CURRENT STANDARDS IN THE DIAGNOSIS AND TREATMENT OF PERIODONTAL AND ENDONTIC DISEASE

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Part 1 - Periodontology

Learning Objectives

- Review the pathogenesis of periodontal disease.
- Review the most important aspects in the diagnosis of periodontal disease
- Review the basic aspects of treatment of periodontal disease.

Introduction

Periodontal disease (PD) is defined as the inflammation and/or destruction of the dental attachment apparatus, or periodontium. The tissues that compose the periodontium are gingiva, alveolar bone, cementum and the periodontal ligament. Periodontal disease is usually progressive and if left untreated may result in tooth loss. Numerous risk factors have been identified; the prevalence of PD is very high among dogs and cats.

The clinical importance of PD is based on the local and systemic consequences. Local effects of PD include oral discomfort/pain, inability to eat, oronasal fistula formation and pathological fracture of the mandibles. Severe chronic PD can also negatively affect distant organs and systems due to intermittent bacteremia and through the release of active substances including cytokines and inflammatory mediators.

Pathogenesis

Dental plaque plays a critical role in the pathogenesis of PD. Plaque is a biofilm that is clinically described as an invisible sticky substance that adheres to the teeth and any other hard surface in the oral cavity, including enamel, dentin, calculus, restorative materials or prosthetics; it is present both supra and subgingivally. Plaque is formed mainly from residues of food, saliva, and millions of bacteria and other microorganisms. It has been shown that the accumulation of plaque on dental surfaces begins within minutes after thorough professional mechanical instrumentation, and that if left undisturbed for several days it will invariably lead to gingivitis.

Subgingival plaque induces an immunological response from the host; if left undisturbed, inflammation invariably occurs and gingivitis is established after only a few days. In susceptible individuals, gingivitis can progress to destructive forms of periodontal disease and loss of attachment including alveolar bone destruction and resultant gingival retraction and/or pocket formation occur. During the progression of PD the subgingival flora shifts from a predominantly Gram-positive to a Gram-negative one. Certain bacterial species are believed to be involved in destructive forms of PD, although their role as true periodontopathogens remains controversial. Gingivitis is considered

reversible and depends on adequate plaque elimination and control; in contrast, attachment loss is considered irreversible.

Epidemiology

Periodontal disease is the most common disease of small animals. Its prevalence varies according to certain variables:

- Age – The prevalence of PD is significantly higher in older animals.
- Occlusion/skull type – Malocclusion is considered a risk factor for PD; crowding of teeth represents plaque-retentive areas and are a risk factor for PD; brachycephalic breeds are more susceptible to PD.
- Immune status – Immunosuppression is a risk factor; any condition or treatment coursing with immunosuppression may increase the risk of developing PD, including poor nutrition, steroid treatment, cancer, diabetes, chronic renal or liver disease, endocrinopathies, etc.
- Genetic susceptibility – Genetics may play a major role in susceptibility to PD; certain breeds appear to be predisposed including small and toy breeds like Yorkshire terriers, miniature poodles, dachshunds, and miniature schnauzer.

Classification

Several classification systems for PD exist. Normally, two phases or stages are recognized: gingivitis and periodontitis. Gingivitis is considered reversible and implies no loss of periodontal tissues; it can be further classified as mild, moderate, or severe. Several scoring methods for the severity of gingivitis exist; the most widely used is that proposed by Silness and Loe, and is based on bleeding upon probing, thus can only be applied with the patient under general anesthesia.

Periodontitis implies loss of periodontal tissues and is considered irreversible. Not every animal with gingivitis will progress to periodontitis. Periodontitis can be further classified based on severity:

- Mild periodontitis implies less than 25% of attachment loss.
- Moderate periodontitis implies 25-50% of attachment loss.
- Severe periodontitis implies more than 50% of attachment loss.

Based on extent, periodontitis is classified as:

- Focal – when only 1 tooth is affected.
- Localized – when 2-10 teeth or less than 30% of the teeth present are affected.
- Generalized – when more than 10 teeth or more than 30% of the teeth present are affected.

Diagnosis

The diagnosis of PD is based on historical, conscious oral examination, anesthetized oral examination and full-mouth radiographs. History is important to determine duration, response to prior treatments, home-care measures in place, concurrent medical conditions, and suitability to undergo general anesthesia. Conscious oral examination may reveal signs suggestive of gingivitis or periodontitis, namely gingival erythema and edema, gingival retraction, root exposure, tooth mobility and furcation involvement. It

may reveal relevant concurrent dental problems as well, including endodontic disease. Conscious oral examination can be very limited and is often deceiving, however. Conscious oral examination is very useful to establish a diagnostic plan and provide the client a tentative diagnosis and a cost estimate. The exact severity and extent of PD cannot be established without dental probing and full-mouth radiography. No patient should undergo general anesthesia for a dental procedure that does not include a comprehensive diagnostic approach.

Clinical dental exam under general anesthesia should include an extraoral exam and assessment of the intraoral and oropharyngeal soft tissues. Periodontal assessment is based on probing using a periodontal probe; all oral examination findings under general anesthesia must be recorded in a dental chart; the dental chart forms part of the medical record of the patient. The following parameters should be evaluated:

- Probing depth - the sulcular probing depth must be measured in millimeters for the entire circumference of every tooth.
- Gingival retraction – Measured in millimeters as the distance between the cementoenamel junction and the gingival margin.
- Tooth mobility – recorded as grade 1 (mild), 2 (moderate) or 3 (severe).
- Furcation involvement/exposure – stage 1 is when the tip of the probe enters the furcation less than halfway in; stage 2 is when the probe enters more than 50% of the way but not through-and-through; stage 3, also known as furcation exposure, is a through-and-through defect.
- Gingival index (Silness and Loe) – grade 1 is mild edema with no bleeding upon probing, grade 2 is mild edema with bleeding upon probing, grade 3 is severe inflammation and spontaneous bleeding.
- Other – oronasal communications, tooth resorption, draining tracts, periodontal abscess, etc.

The clinical examination must be complemented with full-mouth radiography; many lesions or their exact severity are not detected clinically but are revealed radiographically, and vice versa. Additionally, radiographs are essential when extractions are indicated to anticipate the degree of difficulty, determine anatomic variations, and adequately plan the approach. Intra- and postoperative after extractions are also indicated to document complications and address them in the most appropriate manner.

Treatment

Periodontal disease is treated by mechanical and surgical means. Antibiotic treatment or the so-called pulse therapy is not recommended as the primary treatment of periodontal disease. A complete periodontal treatment should include:

- Supra and subgingival plaque and calculus removal; this is achieved using power equipment (i.e. sonic or ultrasonic scaler), and hand instruments (i.e. periodontal scalers and curettes).
- Polishing – two systems are available: cup and pumice, and air-polishing.
- Extractions – See criteria below.
- Periodontal surgery (i.e. GTR, open debridement, pocket-elimination surgery, etc.)

The decision of extracting a tooth is based on objective and subjective criteria. Objective criteria include:

- Teeth with a stage 3 furcation
- Periodontal pocket deeper than 6 mm
- More than 50% of alveolar bone loss
- Simultaneous periodontal and endodontic disease (i.e. complicated crown and root fracture and perio-endo lesions)
- Increased mobility

Subjective criteria to be considered when making a final decision include client's decision, expectations and compliance with home care if tooth is preserved, status of other teeth in the mouth, suitability for repeated anesthesia in the future, etc.

Part II – Endodontics

Learning Objectives:

- Review the most relevant aspects of pulp anatomy and physiology.
- Review the most pathogenesis of endodontic disease.
- Review the most relevant aspects in the diagnosis and treatment of endodontic disease.

Introduction

Endodontics is the discipline that focuses on the diagnostic and treatment of pulp disease. The pulp is composed mainly of connective tissues; although covered by dentin, it is exposed to a variety of insults including physical, thermal, chemical, and electric trauma. Endodontic disease has important clinical implications. The objectives of this lecture are to highlight the most important anatomical and physiologic aspects of endodontic disease, and to provide an overview of the diagnostic and therapeutic implications.

Pulp Structure

The dental pulp is composed of connective tissue derived from the neural crest. It contains different types of cells surrounded by a matrix, and occupies the so-called pulp cavity. Given that dentin has a close anatomical, functional and embryological relationship with the pulp, it forms part of the so-called dentin-pulp complex.

One of the cellular types present in the pulp is the odontoblast. Odontoblasts are in charge of secreting dentin throughout the lifetime of the individual; they possess cytoplasmic extensions called odontoblastic processes that penetrate into the dentinal walls and occupy the dentinal tubules. When the pulp suffers irreversible damage and the odontoblasts are no longer viable, dentin deposition along the internal walls of the tooth is arrested.

Dentin is composed of 70% of inorganic material, 10% water and 20% organic material. Dentin is covered by enamel on the crown portion of the tooth, and by cementum on the root portion of the tooth. The pulp cavity can be divided into different areas: the pulp

chamber corresponds to the area found in the crown portion of the tooth; the root canal is the area found in the root portion of the tooth. In multi-cusped teeth, the pulp chamber extends into each cusp; these areas of the pulp cavity are called the pulp horns. Due to continued dentin deposition, the diameter of the pulp cavity decreases as the animal ages.

The root end contains multiple foramina through which blood vessels, lymphatics and nerves have access into the pulp cavity. Irrigation occurs via venules and arterioles. Nerves are composed by sensitive and sympathetic fibers that originate from the trigeminal nerve and the superior cervical ganglion respectively. The portion of the root where the apical delta is located is also referred to as the root apex. Inflammatory lesions that are the result of endodontic disease are usually located in the periapical tissues; periapical inflammation is also often referred to as apical (or periapical) periodontitis.

Three different types of dentin exist: primary dentin is the type that is deposited during tooth development prior to eruption; secondary dentin is that which is deposited after eruption and throughout the lifetime of the individual; and tertiary dentin is deposited as a response to noxious stimuli, in an attempt to create thicker areas of dentin separating the pulp cavity from the exterior.

Endodontic Disease

Pulp inflammation may be reversible or irreversible. Reversible pulpitis usually occurs in cases in which the insult is not severe enough to compromise irrigation to the pulp. It is more likely to occur in young individuals in which a relatively wide pulp cavity allows inflammation to occur while maintaining adequate blood supply. This inflammation may be chronic and eventually result in irreversible damage and pulp necrosis.

Pulp necrosis can occur secondary to compromised blood supply or from direct insult to the pulp tissue. The clinical implications are varied: acute inflammation causes severe, throbbing and well localized pain; once the pulp becomes necrotic, a periapical lesion ensues in the form of a periapical granuloma, periapical abscess or a periapical (radicular) cyst.

The clinical signs of endodontic disease are the direct result of periapical inflammation. Although there is associated pain, it is of a subtle low-grade type, and thus may be difficult to recognize by pet owners and veterinarians. Clinical signs usually only become evident when the lesion becomes acutely infected and may manifest itself with local swelling and/or a draining tract. Draining tracts can be intraoral, typically located at the mucogingival junction associated with the affected tooth; or extraorally, may times located on the facial region in the case of maxillary teeth, or along the ventral aspect of the mandible.

Diagnosis Of Endodontic Disease

The diagnosis of endodontic disease is based on clinical and radiographic findings. Clinical examination findings that suggest or confirm endodontic disease include: tooth fractures with or without pulp exposure, intra or extraoral draining tracts, facial or submandibular inflammation, and intrinsic tooth discoloration. However, endodontic

disease often times can only be detected or confirmed via dental radiography; the most common radiographic findings indicative or suggestive of endodontic disease are the presence of periapical lucencies, apical inflammatory root resorption, and a relatively wider pulp cavity when compared to a contralateral tooth. However, some cases of endodontic disease may not be detectable in early stages and clinical and radiographic follow up may be necessary to confirm or rule out the suspicion.

Dental Trauma

The most common cause of endodontic disease in cats and dogs is dental trauma. Dental trauma can cause any of the following:

- Complicated crown fracture – The fracture involves enamel, dentin and pulp. Treatment options are endodontic treatment of extraction.
- Complicated crown and root fracture – The fracture involves enamel, dentin, pulp and cementum. If the fracture extends deep into the periodontium, extraction is indicated. If the fracture does not extend deep into the root, endodontic treatment and periodontal surgery, or extraction are indicated.
- Root fracture – if the coronal fragment is present and the fracture is in the coronal or middle thirds of the root, extraction is indicated. If the coronal fragment is present and the fracture is in the apical third of the root and there is no tooth mobility, radiographic monitoring for signs of endodontic disease or extraction is indicted. If the coronal fragment is missing and there are clinical or radiographic signs of inflammation associated with the root, extraction is indicated; if there are no clinical or radiographic signs of inflammation, intentional retention or extraction are indicated.
- Uncomplicated crown fracture – Requires radiographic monitoring; if radiographic signs of endodontic disease are revealed, endodontic treatment or extraction is indicated.
- Uncomplicated crown and root fracture - If the fracture extends deep into the periodontium, extraction is indicated. If the fracture does not extend deep into the root, periodontal surgery and radiographic monitoring for endodontic disease are indicated.
- Tooth luxation – Requires immediate treatment. Lateral luxation requires semi-rigid stabilization for 3-4 weeks and endodontic treatment 2 weeks after the trauma; intrusive luxation has a poor prognosis and extraction may be the best alternative.
- Tooth avulsion – Poor prognosis, extraction is indicated.
- Discolored tooth - Endodontically diseased teeth often become discolored. According to one study, more than 90% of discolored teeth in dogs are non-vital and therefore require endodontic treatment or extraction.
- Abrasion/attrition – if tooth wear occurs at a fast rate, the pulp may not be able to compensate and deposit enough tertiary dentin ultimately resulting in pulp exposure. Pulp exposure is an indication to perform endodontic treatment or extract the tooth.
- Miscellaneous – Tooth resorption and caries may compromise the pulp. Although endodontic treatment may be possible, the amount of tooth destruction by the time this occurs is usually significant and extraction may be the best alternative.

Endodontic Treatment

Endodontic treatments are usually very technique-sensitive and require adequate armamentarium, skills and knowledge of the biologic principles involved and a wide array of materials. The main types of endodontic treatment are:

- Partial coronal pulpectomy – Indicated in pulp exposure of less than 48-hour duration, especially younger animals in which keeping the pulp vital for continued dentin wall thickening is desired, or as an emergency treatment in older animals to treat pain associated with pulp exposure and for which conventional root canal treatment cannot be performed immediately. It consists of removing 6-8 mm of the most coronal pulp tissue and covering it with a 2-mm layer of calcium hydroxide, and a restorative on top. The success rate is approximately 80% when performed within the first 48 hours but drops dramatically if performed later. Radiographic follow up at 3 months and every year thereafter are necessary to assess outcome.
- Conventional root canal treatment – Also called total pulpectomy or non-surgical root canal treatment. The procedure consists of removing the inflamed or necrotic pulp tissues from the pulp cavity while chemically and mechanically disinfecting and shaping it, followed by obturation (filling the pulp cavity with special materials) and restoration. The success rate is high (>90%) if performed adequately, but requires radiographic follow up at 3-6 months and every year thereafter. Failed cases may be treated again using the same technique, may receive a surgical root canal treatment, or are extracted.
- Surgical root canal treatment – Consists of surgically approaching the apex of a tooth previously treated with a conventional root canal treatment (typically a failed case) and excising the apical 3-5 of the root. After exposing the root canal, 3-5 mm of obturation material are removed and retrograde filling of the resultant defect is performed. It is by far the most involved and technically challenging of all the endodontic procedures, but when properly performed the prognosis is good.

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