontaneously occurring periodontal disease characterized histologically by lymphocytes and plasma cells
SIMIANS			
Cebidae:			
Howler monkey (Alloutacarayá)	Male: maximum 10 kg; female: maximum 6.5 kg	I2/2, Cl/1, Pm3/3, M3/3	Spontaneously occurring periodontal disease characterized histologically by lymph
Squirrel monkey (Saimirísciureus)	750-1100 g	I2/2, Cl/1, Pm3/3, M3/3	Experimental Periodontitis characterized histologically by predominance of PMNs and macrophages
Callithricidae:			
Cotton-ear marmoset (Callithrix jacchus)	250-500 g	I2/2, Cl/1, Pm3/3, M2/2	Spontaneously occurring periodontal disease characterized clinically by marked gingival telangiectasia and histologically by predominance of macrophages
Cotton-top marmoset (Saguinusoedipus)	250-500 g	I2/2, Cl/1, Pm3/3, M2/2	Spontaneously occurring periodontal disease characterized clinically by marked gingival telangiectasia and histologically by predominance of macrophages
Cercopithecidae:			
Baboon (Papioanubis)	Male: 22-30 kg; female: 11-15 kg	I2/2, Cl/1, Pm2/2, M3/3	Spontaneously occurring periodontal disease characterized histologically by lymphocytes and plasma cells
Rhesus monkey (Macacamulatta)	Male: 5.6-12 kg; female: 4.4-10.7 kg	I2/2, Cl/1, Pm2/2, M3/3	Spontaneously occurring periodontal disease characterized histologically by lymphocytes and plasma cells
Cynomolgus monkey (Macacafascicularis)	Male: 3.5-8.3 kg; female: 2.5-5.7 kg	I2/2, Cl/1, Pm2/2, M3/3	Spontaneously occurring and experimental periodontal disease characterized histologically by lymphocytes and plasma cells. High carrier rate of A. actinomycetemcomitans and low carrier rate of Actinomyces species compared to humans
Stump-tailed monkey (Macacaarctoides)	Male: < 13 kg	I2/2, Cl/1, Pm2/2, M3/3	A catalase-producing Prevotellamelaninogenica strain has been identified during experimental Periodontitis
Pig-tailed monkey (Macacanemestrína)	Male: < 13 kg	I2/2, Cl/1, Pm2/2, M3/3	
Hominidae			
Chimpanzee (Pan troglodytes)	Male: 45-60 kg; female: 35-45 kg	I2/2, Cl/1, Pm2/2, M3/3	Spontaneously occurring periodontal disease characterized histologically by lymphocytes and plasma cells
Mountain gorilla (Gorilla gorillaberingei)	Male: 135-275 kg; female: 70-140 kg	I2/2, Cl/1, Pm2/2, M3/3	

Common Charectersticts of Non Human Primates

In the research field a special consideration has been given towards NHPS as they show a high genetic resemblance to humans and thus scientists strive to achieve the greatest human benefit withminimal cost to the animals (Barnet, 1971). Most Old-World monkeys are large, expensive, and difficult to handle, and they require considerable space for housing and maintenance (Barnet, 1971). Most of the NHPs used previously in research were wild animals captured from their natural habitats (Soren Schou, 1993). Some of the species of NHPs like squirrel monkeys and marmosets are small in size and relatively easy to handle, but unfortunately,they do not exhibit an inflammatory characteristic of human periodontal

As certain studies have reported sever attrition in older animals compared to young ones (Soren Schou, 1993). The small oral cavities of several NHPs necessitate selection of special examination methods.As the evolution progress from Prosimians to Hominidae there tooth morphology, occlusion and gingiva resembles more towards the homo sapiens (Soren Schou, 1993).

Howler Monkeys (Allotacarayu): It is a small new world monkey native to the jungles of northern Argentina. The normal periodontium of the howler monkey is remarkably similar to that of man. Major differences appear to be the large canines, the presence of diastema between anterior teeth and the presence of three premolars. An exaggerated interdental

"col" is a characteristic of the howler as well as of other monkeys. Microscopically, the normal howler periodontium was similar in many respects to that of humans. The epithelium of the attached gingiva was ten to twenty cells in thickness, displayed prominent rete peg formation and was parakeratotic for the most part, with only occasional areas being orthokeratinized (Hall, 1967).

Squirrel Monkey (Saimiriscioureus): a good in vivo model in the study of subgingival colonization for periodontopathogens like porphyromonas, prevotellas andin study of development and progression of periodontal diseases. Several studies have shown the histologic changes occurring following the placement of silk sutures around the teeth of these animals. The ease of handling and low maintenance costs makes this non human primate the practical model for the study of the bacterial etiology of periodontal disease (Beem, 1991).

Marmosets: These are small South American primates with a periodontal apparatus anatomically similar to that of man. They are small in size. The major disadvantage is they don't exhibit an inflammatory profile characteristic of human periodontal disease (ShaluChandna, 2011). Dreizen etal in 1967 have described about the effects of experimentally induced vitamin D deficiency on periodontal structures. It was denoted by ligamental hemorrhages, ligamental edema, replacement of dense collagen fiber bundles by isolated fibers and fibrils, loss and change in the tinctorial characteristics of the attachment fibers and loosening of the teeth. These findings suggest that the major periodontal aberration invoked by the deficiency state was a breakdown in collagen synthesis (Samuel, 1969).

Baboon (genus Papio): A member of the family Cercopithecidae that has been seldom used for periodontal research. The large oral cavity with similar dental formula with humans and identical radiographic appearance in dentitions make them the good candidate for research activities. In 1971 Hodosh *et al* concluded that baboonsdevelops only gingivitis not periodontitis, by evaluating 40 young baboons in his study (Milton Hodosh, 1971).

Rhesus: Rhesus monkey is a good choice for periodontal studies because of its resemblance in dentition, periodontal structures, oral flora, and masticatory function. Secondly, thoroughly epithelialized, nonregressive, suprabony pockets with pathologic (rather than surgical) horizontal bone loss can be induced easily (Raymon, 1976). It has been used in various studies like shigella associated periodontitis (Raymon, 1976), other regenerative procedures (Sigurd Ramfjord, 1951), attachment procedures (Raymon, 1976) and to evaluate the bone formation (Li, 1996).

Cynomolgus: Silk ligatures were placed around posterior teeth and the shift from gingivitis to periodontitis was followed radiographically and bacteriologically for eight and nine weeks, respectively (Brecx, 1985). The similarity in plaque microbial composition with humans made cyanomogalus monkey a useful model for both dental caries and periodontal disease studies. The clinical and radiographic appearance of this disease is identical to that seen in humans, and the subgingival microflora in M. arctoides (Slots and Hausmann 1979) and in M. fascicularis (Kornman *et al*. 1981) have been shown to closely resemble that of humans (Brecx, 1985).

Mountain Gorilla: Enamel wear in the permanent posterior dentition is moderate. Six periapical abscesses were seen; three are associated with antemortem tooth breakage. No carious lesions were observed. Pronounced calculus buildup and alveolar resorption are the most notable pathological conditions of the dentition and affect all adult animals (Brecx, 1990).

Conclusion

The summary of this current article includes: The non-human primates can manifest a clinically healthy gingiva or a diseased periodontium either as gingivitis or periodontitis. The close anatomic and biologic similarities of non human primates makes them the best animal models in periodontics. NHPs are used widely in periodontal research like investigating the pathogenesis of periodontal disease, in dental implant studies, and other regenerative and surgical procedures.

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