Original Study

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Radiographic Outcome of Vital Teeth Treated with Prosthodontic Crowns in Dogs: 26 Cases (2015-2017)

Grace K. Brown, DVM[1], Katherine Kling, DVM, DAVDC[2], Michael Balke, DVM, FAVD, DAVDC[1], and Lisa Fink, DVM, DAVDC[1]

Abstract

This retrospective study evaluated the effects of prosthodontic crown placement on tooth vitality. Prosthodontic crown placement may be indicated for vital teeth affected by attrition, abrasion, uncomplicated crown fractures, enamel defects, and enamel hypoplasia. This study evaluated 26 vital teeth in 17 patients at the time of crown placement and after 1-year following crown placement. Dental radiographs were used to determine vitality of the 26 teeth. Twenty-five teeth were found to be vital and 1 tooth was non-vital 1-year after crown placement. These results demonstrated that tooth vitality was maintained after titanium alloy crown placement to treat crown attrition, abrasion, uncomplicated crown fractures, and enamel defects.

Keywords

vital tooth, dogs, prosthodontics, titanium, alloy crown

Introduction

Traumatic tooth injury is a common complication in dogs with a reported prevalence of 27% in canine patients.[1] Traumatic dental injury in both dogs and cats is often a result of automobile accidents, fighting with other animals, and falling from heights.[2] Most of the cases regarding this publication occurred due to dogs chewing on inappropriate objects. A vital tooth is a tooth with healthy pulp tissue and normal blood supply to the tooth. In a study of Military Working Dogs, the most common fracture type reported was enamel–dentin fractures at 40.1%.[3]

The currently approved therapy for fractured teeth with exposed pulp is vital pulp therapy when a fracture occurs less than 48 hours from the inciting trauma especially in a patient less than 2 years of age.[4] However, after 48 hours or an unknown duration of pulp exposure, root canal or extraction are more acceptable treatment recommendations.[3,5–10] Full coverage titanium alloy crowns have been shown to improve the long-term prognosis for vital and endodontically treated teeth in humans. The placement of full veneer crowns provides protection for a fractured or severely abraded tooth.[11]

Materials and Methods

All teeth included in this study were treated by placement of full metal titanium alloy crowns. The crowns were fabricated at Creative Dental Laboratory, Inc; based on fine impressions collected at the time of crown preparation. Crown preparations were made with a 0.5 mm axial wall removal and a chamfer margin. A round ended torpedo-shaped diamond bur or similar sized round ball diamond bur (size 016)[a] was used to cut the initial margin using half the diameter of the ball to create the chamfer configuration. The bur type was selected by the veterinary dentist or veterinary resident under the supervision of a board-certified veterinary dentist. The margin was evaluated for a smooth finish. The margins were constructed to ensure the full metal crown was to be seated 1 mm above the gingival margin to prevent adverse effects of periodontitis during the life of the restoration. Bulk tooth reduction was performed using a coarse, round-end, tapered diamond bur[b] and the axial walls were reduced to equal the depth of the margin.

When the crowns returned from the dental laboratory, they were closely examined to ensure they had been accurately cast. The tooth which received the crown was prepared by removing calculus and plaque with nonfluorinated pumice paste. Fluoride minerals may reduce restorative bonding ability and were therefore avoided. The crown restoration was trial fitted with the patient anesthetized prior to cementation to ensure proper fit.

The application of metal primer is a pretreatment agent for conditioning the metal and was used to ensure adhesive

[1]Arizona Veterinary Dental Specialists, Scottsdale, AZ, USA
[2]Veterinary Dental Center, Aurora, IL, USA

Corresponding Author:
Grace K. Brown, Lake County Veterinary Clinics, 557 Scenic Drive, Two Harbors, MN 55616, USA.
Email: gracebrowndvm@gmail.com

capability between the resin and dental alloy. The teeth were acid etched with 40% phosphoric acid left for 10 seconds, rinsed with water, and dried. The tooth was then primed with primer at room temperature prior to application. The cement was mixed according to manufacturer's directions and applied to the inside of the metal crown and the crown was pressed firmly on the tooth which was then light cured for 20 seconds. Finally, the application of an oxygen blocking gel was placed around the base of the crown for 3 minutes then rinsed and rubbed with a clean gauze square.[11] The cement used in this study was resin-based cement[c].

Medical Records and Inclusion Criteria

A medical record search selecting for canine patients receiving prosthodontic crown placement on vital teeth was conducted from 4 private practice veterinary dentistry specialty clinics and spanned a 3-year period (2015-2017). Dogs which had received full metal titanium alloy crowns on vital teeth and had returned for subsequent follow-up evaluation were considered for the study.

To meet inclusion criteria, dental radiographs at the time of treatment and at the time of reassessment 1 year or greater following treatment were required to be available for comparison. Factors which were documented were the tooth affected, indication for crown placement, and whether vital pulp therapy was performed. Additional information that was obtained from medical records included signalment, weight, clinical signs, and physical exam. Patients with incomplete medical/dental records, lacking re-examination and/or radiographs 1-year post procedure were excluded.

Tooth vitality was determined via intraoral dental radiographs. Vital teeth with indication for crown placement had the following conditions: abrasion, uncomplicated crown fracture, uncomplicated crown root fracture, vital pulp therapy, enamel hypoplasia, and cage biting abrasion. Seventeen dogs with a total of 26 crowns placed on vital teeth were identified and evaluated. Treatment was determined to have maintained tooth vitality when re-evaluation radiographs indicated normal periapical tissue, no widening of the periodontal ligament, and previous resorption unchanged from initial treatment date.

Treatment Procedure

All prosthodontic crown placements were performed by a board-certified veterinary dentist or by a veterinary resident directly supervised by a diplomate. Prosthodontic crowns were full coverage titanium alloy crowns. The treatment method used has been previously described in the veterinary literature.[12] All crown therapy procedures were performed in 2 visits. The first visit included prophylaxis, crown preparation, and creation of impressions. The second visit was for crown cementation.

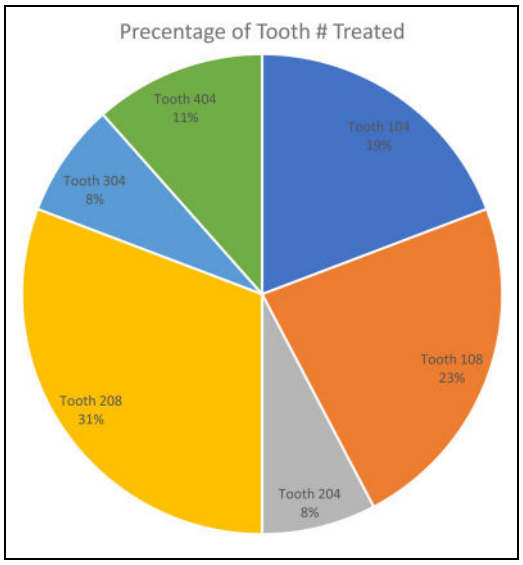

Figure 1. Percentage of teeth which received full metal titanium alloy crowns. Tooth 208 had the highest incidence of damage compared to teeth 204 and 304, whose incidence was only 8%. Abbreviations: 104, Right maxillary canine tooth; 108, Right maxillary fourth premolar tooth; 204, Left maxillary canine tooth; 208, Left maxillary fourth premolar tooth; 304, Left mandibular canine tooth; 404, Right mandibular canine tooth.

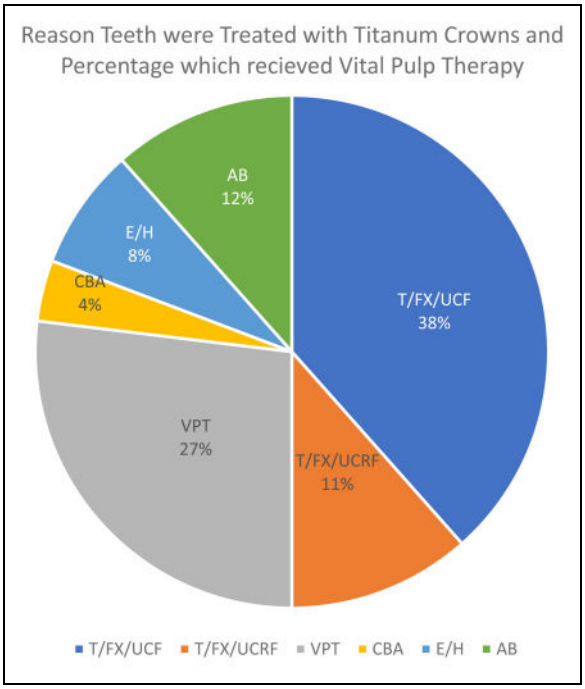

Figure 2. Percentage of teeth receiving titanium crowns by fracture or disorder type and percentage receiving vital pulp therapy. Uncomplicated crown fractures were the most prevalent. Abbreviations: AB, Abrasion; E/H, Enamel Hypoplasia; CBA, Cage Biting Abrasion; VPT, Vital Pulp Therapy; T/FX/UCRF, Uncomplicated Crown-Root Fracture; T/FX/UCF, Uncomplicated Crown Fracture.

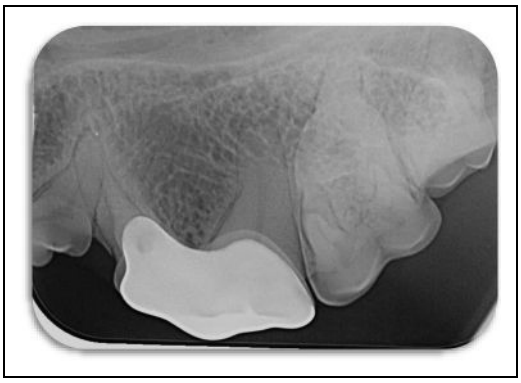

Figure 3. Follow-up radiograph of tooth 208 obtained 2 years after crown cementation. The tooth remained vital.

Figure 4. Photograph showing a full coverage metal alloy crown on tooth 304 1 year after crown cementation on a complicated crown fracture after treatment with vital pulp therapy (see Figure 5 for corresponding dental radiograph).

Radiographic Valuation and Diagnostic Criteria

Treatment was determined to have had no effect on vitality when re-evaluation radiographs indicated normal periapical tissue, no widening of the periodontal ligament, no noted periapical root resorption and pretreatment external inflammatory root resorption (EIRR) if present, was unchanged in size on follow-up.[13] A tooth was determined to be non-vital by observing widening of the periodontal ligament space after treatment or worsening of existing EIRR.

Radiographic images were collected via computed radiography (CR)[d] and reviewed by 4 evaluators which included 1 veterinary dental resident, 2 board-certified veterinary dentists located at Arizona Veterinary Dental Specialists, and 1 board-certified veterinary dentist located off site. Each evaluator reviewed radiographs collected for the 26 patients both on the day of treatment and on the day of reassessment.

Results

The initial search from January 2015 to January 2017 resulted in 42 dogs with a total of 55 prosthodontic crowns placed on vital teeth. All 42 dogs had complete medical records and intraoral dental radiographs and could be evaluated retrospectively. Re-examinations, including dental radiographs, were not available for 25 dogs that had a total of 29 prosthodontic crowns placed. Of those 25 dogs, 3 patients were deceased and the remaining declined recheck and radiographic interpretation after contacting the owners by calling, emailing, and texting. Therefore, the medical and dental radiographs of 17 dogs that had a total of 26 prosthodontic crowns were evaluated.

Figure 5. Radiograph of teeth 304 and 404 treated with vital pulp therapy due to cage biting abrasion. These teeth also received full coverage metal alloy crowns.

Of the 17 dogs in the study and the 26 full metal crowns, 21 crowns were placed on maxillary teeth and 5 placed on mandibular teeth. Twelve teeth which received treatment were canines and 14 were maxillary fourth premolars (Figure 1). The recommendation and reason for a full metal crown were due to abrasion (3), uncomplicated crown fracture (10), uncomplicated crown-root fracture (2), enamel hypoplasia (2), cage biting abrasion (4), and vital pulp therapy (5) (Figure 2). There was one case which had a full coverage crown placed that developed periapical lucency (PAL) at the time of follow-up. This was marked as the only non-successful case by 3 of the 4 reviewers. EIRR was noted in 5 of the treated teeth and was unchanged on recheck radiographs. Twenty-five of 26 teeth which were treated with prosthodontic full metal crowns remained vital (Figures 3 to 6).

Discussion

Seventeen canine patients were evaluated that had 26 teeth treated with full metal titanium alloy crowns. The objective of

Figure 6. Radiograph of teeth 304 and 404 from Figure 5, 1 year after crown placement. These teeth continued to mature appropriately and therefore remained vital.

the study was to determine if full metal titanium crown placement risks vitality of a tooth for which the protection of the tooth is indicated but the tooth in question has not previously been treated by root canal therapy. Of the 26 teeth treated, all but 1 remained vital based on dental radiographs evaluated 1-year after crown placement suggesting that vitality is unlikely to be affected by full coverage crown placement on vital teeth.

The primary limitation of this study was the large number of patients that were lost to follow-up. The limitation is inherent to retrospective investigations. The initial review of medical records revealed 55 cases; however, due to incomplete records or lack of follow-up, only 17 patients with 26 teeth had complete necessary follow-up and were included in the study. It is possible that success may be overestimated based on the use of intraoral radiography alone. Investigations into the use of cone beam computed tomography (CBCT) has shown it to be more sensitive than intraoral dental radiography,[14] and further studies using this modality are indicated.

Crown placement has long been studied for its implications and recommendations for placement after endodontic therapy have been made. Crown placement may reduce microleakage associated with the restoration site which has been demonstrated to lead to endodontic failure and the protection by a crown may also aid in increasing the strength and integrity of the tooth following endodontic treatment.[8] To the authors' knowledge the application of full metal titanium alloy crowns on vital teeth has not been studied in veterinary patients previously.

Vital pulp therapy was included in this study as this is an acceptable treatment option for teeth which have complicated crown fractures occurring within 48 hours of presentation,[4] for incidence of pulp exposure during debridement of deep carious lesions, or to be performed in conjunction with crown reduction for traumatic malocclusion in both dogs and cats.[15] The application of vital pulp therapy includes maintaining the viability of Hertwig's epithelial root sheath and allows for continued root growth and root-end closure. Viable odontoblasts produce additional layers of dentin to strengthen the root and provide a natural dentin barrier or bridge between viable pulp and pulp dressing material. In this study all vital pulp treated teeth received mineral trioxide aggregate (MTA) as dressing material. The duration of pulp exposure is an important factor when determining likelihood of success of vital pulp therapy and in this study vital pulp therapy was offered only in instances where upon crown fractures had occurred 48 hours or less from the time of treatment.[4,16] The 7 teeth which had vital pulp therapy and full metal titanium crowns were determined to be vital by all 4 reviewers when assessed 1 year or greater after treatment.

The results of this study suggest that prosthodontic crown placement on vital teeth is unlikely to negatively impact the vitality of the tooth. Prosthodontic crown placement may clinically benefit vital teeth affected by attrition, abrasion, uncomplicated crown fractures, enamel defects and enamel hypoplasia.

Materials

(a) 801-016 M, Maxima Diamond, Henry Schein, Melvill, NY.
(b) 850L-016-12 ML, Gold Diamond, Diatech USA, Mt. Pleasant, SC.
(c) Panavia F 2.0, Kuraray Medical Inc., Okayama, Japan.
(d) CR7 Vet, iM3, Vancouver, WA.

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Declaration of Conflicting Interests

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ORCID iD

Grace K. Brown https://orcid.org/0009-0003-1537-9711

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