

Periodontal Diseases in Pet Animals

Elif Dogan, Zafer Okumus and Latif Emrah Yanmaz
Department of Surgery, Faculty of Veterinary Medicine,
Atatürk University, Erzurum 25700, Turkey

Abstract: Periodontal disease is an inflammation of periodontal tissues that include gingiva, cementum, alveolar bone and periodontal ligament. They occur mostly in dogs and cats mainly due to a lack of oral hygiene. Therefore, care must be taken to minimize occurrence of these problems. Since periodontal diseases can occur as a complex in 4 stages, clinical symptoms should be carefully evaluated for effective treatment. This review study provides extensive information on etiology, epidemiology, treatment and prognosis of periodontal diseases in pet animals.

Key words: Periodontal disease, veterinary medicine, pet animals

INTRODUCTION

Periodontal disease is commonly seen in pets. Disease begins with inflammation of gingiva and may advance into deep tissues including alveolar bone and periodontal ligament. At this level, periodontal disease can be incurable. Thus, early diagnosis is important for treatment and prognosis of the periodontal diseases. The objective of this study is to present current literature and approaches for treatment and management of the periodontal disease in pet animals.

ANATOMY OF TEETH

To elucidate mechanisms by which periodontal diseases occur, anatomical structure of teeth should be reviewed. Tooth consists of several tissues (Veterinary Density Basics, 2006) (Fig.1). The crown is encased in enamel and root in cementum. Each tooth has one root, however, premolar and molar teeth may have more than one root. Area between 2 roots is called bifurcation. This therefore may be trifurcation for premolar and molar teeth. *Lamina dura*, a tissue covering the root is visible in only health tooth and disappears in periodontal diseases, which may ease the diagnosis. Tooth contains the hardest mineralized tissue in the body, called enamel. Enamel is packed with hydroxyapatite crystal and heavily mineralized with calcium salts. Tissue resides under enamel is known as dentine. Pulp present in teeth includes blood vessels, lymphatics and nerves.

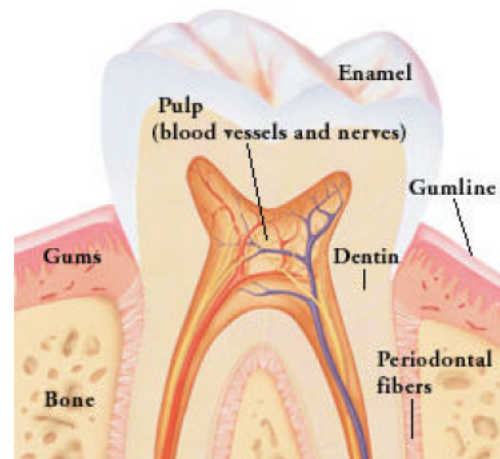


Fig. 1: Macroanatomy of tooth

STRUCTURES FORMING PERIODONTAL TISSUE

Periodontal tissue consists of four layers: gingiva, cementum, alveolar bone and periodontal ligament (Veterinary Density Basics, 2006).

Gingiva: When mouth is opened, gingiva is normally seen because it surrounds teeth's periphery. Gingiva can be evaluated in 2 parts:

Attached gingiva: Because attached gingiva is expose to stress of remaining pieces of foods, is keratinous. It is tightly tied area under the connective tissue.

Free gingiva: Free gingiva covers teeth's periphery and finishes like pyramid.

Cementum: Cementum covers dentine of tooth. Histologically, we know that it is similar to bone. It is thicker than crown.

Alveolar bone: The roots are buried in alveolus. Most intensive bone is alveolus and this is sometimes determined as a white line in radiography. This structure is called *Lamina dura*. If periodontal disease is absent, *Lamina dura* will be seen continuously.

Periodontal ligament: This is one of the periodontal structures, which contain collagen fiber. It includes pain fibers and highly vascularized.

Some other areas significant in periodontal disease are as follow (Veterinary Density Basics, 2006):

Mucogingival Junction (MGJ): MGJ is line between oral mucosa and attached gingiva. Changes in its position may sign periodontal disease.

Gingival sulcus: It is canal between free gingiva and surface of tooth. This sulcus includes crevicular fluid. Normally, its depth is 0.5-1 mm in cats and 0.5- 3 mm in dogs.

Junctional Epithelium (JE): JE has protective role and it is located under remaining tissues. Cleavage may occur in some regions of junctional epithelium in the disease.

Cemento-Enamel Junction (CEJ): This is a line separating cementum and enamel. Also, it is settled apically at the extent of the junctional epithelium.

PERIODONTAL DISEASE

Because it adversely affects health and life quality, periodontal disease is very important. Commonly, disease is seen cats and dogs (Veterinary Density Basics, 2006). It is defined as inflammation of the deep structures and begins when wholeness of gingival sulcus is cleavage and plaque is accumulated on surface of teeth (Cecilia, 2003). Small breed dogs and dogs older than 3 years are more to the disease. According to the recent study (Pavlica *et al.*, 2003), incidence and severity of this problem is increases with aging. Moreover, superior and inferior premolar tooth of cats are more affect than other teeth (Samsar *et al.*, 2003). Unless periodontal disease is prevented, causing bacteria may reach other tissues (liver, kidney etc.) via circulation (Periodontal Disease, 2006).

ETIOLOGY

The primary cause of disease is plaque accumulation on surface of tooth (Cecilia, 2004). Plaque is composed of oral debris, bacteria and by-their products and inflammatory cells. Plaque can placed subgingivally and supragingivally. Subgingival plaque irritate gingival. Diet is also responsible for occurrence of periodontal diseases (Cecilia, 2004). In general, softer diets increase the likelihood. Directly or indirectly, several bacteria also play a role in etiology of the periodontal diseases (Cecilia, 2004). These bacteria are *Streptococcus sanguis*, *Actinomyches viscosus*, *Porphyromonas gingivalis*, *Prevotella sp.*, *Bacterioides sp.*, and *Fusobacterium sp.*. Some bacteria are specific to dogs and include *Porphyromonas salivosa*, *Porphyromonas denticanis* and *Porphyromonas gulae* (Veterinary Periodontal Disease, 2006). Moreover, *Reptostreptococcus sp.* is specific to cats (Samsar *et al.*, 2003).

Factors predisposing to periodontal disease

Age and general health status: Periodontal disease more affects older animals than young animals.

Diet and chewing behavior: Plaque formation more excessive in animal fed soft diet. Dogs remove some of the plaque with chewing toy.

Breed, genetic and tooth alignment: Periodontal disease more common in small breed because mechanic cleaning is hindered. Also, brachycephalic dogs, Maltese terriers, Schnauser and Greyhound dogs as well as Abyssinian and Somali cats are more susceptible to disease.

Mouth environment: Dogs that open mouth to breathe are more prone to the disease (Veterinary Periodontal Disease, 2006).

Other factors contributing to periodontal disease: Structures or agents existing depending on etiological factors may also contribute to pathogenesis of the periodontal diseases. Broadly, it follows sequence given below.

Plaque accumulation: Initially, a layer called pellicle on surface of teeth forms. Pellicle comprises of glycoproteins and salivary proteins. Namely, *Streptococcus sanguis* and *Actinomyches viscosus* adhere on pellicle and these bacteria produce extracellular polysaccharides. Thus, other bacteria adhere on pellicle and plaque forms within 6 -8 h (Veterinary Periodontal Disease, 2006). Unless plaque is removed, the mineral salts precipice and form calculus. Calculus irritates gingival tissue (Cecilia, 2004).

Depth of sulcus: During disease, spirochetes and anaerobic microflora increase in subgingival area. The junctional epithelium participates in inflammation and sulcus depth increases. Tissues swell because of edema (Veterinary Periodontal Disease, 2006).

Plaque accumulation in subgingival area: Because the junctional epithelium swells and sulcus depth increases, plaque in supragingival area advances to subgingival area (Veterinary Periodontal Disease, 2006).

Toxins: Microbes accumulating on surface of teeth (*P. gingivalis*, *B. asacharolyticus*, *F. nucleatum*, *A. viscosus* and *A. odontolyticus*) produce metabolic products such as hydrogen sulfide, ammonia, endotoxin, hyaluronidase, chondroitin sulfatase, mucopeptides, lipoteichoic acids, acetate, butyrate, isovalerate and propionate (Veterinary Periodontal Disease, 2006). These products accelerate tissue destruction and lead to attachment loss (Periodontal Disease, 2006).

Attachment loss: Because tissue destruction is very rapid, connection of teeth breaks off (Veterinary Periodontal Disease, 2006).

Tooth loss: Because of destruction, the junctional epithelium becomes distant and apart on surface of tooth. Debris fills up this cavity and microbes grow. When microbes advance 0.5 mm, osteoclastic resorption begins and results in tooth loss (Veterinary Periodontal Disease, 2006). Tooth loss occurs in the order of incisors, premolar and canine teeth in cats (Samsar *et al.*, 2003).

Periodontal diseases may also occur as a complication of other diseases including oronasal fistula, spontaneous fractures and osteomyelitis.

Oronasal fistula: It is common in old and small breed dogs. If periodontal disease occurs palatal surface of maxillary canine teeth, fistula may form. Periodontal disease damages bone structure between roots and nasal cavity. Debris gets into this space. Thus, nasal flow, sneeze, sometimes anorexia and bad breath occur.

Spontaneous fractures: Bones weakness due to periodontal disease may result in fractures, especially during eating.

Osteomyelitis: Dental diseases are significant in etiology of oral osteomyelitis (Gabriel, 2003).

PATHOGENESIS

Periodontal disease develops in four major steps. These are as follow:

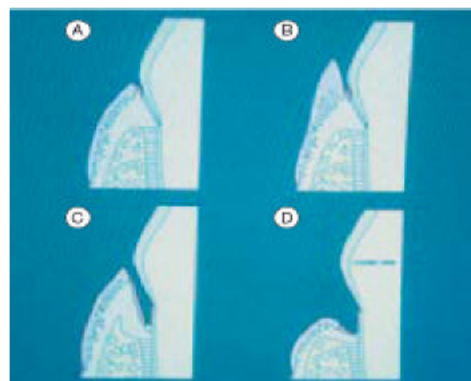


Fig. 2: Pathogenesis of periodontal disease (Cecilia, 2004). A. Gingivitis: It is inflammation of gingival and reversible. B. Gingival hyperplasia: If gingival hyperplasia occurs, periodontal probing depths are increase. This may be idiopathic or familiar origin. C. Periodontitis with vertical bone loss: Alveolar bone is destructed vertically. D. Periodontitis with horizontal bone loss: Alveolar bone is destructed horizontally

Stage 1: First stage is called gingivitis. In this stage, there is no attachment loss. Gingivitis is associated with bleeding, plaque and calculus on teeth, edema and inflammation. In some cases, pseudopockets may be formed. Failure to treat may lead to second stage (Sandra, 2001).

Stage 2: Second stage is called periodontitis and is characterized by an attachment loss up to 25%. Horizontal bone loss precedes vertical bone loss. Plaque and calculus are progressed onto root. Sulcus is deepened because of exposure to bacteria resulting from attachment loss. Consequently, this tissue recedes (Sandra, 2001).

Stage 3: There is attachment loss from 25-50%. Probing depths may not increase because of gingival recession. However, severe inflammation is present in all tissue. Tooth strength in the root is weakened (Sandra, 2001).

Stage 4: Attachment loss is more than 50%. Infrabony pockets may occur. There is severe inflammation, plaque and calculus accumulation and loss of all tissue (Sandra, 2001).

Consequences of all these steps including gingivitis, gingival hyperplasia, periodontitis with vertical bone loss and periodontitis with horizontal bone loss are shown in Fig. 2 (Cecilia, 2004).

SYMPTOMS

Symptoms of the periodontal diseases change depending upon its severity and stage (Periodontal Disease, 2006; Canina Periodontal Disease, 2006).

Stage 1: Inflammation, bad breath, drooling, red gums, easily bleeding, receding gumline (gingival recession), being reluctant to eat and plaque and calculus formation.

Stage 2: Bad breath, bleeding gums, receding gumline, mucous membrane ulceration, motile tooth, subgingival calculus, rocket formation and alveolar bone loss.

Stages 3 and 4: Drooling saliva may be tinged with blood. Other signs are inability to close mouth, abscesses, pus, pain, stomach and intestinal upsets, irritability or depression, pawing at the mouth and occasional oronasal fistula.

Pockets occurring in periodontal diseases influence decision making for treatment and prognosis. These are as follow:

Supra-bony pocket: Extent of forming pocket does not reach alveolar bone because it is limited by soft tissue.

Infra-bony pocket: Forming pocket reaches crestal alveolar bone. This will be below and within bone. This status can be determined by radiography.

Pseudopocket: If gingiva is hyperplastic, sulcus depth will increase. Predisposed breeds are Dalmatians, Collies, Dobermans, Setter and Boxer. Some drugs such as epanutin may cause hyperplastic gingiva (Veterinary Periodontal Disease, 2006).

DIAGNOSIS AND TREATMENT

The diagnosis is made by clinical examination and radiography. Sixty percent of cases, the inflammation is under gingival margin. Also, probing and measurement of attachment loss are made during diagnosis.

Periodontal probing: A probe marked in millimeter gradations is inserted in gingival sulcus or pocket. Probing is made in different points surrounding tooth. Probing depths of all teeth are noted. Normally probing depths ranges from 1 to 3 mm in dogs and from 0.5 to 1 mm in cats (Periodontal Disease, 2000). According to Rubach and Mitchell probing depths can be categorized into four levels groups: A, >0-2 mm; B, 3-5 mm; C, 6-8 mm; and D, >8 mm.

Measurement of attachment loss: Distance between CEJ and apical extent of pocket are appraised to measure of attachment loss. Even if distance is short, this is abnormal. Attachment loss can be measured with a periodontal probe (Periodontal Disease, 2006).

Radiography: There is no finding of radiography at stage 1. When the periodontal disease advances more, destruction of alveolar bone becomes more apparent in radiography. Loss of alveolar bone may be oblique, vertical or horizontal (Pavlica *et al.*, 2003).

Treatment is necessary to prevent tissue loss and tooth loss. Treatment strategy covers supragingival and subgingival scaling, root planning, subgingival curettage, polishing, irrigation, oronasal fistula repair, antibiotic therapy, periosteal care, home care, exodontia and periodontal surgery (Sandra, 2001). According to the stage of illness, treatment approaches focus on Polishing and home care (stage 1), scaling, root planning and polishing (stage 2), scaling, root planning, polishing and surgery (stage 3) and scaling, root planning, polishing, surgery and exodontias (stage 4) (Periodontal Disease, 2006).

Supra gingival scaling: Supragingival scaling can be assessed by hand piece, ultrasonic or sonic scaler (i.e., ultrasonic piezoelectric scaler, ultrasonic magnetostrictive scaler, sonic scaler and rotonomic scaler). To reduce external bacterial count, if necessary, 0.12% chlorhexidine might be applied to mouth of patient. If ultrasonic magneto-strictive scaler is used, adequate water flow will be essential to prevent pulp tissue injury. Tooth scaling should not last more than 15 sec. Rotosonic scaler is not recommended for removing calculus. If hand piece is used to remove calculus, initially calculus gently must be removed with extraction forceps. Then, hand piece should be continuously slid towards surface of tooth (Sandra, 2001).

Subgingival scaling: For this procedure, curette is necessary. Curette removes subgingival calculus at an angulation of 45 degrees. Initially instrument is inserted subgingival area and then pulled coronally (Sandra, 2001).

Root planning: Curette is also needed for this process. Root surface is smoothed. When the process is completed, root surface becomes like hard glass (Sandra, 2001).

Subgingival curettage: This procedure is used to remove diseased soft tissue (Sandra, 2001).

Polishing and irrigation: Polishing is performed by prophylaxis. After placing paste on surface of tooth, prophylaxis is turned to slow-speed. In this procedure, a tooth should not be polished more than 15 sec. Then, gingival sulcus is irrigated with 0.12% chlorhexidine to remove debris (Sandra, 2001).

Repairment of oronasal fistula: If periodontal disease develops in palatal aspect of maxillary canine tooth, fistula may occur. According to Sandra Manfra Marretta repairment of oronasal fistula is performed: A thin layer of mucosa is removed from surrounding fistula. Incisions are made mesial and distal fistula in alveolar mucosa. Mucoperiosteal flap is elevated. Then, the mucoperiosteal flap is retracted laterally and apically to expose periosteum of flap. Region exposing to periosteum is incised in apical region and the flap is positioned over the fistula. Finally, the flap is sutured with a simple interrupted pattern 3-0/4-0 absorbable monofilament suturing material (Sandra, 2001).

Antibiotic therapy: If tooth is cleaned regularly in cat and dogs, antibiotic therapy may not be required, but it is applied for 4-5 days before periodontal surgery. Conditions that necessitate antibiotics include oral ulceration, persistent disease and bacteriemia (Ampicillin, 10 mg kg⁻¹ IV or 20 mg kg⁻¹ orally an hour or more before anesthesia and 10 mg kg⁻¹ orally for 4-5 days before surgery; Clavamox, 5-10 mg kg⁻¹ orally twice daily; Clindamycin, 1 mg kg⁻¹ orally twice daily, a week before periodontal surgery, 15 minutes before surgery and for 7-10 days after surgery; Metronidazole, 5-10 mg kg⁻¹ orally twice daily) (Harvey *et al.*, 1995). In a study, it was shown that dogs not receiving antibiotics previously, local application of Doxycycline reduced the pocket depth by 39% and attachment loss by 38% 6 weeks later (Harvey *et al.*, 1995). Carprofen is used (2 mg kg⁻¹ every 12 h) for reducing pain in dogs free of renal and gastrointestinal diseases. Similar study also demonstrated that *F. nucleatum*, *P. heparinolytica*, *R. micros*, *S. milleri*, *A. israeli* and *A. coronabacterium haemolyticum* are sensitive to clindamycin (100%), penicillin (96%), ceftriaxone (96%), ciprofloxacin (54%), trimethoprim-sulfamethoxazole (7%).

Perioceutics: Perioceutics are placed into or near the gingival sulcus or pocket. They are pharmaceutical formulations. Heska is only prepared for veterinary use in USA. Heska includes doxy-cycline hyclate, an anticollagenase and antibacterial. Collagen is the most significant protein of gingiva, periodontal ligament and alveolar bone. Neutrophil and bacteria produce collagenase and cause destruction. Local perioceutics are applied with a syringe and blunt-tipped periodontal

needle. After the solution is placed, it is coagulated. Thus, it forms a firm gel and permits for treatment of periodontal disease. Perioceutics allows local treatment for 2-3 weeks. However, tooth brushing delays this time. Chlorhexidine solution is recommended in affected mouth (Sandra, 2001).

Home care: Home care is significant to prevent advancement of the periodontal disease. It covers tooth brushing, antibiotic therapy, chemical plaque control and chewing toys using. According to a study (Lommer and Verstraete, 2006) among beagle dogs fed with the same food, dogs performed brushing daily did not show symptoms of periodontal disease. Also, removing old plaque would help preventing the disease. The most important factor in buying any toothbrush is to choose one with a soft bristle. Also toothpaste choosing is important. It should taste livestock, barley or seafood and never froth. Paste for human should be avoided. If pets refuse brushing, antiseptic gels containing chlorhexidine or stannous fluoride are recommended. These chemicals have antiplaque and antibacterial properties (Lommer and Verstraete, 2006). Gels are applied using by finger toothbrush. Tooth brushing should be performed every two days (Sandra, 2001). Home care according to stages of the periodontal disease covers tooth brushing daily with toothpaste (stage 1), plus application gel including stannous fluoride twice of weeks and antibiotic therapy (stage 2), tooth brushing daily with toothpaste including fluoride (stage 3) and application of 0.12% chlorhexidine and chlorhexidine gluconate and antibiotic therapy (stage 4) (Periodontal Disease, 2006). Chlorhexidine and fluoride should never be used at the same time because of inactivatory effect for each other. Diet choice should favor for dry food to decrease calculus formation.

Exodontia: If periodontal disease advances to stage IV, exodontia becomes indicated. Affected tooth is the source of infection. Thus, tooth should be extracted. Also extraction is recommended if periodontal pocket reaches at least one root of a multirrooted tooth (Sandra, 2001).

Periodontal surgery: Periodontal surgery is indicated when gingival recession and attachment loss are advanced. Aim of surgery is to eliminate the pocket and pseudopocket and alleviate attachment of tissues. Surgical interventions cover gingivectomy and flap techniques.

Gingivectomy: Gingivectomy is performed under general anesthesia. Initially pocket depth is determined with probe. It is created a bleeding point on the buccal surface in gingiva. Gingiva is cut by oblique incision under bleeding point to attachment. After the completion of

incision, surrounding area has an apparent slope. Hemorrhage is controlled. After removing incised area, root planning and scaling are performed. Healing initiates with epithelial migration superficially. However, this epithelium is thin and nonkeratinized. Surgical intervention should follow twice daily application of chlorhexidine and tooth brushing every two days (Cecilia, 2004).

Flap techniques: Flap techniques are simple flap procedures (modified Widman method and apically repositioned flap), sliding flap, free gingival graft (Veterinary Periodontal Disease, 2006). In modified Widman method, at first, around the tooth approximately 1 mm from the gingival margin, incision at 10 degrees to the long axis of the tooth is made. Incision releases at the line angle of the adjacent healthy teeth. Then gingival flap is reflected with elevator. However, sulcus epithelium must remain attached to the tooth. Gingival margin is removed and osseous defects are planed. Finally flap is sutured with interrupted sutures. Apically repositioned flap is similar. Incision is not made to create gingival margin and flap is repositioned at the final stage. Incision is made at the line of the adjacent healthy teeth. Flap is reflected with elevator beyond mucogingival junction. Then, root is planed and exposed surface curetted. Finally flap is repositioned further down the long axis of the root. Thus, pocket formation is eliminated.

In sliding flap method, initial incision is made horizontally in gingiva. Both sides of the first incisions are cut vertically. Depth of incision should contain connective tissue and epithelium. Removed graft is slid laterally onto gingival defect on canine tooth and fixed with interrupted suture adjacent gingiva and alveolar mucosa. Free gingival graft technique is performed to increase width of adjacent gingiva or absent of gingiva. Firstly, surround of defect or affected tooth carefully is cleaned. It is made a template of original defect with tinfoil. However, width of template 2.5 folds greater than original area. After template is transported on healthy area with pliers, it is incised on gingiva. The template is then removed and incision is deepened approximately 3 mm. Free gingival graft is kept on a sponge saturated with saline, while it is prepared for receiver area. After the template is placed on receiver area, incision is made on perimeter of template. The template is removed by deep incisions using periosteal elevator. Exposed surface of tooth is cleaned and graft is placed on the defect. Finally, it is sutured with interrupted suture.

ACKNOWLEDGEMENT

The authors would like to thank Dr. Armagan Hayirli for editing this manuscript.

REFERENCES

- Canine Periodontal Disease, 2006. <http://www.cavaliersonline.com/archives/k9perio.html>.
- Cecilia Gorrel, 2003. Periodontal Disease. 28.th World Congress of the World Small Animal Veterinary Association, Bangkok, Thailand.
- Cecilia Gorrel, 2004. Health Sciences, Veterinary Dentistry for he General Practitioner, Periodontal Disease, pp: 88- 89.
- Gabriel Varga, 2003. Kedi ve Kopeklerde Periodontal Hastalýklarýn Teshis ve Tedavisi.
- Harvey, CE., Thornsberry, B.R. Miller and F.S. Shofor, 1995. Antimicrobial susceptibility of subgingival bacteri flora in dog with gingivitis, J. Vet. Dent., 12: 4.
- Lommer, M.J. and F.J.M. Verstraete, 2006. Dental Disease in Dogs and Cats. http://www.integrityweb.com/news/integritywebcom_DentalDiseaseindogsandCats.htm.
- Pavlica, Z., V. Erjavec, D. Erzen and M. Petelin, 2003. A Full-Mouth Radiographic Survey of Periodontal bone Loss in Dogs. Actavet. Brno, 72: 391- 398.
- Periodontal Disease, 2006. <http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/20408.htm>.
- Periodontal Disease, 2006. <http://www.peteducation.com/article.cfm?cls=2andcat=1633andarticleid=379>.
- Periodontal Disease, 2006. Treatment and Procedures. <http://www.vetdentistry.com/periodontal.html>.
- Periodontal Disease. http://www.dentalvet.com/vets/periodontics/periodontal_disease.html,06.12. 2006.
- Samsar, E., O. Besalty, A. Ozak and S. Yavuzdemir, 2003. J. Turk. Vet. Anim. Sci.,27, Kedilerin Periodontal Hastalýk Prevelansýna Diagnostik Yaklasym. pp: 349- 357.
- Sandra Manfra Marretta, 2001. Periodontal Disease in Dogs and Cats. University of Illinois, Atlantic Coast Veterinary Conference.
- Veterinary Dentistry Basics, 2006. http://www.rvc.ac.ukreviewDentistryShared_MediapdfsBasics_print.pdf.
- Veterinary Periodontal Disease, 2006. http://www.vet.ed.ac.uk/clive/cal/Dentistry/Website/Shared_Media/pdfs/perio_print.pdf.