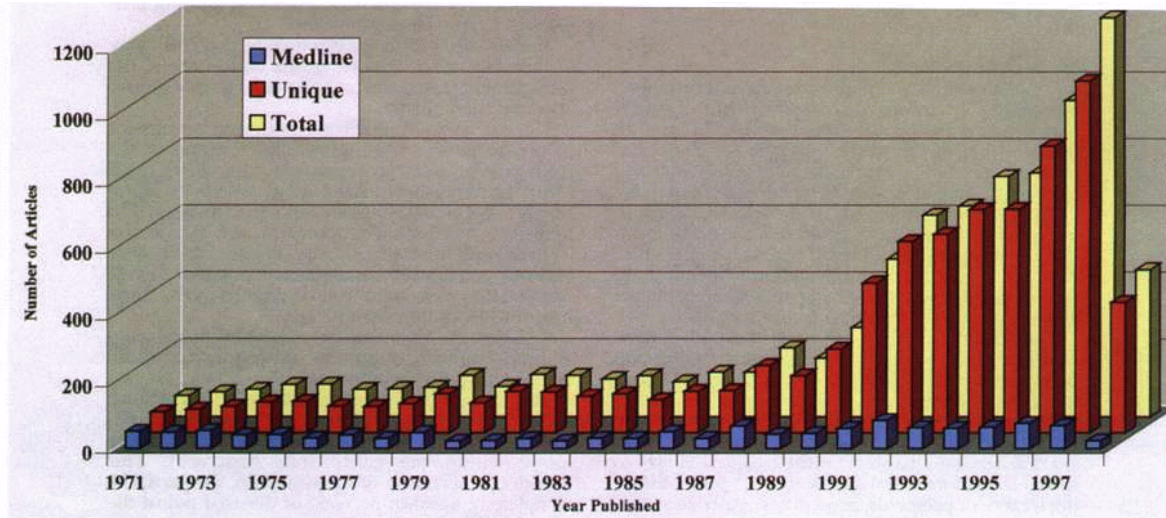


**A REVIEW OF THE EXPANDING FIELD
OF EXOTIC ANIMAL ORAL HEALTH CARE
VETERINARY DENTISTRY**

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Abstract: This article reviews and considers the clinical literature of the field of Veterinary Dentistry from its conception in the late 1960's and early 1970's to its rapidly expanding role today as an emerging clinical specialty practice in veterinary medicine. It defines eight dental sub-disciplines in contemporary veterinary oral health care from a practical point of view, and it provides information concerning standardization of key words searches, definition of terms and use of the expanded Medical Subject Headings (MeSH) necessary for a comprehensive review of the rapidly expanding literature stored in electronic databases.



Number of Veterinary Dental Articles Published Per Year, 1971 to 1998
 Number of citations found after searching the databases listed in Appendix A which reference veterinary science articles. There is little difference between the Unique and Total columns, which indicates that few articles are cited in 2 or more databases. It should also be noted that not all databases began online indexing in 1971 (see Table 3).

TOTAL = the number of citations retrieved in all eight databases shown in Table 3.
 UNIQUE = the number of citations retrieved when duplicate citations appearing in 2 or more databases were removed.
 MEDLINE = the number of citations in the Medline database.

INTRODUCTION

In 1970 a veterinary practice entirely limited to dentistry was very rare, and dentistry was essentially non-existent as a focus of clinical interest in exotic animal veterinary medicine. Veterinary students received limited instruction relating to the cause, treatment and prevention of oral disease. The field of veterinary dentistry has since blossomed. Veterinarians, researchers and animal management personnel have begun to appreciate and understand the significant impact oral disease has upon an animal's overall health, maintenance and reproductive status. An extensive repository of material is now readily available in electronic databases to guide the interested clinician in the prevention and treatment

of oral disease and oral health care issues in many species of domestic and exotic animals.

A comprehensive review of the dental, veterinary, agricultural and wildlife zoology literature strongly suggests that wildlife, captive exotic and domestic animals are afflicted with most dental and maxillofacial diseases and disorders reported in the human population. This includes chronic sinusitis, severe genetic malocclusion, dental caries, periodontitis, facial trauma, peri-apical abscessation, oral fistulas, and a variety of facial and oral neoplasm.

Exotic Animal Oral Health Care / Veterinary Dentistry can be defined as the branch of zoo and wildlife veterinary medicine that addresses issues related to the entire oral cavity, its associated soft tissues, bony structures, supporting musculature, and dentition. This field specializes in the diagnosis, prevention and treatment of the animal's entire masticatory apparatus. This includes all oral disease, oral and facial trauma, as well as hereditary and developmental defects. With varying degrees of modification many of the past and current human dental standard-of-care procedures, materials and techniques have potential application in any comprehensive clinical veterinary dental practice.

While environment and heredity greatly impact the condition and health of an animal's masticatory apparatus, diet has been found to also have a tremendous impact upon oral health. Identifiable oral health concerns have been recognized in the alphabetical spectrum of animals from aardvark to zebra, and in size from marmoset to elephant. This patient population potentially includes all of the carnivores, primates, herbivores and many of the avian species. Too much unrecognized and untreated oral disease is present in populations of aging captive exotic animals.

Exotic animal practitioners have much to gain from the experience of the domestic animal clinician, whose patients are not only more abundant and accessible, but

easier to restrain, examine, diagnose, anesthetize and to follow during post-operative recovery. Domestic animals also spend a great deal more time associating with humans. Thus, detection of their dental and oral health problems may occur at an earlier stage, as a result of the opportunity for closer observation of subtle changes in behavior. The majority of oral health care issues in captive exotic animals do not present to the clinician until the disease process has either acutely exacerbated or chronically progressed to the point of obvious incapacity or debilitation.

Consequently, anyone involved with management in the exotic animal field could benefit from an increased familiarity with the presentation, diagnosis and treatment of oral conditions of domestic animals. Domestic animal and exotic animal clinicians deal with diseases of very similar causation and manifestation, even though the process of clinical intervention and correction may vary, or come into play at different stages for an entirely unique set of reasons. However, the standard of care in both cases has much in common. It has been the repeated experience of the authors that many of the traditional orthodox solutions from domestic animal practice have practical and beneficial, although perhaps on occasion unorthodox, application to exotic animal veterinary oral and dental care.

Knowing that this wealth of material is so readily available, and how to quickly and specifically access it, cannot help but improve the current clinical state-of-affairs, and perhaps avoid some of the all too common time, expense and frustration associated with "re-inventing the wheel".

LITERATURE REVIEW

A review of the research monographs and literature available in the field of veterinary dentistry has proven to be a difficult and arduous task. To obtain a complete search, a clinician must review the journal literature

present in three or four distinctly disassociated subject areas, i.e., dentistry, veterinary science, and depending on whether one's patients are domestic or exotic, agriculture and wildlife zoology. In order to review the widest possible selection of relevant citations, it is necessary to select the desired topic area using very specific *key words that possess universally accepted meanings*. A suggested starter list of 62 of the most commonly cited veterinary / dental terms is included in **FIGURE 1**. An expanded list of their specific definitions, called "scope notes" including their most frequently associated "subheadings", "narrower headings", and "broader headings" subjects is attached as **APPENDIX A**.

All on-line databases are focused by design and intent so as to only include a very specific previously selected portion of the total citation material available on any particular subject. Therefore, no single database currently provides a comprehensive overview of all of the available citations relevant to a particular search topic. Analysis of which periodical indexes cover the largest percentage of the veterinary sciences journals based upon the University of California's MELVYL Catalog record data and Ulrich's International Periodicals Directory, reveals that the coverage of the "Veterinary Sciences" category is seriously flawed (**FIGURE 2**).

For these reasons, a comprehensive search of the literature relating to topics in veterinary dentistry, *requires the use of multiple databases indexed to the bulk of the relevant journals and publications*. It is also necessary to decide whether or not to eliminate laboratory animal model references from the search results, because most of the articles discussing dentistry in laboratory animals relate to "materials" testing for human product development and/or application. These subjects may have limited value for the clinical practitioner.

FIGURE 3 lists the databases consulted to conduct what we considered to be a thorough literature search of our subject. An expanded description of each of these seven databases with information on how and where to

access them is located in **APPENDIX B**. Our initial search, including laboratory animal references, resulted in 1,332,209 citations. Further refinement of the search parameters finally resulted in 9,130 citations between 1970 and 1998. A representative sample of the articles and monographs are included in the references.

Searching the journal literature for topics in veterinary dentistry using any database should be fairly straight forward. One quickly discovers that not to be the case. Of the 37 journals listed in the "*Dentistry/Oral Surgery & Medicine*" category of the 1994 *Science Citation Index Journal Citation Reports* (SCI JCR), 100% can be located by using the Index to Dental Literature (one of the titles found in the National Library of Medicine's MEDLINE database). Therefore MEDLINE appears to be the electronic resource of choice. However, only 59.9% of the 92 journals in the SCI JCR's "*Veterinary Sciences*" category are available through either *Index Medicus* or *the International Nursing Index* (the other two components of the MEDLINE database). So, while a search utilizing MEDLINE will provide excellent coverage of the human dental journal entries, it will miss approximately 40% of the major veterinary dentistry science-related journals, and will provide virtually no coverage of the available agricultural and zoological literature. Moreover, with the current lag time of several months to five years or more between publication of the journal and entry in an electronic database, it becomes quite clear that a single database search result is not a complete and up-to-date listing of what is actually available.

For example, our search of the seven databases listed in **FIGURE 3** demonstrated that the literature within a particular field topic only rarely overlaps into another database. Even the indexes that purport to cover journals within the same field are highly segregated. Consequently, publishing an article in any single journal will reduce the likelihood that a significant portion of its potentially interested audience will be able to locate it through the index of their choice.

One solution used in some fields, for example psychology, is to reprint articles in several journals so as to ensure access to a wider or more specific broadly targeted audience. This practice could also be used in veterinary medicine to diminish the aforementioned problem by agreement to acknowledge the initial publishing journal's copyright position. However, this cure could soon become worse than the original problem because of the overwhelming mass of database citations.

The lack of significant overlapping of topic fields within databases is primarily caused by the lack of familiarity with database information and the failure to use a uniform vocabulary amongst various clinicians and researchers. This is easily demonstrated by the fact that the databases indexes covering human research and clinical/technique data are separate from those covering veterinary and laboratory animal research and clinical/technique data. An example of the language barrier is found in the use of words like "arcade". "Arcade" is **not** a commonly used dental term, but is a term used extensively in the veterinary and engineering fields. Moreover, the term has different meanings in each of these three fields.

These situations clearly contribute to the confusion and reduce the availability and dispersion of information between the veterinary and dental fields. To begin to resolve the problem, an established set of vocabulary should be adapted over time, and used by concerned individuals in their respective fields, so that information storage and retrieval will eventually become simpler, predictable and much more dependable. We propose the acceptance and use of the terms listed in **FIGURE 1** as a possible first step toward accomplishing this objective.

The database searches used in preparing this article clearly demonstrated an explosion of growth within the field of veterinary dentistry. As shown in **FIGURE 4**, the total number of journal articles in the field listed in databases has risen dramatically in the past five years. However, the number of relevant journal articles cited by

the MEDLINE database has remained relatively constant over time. This suggests that most recent veterinary dentistry articles have been published in journals outside the scope of the database indexes included in MEDLINE. In 1971, MEDLINE referenced 83.9% of the articles indexed in on-line databases. However, as a result of an increase of material published in journals not indexed by MEDLINE, by 1997 this figure has dropped to only 6.62%. In other words, the principal growth of new articles published is now found in the agricultural, zoological and veterinary journal, so the researcher using only MEDLINE to conduct a search will miss 90+/-% of the relevant articles on veterinary dentistry.

The difference between the "unique row" and the "total row" of articles in **FIGURE 4**, clearly demonstrates the very small percentage of articles that appear in two or more of the indexes used in this search. This further illustrates the segregation of the rapidly growing discipline of veterinary dentistry articles to journals **not** covered by MEDLINE. Therefore, veterinarians limiting their searches to MEDLINE tend to have limited access to relevant articles appearing in their own journals. Zoologists have limited access to relevant articles in veterinary or wildlife management journals; and so on. Therefore, clinical practitioners do not benefit fully from advances of others who are performing and publishing relevant veterinary dental research and/or procedures.

SUB-DISCIPLINES

In spite of the structural inadequacies of the various on-line electronic databases, the field of veterinary dentistry has continued to evolve over the years to become an intricate part of veterinary medicine for all patient populations (captive exotic, wildlife, production and companion animal species). The etiology of oral disease has been observed to be associated with many different causes: improper diet, behavioral problems, restricted living space, management problems, trauma, genetic influence, etc. There is now increasing evidence

that, when left untreated, oral disease can severely impact an animal's health and reproductive potential.

Indications are that the field of veterinary oral health care will continue to develop as a useful "arrow in the quiver" of those individuals dedicated to maintaining the health and quality of life of domestic animals, captive exotic collections, and breeding populations of free ranging endangered species. This diverse group of practitioners will continue to sharpen their clinical ability to recognize and treat oral disease, as their individual case load dictates. The process can be made easier by the sharing of treatment protocols, procedures, experience and research.

The practical consequence of this increased knowledge dispersion is the enhanced visual appraisal of the animal's oral problems; oral disease will be detected earlier, and eliminated before systemic health becomes compromised. It has been our experience that early detection and treatment occurs more predictably, as a result of the heightened awareness of oral health, disease and behavior by **all** of the individuals who come into contact with the potential patient population. This contribution from the entire para-professional staff should not be overlooked as a contributing factor to the reduction of the overall traumatic impact of oral disease, through the process of early detection and/or prevention.

As the mass of database indexed material increases, it will become increasingly important to render access to it into more applicable "bite sized" chunks of information. This will facilitate timely and focused retrieval. An understanding of the principal sub-discipline categories of clinical veterinary oral health care is an essential first step to begin this process. A brief definition and discussion of the eight major sub-disciplines follows:

1. PREVENTION

Clinical treatment with the goal of prevention of disease and the maintenance and promotion of oral health.

This category includes the maintenance and promotion of the oral cavity, masticatory apparatus and their associated structures in their normal functional state. This includes the prevention of adverse systemic diseases or disorders secondary to primary oral disease and/or trauma.

Examining the dentition of an exotic animal is never an easy task. Therefore, examinations are commonly made on the "fly" as circumstances permit. Treatments are often scheduled and performed as part of an animal's annual physical examination, or during other necessary immobilization procedures unless contra-indicated. Many preventative treatment procedures are most productive when initiated during the period when the animal's teeth are erupting. Young animals may retain deciduous teeth, necessitating removal for proper eruption and placement of the adult dentition.

2. SURGERY

Focuses on various treatment techniques, materials, pre & post operative protocols, etc., including the diagnosis of surgical procedures associated with the oral cavity and its surrounding structures.

This category covers the performance of any cutting operations on the entire masticatory apparatus and associated structures including the removal, restoration, and/or reconstruction by bone grafting procedures to treat disease or injury.

3. PERIODONTICS

Covers the histology, physiology, and pathology of the tissues that support, attach, and surround the teeth, and of the treatment and prevention of disease affecting these tissues.

This category covers the prevention and treatment of the diseases of the supporting structures of the teeth; e.g. the alveolar processes, the periodontal ligament,

and the surrounding gingiva with its blood supply. Periodontal disease is often found in primates, with a manifestation of the disease similar to that seen in man. It is also common in herbivores, where its impact can be much more dramatic and destructive to the tissues. Guided tissue regeneration procedures can be utilized in the treatment of this destructive disease.

4. ENDODONTICS

Maintenance of the dental pulp in a state of health and with the diagnosis, treatment and restoration of the endodontic pulp chamber and canal(s).

This category is concerned with the maintenance and treatment of the dental pulp; i.e., the connective tissue, the blood and vessels, and the nerve tissue found within the hard tooth structure. This includes: preservation of the vital pulp; or the partial or complete removal of necrotic or diseased pulpal tissue with the accompanying sterilization of the root canal system and obliteration of the resulting space; and treatment of periapical disease.

Endodontic treatment is commonly required in carnivores. Aggression, nervous displacement activity, abnormal wear from diet and/or behavior can result in the excessive wear or breakage of teeth.

5. RESTORATION

Concerned with the restoration of dentition to natural form and function.

This category includes all procedures to restore or treat faulty, missing or diseased parts of natural teeth whether from caries, trauma, impaired function, attrition, abrasion, or erosion. The objectives are the inhibition of pathologic processes and the restoration of anatomic form and function.

All animals are susceptible to facial trauma and avian species have a particular need for and benefit from

functional restoration of a fractured or broken bill or beak.

6. FORENSICS

The application of dental knowledge to questions of law, including determination of age or identity of an animal by its dentition.

These matters also include body and disease identification, as well as the application of the principles of law and justice to the practice of veterinary dentistry.

7. ORTHODONTICS

The prevention and/or correction of dental or facial anomalies, malocclusions or structural relationships.

Much of clinical dentistry is concerned with the prevention and/or correction of anomalies and malocclusion associated with the placement or arrangement of teeth for the purpose of maintaining proper oral function. The term orthodontics applies when this "restorative procedure" is accomplished by the simple moving, rearranging, or transplanting of naturally occurring teeth. This usually involves the design and fabrication of artificial appliances of one sort or another.

8. ORAL-RADIOLOGY

The application of a radiant energy source to the tissues of the head and neck for the purpose of identification, diagnosis and/or treatment.

There have been many advances in the use of various energy sources in this rapidly developing field which now includes not only the traditional intra-oral and extra-oral radiographs, panographic techniques, filmless image digitizing screens for computer utilization, etc., but C.T. Scans, M.R.I.'s and Ultrasonic Imaging.

CONCLUSION

It is clear that oral and dental diseases are serious and common problems of many animals, which can often present under the guise of a systemic malady. It is the obligation of the responsible clinician to become familiar with the common signs, symptoms and "standard of care" treatment alternatives for each particular oral disease problem. In recent years, with the exponential increase in the use of the electronic database as the storage media of choice, this has become a much more difficult task. Clinicians must now also learn the methods necessary to retrieve relevant diagnostic and treatment practices from a variety of sources. Two techniques for understanding how to minimize some of the difficulties associated with this potentially daunting task have been proposed. The utilization of *MeSH keywords and sub-discipline classifications*, combined with *multiple database searches* will eliminate two of the major obstacles of focused electronic information gathering.

An understanding of the important issues associated with the electronic storage of literature-based knowledge, as well as a familiarization with a few of the methods necessary to retrieve a focused literature search, will go a long way toward assisting the responsible clinician to promptly and correctly diagnose the problem, be aware and thus able to proceed with or refer for appropriate treatment alternatives, and clinically achieve the desired solution.

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