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CASE REPORT

Feline Dental Implants: New Paradigm Shift in Maxillary Cuspid Extraction Treatment Planning

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ABSTRACT

Felines are obligate carnivores and use their teeth for prehending as well as tearing and dissecting their food. Mastication is the first step of digestion, aiding in the lubrication of the food and the 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 which 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 some mammals can still survive with few or no teeth at all, cats included, losing teeth can influence the types of foods that can be eaten, and will affect the ability to masticate and processing of the food prior to swallowing.

Dental Implants have become an option for replacement of lost canines in these animals. Although cats appear to manage well after a canine extraction, complications such as lip entrapment can occur, especially after maxillary canine tooth extraction. Even cats with a complicated crown fracture of the maxillary canine tooth that have had root canal therapy to preserve the tooth, can still suffer from lip entrapment. This can lead to painful lip ulcers and the need for further dental treatment. Today, canine tooth replacement with a dental implant/crown is a predictable option that can be offered to clients who would like to replace a lost canine tooth. This report will discuss two long term cases of lost maxillary canines and replacement by dental implant/crowns.

Keywords: Canine tooth, Dental homecare, Dental implant, Maxilla, Osseointegration, Prosthetic crown.

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INTRODUCTION

Felines (cats) are by nature carnivores, and as such their diet reflects that. It is accepted that diet affects health, and the ability to eat can have negative effects on the diet and, thus, general health. Implants have become an option for replacement of lost canines in these animals. This allows the animal to maintain the level of mastication found in those felines who have normal oral health and, thus, permit better nutrient uptake as well as psychological maintenance of the animal. We will discuss two cases of lost maxillary canines and implant treatment to replace the lost teeth.

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CASE REPORTS

Case 1

A 4.5-year-old male neutered Russian Blue cat weighing 11.5 pounds was referred for multiple bite wound evaluation and a luxated R maxillary canine tooth (#104) of 3-day duration. On initial examination, there were multiple bite wounds with deep penrose drains in place, bruising, and abrasions in the inguinal areas. The sites were stable. Also, the R maxillary cuspid was luxated with a slight mesial deviation, mobility, and pain.

All treatment options were considered with the owner of the pet. These included: Stabilization of the luxated tooth followed by endodontic treatment in 2 to 3 months, extraction of the canine and no replacement, or extraction with immediate implant placement provided the alveolar process and vault were intact, and primary stability of the implant could be attained. After discussion with the feline's owner, reviewing the pros/cons of the different treatment options, they chose to have the canine extracted and implant placement.

The authors believe all three options have their own inherent complications. The owner did not desire having a cat without prominent anterior tooth. As the owner is a well-educated engineer, after analysis of the options, he made an informed decision.

The lead author has performed numerous stabilization and endodontic treatment cases with luxated canines in dogs with relatively good results. In his experience, a figure 8A and B wire around the canines and use of acrylic or spot cure with some flowable composite have not been a positive experience for cats with luxated canines. They typically do not tolerate the procedure very well. With a fracture as presented in this case, the maxillary right cuspid (tooth #104) was not very stable and can be a challenge for maintaining proper occlusion. Even with the best intentions, possible periodontal ligament devitalization and endodontic treatment being attempted in 2 to 3 months, a very good possibility of root resorption complication exists.[1] Additionally, extraction and immediate

implant placement can also be problematic. However, it is less problematic than attempting to stabilize the luxated canine with subsequent endodontic treatment.

At the time surgery was performed, all past immediate implants in cats have integrated and no integration failures have been observed during long-term follow-up. If the implants are not restored (put to sleep), the buccal osseous morphology is well maintained, preventing a traumatic episode with the ipsilateral canine. Implant placements in these situations are becoming more predictable with happy owners and patients.[2]

SURGICAL PHASE

The patient was premedicated with atropine sulfate (1/120 grain; 1 mL/20#; subcutaneously: VetOne, Boise, Idaho) and acepromazine (10 mg/mL; 0.02–0.05/#; subcutaneously; VetOne). Atropine is given before anesthesia to decrease mucus secretions orally, and has the added benefit of regulating heart beat during sedation. Acepromazine is a common tranquilizer and central nervous system depressant given to pets. It is also used to prevent anxiety associated with thunder, fireworks, vet, or groomer visits.

General anesthesia was induced by mask with sevoflurane (vaporizer #7, O_2 at 4 L/min) (VetOne). Oral tracheal intubation was completed and anesthesia was maintained at vaporizer setting #3, O_2 1 L/min following feline anesthetic protocol (FAP).

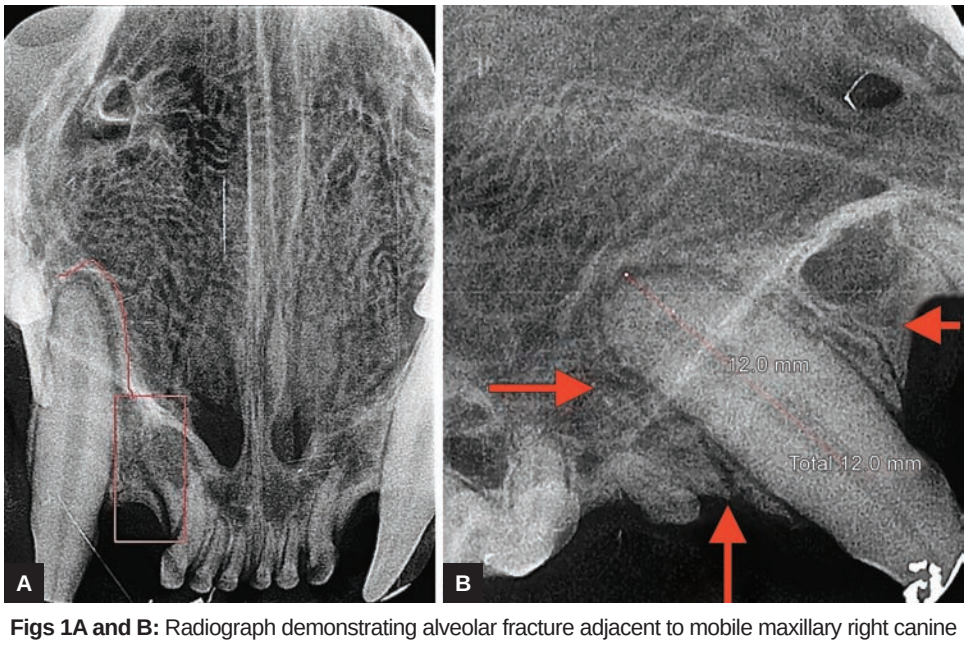
A complete oral exam and digital posteroanterior radiographs were obtained. A luxation of tooth #104 and some mobility was noted. Additionally, a widening of the periodontal ligament space with a vertical fracture of the incisive bone at the diastema of teeth 103/104 was observed (Figs 1A and B).

A sulcular full-thickness medial plantar flap was elevated to evaluate the alveolar process of the maxillary bone. The canine tooth (#104) was atraumatically extracted to avoid any further damage to the alveolar socket and surrounding bone. Socket debridement was performed and copious levage was complete with 0.9% NaCl (VetOne). The site was prepared to accept a 5.0 × 10 mm Engage implant (OCO Biomedical, Albuquerque, NM, USA), which was subsequently placed into the osteotomy and positioned subcrestally with a final insertion torque of 45 Ncm. The crestal gap between the implant and socket was filled with fusion bone putty (Veterinary Transplant Services, Kent, Washington, USA) to assist in socket regeneration and minimize bone resorption.[3-5] A cover screw was placed and the flap repositioned to achieve primary closure with 5-0 resorbable monofilament sutures (Securos Surgical, Fiskdale, MA, USA) (Figs 2A to C). Recovery was uneventful and the patient was discharged with postsurgical instructions the same day. Clavimox (62.5 mg/mL at 1 mL bid) (Zoetis, Florham Park, NJ, USA), a broad-spectrum antibiotic, and buprenorphine (0.1 mL bid orally for 3–5 days) (Reckitt Benckiser Health care, Parsippany, NJ, USA), an opioid pain reliever, were dispensed to the owner.

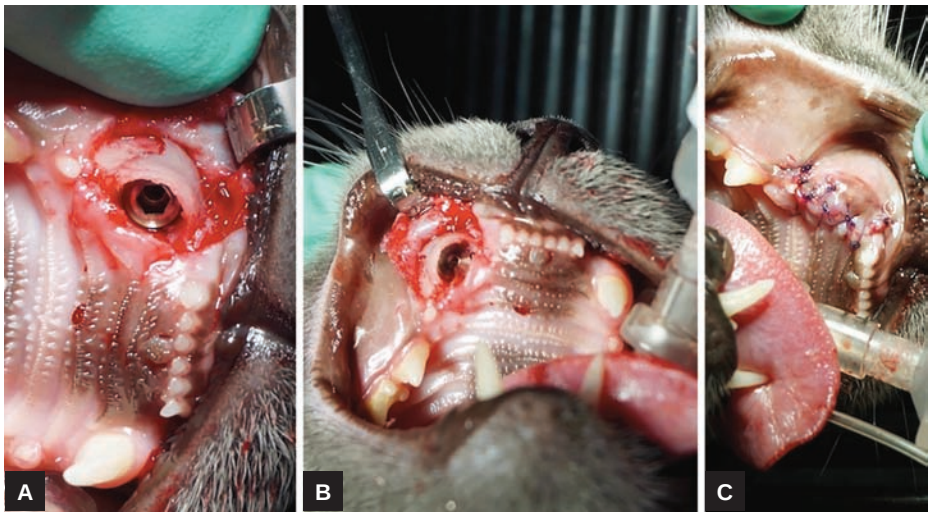
UNCOVERING AND RESTORATION PHASE

At 6 months postinsertion, the patient was reevaluated for soft tissue healing and osseointegration. The FAP was again utilized as in the surgical phase. Dental radiographs were evaluated, and implant stability and integration were determined to be adequate.

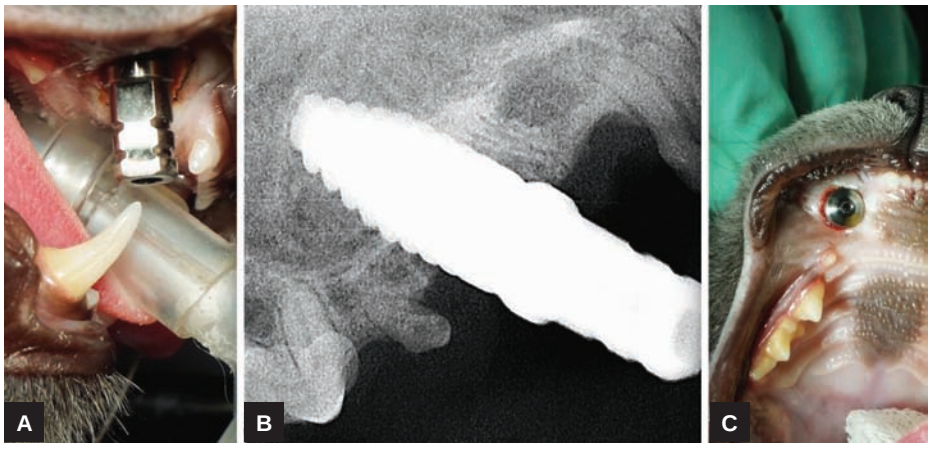
A tissue punch was used to expose the implant head preserving adequate attached gingiva on the buccal.



Figs 1A and B: Radiograph demonstrating alveolar fracture adjacent to mobile maxillary right canine



Figs 2A to C: Implant placed into osteotomy at immediate extraction site at the right maxillary canine with buccal flap (A and B) and primary closure of the site (C)



Figs 3A to C: Closed tray impression coping placed into the implant (left) (A), radiograph to verify part mating (center) (B) and healing abutment placed (right) (C)

The cover screw was removed and closed tray implant impression abutment was placed (OCO Biomedical) and a radiograph taken to verify proper mating of the impression head to the implant (Figs 3A and B). Impressions were fabricated with a fast set VPS hand mix putty and a fast set light body VPS impression material (Benco Dental Supply, Tucson, Arizona, USA).

A transmucosal healing abutment (OCO Biomedical) was placed to ensure proper emergence profile to support the future prosthetic components[6,7] (Fig. 3C). The impression was sent to the dental lab (Doks Dental, Tucson, Arizona, USA), and a soft tissue stone model was fabricated with analogs embedded within. The planned prosthetic was waxed up for a palladium implant restoration, which would be luted into the implant (Fig. 4).

At 1 month postimpressions, the patient returned for delivery of the implant restoration. The FAP was again utilized and the prostheses was tried in and then was cemented into the integrated implant utilizing a self-adhesive resin cement (BisCem, Bisco Inc., Schaumburg, IL, USA) (Fig. 5).

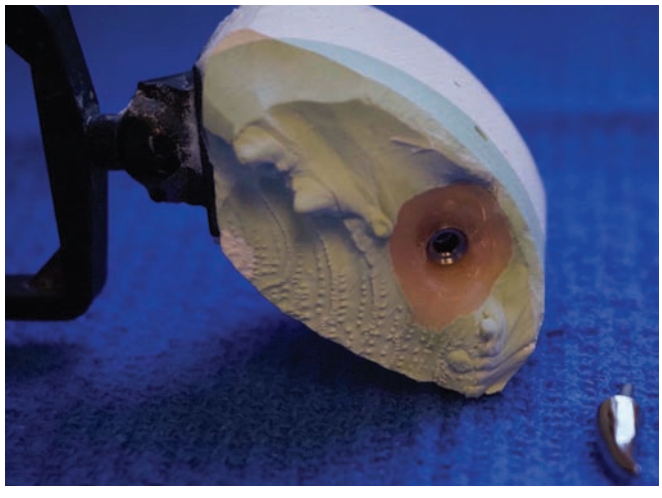
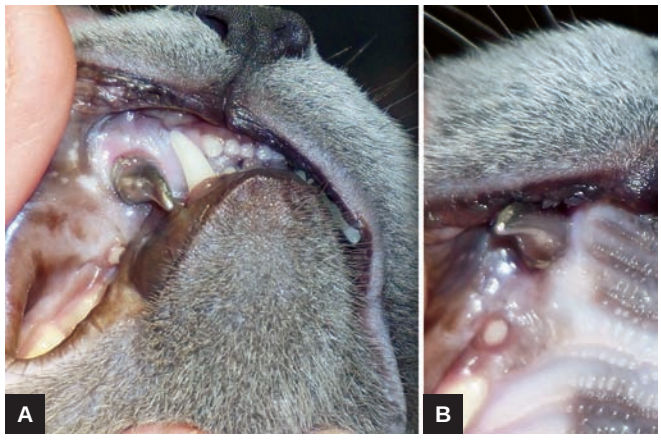


Fig. 4: Soft tissue model with analog and completed cast abutment–crown ready for cementation into the implant intraorally

The 26 months follow-up demonstrated excellent emergence profile, implant stability, with no evidence of peri-implantitis or soft tissue inflammation surrounding the implant restoration (Figs 6A, B and 7).

Fig. 5: Completed and luted abutment–crown intraorally



Figs 6A and B: Case 26 months postinsertion of the abutment–crown demonstrating good gingival health with a lack of inflammation

Fig. 7: Radiograph at 26 months postinsertion demonstrating maintenance of bone at the same level as at insertion with no evidence of peri-implantitis

Case 2

A 14.3-year-old male neutered domestic longhair cat weighing 16.2 lbs presented for an oral examination. Generalized calculus and gingivitis were noted, as well as multiple feline oral resorptive lesions (FORLs), and a complicated crown fracture of the right maxillary canine (#104).

Initial treatment options were discussed with the owner, which included: Scaling and root planning to treat the generalized periodontal condition and selective extractions determined by the initial probing and dental radiographs. The fractured canine treatment would be discussed after a complete oral examination, and radiographs were completed under a general anesthesia. The right maxillary canine (#104) fracture appeared to have been present for a long period with some definite buccal bone changes related to the fracture.

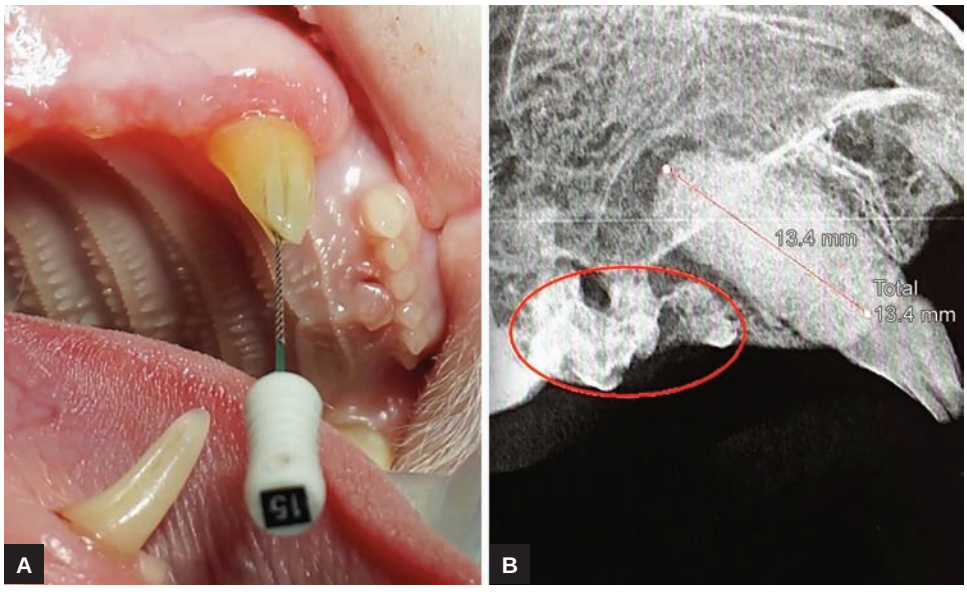
SURGICAL PHASE

Patient was premedicated with atropine sulfate (1/120 grain; 0.2 mL subcutaneously) (VetOne) and acepromazine (10 mg/mL; 0.05 mL subcutaneously) (VetOne). General anesthesia was induced by mask with sevoflurane (Vaporizer #7/O_2 at 4 L/min) (VetOne). Oral tracheal intubation was completed and anesthesia was maintained at vaporizer setting #3/O_2 at 1 L/min following FAP.

A complete oral exam and dental radiographs were obtained. Multiple FORLs were noted and charted. The FORLs are common in cats and are similar to cervical external resorptive lesions in humans. These teeth typically have a poor prognosis and require extraction to treat them. Selective surgical extractions were successfully completed, while tension-free tissue flaps placed at the extraction sites to achieve primary closure.

The right maxillary canine (#104) had sustained a prior traumatic fracture with pulp exposure. Definite buccal enlargement consistent with alveolar inflammation (osteitis) was present. Radiographs confirmed the diagnosis with secondary root changes evident (Figs 8A and B). Endodontic treatment would have been an option; however, the root morphology and sclerotic canal would be problematic. As in case 1, the owner elected to extract the tooth and place an immediate endosseous implant, if possible, and wait 4 to 6 months before a final restoration could be placed. The author in many cases is placing immediate implants, with the future option of restoration utilizing digital treatment planning. Using these advanced computer-aided techniques (extraoral scanning, computer-aided design, and computer-aided manufacturing (CAD CAM) design and milling), the final results have proven to be exceptional compared with the traditional methods of VPS impression taking and wax-cast restorations.

A coronectomy was made on the right maxillary canine (#104) for easy access of the tooth root. It is imperative to remove the remaining root while maintaining the buccal eminence. A mini envelope flap was utilized to maintain a good blood supply to the crestal bone. A fine diamond burr (#FG 703) (Benco Dental) in a high-speed water-cooled drill was used to detach the periodontal ligament, making luxating and extraction

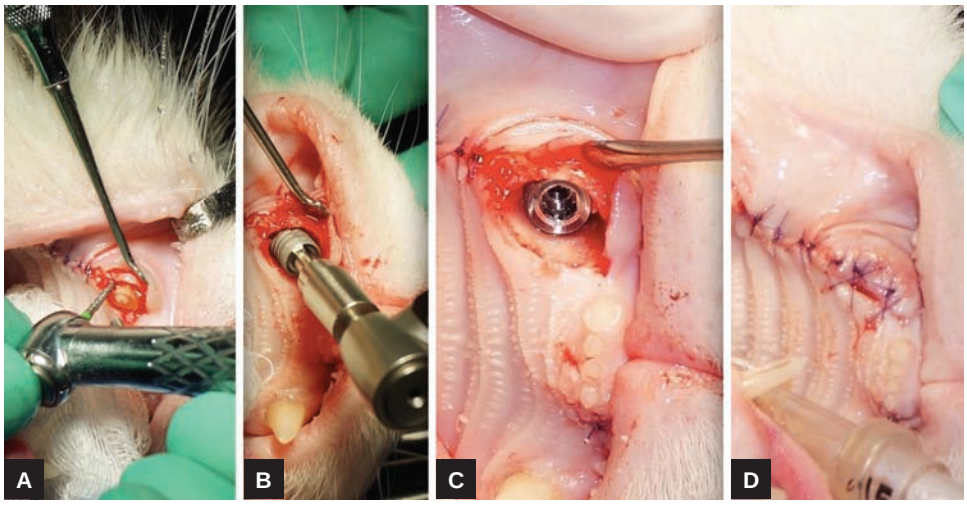


Figs 8A and B: Clinical examination with endodontic file in the right maxillary canine (left) (A) and radiograph demonstrating apical pathology at the mobile tooth (right) (B)

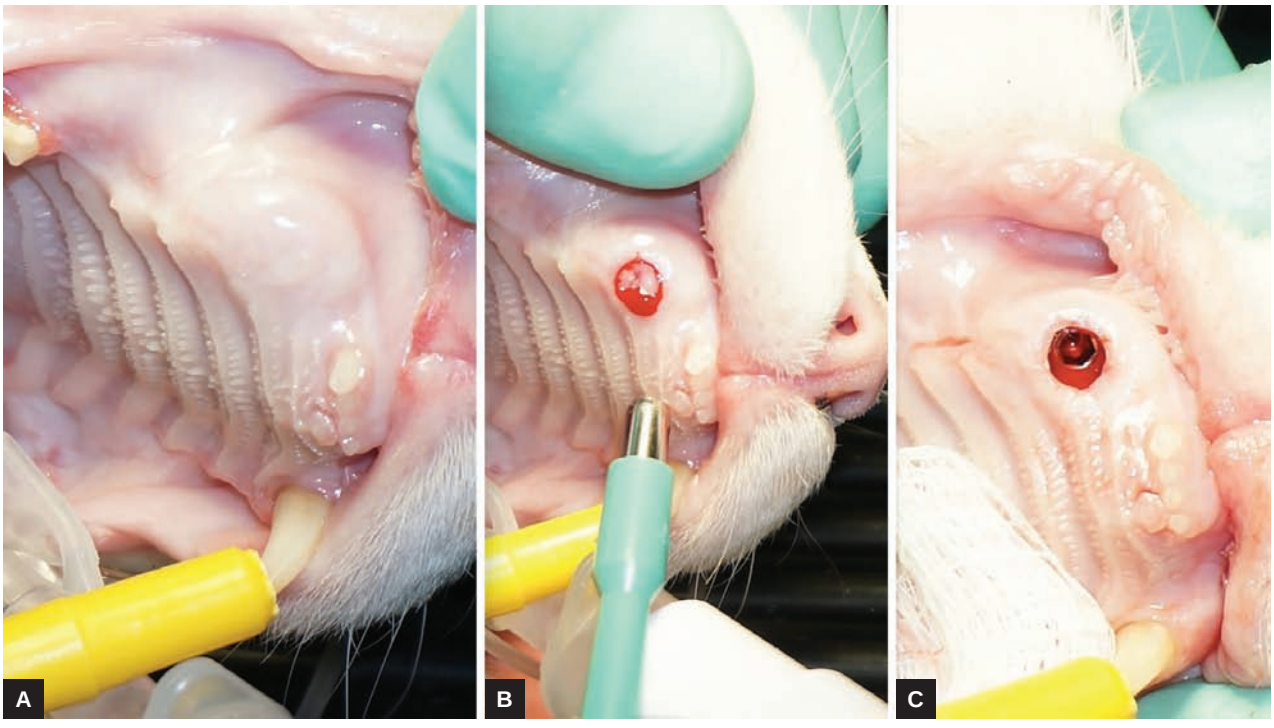
a simpler process with less risk of alveolar fracture (Fig. 9A). Examination of the socket was performed and removal of any inflammatory granulation tissue was accomplished with a curette and fissure burr. Socket measurements (probing and radiograph) were obtained, and the site was prepared to accept a 5.0 × 10 mm Engage implant (OCO Biomedical), which was inserted subcrestally with a final insertion torque of 50 Ncm (Figs 9B and C). The crestal gaps between the implant and osteotomy were augmented with feline periomix, a demineralized freeze-dried bone allograft product (Veterinary Transplant Service, Kent, Washington, USA), which was rehydrated with 2% xylocaine with 1:50,000 epinephrine (Dentsply, York, USA). Flap apposition was made to achieve primary closure with a combination of simple interrupted and cruciate suture patterns. Suture material was 5-0 securocryl with a reverse cutting P3 needle (Securos Surgical, Fiskdale, MA, USA) (Fig. 9D). Recovery was uneventful and the patient was discharged with postsurgical instructions the same day. Clavimox (62.5 mg/mL for 1 mL bid) (Zoetis) and buprenorphine (0.1 mL bid orally for 3–5 days) Reckitt Benckiser Health Care) were dispensed.

UNCOVERING AND RESTORATION PHASE

At 5 months postimplant placement, the patient returned for the start of the restorative phase (Fig. 10A). The FAP was administered and radiographs were obtained to



Figs 9A to D: Diamond being used on the residual root (A) to atraumatically extract the root, implant being inserted into the osteotomy (B), implant placed subcrestally (C), and site closed by primary intention (D)



Figs 10A to C: Patient at initiation of restorative phase showing lack of inflammation at previously placed implant (A), tissue punch being used to expose the implant (B), and uncovering of the cover screw (C)

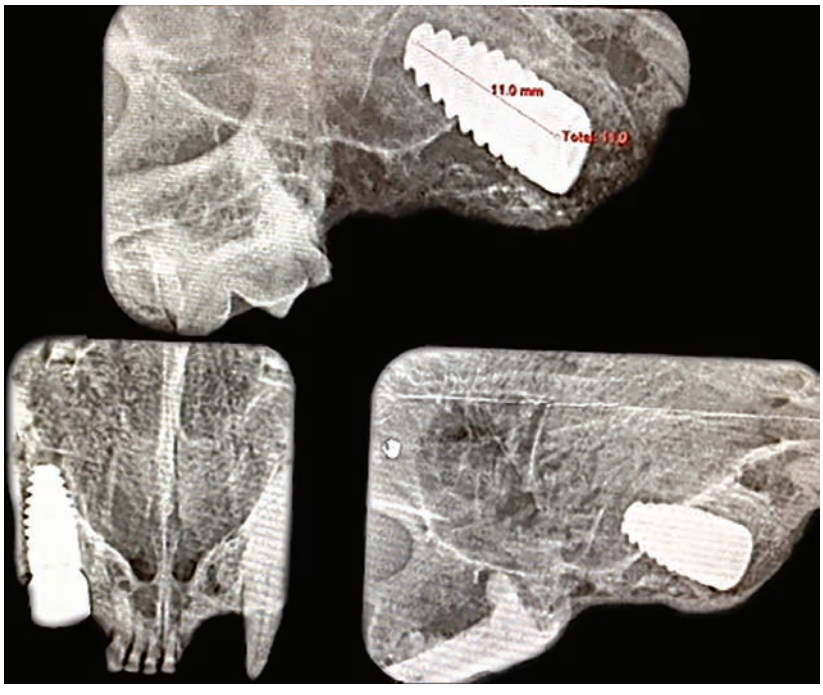


Fig. 11: Radiograph of the implant at initiation of the restorative phase (top and bottom right) and after placement of healing abutment (bottom left)

verify osseous integration (Fig. 11). A tissue punch was utilized to expose the cover screw and it was removed from the implant (Figs 10B and C). It is crucial to develop and maintain healthy keratinized tissue (KT) at the healing abutment site. This KT will minimize bone resorption and inflammatory reaction around the prosthetics.[6,7] A closed tray impression coping was secured to the implant (Fig. 12 left) and VPS impressions are obtained. The impression coping was removed intraorally and a healing abutment was placed (OCO Biomedical) to develop the tissue emergence profile (Fig. 12 right).

The impressions were sent to the dental lab (Precision Ceramics, Montclair, CA, USA) and a soft tissue stone

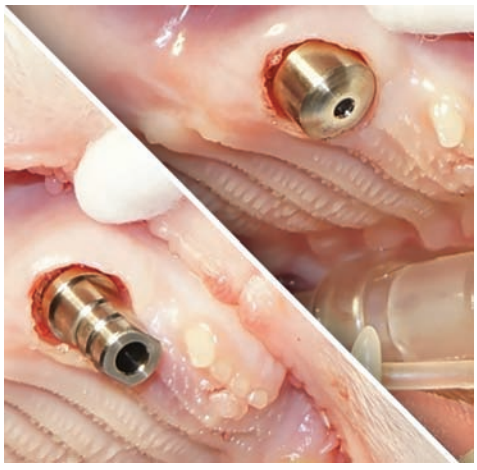


Fig. 12: Closed tray impression head placed onto implant to take impression (bottom left) and healing abutment in place (top right)

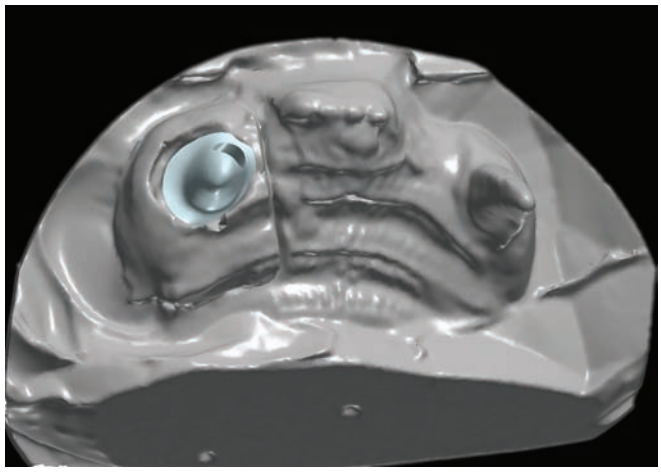
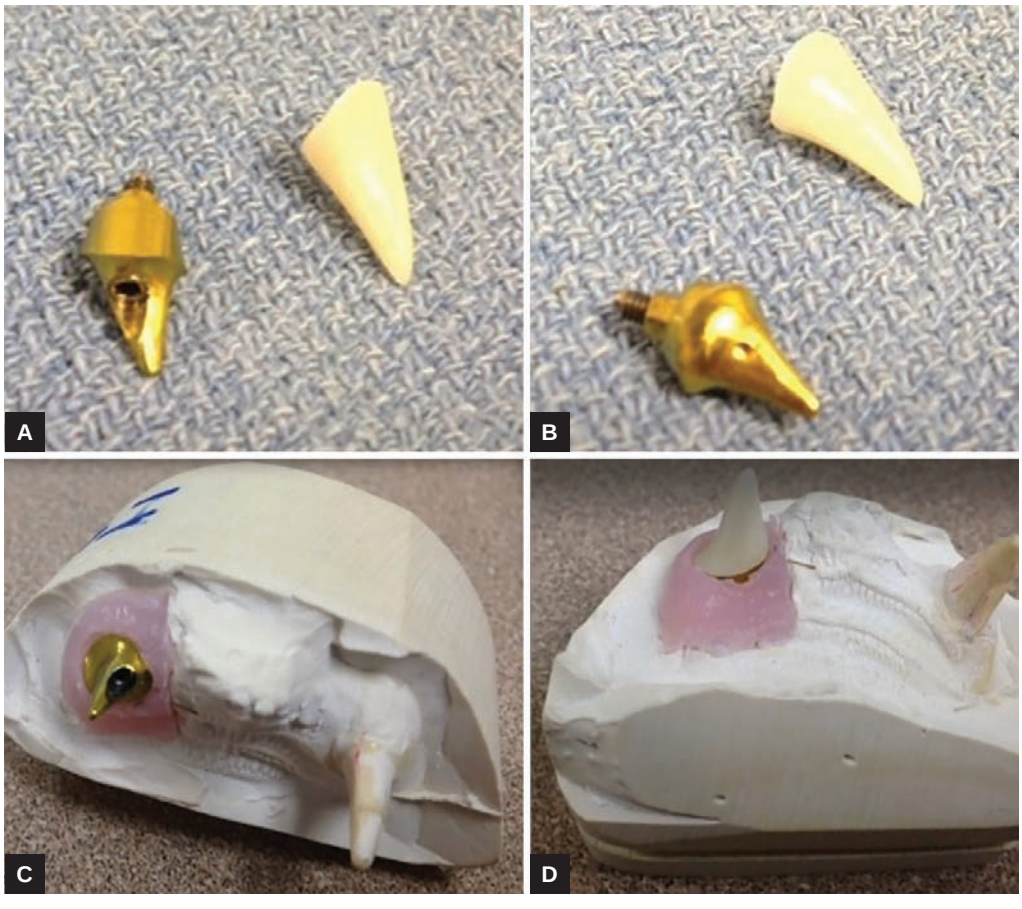


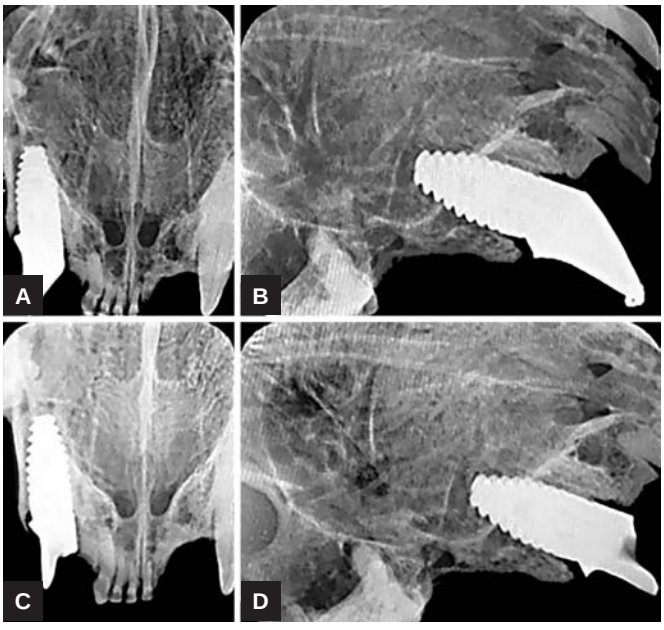
Fig. 13: Virtual cast with analog created using digital scanning of the soft tissue model ready for virtual design of the restoration



Figs 14A to D: Completed CAD/CAM metal abutment and zirconia crown (A and B) and the abutment on the soft tissue model (C) and with crown inserted over the abutment (D)

model was created with the implant analogs within the model. The final restoration would be a custom-anodized abutment and solid zirconia crown to be luted to the abutment. The soft tissue model was digitally scanned and designed virtually (Fig. 13). The abutment was CAD/CAM milled, and then the zirconia crown was milled to fit the abutment (Figs 14A to D).

One month postimpressions, the patient again returned for delivery of the final components. Patient was anesthetized following the same protocol utilized at the prior appointments. Radiographs were obtained to verify the proper seating of the abutment into the implant (Figs 15A to D). After verification, the abutment screw was hand tightened and checked with the torque wrench for the manufacturer recommended 30 Ncm. The zirconia crown was cemented to the abut-



Figs 15A to D: Radiographs at abutment placement to verify part mating at insertion appointment

Fig. 16: Completed restoration 7 months postinsertion demonstrating a lack of soft tissue inflammation

Figs 17A to C: Completed restoration 10 months postinsertion demonstrating a lack of soft tissue inflammation

ment utilizing BisCem (Bisco, Inc.) and the prosthetics were complete.

The patient was seen for several postoperative appointments. At the 7- and 10-month visits, photos demonstrated exceptional results with this paradigm shift in the treatment of nonrepairable fractured maxillary cuspids in this cat (Figs 16 and 17A to C).

CONCLUSION

Replacement of lost canines in felines assists in the animal maintaining a better diet, allowing them to better masticate food. This allows the animal to gain proper nutrients from their food, which will help maximize their overall health and lifespan. Additionally, as the animal is able to chew normally, they have a better psychological well-being, leading to a happier animal, which enhances their quality and ultimately quantity of life.

Digital treatment planning has made a dramatic change in the way dental implants can be incorporated into our canine and, especially, our feline patients. This provides easier treatment by the practitioner, yielding a superior product as compared with traditional methods previously utilized as discussed in case 1. As with human patients, treatment options need to be provided with the pros/cons for each, and allow the animal's owner to make an informed decision on the care to be rendered.

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