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Feline Dental Implants: A Long-Term Case Review

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Abstract

Dental implants have become an option for replacement of lost canine teeth in cats. Although cats appear to manage well after a canine extraction, complications such as lip entrapment can occur after maxillary canine tooth extraction. Even cats with a complicated crown fracture of the maxillary canine tooth that have had root canal therapy can develop lip entrapment. This can lead to painful lip ulcers and potential need for further dental treatment. Canine tooth replacement with a dental implant and prosthodontic crown is, in the authors' experience, a predictable option that can be offered to clients who would like to replace a lost canine tooth. This report will discuss 2 long-term cases of maxillary canines replaced by dental implants/crowns.

Keywords

cats, canine tooth, dental implant, osseointegration, prosthetic crown, feline, veterinary dentistry

Introduction

Clinical applications of feline dental implantology, and more generally, applications in companion animals, have been lacking in the veterinary literature. However, the science behind dental implantology is sound and has been successfully utilized in human dentistry for over 50 years.

As with any treatment option, dental implants should be subjected to the same level of scrutiny as other treatment modalities. However, being a relatively new area of veterinary dentistry, long-term clinical success of dental implants has not been established in cats. Owners need to be made aware of this and the importance of periodontal maintenance (home care) prior to obtaining informed consent. Also, only experienced and well-trained clinicians with a sound knowledge of the principles and practice of dental implantology should embark into this field. Treatment planning for a dental implant is no different than planning for any oral surgical procedure. Before any diagnosis or treatment plan is formulated, it is essential that an intraoral examination, including a complete oral health assessment, be performed under general anesthesia. When dental implants are being considered as a treatment option, radiographs are critical in treatment planning to evaluate the affected tooth and the surrounding bone and anatomical structures. If available, computed tomography can be utilized to complete a diagnostic and treatment plan. Unfortunately, computed tomography is not available to most general practitioners and some veterinary dentists. The cases discussed in this article suggest dental implants are an option for restoring feline patients to full oral function. Two cases of extracted maxillary canines, immediate placement of dental implants, and subsequent restoration with prosthetic crowns are discussed.

Case 1

A 4.5-year-old neutered male Russian blue cat weighing 5.2 kg was referred for evaluation of multiple bite wounds and a mesially luxated right maxillary canine tooth (104) of 3 days duration. On initial examination, the presence of multiple bite wounds was noted with Penrose drains in place, along with bruising and abrasions in the inguinal areas. Tooth 104 was luxated with a slight mesial deviation and mobility. The tooth was painful when touched during conscious examination.

All treatment options were presented and discussed with the pet's owner. These included (1) stabilization of the mesially luxated tooth followed by root canal therapy (RCT) in 7 to 14 days post-trauma, (2) surgical extraction, and (3) careful extraction (preserving labial plate) with immediate placement of an endosseous implant, an option that would only be possible if the labial alveolar process and palatal cortical plate were intact and primary implant stability could be attained. Option 3 would involve placement of a prosthetic restoration following a healing and osseointegration phase. After discussion with the pet's owner of the advantages and disadvantages of available

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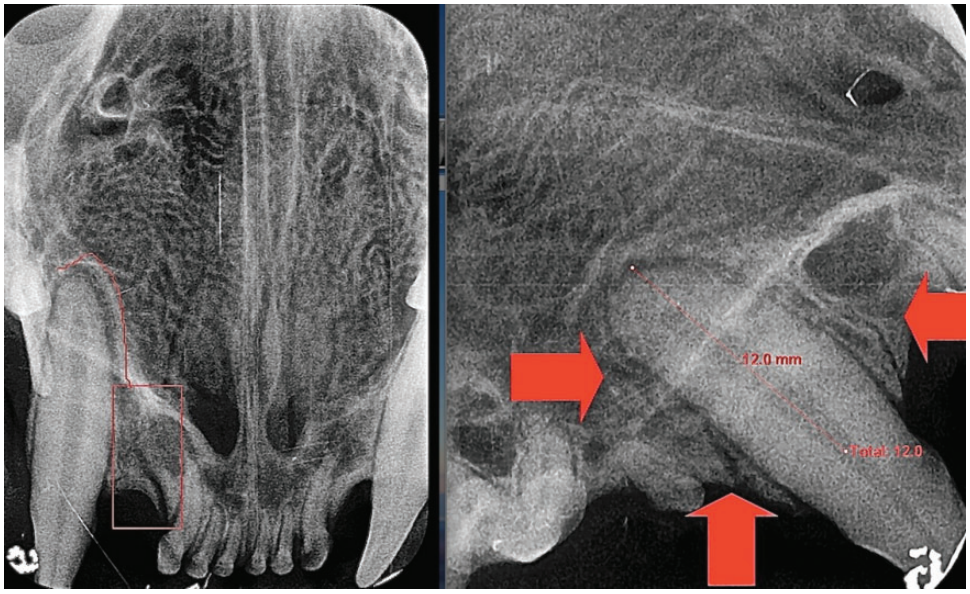

Figure 1. Radiographs demonstrating alveolar fracture adjacent to tooth 104, resulting in mobility and widening of the periodontal ligament space.

treatment options, he decided to pursue extraction and immediate implant placement.

Although the principal author has performed numerous stabilization/RCT of luxated teeth in dogs with relatively good results, with the complication of the alveolar fracture in this feline patient, tooth 104 was unstable and there could be a challenge in maintaining a pretrauma occlusion. Even with a periodontally stable tooth, possible periodontal ligament devitalization (compromise of blood supply) may lead to eventual ankylosis or external root resorption with potential loss of the tooth, even after RCT is performed.[1] Extraction and immediate dental implant placement can also be problematic. However, in the authors' experience, implant placement is less problematic with possibly fewer potential complications than salvage of luxated/avulsed teeth.

Surgical Phase

Prior to the surgical appointment, venous blood was drawn and a complete blood count and serum biochemistry profile were tested to check the patient's general health. Patient was premedicated with atropine sulfate[a] (0.01 mg/kg subcutaneously) and acepromazine[b] (0.02 mg/kg subcutaneously). An intravenous (IV) catheter was placed and lactated Ringer's solution was started at a rate of 3 mL/kg/h. General anesthesia was induced by mask with sevoflurane.[c] Intubation with a cuffed endotracheal tube was completed, and anesthesia was maintained at a vaporizer setting of 3% and oxygen flow of 1 L per minute. An infraorbital nerve block was administered with 0.5% bupivacaine[d] (0.1 mL per site) and buprenorphine[e] (0.01 mg/kg IV).

Oral examination was completed on the anesthetized patient, and digital intraoral radiographs were obtained (Figure 1). Mesial luxation of tooth 104 and grade 3 mobility of the tooth were noted. A widening of the periodontal ligament space surrounding tooth 104 was noted radiographically with a vertical fracture of the incisive bone at the diastema between teeth 103 and 104.

An intrasulcular horizontal releasing incision was made, and a full-thickness mucoperiosteal envelope flap was elevated to evaluate the labial alveolar process of the maxillary bone around the tooth being treated. Tooth 104 was atraumatically extracted to avoid any further damage to the alveolar bone. Socket debridement was performed utilizing a curette and copious lavage with sterile saline. Specific sequential implant osteotomy burs[f] in a surgical handpiece with saline irrigation was utilized to prepare the site for implant placement. Digital radiographs and measuring tools were utilized to estimate the width and depth of the dental implant to be placed. Care was taken not to perforate the labial or palatal plates. A 5 mm × 10 mm implant[g] was placed by hand and positioned to place the implant platform subcrestally with a final insertion torque of 45 N·cm as measured with an implant torque wrench (Figure 2). A gap was noted between the coronal aspect of the implant and the socket walls and was filled with injectable bone putty[h] to assist in socket regeneration and to minimize bone resorption.[3-5] A flat healing screw was placed on the implant (Figure 3), and the flap was sutured with 5-0 absorbable monofilament[i] (Figure 4). Recovery was uneventful and the patient was discharged with postsurgical instructions the same day. Amoxicillin/clavulanic acid (62.5 mg every 12 hours)[j] and buprenorphine[e] (0.01 mg/kg orally every 12 hours for 5 days) were dispensed.

Uncovering and Restoration Phase

Six months after implant surgery, the patient was reevaluated for soft tissue healing and implant osseointegration. A similar

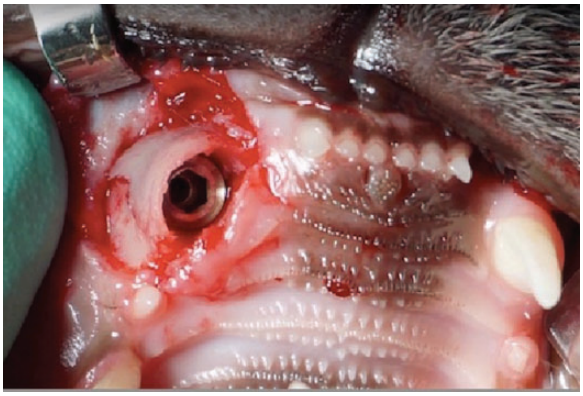

Figure 2. Photograph of implant placed subcrestally prior to cover screw placement and flap closure.

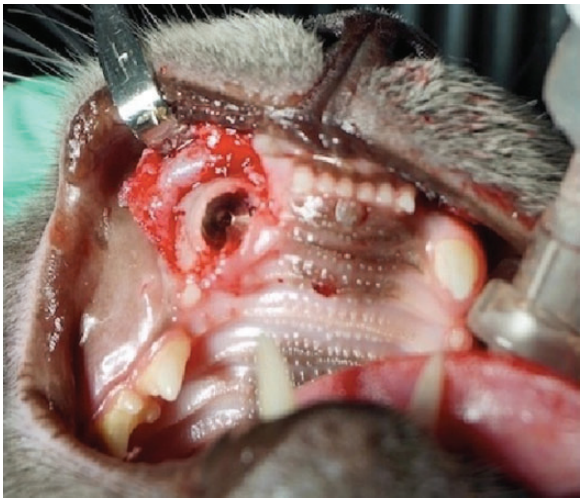

Figure 3. Cover screw was placed into the implant prior to flap closure.

Figure 4. Primary closure of the flap was achieved with interrupted sutures.

Figure 5. Healing abutment placed into the implant to help develop the soft tissue at the punched site.

anesthetic protocol was used as described previously. Dental radiographs were obtained and evaluated. Implant stability and integration were determined to be adequate. A 5-mm tissue punch was used to expose the implant. The cover screw was removed with a hex wrench, and a healing abutment was placed (Figure 5). The patient was discharged to allow the soft tissue to heal for a few weeks.

Three weeks later, the patient returned and the healing abutment was removed. A closed tray impression abutment was inserted (Figure 6) and a radiograph was taken to verify part mating between the parts (Figure 7). [AQ1]Impressions were fabricated with a vinyl polysiloxane (VPS) hand-mixed fast set putty[k] (base and catalyst) and VPS light body fast set impression material.[l] The transmucosal healing abutment was reinserted.[6,7]

The impression was sent to a dental laboratory. An implant analog was attached to the closed tray impression abutment, inserted it into the impression, and a soft tissue stone model was created. The planned prosthetic was waxed up for a palladium single-unit crown/abutment (Figure 8), with the restorative cemented into the implant.

One month after the impressions were made, the patient returned for delivery of the prosthetic crown/abutment component. A similar anesthetic protocol was utilized and the prosthesis was tried in and then cemented into the integrated implant utilizing a dual-cure resin cement[m] (Figure 9). The occlusion was checked with the endotracheal tube removed to look for any abnormal contacts with the prosthetic crown.

The 36-month follow-up demonstrated excellent emergence profile and implant stability with no noted mobility. The emergence profile is the axial contour of the natural tooth or prosthetic crown as it relates to the adjacent soft tissue—a good emergence profile is important to prevent plaque being trapped

Figure 6. Impression abutment has been placed into the uncovered implant following cover screw removal at the punched site.

Figure 7. Radiograph of the impression abutment inserted into the integrated implant to verify mating of the parts. Note lack of radiolucent area around implant and bone in intimate contact with the implant indicating osseointegration. Bone radiodensity is slightly decreased at the alveolar margin, but this proved to be stable at the 36-month visit (Figure 11).

at the soft tissue/crown interface and protect the crestal gingiva from potential recession related to mastication. The gingival tissue was absent of inflammation with no evidence of periimplantitis or mucositis based on periodontal probing and intraoral radiographs (Figure 10A). A periapical radiograph demonstrated stable bone with no osseous loss over the ensuing 36 months since restoration of the implant (Figure 11). The

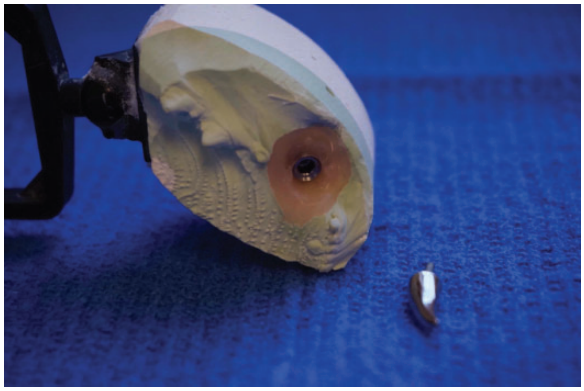

Figure 8. Soft tissue stone model with analog and implant restoration fabricated on it.

Figure 9. Final metal restoration, cemented 7 months after implant placement.

51-month conscious reexamination showed no evidence of inflammation or gingival recession (Figure 10B).

Case 2

A 14-year-old male neutered domestic long-hair cat weighing 7.4 kg was presented for an oral examination. Clinical examination revealed mild generalized calculus and gingivitis, multiple teeth affected by tooth resorption, and a complicated crown fracture of the right maxillary canine (tooth 104).

The treatment plan was discussed with the client. These included dental cleaning and polishing and selective extractions determined by periodontal probing, exploration, and intraoral radiographs. Treatment options for the complicated crown fracture of tooth 104 were discussed after a complete oral examination and intraoral radiographs under general

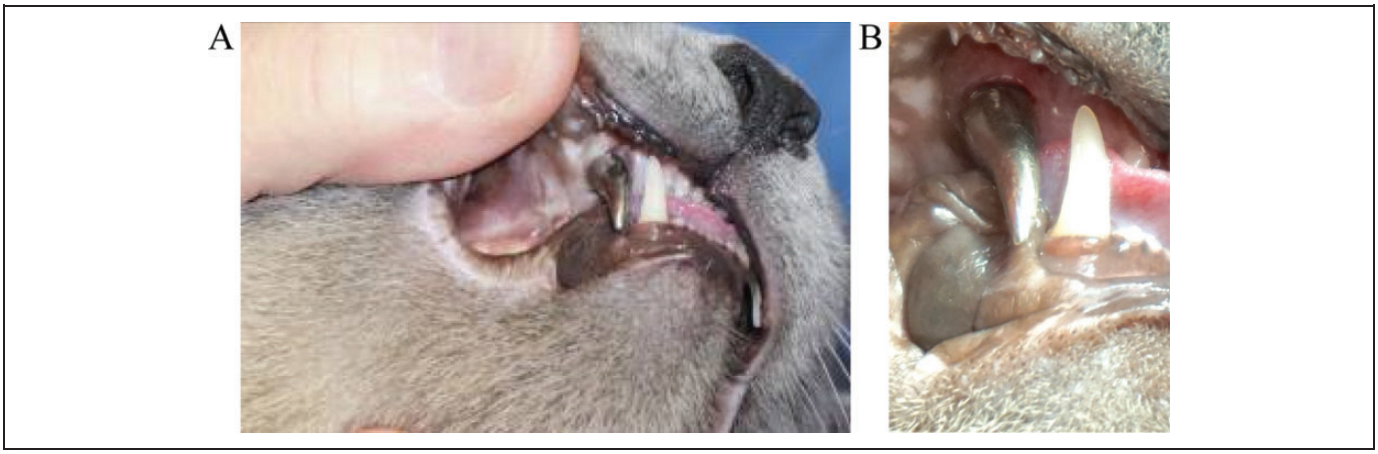

Figure 10. A, Patient at the 36-month postoperative examination demonstrating healthy noninflamed soft tissue around the implant restoration. Probing depths were found to be normal. B, Conscious reexamination 51 months after placement shows no evidence of recession or inflammation.

Figure 11. Radiograph at 36-month postoperative examination demonstrating integration of the implant and stability of the crestal bone level. Also note the healed fracture site.

anesthesia. The fracture appeared to have been present for a long period of time, and buccal alveolar bone expansion was present lateral to the tooth.

Surgical Phase

Prior to the surgical appointment, a complete blood count and serum biochemistry profiles were obtained to check the patient's general health. The patient was premedicated with atropine sulfate[a] (0.02 mg/kg) and acepromazine[b] (0.06 mg/kg) subcutaneously. An IV catheter was placed and lactated Ringer's solution was started at a rate of 3 mL/kg/h. General anesthesia was induced by mask with sevoflurane.[c] Endotracheal intubation was completed and anesthesia was maintained at vaporizer setting of 3% at 1 L/min. Bupivacaine[d] (0.1 mL of 0.5%) was administered as an infraorbital nerve block. Buprenorphine[e] (0.02 mg/kg IV) was administered.

Oral examination and intraoral radiographs were performed. Multiple tooth resorptions were identified and charted. Selective surgical extractions were completed and closed by tension-free tissue flaps at the extraction sites.

Tooth 104 sustained a traumatic fracture with pulp exposure. Labial enlargement consistent with either alveolar osteitis or alveolar bone expansion was present on oral examination. Intraoral radiographs confirmed the diagnosis with secondary root changes, including mottled root appearance, periapical radiolucency, and obliteration of the root canal (Figure 12). The obliterated canal precluded RCT. The owner elected to extract the tooth and place an immediate endosseous implant if possible after tooth extraction and wait 4 to 6 months before final restoration.

A crown reduction was performed on tooth 104 for improved access to the tooth's root. The remaining root was removed while maintaining the labial buccal eminence and preventing damage to the labial crestal bone. A labial envelope mucoperiosteal flap was utilized to maintain good blood supply to the site's bone. A fine diamond[n] with a high-speed, water-cooled handpiece was used to break down the periodontal ligament attachments to the tooth root, making extraction easier (Figure 13). Examination of the alveolus and removal of any inflammatory and granulation tissues were accomplished using a curette. Socket osteotomy was accomplished with an osseodensification drilling protocol known as compaction autografting, which compresses the osteotomized alveolar bone increasing its density. The burs[o] utilized to achieve this rotate counterclockwise at 800 to 1200 rpm, compacting but does not cut bone. This technique has shown to yield better primary stability and superior bone-to-implant contact when the implant is inserted.[8-11] Socket measurements (periodontal probing and intraoral radiographs) were taken and a 5 mm $\times$10 mm implant[g] was inserted subcrestally with a final

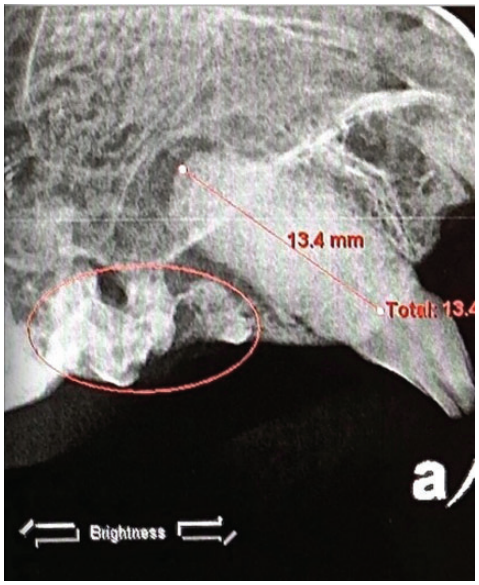

Figure 12. Radiograph demonstrating buccal enlargement consistent with alveolar osteitis or alveolar bone expansion with secondary root changes (external root resorption) of the canine and tooth resorption of teeth 106 and 107.

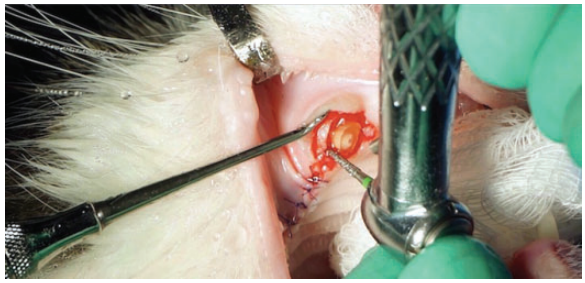

Figure 13. High-speed handpiece and bur used to perform coronectomy on the canine.

insertion torque of 50 N·cm (Figures 14 and 15). A flat healing screw was placed into the implant and the gaps at the crest between the implant and socket walls were augmented with demineralized freeze-dried bone allograft,[p] which had been rehydrated with 2% xylocaine with epinephrine.[q] Flap apposition was made with a combination of simple interrupted and cruciate suture patterns using 5-0 poliglecaprone 25[r] with a reverse cutting P3 needle (Figure 16).

Recovery was uneventful and the patient was discharged with postsurgical instructions the same day. Amoxicillin/clavulanic acid[j] (62.5 mg orally every 12 hours) and buprenorphine[e] (0.01 mg/kg orally every 12 hours for 5 days) was dispensed.

Uncovering and Restoration Phase

Five months after implant placement, the patient returned for the start of the restorative phase and it was noted that the

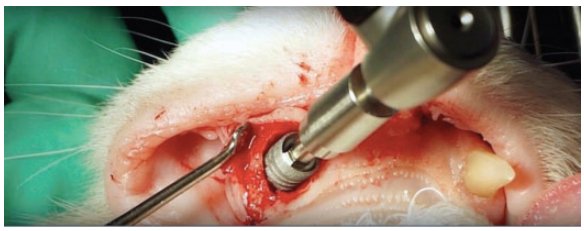

Figure 14. Implant was inserted at low speed with a handpiece into the prepared osteotomy site.

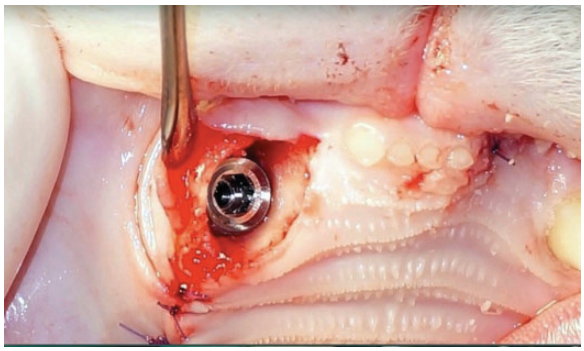

Figure 15. Implant was placed subcrestal to the buccal aspect of the crest.

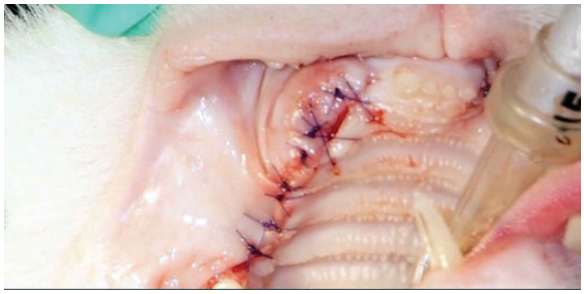

Figure 16. Primary closure achieved of the soft tissue flap with interrupted sutures.

gingival tissues conferring the implant site were not inflamed (Figure 17). A similar anesthetic protocol was administered and intraoral radiographs were obtained to verify osseointegration (Figure 18). A 5-mm tissue punch was utilized to expose the implant cover screw (Figures 19 and 20).

The cover screw was removed and the final implant stability quotient (ISQ) was recorded with a reading of 72 as taken with an instrument that measures resonance frequency analysis. Implant stability quotient is the value on a scale of 1 to 100, which indicates the level of stability and osseointegration in dental implants. Implant stability quotient values are obtained using resonance frequency analysis. Higher values indicate greater stability. The acceptable stability range is considered to be between 55 and 85 ISQ. An implant impression abutment

Figure 17. Photograph taken 5 months after implant placement, the soft tissue demonstrates good health absent of inflammation over the implant.

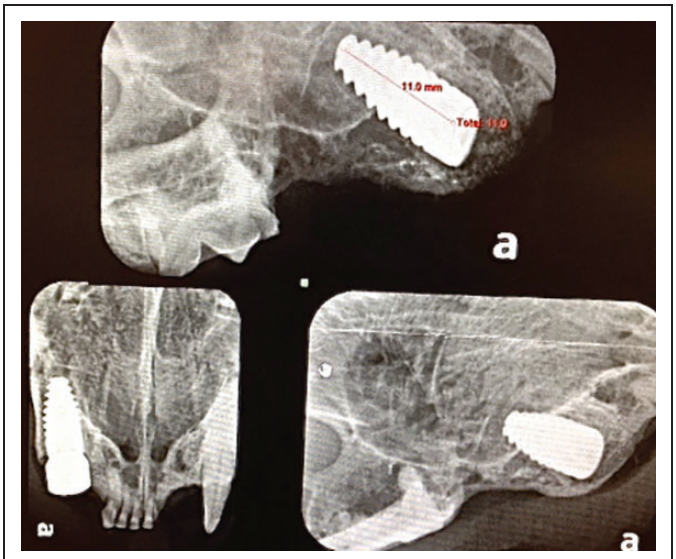

Figure 18. Radiographs demonstrating integration of the implant in the surrounding bone.

Figure 19. Tissue punch utilized to uncover the implant and initiate the restorative phase.

Figure 20. Implant has been uncovered and cover screw was removed.

Figure 21. A, Impression abutment (bottom left) placed into the uncovered implant ready for impression to be taken. B, Healing abutment (top right) placed into the implant to allow soft tissue development until the prosthetics is ready to insert.

was secured to the implant (Figure 21A). Vinyl polysiloxane impressions were obtained as in case 1. The impression abutment was detached and a healing abutment (5 mm × 5 mm) placed into the implant to begin the tissue emergence profile development (Figure 21B). It is crucial to develop and maintain healthy keratinized tissue around the implant to have stable soft tissue long term. This aids in minimizing bone resorption and inflammatory reaction around the prosthetics under function.[6,7]

The VPS impressions were sent to the dental laboratory, and a soft tissue stone model was created with the implant analog within the model and scanned to create a virtual model (Figure 22). The final components, a custom anodized metal abutment and a solid zirconia crown, were designed digitally and CAD/CAM milled (Figure 23)[AQ2].

One month after impressions were made, the patient returned for delivery of the final restorative components. The patient was anesthetized with the same protocol utilized in the prior procedures. Intraoral radiographs were obtained to verify

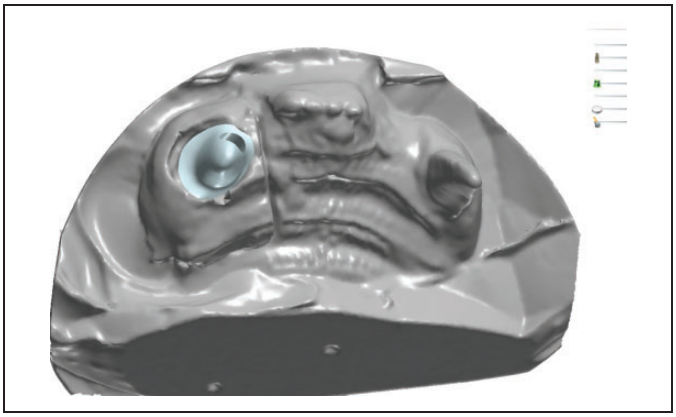

Figure 22. Virtual model with screw-retained implant custom abutment present ready for CAD/CAM milling[AQ3].

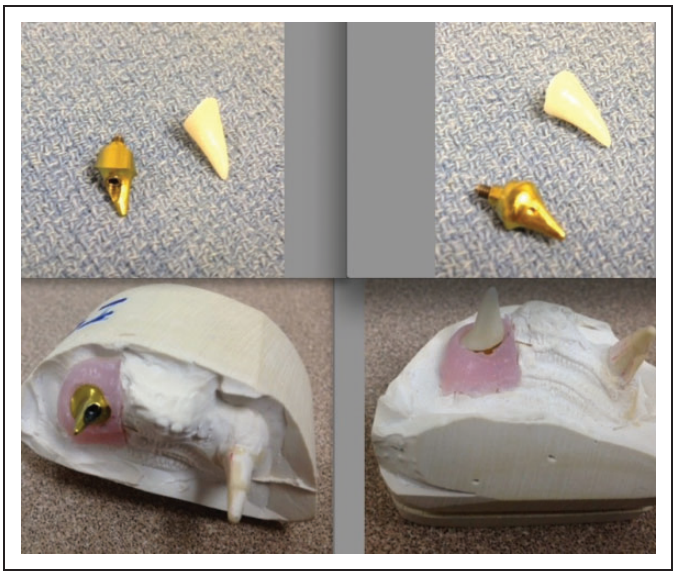

Figure 23. CAD/CAM gold anodized abutment and zirconia crown shown on and off the physical model.

the proper seating of the abutment to the implant (Figure 24). After verification, the abutment screw was hand tightened and checked with the torque wrench (20-25 N·cm) as per manufacturer's recommendation. Teflon tape was placed over the abutment screw to seal the screw access holes in screw-retained implant restorations and prevent cement from filling the screw's hex. This product can be found in any hardware store. Traditionally, a cotton pellet has been used for this purpose, but this may harbor bacteria over time and it has been replaced by Teflon tape in human implant treatment[AQ4]. It also simplifies removal if you need to reenter the screw hole to remove or retighten the screw. Teflon tape can also be utilized as retraction cord and to isolate teeth during cementation. The zirconia crown was cemented[m] to the abutment. The occlusion was checked with the endotracheal tube removed to look for any abnormal contacts with the prosthetic crown.

The patient was seen 7 months after restoration, demonstrating the exceptional results with noninflamed gingiva noted

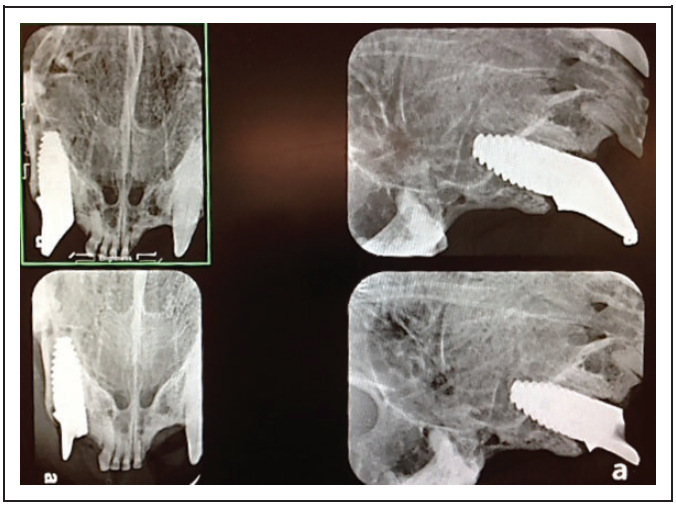

Figure 24. Radiograph of the custom CAD/CAM milled abutment intraorally to verify fit of the implant.

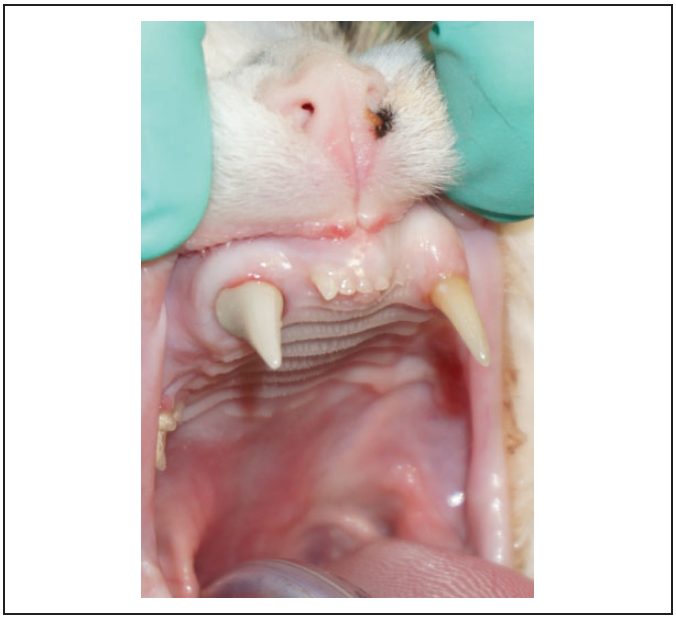

Figure 25. Photograph taken 7 months after restoration of the implant demonstrating healthy noninflamed soft tissue around the implant restoration.

surrounding the implant restoration (Figure 25). The same observation was observed at a recall appointment 14 months after restoration (Figure 26). Standard implant home care instructions as described with the previous case were given to the pet's owner.

The patient at 28 months post implant restoration presented with chronic vomiting and associated abdominal pain. Blood test demonstrated pancreatic enzymes had tripled, indicating severe pancreatitis with a final diagnosis of pancreatic neoplasia. The owner chose not to pursue further diagnostics or necropsy and elected to euthanize the animal. Permission was given to examine the implant site following euthanasia as part

Figure 26. Photograph taken 14 months after restoration of the implant demonstrating healthy noninflamed soft tissue around the implant restoration.

Figure 27. Patient at 28 months post implant restoration following euthanasia due to medical issues following flapping of the implant site demonstrating no crestal bone loss. This patient received brushing with a gauze pad of this area no more frequently than twice weekly.

of the primary author's ongoing study of implant success in felines. A full-thickness flap was elevated and bone was present at the crest of the implant with no discernable bone loss during the ensuing 28 months (Figure 27). The owner did not allow for histopathology of the implant site.

Discussion

Cats are obligate carnivores and use their teeth for prehending, tearing, and dissecting their food. Mastication is the first step of digestion, aiding in the lubrication of food and formation of a bolus. Mastication also increases the surface area of the food to be initially digested by salivary enzymes before being more easily swallowed. The teeth are specialized structures that play an important role in mastication, grooming, supporting the lips and the tongue, as well as being used as weapons for hunting and for self-defense. Although cats can survive with few or no teeth at all, losing teeth can influence the types of foods that can be eaten and will affect the ability to masticate and process the food prior to swallowing.

Dental implants in companion animals should be considered experimental under real-world conditions strictly due to the lack of clinical case series documenting success with long-term follow-up. However, since nearly all the human implantology research has been performed on dogs and cats, there is ample experimental documentation of use in these species. Some veterinarians have recommended that under no circumstances should dental implants be placed in dogs and cats due to a number of reasons including a lack of any formal training programs in implantology.[12] The authors would agree that most veterinarians have little or no training in dental implant placement and would also agree that the placement of dental implants without any formal and rigorous training carries a number of unacceptable risks to the pet and the owner. The cost of implant hardware and diagnostic tools is also a consideration. In many cases, the principal author is placing immediate implants with the future option of the crown restoration being done by utilizing complete digital treatment planning (compared to older methods of direct wax-ups). With digital treatment planning, the laboratory creates the soft tissue model and subsequent castings utilizing advanced computer-aided techniques with extraoral scanning and CAD/CAM design. This computer-aided process provides more precise restorative results than the wax/cast traditional methods employed in the past.

In humans, placement and restoration of dental implants is regarded as a very predictable procedure with long-term survival of implant/crowns if maintenance protocols are strictly followed. As with any procedure performed in companion animals, there has to be a detailed discussion with the pet's owner to obtain informed consent. Based on this information and the predictability of a particular procedure, it is up to the owner to make the final decision. Other treatment options need to be discussed with the owner, and when available, success rates should be incorporated into this discussion. Currently, success rates of dental implants and some other dental procedures in companion animals have not been well established. It must be said that most animals can adequately manage without teeth and that tooth extraction is a predictable procedure (but not always complication free) when dealing with a compromised tooth. Some of the risks and complications associated with dental implants can include perforation into an anatomical structure or space with endosseous drills or the implant, postoperative bleeding, swelling, or infection causing early loss of the implant.

In both cases described here, detailed postoperative instructions were discussed and home care directives were provided. This included type of food to be fed and avoidance of hard play toys. Alteration in the patient's diet to soft foods and avoiding dry food during the initial 4 to 6 weeks following restoration of the implant allowed the patient to adapt to having the tooth for function. Dry cat food was then reintroduced to the diet. These dietary recommendations allow progressive loading of the implant, providing increasing stimulation to the bone

surrounding the implant and its restoration and avoid accidental overloading.

Early loss of the implant is seen due to failure of osseointegration, whereas the medium-/long-term loss of the implant/crown is often due to poor or nonexistent home care. In case 1, the patient benefited from exceptional home care including daily soft brushing with periodontal brushes to keep the interface of the gingival margin and crown clean. The patient in case 1 was an outdoor hunter and continues to hunt with no problems. The patient in case 2 received less frequent home care in the form of brushing with a gauze pad twice weekly at the most. Also, trauma to the implant/crown and/or the supporting bone due to lack of restriction to hard objects is a potential complication.

A lack of adequate training of the clinician would be considered an important risk factor when placing dental implants. Pain after implant placement, at least in man, is described as being generally mild and decreasing over time.[13] It is the opinion of the authors that this would be also true in companion animals, and the degree of pain that would be expected in implant placement is similar to that experienced following a surgical tooth extraction. Appropriate management of pain and potential infection is warranted when placing dental implants.

Antibiotics given in food or given orally on opposite side of the surgical site was considered safer and more practical than daily home care of the actual surgical site, since most cats will not be still for daily home care of a painful surgical site. Therefore, antibiotics were prescribed for the initial few days following implant placement to keep oral bacteria at a lower level, hopefully decreasing potential for initiation of peri-implantitis before the incision has healed.

Dental implants are not an inexpensive treatment, but in both of these cases, the owners were presented with the available treatment options and the owners made their decision to proceed with the implant placement and subsequent prosthetic restoration. Home care may be an important component of success. The patient in case 1 received exceptional home care, including daily soft brushing with a periodontal brush to keep the gingival margin and crown clean. The patient in case 2 received soft brushing with a water-soaked gauze pad no more than twice weekly.

Conclusion

Dental implants were a viable long-term treatment option in the 2 cats described in this article. The best approach seems to be immediate implant placement at the time of extraction to maintain the surrounding osseous structures and prevent collapse of the labial buccal plate that may result when a delayed placement approach is undertaken. With careful treatment planning and informed owner consent, implants placed into the canine area to replace a fractured or badly damaged tooth can restore the feline to normal function. Thus far, the authors have placed 21 implants in 15 feline patients (14 of which have been restored), and no integration failures have been observed to date. Long-term results have shown implants and crown restorations can be maintained without adverse periodontal sequela or crown fracture. Continued follow-up of these cases is ongoing.

Materials

a. Atropine sulfate, MWI Veterinary Supply, Boise, Idaho.
b. Acepromazine, MWI Veterinary Supply, Boise, Idaho.
c. Sevoflurane, MWI Veterinary Supply, Boise, Idaho.
d. Bupivacaine, Benco Dental, Tucson, Arizona.
e. Buprenorphine, MWI Veterinary Supply, Boise, Idaho.
f. Osteotomy burs, OCO Biomedical, Albuquerque, New Mexico.
g. Engage implants, OCO Biomedical, Albuquerque, New Mexico.
h. Fusion Bone Putty Veterinary Transplant Services (VTS), Kent, Washington.
i. Monocryl, Ethicon, Somerville, New Jersey.
j. Clavamox, Zoetis, Parsippany, New Jersey.
k. Valuline putty, Benco Dental, Tucson, Arizona.
l. Valuline wash, Benco Dental, Tucson, Arizona.
m. BisCem, Bisco Inc, Schaumburg, Illinois.
n. BluWhite Diamond, Kerr Dental, Orange, California.
o. Densah burs, Versah LLC, Jackson, Michigan.
p. Feline Periomix, Veterinary Transplant Services, Kent, Washington.
q. Xylocaine with epinephrine, Benco Dental, Tucson, Arizona.
r. Securocryl, Securos Surgical, Fiskdale, Massachusetts.
s. Osstell ISQ, Osstell USA, Columbia, Maryland.[AQ5]

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