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Table of Contents

11 Localized Ridge Augmentation using Titanium Mesh with Alloplast and Simultaneous Implant Placement: A Case Report
Dr. Lanka Mahesh, Dr. Dildeep Bali, Dr. Vishal Gupta, Dr. Taran Preet Singh

21 Treatment of a Central Giant Cell Granuloma of the Mandible
Robert Schneider, Steven L. Fletcher, Kyle M. Stein

31 The Effects of Reinforcement on the Fracture Rates of Provisional All-On-4 Restorations: A Retrospective Report of 257 Cases Involving 1182 Dental Implants
Dr. Dan Holtzclaw
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Table of Contents

39 Effect of Root Support versus Implant Support on the Biting Force of Attachment Retained Mandibular Overdentures
Dr. Maha W. Elkerdawy,
Dr. Nancy N. Elsherbini

47 Comparative Analysis of User Generated Online Yelp Reviews for Periodontal Practices in Multiple Metropolitan Markets
Dr. Dan Holtzclaw

59 Analysis of Online Review Characteristics and Filtering Rates for User Generated Yelp Evaluations of Periodontal Practices in a Major Metropolitan Market
Dr. Dan Holtzclaw
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Implant placement in the atrophic anterior part of the maxilla was once a difficult task. Many procedures have been developed over the years for reconstruction of the alveolar ridge to enable implant placement. Alveolar ridge augmentation along with guided bone regeneration has been introduced in recent years to re-establish an appropriate alveolar ridge width. In guided bone regeneration, the quantity of bone regenerated under the membranes has been demonstrated to be directly related to the amount of the space under the membranes. This space can diminish as a result of membrane collapse. To avoid this problem, a new technique of ridge augmentation, which involves the use of a titanium mesh barrier to protect the regenerating tissues and to achieve a rigid fixation of the bone segments is been used. In this case, excellent results can be seen in which maxillary anterior defect is augmented using guided bone regeneration with simultaneous placement of implant at the site 11 (FDI Tooth Numbering System) using alloplast graft material protected by titanium mesh.

**KEY WORDS:** Oral tumors, dental implants, CAD/CAM frameworks, partial mandibulectomy, central giant cell granuloma, grafting

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INTRODUCTION

Resorption of the edentulous or partially edentulous alveolar ridge or bone loss due to periodontitis or trauma frequently compromises dental implant placement in a prosthetically ideal position. Therefore, augmentation of an insufficient bone volume is often indicated prior to or in conjunction with implant placement to attain predictable long-term functioning and an esthetic treatment outcome.1 These deformities can lead to complications in attempts for the restoration of related areas. In recent years there has been an increase in the number of studies focusing on the augmentation of these atrophic ridges either before or at the time of implant surgery.2-6 Predictable bone regeneration of large alveolar defects with complex morphology can pose a significant clinical challenge. Preservation or creation of a soft tissue scaffold needed to create the illusion of a natural tooth is often challenging and difficult to achieve.7 A subtle mistake in the positioning of the implant or the mishandling of soft or hard tissue can lead to esthetic failure and patient dissatisfaction.8-10

Autogenous bone grafts are still considered the gold standard in bone regeneration procedures.11 However, donor site morbidity, unpredictable resorption, limited quantities available, and the need to include additional surgical sites are drawbacks related to autografts that have intensified the search for suitable alternatives. Bone-substitute materials have increased in popularity as adjuncts to or replacements for autografts in bone augmentation procedures to overcome the limitations related to the use of autografts. Bone-substitute materials can be categorized in three groups: (1) allogenic, from another individual within the same species; (2) xenogeneic, from another species; or (3) alloplastic, synthetically produced.

The technique of guided bone regeneration (GBR) was evolved to augment atrophic or damaged ridges.11 GBR employs a physical barrier to selectively allow new bone growth into the space created between the barrier and the existing bone.12 The emergence of synthetic bone substitutes for grafting should enable today’s practitioners to perform an almost endless variety of procedures that involve the repair or regeneration of alveolar bone around dental implants or natural teeth. Such materials must satisfy various regulatory requirements and meet clinicians expectations for safety and effectiveness.13 It has been shown that an expanded polytetrafluoroethylene membrane can be used to improve the healing of both pathologic and experimentally created defects.14 The rationale of using a titanium mesh is to contain and stabilize the graft, allowing maximum bone regeneration and minimizing overall loss of bone volume. Various forms of titanium mesh have been successfully used to rigidly maintain the alveolar contour with different types of grafts. Graft materials such as alloplast in combination with membranes enhance success of the treatment of bone defects.

CASE REPORT

A 19-year-old male reported with missing maxillary right central incisor. The patient gave history of trauma due to accident which resulted in loss of maxillary right central incisor. On clinical examination, deficiency in the anterior residual alveolar ridge with loss of buccal cortical plate was noted. The patient was in good health and was a non-smoker with no medical contraindications for surgery, with excellent oral hygiene and a strong desire to restore the area with a fixed prosthesis. On examination there were no clinical signs of
periodontitis and dental caries. Radiographically the clinical findings were verified and revealed vertical and horizontal bone loss that was limited to the maxillary right central incisor (Fig 1).

**TREATMENT PLANNING**
The patient was presented with different treatment options, after discussing the pros and cons of each the following treatment option was planned to receive an implant supported crown restoration after augmentation of the compromised alveolar ridge in the area of missing tooth 11 using alloplast bone graft secured with titanium membrane. Fixed partial denture was planned for replacing mandibular central incisors because of patient’s economic problems. Nonetheless, he gave informed consent for the same.

**TREATMENT PROCEDURE**
A local anesthetic was administered in the area of the maxillary right upper central incisor. An incision was made on the buccal and palatal aspect of the involved edentulous ridge and a full thickness flap was reflected from tooth 12...
to tooth 21 and bone defect was found deficient both horizontally and vertically (Fig. 2). The Osteotomy was created under copious irrigation on surgical site. A Kelt implant of 3.8x11.5mm (Bioner, Barcelona, Spain) was inserted at 35 Ncm (Fig. 3). Approximately 1 cc of calcium phosphosilicate (CPS) alloplast morsels (NovaBone, Alachua, FL, USA) (Fig. 4) was mixed with sterile saline and allowed to hydrate before being placed and packed into the defect and positioned to fill all void areas. A titanium mesh (Fig. 5) was trimmed to size and placed under the facial flap following the GBR protocol to secure the bone graft in its place and was fixated with the cover screw of the implant. Extensive periosteal releasing incisions were made in the facial flap and permit complete coverage of the membrane. Primary wound closure was obtained by horizontal mattress and interrupted polytetrafluorethylene (PTFE) 4-0 sutures (Osteogenics Lubbock, Texas, USA). Oral hygiene instructions were given to the patient.

The patient was seen post surgically after two weeks for suture removal and no untoward post-operative symptoms were noted. The patient was put on a two week, one month, three month and six month recall ensuring the proper management of implant site. An interim fixed Maryland bridge was resin bonded during the healing phase. After 5 months, prior to second stage surgery a cone-beam computed tomography (Fig. 6) was performed and a horizontal bone gain of 5.3 mm was noted (Fig 7). The patient was recalled for second stage surgery where the titanium membrane was removed and the healing collar placed (Fig. 8). Following three weeks, upper and lower impressions were made with Impregum (3M ESPE, St. Paul, Minnesota, USA). The final prosthesis was then delivered (Fig. 9). The radiographic image after final prosthesis (Fig. 10).

**DISCUSSION**

A differential diagnosis to the cause of the problem associated with the patient’s maxillary right central incisor was ambiguous. The patient did present with a history of trauma but the typical findings of wounds, injuries to the oral mucosa, fracture of the tooth, pulp exposure, displacement and mobil-
ity were not evident. The patient did report displacement but it would be difficult to conclusively state that as the reason for the problems. Another diagnosis could be localized aggressive periodontitis which exhibits itself typically with small amounts of plaque, mobility and migration of the molars and incisors, increase in the size of the clinical crown and rapid progression. Despite the inconclusive etiology, the diagnosis of a hopeless tooth was made on sound clinical signs and symptoms.

Alternate treatment modalities to our treatment plan included a removable partial denture, Figure 6: Post-surgical CBCT scan.
fixed partial dentures and resin bonded bridges (Maryland bridges). Removable partial dentures while an option can contribute to the loss of alveolar bone on both abutment and non-abutment teeth\textsuperscript{17} along with that the dissatisfaction rate of removable partial dentures is relatively high.\textsuperscript{18} On the other hand the use of fixed partial dentures would have required the unnecessary destruction of adjacent teeth to prepare them as abutments and loss of pristine tooth structure. Another option would be a resin bonded bridge, which would reduce the amount of adjacent tooth destruction. However, with a high incidence of pontic failure and debonding,\textsuperscript{19} we felt an implant would have been the best option.

Using the classification system proposed by Funato et al. 2007,\textsuperscript{20} the site in this case was Class IV which is characterized by vertical and buccal bone loss. It was thus necessary to perform bone and tissue augmentation so that optimal gingival profiling and a more esthetic result could be achieved.

Reconstruction of defects in the anterior part of the maxilla to enable implant placement is a challenging treatment. The alveolar ridge augmentation along with GBR has been introduced in recent years to re-establish an appropriate alveolar ridge width. Bone regeneration in membrane protected defects heal in a sequence of steps that stimulated bone for-

\begin{figure}[h]
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\caption{Pre and post-surgical CBCT scans for comparison.}
\end{figure}
formation after tooth extraction. After blood clot formation, bone regeneration is initiated by the formation of woven bone initially along new blood vasculature at the periphery of the defect. The woven bone is subsequently replaced by lamellar bone, which results in mature bone anatomy. Ultimately, bone remodeling occurs with new, secondary osteons being formed.

Bone graft materials have been used to facilitate bone formation within a given space by occupying that space and allowing the subsequent bone growth. The biologic mechanisms that support the use of bone graft materials are osteoconductivity, osteoinduction, and osteogenesis.

Barrier membranes are biologically inert materials that serve to protect the blood clot and prevent soft tissues cells (epithelium and connective tissue) from migrating into the bone defect, allowing osteogenic cells to be established. Vertical increase of a narrow alveolar crest has been shown to be possible with membranes.21,22 Membranes have been manufactured from biocompatible materials that are both non resorbable and resorbable. The advantage of a titanium barrier membrane (non-resorbable) is its ability to maintain separation of tissues over an extended time. Unless the barrier is exposed, it can remain in place for several months to years but it requires a subsequent surgical procedure to remove them.

Bone augmentation and simultaneous implant surgery procedures allow clinicians to reconstruct alveolar bone deficiencies, preserve alveolar dimensions, and replace missing teeth with dental implants in a prosthetically driven position with natural appearance and function. The two year clinical results obtained in this case demonstrate CPS alloplast with GBR along with simultaneous implant placement to be a predictable and successful procedure to augment bone at sites exhibiting insufficient bone volume for implant placement under standard conditions and proved to be a successful strategy for anterior esthetic rehabilitation.

CONCLUSION
Placing dental implants in the maxillary anterior...
region requires precise planning, surgery, and prosthetic treatment. This article has illustrated the steps needed to create ideal aesthetics in the maxillary anterior region. Rigorous treatment planning allows the implant surgeon, working with the restorative dentist, to select location, angulation, and spacing of dental implants to achieve ideal aesthetics. Treatment planning also dictates the necessity for hard- and soft-tissue grafting, which is often crucial for an ideal aesthetic result. Further, the prosthetic restoration of a dental implant must be ideal to achieve the desired aesthetic result. This article has discussed the importance of a comprehensive and interdisciplinary approach to treatment planning, surgery, and restoration of dental implants in the maxillary anterior region of the mouth.

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Disclosure
The authors report no conflicts of interest with anything mentioned in this article.

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Removal and restoration of oral/dental tumors require multidisciplinary treatment planning and are very challenging for the patient, clinician and dental technician. Today CAD/CAM technology and advances in dental technology frequently allow for a successful and predictable treatment outcome for the patient. A multidisciplinary approach to a patient’s surgical and prosthodontic rehabilitation will be presented. The use of a CAD/CAM designed and milled titanium framework and resultant definitive prosthesis will be discussed. The coordination of treatment with the surgeon, prosthodontist and dental technician are paramount in the successful treatment of the patient. The prosthesis fabrication approach described has proven superior to the previous techniques of waxing and casting metallic frameworks in regards to time, accuracy and successful long-term predictability for the patient. The surgical and prosthodontic treatment of a patient presenting with a mandibular central giant cell granuloma will be discussed.

**KEY WORDS:** Oral tumors, dental implants, CAD/CAM frameworks, partial mandibulectomy, central giant cell granuloma, grafting

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INTRODUCTION

A 21 year old female was referred to the University of Iowa Hospitals and Clinics (UIHC), oral and maxillofacial surgery clinic by an out of town oral surgeon. She presented with a history of endodontic therapy on tooth #29 with a resultant apical radiolucency. The lesion was followed in that office with serial radiographs for several months until the patient began to notice pain and swelling in the right side of her mandible (Fig 1). The lesion was diagnosed via biopsy as a central giant cell granuloma (CGCG), she was then referred to UIHC for definitive surgical and prosthodontic treatment.

A CGCG is a non-malignant lesion which can be rapidly enlarging and destructive to the bone and teeth. It is twice as likely to affect women and is more likely to occur in 20-40 year old individuals. CGCG’s are more common in the mandible and often cross the mid-
line. They are characterized by large lesions that expand the cortical plate and can resorb roots and move teeth. Radiographically it appears as multilocular radiolucencies of bone. CGCG was classified by the World Health Organization in 2005 as a rarely aggressive idiopathic benign intraosseous lesion that occurs almost exclusively in the jaws.\(^1\)

**PATIENT TREATMENT**

The patient’s medical history was benign with a dental history consisting of orthodontic treatment completed at the age of 16 years of age with good results and stable occlusion and the previously mentioned endodontic treatment of tooth #29. A CT scan of the mandible was ordered and showed a large, expansile lesion of the mandible extending from teeth #22 to #31 with erosion through both buccal and lingual

\(^1\) Schneider et al

**Figure 5:** Occlusal view of mandibular defect area.

**Figure 6:** Diagnostic wax up on casts, occlusal view.
cortices. Multiple treatment options were discussed including intralesional steroid injections, enucleation and resection. Following detailed discussion with the patient the decision was made to treat the lesion conservatively, which would include extraction of the involved teeth, then enucleation of the lesion.\(^\text{2,3}\) Once early recurrence of the tumor was ruled out the defect would then be constructed with an anterior iliac crest bone graft (AICG) to the area for future implant placement and restoration (Figs. 2-3). The patient was also referred to the maxillofacial prosthodontic clinic at UIHC prior to the surgical procedure to discuss the restorative options and timing of the procedures (Figs. 4-5).

At the prosthodontic evaluation mounted diagnostic casts were made and a discussion with the patient on the treatment options was undertaken. The family was given the option of restoration with a removable partial denture...
or dental implant supported fixed partial denture with the understanding treatment with dental implants would require an AICG to provide adequate alveolar volume for implant placement in the optimal position for the fixed prosthesis. The patient was enthusiastic about proceeding with the plan for restoration with the implant supported fixed partial denture (Fig 6).

After the treatment plan was established, teeth #24-31 were removed. Following six weeks to allow for adequate soft tissue healing, the lesion was enucleated via an intraoral approach. The lesion was intimately associated with the inferior alveolar nerve and as a result, the patient did experience some right V3 paresthesia following enucleation. Several months after enucleation, a small infection was noted associated with tooth #25. The tooth was removed at that time and the patient had an uneventful recovery from that point.
Repeat panoramic radiographs at one year and at 18 months showed no recurrence of the tumor and at 20 months post enucleation, an AICG was secured in the defect area.

The decision was made that four dental implants would provide adequate support for a screw retained fixed partial denture processed in injection molded/heat polymerized acrylic resin. A porcelain fused to metal restoration or all zirconium restoration could also be fabricated, however the prosthodontic author prefers processed acrylic resin for this type of reconstruction due to ease of adjustment, repairability, lack of abrasiveness to the opposing occlusion, relative ease of fabrication and the possibility of recurrence of the CGCG requiring removal/modification of the prosthesis.

Planning for the definitive implant placement was completed through the evaluation of mounted diagnostic casts of the grafted mandible and a diagnostic wax-up that was tried in the patient’s mouth for verification of occlusion and esthetics. The prosthodontic treatment planning discussion included the oral surgeon(s) and dental technician. Utilizing the wax-up a restrictive surgical guide was fabricated to allow fabrication of a screw retained implant supported fixed partial denture (Figs 7-8). In consultation with the oral surgeon it was determined we would place a narrow diameter implant (3.3mm) in the area of #25, standard diameter implants (4.1 mm) in the area of #27 and 28, and a wide diameter implant (4.8 mm) in the area of #30. The restrictive surgical guide
was fabricated using clear polymethyl methacrylate. Parallel holes were drilled in the guide for placement of the restrictive guide sleeves. It was also determined that tooth #24 had inadequate alveolar support on the mesial from the previous surgeries and was extracted at the time of implant placement. The oral surgeon placed the implants using standard osteotomy preparation procedures utilizing the restrictive guide without complications. A one stage surgical approach was utilized. The implants were allowed to heal for 8 weeks before making final impressions. The patient maintained good oral hygiene and continued with chlorhexidine oral mouth rinse applied locally to the surgical site during the healing period (Fig. 9).

The final implant level impression was made with a custom tray and polyvinyl siloxane impression material to be mounted on the articulator with a facebow. A verification
index was fabricated in the laboratory for intra-oral try-in at the maxillo-mandibular relationship appointment to confirm the accuracy of the master cast. Following the verification process the tooth arrangement was completed on the master cast trying to as closely as possible duplicate the patient’s pre surgery tooth position (Figs. 10-11). Following confirmation of the intraoral accuracy of the wax prosthetic tooth arrangement by the prosthodontist and the patient, the wax-up and master cast were sent to the dental laboratory to be scanned, the framework designed and sent to a milling facility to fabricate the prosthesis substructure with the design as verified by the prosthodontist and the technician (Figs. 12-13). A wax try-in which would also include the final framework can also be done, however the prosthodontic author has not requested this step from the laboratory for several years due to the verification index confirmation of master cast accuracy. The prosthodontist requested a “high-water” pontic design for this patient to help facilitate oral hygiene procedures which was included in the framework design consideration.

A multitude of design concepts are available and can be utilized. The technician and the prosthodontist can both evaluate the design with a 3D viewing program that allows evaluation from any angle with or without the replacement tooth overlay. This allows critical analysis of the framework design to provide satisfactory support/retention and thickness of material of the final prosthesis.

The framework is milled using titanium alloy (Ti6Al4V) (Fig. 14). The prosthetic teeth are added to the framework according to the definitive wax-up and processed utilizing an injection molded technique which helps eliminate stress/potential distortion to the framework (Fig. 15). When the polymerization and deflashing process is complete the prosthesis can then be finished a routine manner and returned for delivery to the patient.

At completion the prosthesis was delivered from the laboratory for insertion (Figs. 16-17). The healing caps were removed and the prosthesis went to place passively following placement of the appropriate screw retained abutments (Figs. 18A, 18B, 19). The narrow implant component was milled to fit directly to the implant due to the design of the top of the implant. The occlusion was checked and very minor adjustments made with a laboratory remount procedure. The patient was given oral hygiene instructions and the appropriate hygiene armamentaria were provided to her. A delivery radiograph was taken to verify accuracy of fit of the framework and to serve as a baseline evaluation for alveolar bone levels around the implants (Fig. 20).

**CONCLUSION**

The reconstruction of oral tumors requires the use of a multi-disciplinary approach which can lead to a very predictable outcome for the patient. Every member of the surgical, prosthodontic and dental technician team is critical to the success of the outcome. Surgical, prosthodontic and dental technology techniques and material use are advancing rapidly. All members of the implant/reconstruction team must be aware of these advancements and work closely together to understand the limits and possibilities of treatment. The successful surgical and prosthodontic reconstruction of
an oral tumor was illustrated with a very positive outcome and predictable longevity. This allowed the patient to return to near normal function with an excellent phonetic/esthetic outcome very near her pre diagnosis situation.

We recommend continued follow-up and annual radiographs to evaluate the possibility of reoccurrence of the CGCG and observation of the alveolar bone levels around the implants. She will also see her general dentist twice annual for routine prophylaxis and scaling.

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Acknowledgement
Thank you to Danny Roberts, CDT for his skill, expertise and advice in the scanning and design/finishing of the definitive prosthesis.

References
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Case courtesy of Dr. Mariano Polack and Dr. Joseph Arzadon, Gainesville, VA
The Effects of Reinforcement on the Fracture Rates of Provisional All-On-4 Restorations: A Retrospective Report of 257 Cases Involving 1182 Dental Implants

Dan Holtzclaw, DDS, MS¹

Abstract

Background: Immediately loaded full arch dental implant restorations rely on immediately delivered acrylic provisional restorations for esthetics, masticatory function, and cross arch stabilization. These provisional restorations may be in function from 4-12 months prior to delivery of a definitive final restoration. Fracture of the acrylic provisional restoration during the healing phase has been reported anywhere from 11-40% of cases in dental literature. Recent studies have suggested that reinforcement of the provisional restoration with a variety of materials may improve rigidity and decrease fracture rates. The purpose of this retrospective review is to evaluate if reinforcement of immediately loaded full arch transitional dental implant restorations has any effect on fracture rates during the healing phase.

Case Series: A retrospective chart review was conducted for all patients treated with the All-On-4 treatment concept at the private practice of the author in Austin, Texas between January 2014 and March 2016. A total of 69 men and 112 women with a mean age of 61.6 years were treated with the All-On-4 treatment concept using 1182 dental implants. A total of 243 dentate and 14 edentulous arches were treated. Non-reinforced transitional restorations had a fracture rate of 16.14% while reinforced transitional restorations had a fracture rate of 4.17%. There was no difference in overall dental implant survival between the two groups.

Conclusions: Reinforcement of All-On-4 acrylic provisional restorations with interplaited steel wire reduces fracture rates. Further studies are warranted to investigate whether or not these reduced fracture rates have any effect on dental implant survival.

KEY WORDS: Dental implants, prosthodontics, immediate dental implant loading, temporary dental restoration, dental materials

¹. Private practice, Austin, Texas, USA
BACKGROUND
Since its initial report in dental literature over 12 years ago, the All-On-4 treatment concept has proven to be a predictable method for full arch immediately loaded dental reconstruction. One hallmark of this procedure is “immediate” delivery of a screw retained provisional restoration within 2-24 hours of dental implant placement. In addition to providing immediate masticatory function for the patient, the provisional restoration helps to stabilize the newly placed dental implants by improving stress distribution through cross arch stabilization. Previously published studies have indicated that these provisional restorations may be used...
anywhere from 4-12 months prior to delivery of a final prosthesis²-⁴,⁷ and that fracture rates up to 40% may occur during this timeframe.⁸ A recent number of studies suggest that reinforcement of transitional All-On-4 restorations with materials such as braided wire⁶ or various fibers⁸ may improve rigidity of the prosthesis. Accordingly, the purpose of this retrospective review is to evaluate if reinforcement of All-On-4 transitional restorations has any effect on fracture rates during the healing phase.

**CLINICAL PRESENTATION**
A retrospective chart review was conducted for all patients treated with the All-On-4 treatment concept at the private practice of the author in Austin, Texas between January 2014 and March 2016. A total of 69 men and 112 women with a mean age of 61.6 years were treated with the All-On-4 treatment concept using 1182 dental implants. A total of 243 dentate and 14 edentulous arches were treated. All patients provided both verbal and signed consent prior to treatment. As this was a retrospective chart review, there were no exclusionary criteria. All-On-4 provisional fractures were graded according to Holtzclaw All-On-4 Fracture Classification⁷ (Table 1, Figures 1-4) and dental implant survival was determined according to the Malo Clinic Survival Criteria⁴ (Table 2).

**CASE MANAGEMENT**
All provisional restorations were fabricated in a similar fashion. Following the surgical process of the All-On-4 style dental implant surgery, a conventional acrylic complete denture was adjusted to accommodate the dental implant/multi-unit abutment/transitional coping complex (Figure 5). Jet acrylic (Land Dental Manufacturing, Wheeling, Illinois, USA) was mixed according to manufacturer’s directions and injected around the transitional copings intraorally (Figure 6). Once the transitional copings were rigidly fixed to the acrylic denture with set Jet acrylic, the denture was removed from the mouth and finished extraorally. For non-reinforced provisional prostheses, the restoration was finished with additional Jet acrylic using a heated pressure pot set to 20PSI, contoured, and polished (Figure 7). For reinforced provisional prostheses, an insert consisting of two 1mm diameter

<table>
<thead>
<tr>
<th>Fracture Classification</th>
<th>Fracture Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>Fracture of tooth only (Figure 1)</td>
</tr>
<tr>
<td>Class 2</td>
<td>Fracture including the acrylic base located anterior to the distal most implant transitional coping (Figure 2)</td>
</tr>
<tr>
<td>Class 3</td>
<td>Fracture including the acrylic base located at or distal to the most distal transitional coping (Figure 3)</td>
</tr>
<tr>
<td>Class 4</td>
<td>Any fracture that does not clearly fit into Class 1-3 (Figure 4)</td>
</tr>
</tbody>
</table>
interplaited steel wires was custom bent with orthodontic pliers and secured within the prosthesis using Jet acrylic (Figure 8). The reinforced provisional prostheses were then contoured and polished in the same manner as the non-reinforced prostheses (Figure 9). Both types of prostheses were then delivered to patients (Figures 10, 11) and screws were torqued to 15Ncm according to manufacturer’s directions. Screw access holes were filled with Teflon tape and sealed with either composite or Gingifast (Zhermack SpA, Italy) depending on the location of the hole.

### CLINICAL OUTCOMES
A total of 257 arches were treated using 1182 dental implants. The initial 161 arches were treated with non-reinforced transitional restorations while the latter 96 arches were treated with reinforced restorations. Fracture rates of non-reinforced transitional restorations were 16.14% (26 of 161) while reinforced restorations had a fracture rate of 4.17% (4 of 96) prior to delivery of final restoration. Fracture types according to the Holtzclaw classification are listed in Table 3. At the time of final restoration, 13 dental implant failures were noted in non-reinforced cases (13/740 = 98.24% dental implant survival rate) while reinforced cases had 2 failures (2/442 = 99.17% dental implant survival rate).

### DISCUSSION
“Immediate” delivery of a provisional screw retained prosthesis within 2-24 hours is a proven and effective technique for All-On-4 style dental implant procedures. The cross arch stabilization provided by the provisional restoration improves stress distribution among the osseointegrating dental implants and improves survival rates for implants with less than desirable initial torque values. In the event

<table>
<thead>
<tr>
<th>Criteria Number</th>
<th>Criteria Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria 1</td>
<td>The dental implant fulfilled its purported function as support for reconstruction</td>
</tr>
<tr>
<td>Criteria 2</td>
<td>The dental implant was stable when individually and manually tested</td>
</tr>
<tr>
<td>Criteria 3</td>
<td>No signs of infection were observed around the dental implant</td>
</tr>
<tr>
<td>Criteria 4</td>
<td>No radiolucent areas were observed around the dental implant</td>
</tr>
<tr>
<td>Criteria 5</td>
<td>The dental implant demonstrated good esthetic outcome of rehabilitation</td>
</tr>
<tr>
<td>Criteria 6</td>
<td>The dental implant allowed for construction of the implant supported fixed prosthesis</td>
</tr>
</tbody>
</table>
Holtzclaw

of provisional prosthesis fracture, cross arch stabilization is lost and may have deleterious effects on osseointegrating dental implants. Furthermore, fracture of All-On-4 provisional restorations is unsettling to the patient as it disrupts masticatory function, marginalizes esthetics, and requires an additional appointment to repair the prosthesis.

Provisionalized All-On-4 restorations typically consist of a traditional all-acrylic complete denture that is modified to fit newly placed dental implants and their associated multi-unit abutments/transitional copings. Upon modification, the conventional denture is converted into an all-acrylic bridge that ranges in thickness between 9-12mm. Fracture of All-On-4 acrylic provisional restorations is a known risk factor with rates ranging from 11-40% in published dental literature.

Over the past 20 years, a number of attempts have been made to improve the fracture resistance of all-acrylic restorations with reinforcement materials such as

Figure 5: Conventional acrylic denture modified to fit dental implant/multi-unit abutment/transitional coping complex.

Figure 6: Transitional coping secured to conventional acrylic denture using Jet acrylic.

Figure 7: Polished non-reinforced transitional restoration prior to delivery.

Figure 8: Interplaited steel wire inserted into transitional restoration.
woven glass fibers,\textsuperscript{8,13} woven polyethylene fibers,\textsuperscript{13} nylon,\textsuperscript{12} and metal.\textsuperscript{6,8,13-15} A recent in vitro study by Li et al.\textsuperscript{8} examined the effects of reinforcement on flexural properties of All-On-4 provisional fixed denture base resin using a 3-point loading test. The results of this study indicated that reinforcement of All-On-4 provisional restorations not only increased fracture resistance, but also changed typical locations of the fractures. The in vitro findings of Li et al. are supported by the findings of the current retrospective study in which All-On-4 provisional restorations reinforced with interplaited steel wire had lower fracture rates than non-reinforced provisional restorations. Furthermore, the nature of these fractures also changed according to their Holtzclaw fracture classification grouping. Although fracture rates were reduced for reinforced provisional restorations compared to non-reinforced restorations, dental implant survival at the time of final prosthesis delivery was similar amongst the two groups.

**SUMMARY**

Reinforcement of All-On-4 acrylic provisional restorations with interplaited steel wire reduces fracture rates. Further studies are warranted to investigate whether or not these reduced fracture rates have any effect on dental implant survival. of the provisional restoration is performed. ●

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Table 3: Fracture types according to Holtzclaw Fracture Classification

<table>
<thead>
<tr>
<th>Fracture Class</th>
<th>Non-reinforced Prosthesis</th>
<th>Reinforced Prosthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>Class 2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Class 3</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Class 4</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Acknowledgements
None. The author reports no conflicts of interest with anything mentioned in this article.

References
Elkerdawy et al

Oralife is a single donor grafting product processed in accordance with AATB standards as well as state and federal regulations (FDA and the states of Florida, California, Maryland and New York). Oralife allografts are processed by LifeLink Tissue Bank and distributed by Exactech Inc.

1. Data on file at Exactech.
Background: Over denture treatment modality either tooth supported or implant supported aim to improve the quality of life regarding function and self-image. The main difference between implant supported and tooth supported overdenture is the nature of their attachment to bone which is different in both cases due to the presence of periodontal ligament present in tooth supported overdenture which is clearly absent in the case of osseointegrated implants. The aim of this study was to compare the effect of difference in support type of the overdenture on the maximum biting force.

Methods: 20 patients were selected ten of which were completely edentulous patients where two implants were installed in the mandibular canine area. The other ten patients were presented with two residual canines in their lower arches. For the implant supported group, overdentures were fabricated and were retained by a locator attachment. Regarding the tooth supported group, the canines were prepared to receive a locator attachment over which an overdenture was fabricated. The biting force was recorded for both groups at prostheses insertion 3 months and 6 months post insertion.

Results: in both groups there was statistically significant increase in biting force after 3 months follow up period. Moreover, root supported overdenture showed significantly higher biting force than implant supported through the whole follow up period.

Conclusion: the biting force increased in both root and implant supported overdentures, meanwhile the biting force was higher in the root supported group.

KEY WORDS: Biting force, overdenture, implant overdentures, and locator attachment

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INTRODUCTION
An overdenture is a complete or removable partial denture that has one or more tooth roots or implants to provide support.\(^1\) A very important advantage in natural teeth is the presence of the periodontal ligament PDL, which is the natural mechanism of attachment of the tooth to its socket in the alveolar bone.\(^2\) One of the main functions of the PDL is to provide sensory feedback in the masticatory cycle during chewing. Humans are capable of detecting the presence of very small particles between the occlusal surfaces of teeth.\(^3,4\) Forces transmitted to the bone are either axial forces or horizontal tipping forces that are applied to a tooth, a tendency toward displacement of the root into the alveolus occurs with the axial load, while horizontal / tipping forces result in two phases of tooth movement. The first occurs within the confines of the periodontal ligament, while the second produces a displacement of both the facial and lingual bony plates.\(^4\) The PDL mechanoreceptors are particularly important for neuromuscular and tactile activity in the stomatognathic system as it is responsible for perception of load. When remaining roots are retained to support an over denture all these advantages of the PDL will be preserved also when this is combined by the use of dental attachments this will also improve retention which will magnifies the efficiency of the over denture therapy.\(^6,7\) Insertion of two implants in completely edentulous patients will improve support which is a great problem for those patients especially for those suffering from severely resorbed ridges either due to long stay without treatment, under serviced dentures or due to a debilitating disease that affected the bone.\(^8\) If the implant placement was combined with the use of attachment so the mechanical retention of the overdenture will much improve.\(^9\) Individual bite force level determination has been widely used in dentistry, mainly to understand the mechanism of mastication for evaluation of the therapeutic effects of different prosthetic devices and providing reference values for studies on the biomechanical function of prosthetic devices.\(^10,11\) The functional state of the masticatory system can be evaluated by the Bite force that results from the action of jaw elevator muscles modified by the craniomandibular biomechanics.\(^12,13\) Therefore this study was conducted to compare the effect of different support types on the maximum biting force of attachment retained overdentures.

MATERIALS AND METHODS
Patient Selection
Twenty male patients were selected from the outpatient clinic, Removable prosthodontic department, faculty of oral and dental medicine, Cairo University. Ten patients were presented with completely edentulous upper and lower arches (group I); the other ten patients were presented with upper completely edentulous arches against remaining two mandibular canines (group II). Male patients were selected to avoid any hormonal disturbance that may affect the bone quality that may affect the success of the clinical outcome. The patient ages ranged from 45-55 years of age so that the patients possessed a well-developed muscular system. Also all patients were medically free from debilitating diseases that may affect the bone quality and quantity as diabetes mellitus and parathyroid disorders, patients were free from diseases that might affect the muscle coordination as Parkinson’s disease to make sure no excessive uncontrolled forces are exerted.
during measuring the biting force. Cases with normal Angle’s class I were selected to obtain proper direction of force with the long axis of the teeth. Smokers were excluded as smoking, beside its effect on the hard and soft marginal tissues, could lead to anoxia of the oral cavity, a thing which could be associated with high level of marginal bone loss leading to poor prognosis for the treatment success. Canines were chosen owing to their strategic position in the arch and their strong roots, thus provide good denture support and stability. They also help in preserving bone in the anterior region of the dental arch which is more susceptible to resorption.

**Group I**
Delivered mandibular dentures were duplicated to produce a clear acrylic resin radiographic template to evaluate the amount of the bone available at the proposed implant sites. After administrating peripheral infiltration anaesthesia, the surgical template was used to place two immediately loaded 3.7 in diameter and 13mm in length implants (Legacy, Spectra system, Implant direct, U.S.A.) in their prepared implant beds at the canine area on each side using the punch technique. Implants were left for 3 months to osseointegrate, after which patients were recalled. The placed implants were exposed and two Locator attachments were screwed on the implants and tightened in place (fig.1). White block out spacers were slipped around the Locator abutments to facilitate the pickup procedure. Then the metal housings with their black processing caps were placed directly over the Locator abutments and the denture was then properly relieved opposite to the attachment sites and assured for proper seating. A hole was made from the lingual aspect to allow for escape of excess resin. Cold cure resin (Repair acrylic Garreco. P.O. Box 1258, Herber springs. USA) was placed in the relieved areas of the denture which was seated in position and the resin was left to polymerize while the patients were instructed to close in centric relation with minimal pressure. The denture was removed with the metal housings picked up in its fitting surface. The chosen Locator replacement male was firmly pushed into the metal housing using the male seating tool then a click was heard confirming the full seating of the male part.
Group II
The two canines were reduced to within 1.0 mm supragingivally by the use of the Locator The locator root attachment kit (Zest Anchors, Inc. Escondido, CA 92029 USA). The top of the root surface was prepared as flat as possible from the mesial to the distal portion of the tooth. A white plastic reference ring was adjusted on the pilot drill to a depth of 1.0 mm longer than the length of the female post and drilling was performed in the patient mouth. The counter-sink diamond bur was used making a very shallow recessed seat on the root surface (fig.2). Root surface Paralleling post was used to detect parallelism of the preparation. The locator was then cemented in the root (fig.3) using glass ionomer cement (Glass ionomer cement, 3M Center Building 275-2SE-03St. Paul, MN 55144-1000, U.S.A.) with locator post attached to it. The spacer was then placed around the locator’s neck and the black processing cap was attached over the locator. A recess was then prepared in the fitting surface of the denture opposite to the processing cap. Chair side self-cured repair material acrylic resin (Repair acrylic Garreco. P.O. Box 1258, Herber springs. USA) was mixed and placed in the prepared recess. The denture was then seated into the patient’s mouth and the patient was guided to close in centric occlusion position maintaining a proper relationship with the opposing arch, excessive occlusal pressure was avoided. After the acrylic resin has cured the denture was removed from the patient’s mouth, excess acrylic was removed and the white spacer was discarded. The locator male removal tool was then used to remove the black male processing cap. The chosen Locator replacement male was firmly pushed into the metal housing using the male seating tool then a click was heard confirming the full seating of the male part. The denture was then placed in position and mild refinement of occlusion was done using articulating paper. The patient was then guided for how to insert and remove his denture.

Recording the Maximum Biting Force
For both groups the biting force was measured immediately on the day of prostheses insertion 3 months and then 6 months post insertion. Biting force was measured using iloadstar sensor (Loadstar sensors. 453 Riverdale Drive, Mountain View, CA94043). The iloadstar sensor was used to measure the maximum biting force; the sensor was prepared before reading by placing it in the working environment for 24 hours before measurement to avoid errors in calibration due to sudden changes in temperature. The patients were asked to sit in an upright position so that the force application direction is vertical, and the dome shaped top of the sensor was placed in the occlusal embrasure between the upper second premolar and the adjacent first
molar as this area allows the patient to exert maximum controlled force. The maximum capacity of the sensor is 907 N so care was taken not to overload the sensor beyond the rated value. The impact of the force was measured to detect the relative difference in the perception of force concerning the difference in the nature of attachment to the bone. One-way Analysis of Variance (ANOVA) test and the Tukey-Kramer Multiple Comparisons test were used to investigate significant differences among the groups.

RESULTS

Effect of time on the two groups
Regarding the effect of time on the biting force after 3 months of overdenture insertion regardless the type of support (implant support and root support) there was statistically significant increase in the biting force, after 6 months of overdenture insertion the root supported group showed no statistically significant increase in the biting force. On the other hand the implant supported group showed statistically significant increase in the biting force in 3 month to 6 months follow up interval.

Table 1: Mean Values and Standard Deviation (SD) of the Biting Force (N) for Both Groups Along the Follow Up Intervals

<table>
<thead>
<tr>
<th></th>
<th>Implant (gp I)</th>
<th>Root (gp II)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td>163.7857±25.56Ab</td>
<td>221.22±29.87Ab</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>3-month</td>
<td>192.1629±34.89Ab</td>
<td>273.63±33.51Bb</td>
<td></td>
</tr>
<tr>
<td>6-month</td>
<td>231.1186±47.04Ba</td>
<td>274.5±20.98Ba</td>
<td></td>
</tr>
</tbody>
</table>

Significant at p ≤ 0.05 Different capital letters indicate significant difference between different follow up periods within the same group. Different small letters indicate significant difference between the two groups within the same follow up period.

Effect of type of support on the biting force in the two groups
Regarding the effect of type of support on the biting force there was a statistically significant higher biting force recordings for the root supported group immediately after insertion with a mean value of 221.22 N, a mean value of 273.63 N at 3 months and 274.5 N at 6 months after insertion respectively. While the implant supported group the mean values were 163.7857 N, a mean value of 192.1629 N at 3 months and 231.1186 N at 6 months after insertion respectively.

DISCUSSION

Generally speaking and from a subjective point of view, all patients who participated in this study appreciated their root supported overdenture and implant supported overdenture. With no doubt, the enhanced support, stability and retention provided by the attachments improved denture functionality, chewing efficiency, and allowed for shorter adaptation periods with minimal post-insertion complaints. This in turn led to increased patient...
comfort and acceptance of the prosthesis.

Regarding the effect of time the results of this study revealed a statistically significant increase in biting force at 3 months. This was true for the two treatment situations i.e. root overdenture and implant overdenture. This may be explained by the gradual building up experience and patient adaptation to the new prosthesis. This was in agreement with the results recorded by previous studies.14,15 Were they concluded that regardless the type of prosthesis, patients usually function with their prosthesis much better after sometime, after they become “used to it” and “to their existence” in their mouths.

Regarding the type of support the biting force was significantly higher in the root supported over denture than implant supported overdenture immediately after insertion, 3 months and 6 months after insertion and this may be attributed to the reduced periodontal support in the implant supported overdenture which may have decreased the threshold level of the mechanoreceptors function\textsuperscript{16,17} causing changes in the biting force. Also patients with loss of periodontal attachment have shown impaired sensory function resulting in reduced control of biting force. These results are consistent with those of another study in which a positive correlation between reduced periodontal support and decreased biting force has been shown\textsuperscript{18}.

Graph 1: A Chart Showing Mean Values of the Biting Force (N) Recorded Along the Follow Up Intervals in Both Implant and Root Supported Groups
CONCLUSION

Biting force increased in both root and implant supported overdentures; meanwhile the biting force was higher in the root supported group. In 3 month to 6 months follow up interval the root supported group showed no increase in biting force. On the other hand the implant supported group showed an increase in biting force.

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Email: dr.nancynader@gmail.com

Product Disclosure

- Dental implants (Legacy, Spectra system, Implant direct, USA)
- Cold cure resin (Repair acrylic Garreco. P.O. Box 1258, Herber Springs, USA)
- Locator root attachment kit (Zest Anchors, Inc. Escondido, CA 92029 USA)
- Glass ionomer cement (3M, 275-2SE-03St. Paul, MN 55144-1000, USA)
- Repair acrylic (Garreco. P.O. Box 1258, Herber Springs, USA)
- Loadstar sensors (453 Riverdale Drive, Mountain View, CA 94043, USA)

References:

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Comparative Analysis of User Generated Online Yelp Reviews for Periodontal Practices in Multiple Metropolitan Markets

Dan Holtzclaw, DDS, MS

Abstract

Background: Previously published research for a single metropolitan market found that Periodontists fared poorly on the Yelp website in regards to nearly all metrics including average star ratings, number of reviews, review filtering rate, and evaluations by Elite Yelp users. The purpose of the current study was to confirm or refute these findings by expanding the data sets to additional metropolitan markets of varying sizes and geographic locations.

Methods: A total of 6,559 Yelp reviews were examined for General Dentists, Endodontists, Pediatric Dentists, Oral Surgeons, Orthodontists, and Periodontists in small (Austin, Texas), medium (Seattle, Washington), and large (New York City, New York) metropolitan markets. Numerous review characteristics were evaluated including total number of reviews, average star rating, review filtering rate, and number of reviews by Yelp members with Elite status. Results were compared in multiple ways to determine if statistically significant differences existed.

Results: In all metropolitan markets, Periodontists were outperformed by all other dental specialties for all measured Yelp metrics in this study. Furthermore, inter-metropolitan comparisons of periodontal practices showed no statistically significant differences between them.

Conclusion: The poor performance of Periodontists on Yelp may be related to the age profile of patients in the typical periodontal practice. This may result in inadvertent filtering of periodontal reviews and subsequently poor performance in multiple other categories.

KEY WORDS: Marketing of health services, practice management dental, online input, specialties dental

1. Private practice, Austin, Texas, USA
INTRODUCTION
A 2012 study comprising a representative sample of the US population found that 76% of respondents indicated that online doctor ratings were important for them when searching for a provider. In the United States alone, more than 5 million online reviews have been posted about the healthcare industry on the Yelp website. The Yelp website has 165 million unique monthly visitors and affords dental practices the opportunity for significant direct to consumer exposure. Numerous studies have documented the ability of positive Yelp reviews to improve business results. Unfortunately, this has encouraged many businesses to manipulate their Yelp reviews to achieve financial gains. To counter such fraudulent activity, Yelp employs proprietary algorithms to identify and remove (filter) suspected illegitimate reviews. In a previous study, we examined review characteristics and filtering rates of more than 2,000 Austin, TX based dental practices on the Yelp website. The findings of this study were particularly concerning for the specialty of Periodontics as periodontal practices had high filtering rates, low star ratings, and low total review postings compared to other dental specialties. Although intriguing these results were representative of one single metropolitan area. As such, the purpose of this follow up study was to confirm or refute these findings by comparing them to Yelp metric data from other metropolitan areas of varying sizes and geographic locations.

METHODS AND MATERIALS
In the current study, Yelp data for the cities of New York City, New York and Seattle, Washington were examined and compared to the Austin, Texas data collected from our previous study. Specifically, the search parameters for the current study were as follows: City – New York City, New York; Category – Dentists; Category – Endodontists; Category – Orthodontists; Category – Oral Surgeons; Category – Pediatric Dentists; Category – Periodontists. The same category searches were also performed for the city of Seattle, Washington. As in our previous study, the top 10 results were examined for each query. If General Dentists appeared in specialist search queries, they were ignored. Conversely, if specialists appeared in search results for General Dentists, the specialist results were ignored. All results were examined for “recommended” (non-filtered) reviews and non-recommended (”filtered”) reviews. Furthermore, these reviews were also evaluated for star ratings, total review numbers, and Elite Yelp reviews. These results were then compared city to city in pairs using unpaired Student’s T Test with 2 tailed P-values on GraphPad InStat Software (GraphPad Software, Inc., La Jolla, California). The data for periodontal practices in Austin, New York City, and Seattle were then compared to one another in a similar fashion. Finally, the data for all periodontal practices were combined and compared to combined data for each dental specialty in the study.

RESULTS
A total of 6,559 Yelp reviews for General Dentists, Endodontists, Oral Surgeons, Orthodontists, Pediatric Dentists, and Periodontists in multiple metropolitan markets (Table 1). Comparisons of Yelp metric data for Periodontists versus other dental specialties in the cities of
<table>
<thead>
<tr>
<th>Dental Specialty</th>
<th>Metropolitan Area</th>
<th>Average Yelp Star Rating</th>
<th>Total Yelp Review</th>
<th>Yelp Filtering Rate (%)</th>
<th>Average Number of Elite Yelp Reviewers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gen Den</td>
<td>Austin</td>
<td>4.81</td>
<td>703</td>
<td>25.35</td>
<td>2.7</td>
</tr>
<tr>
<td>Gen Den</td>
<td>NYC</td>
<td>4.69</td>
<td>908</td>
<td>26.78</td>
<td>4.1</td>
</tr>
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<td>Gen Den</td>
<td>Seattle</td>
<td>4.67</td>
<td>620</td>
<td>25.08</td>
<td>3.3</td>
</tr>
<tr>
<td>Gen Den</td>
<td>Mean</td>
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<td>743.67</td>
<td>25.74</td>
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<td>202</td>
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<td>226.67</td>
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<td>0.77</td>
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<td>346</td>
<td>47.87</td>
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<td>46.85</td>
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<tr>
<td>Orthodontists</td>
<td>Seattle</td>
<td>4.82</td>
<td>297</td>
<td>49.44</td>
<td>0.7</td>
</tr>
<tr>
<td>Orthodontists</td>
<td>Mean</td>
<td>4.79</td>
<td>369.67</td>
<td>48.05</td>
<td>0.53</td>
</tr>
<tr>
<td>OMFS</td>
<td>Austin</td>
<td>4.47</td>
<td>266</td>
<td>26.82</td>
<td>1.3</td>
</tr>
<tr>
<td>OMFS</td>
<td>NYC</td>
<td>4.78</td>
<td>616</td>
<td>29.70</td>
<td>3.6</td>
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<tr>
<td>OMFS</td>
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<tr>
<td>OMFS</td>
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<td>360.67</td>
<td>28.07</td>
<td>2.17</td>
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<tr>
<td>Pediatric Den</td>
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<td>4.54</td>
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<tr>
<td>Pediatric Den</td>
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<td>256</td>
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<td>Pediatric Den</td>
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<td>41.94</td>
<td>0.8</td>
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<tr>
<td>Pediatric Den</td>
<td>Mean</td>
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<td>311.33</td>
<td>43.73</td>
<td>0.67</td>
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<tr>
<td>Periodontists</td>
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<td>4.19</td>
<td>140</td>
<td>44.47</td>
<td>0.6</td>
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<td>NYC</td>
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<td>198</td>
<td>52.51</td>
<td>0.4</td>
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<tr>
<td>Periodontists</td>
<td>Seattle</td>
<td>4.21</td>
<td>185</td>
<td>50.97</td>
<td>0.3</td>
</tr>
<tr>
<td>Periodontists</td>
<td>Mean</td>
<td>4.11</td>
<td>174.33</td>
<td>49.32</td>
<td>0.43</td>
</tr>
</tbody>
</table>
Austin, New York City, and Seattle are presented in Tables 2-4. Combined metropolitan data for Periodontists versus other dental specialties is presented in Table 5. Finally, intermetropolitan comparisons of Yelp metric data for Periodontists are presented in Table 6.

In examining gross reporting data in Table 1, Periodontists ranked last among all dental specialties for average Yelp star ratings and total number of Yelp reviews. These findings were consistent in all metropolitan areas of this study. For review filtering rates and average number of Elite Yelp reviews, Periodontists ranked last or second to last amongst all dental specialties. Orthodontists had the highest average star rating followed closely by Endodontists and General Dentists. For total Yelp reviews, General Dentists far exceeded all other dental specialties receiving double the amount of reviews of the next closest competitor and more than 4 times the average number of reviews for Periodontists. In terms of review filtering rates, Periodontists, Orthodontists, and Pediatric Dentists were the most likely to have reviews removed by the Yelp filtering algorithm. Periodontists were nearly twice as likely to have reviews filtered compared to General Dentists, the lowest filtered dental specialty. Concerning Elite Yelp reviews, General Dentists and Oral Surgeons

<table>
<thead>
<tr>
<th>Yelp Metric</th>
<th>General Dentists</th>
<th>Endodontists</th>
<th>Oral Surgery</th>
<th>Orthodontists</th>
<th>Pediatric Dentists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Yelp Reviews</td>
<td>P=0.0038 VS</td>
<td>P=0.0048 VS</td>
<td>P=0.0046 VS</td>
<td>P=0.0002 VS</td>
<td>P=0.0001 VS</td>
</tr>
<tr>
<td>Average Yelp Star Rating</td>
<td>P=0.0240 SS</td>
<td>P=0.0451 SS</td>
<td>P=0.3362 NS</td>
<td>P=0.0214 SS</td>
<td>P=0.2752 NS</td>
</tr>
<tr>
<td>Yelp Review Filtering Rate</td>
<td>P=0.0053 VS</td>
<td>P=0.0340 SS</td>
<td>P=0.0079 VS</td>
<td>P=0.6848 NS</td>
<td>P=0.4252 NS</td>
</tr>
<tr>
<td>Average # of Elite Yelp Reviews</td>
<td>P=0.0290 SS</td>
<td>P=0.4331 NS</td>
<td>P=0.1964 NS</td>
<td>P=1.0 NS</td>
<td>P=0.6601 NS</td>
</tr>
</tbody>
</table>

Two tailed P values. (SS) statistically significant; (NS) not statistically significant; (VS) very statistically significant; (ES) extremely statistically significant
were the most likely to get reviewed by members with Elite Yelp status while Periodontists were the least likely to receive this type of review. General Dentists received nearly 8 times more Elite Yelp reviews compared to Periodontists while Oral Surgeons received over 5 times as many.

In evaluating individual metropolitan data with Periodontists being compared to all other dental specialties (Tables 2-4), periodontal practices fared poorly in every category. In Austin (Table 2), Periodontists received significantly fewer reviews than all other dental specialties with differences being very statistically significant. Concerning average star rating, Periodontists were the lowest rated of all dental specialties with only Oral Surgeons and Pediatric Dentists having ratings that were not statistically significant different. Periodontists had the second highest review filtering rate, second only to Orthodontists. Filtering rate differences were statistically significant for all dental specialties with the exception of Orthodontists and Pediatric Dentists. Concerning Elite Yelp reviews, Periodontists and Orthodontists received the fewest, but the only difference for Elite reviews of statistical significance was for General Dentists.

In New York City (Table 3), Periodontists received the fewest reviews with only Endodontists and Pediatric dentists having differences.

<table>
<thead>
<tr>
<th>Yelp Metric</th>
<th>General Dentists</th>
<th>Endodontists</th>
<th>Oral Surgery</th>
<th>Orthodontists</th>
<th>Pediatric Dentists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Yelp Reviews</td>
<td>P=0.0029 VS</td>
<td>P=0.5924 NS</td>
<td>P=0.0001 ES</td>
<td>P=0.0052 VS</td>
<td>P=0.4059 NS</td>
</tr>
<tr>
<td>Average Yelp Star Rating</td>
<td>P=0.029 VS</td>
<td>P=0.0036 VS</td>
<td>P=0.0015 VS</td>
<td>P=0.0039 VS</td>
<td>P=0.0403 SS</td>
</tr>
<tr>
<td>Yelp Review Filtering Rate</td>
<td>P=0.0022 VS</td>
<td>P=0.0309 SS</td>
<td>P=0.0076 VS</td>
<td>P=0.4778 NS</td>
<td>P=0.7585 NS</td>
</tr>
<tr>
<td>Average # of Elite Yelp Reviews</td>
<td>P=0.0101 SS</td>
<td>P=0.6278 NS</td>
<td>P=0.0016 VS</td>
<td>P=0.7730 NS</td>
<td>P=1.0000 NS</td>
</tr>
</tbody>
</table>

Two tailed P values. (SS) statistically significant; (NS) not statistically significant; (VS) very statistically significant; (ES) extremely statistically significant
that were not statistically significant. For average star rating, Periodontists were the lowest rated with results being statistically significant compared to all other dental specialties. Concerning filtering rates, Periodontists had the most reviews removed with only Orthodontists and Pediatric Dentists having comparative differences that were not statistically significant. The fewest number of Elite reviews were seen for Orthodontists, Periodontists, and Pediatric Dentists respectively. The differences for Elite reviews were not statistically significant for these particular specialties.

In Seattle (Table 4), Periodontists received the fewest reviews of all dental specialties, but only General Dentists and Orthodontists had review differences that were of statistical significance. Periodontists had the lowest average star rating in Seattle and, once again, only General Dentists and Orthodontists had differences that were of statistical significance. As with the other metropolitan areas in this study, Periodontists, Orthodontists, and Pediatric Dentists had the highest filtering rates with no differences of statistical significance existing between these specialties. Finally, concerning Elite Yelp reviews, Periodontists received the fewest with only General Dentists and Oral Surgeons having differences of statistical significance.

In evaluating combined data with Periodontists being compared to all other dental specialties...
(Table 5), findings were again consistent with Periodontists ranking last in every measured metric with differences of statistical significance for most categories. The only exceptions to these findings where differences of no statistical significance were seen are as follow: a) Total Yelp reviews - Endodontists; b) Average Yelp star rating – None; c) Yelp filtering rate – Orthodontists and Pediatric Dentists; d) Elite Yelp Reviews – Endodontists, Orthodontists, and Pediatric Dentists. Finally, in evaluating and comparing Yelp metrics for Periodontists alone for the 3 evaluated metropolitan areas of this study (Table 6), no difference of any statistical significance was found in any category.

**DISCUSSION**

Our previous study was the first of its kind to evaluate characteristics and metric data for online reviews of dental practices.\(^6\) The findings of that study were intriguing, particular for Periodontists as it was shown that periodontal practices fared poorly in all measured categories compared to other dental specialties. The findings of the prior study, however, only represented one metropolitan area and could be anomalous. To confirm or refute these findings, the current study used a similar data collection format with both expanded and varied data sets. In an effort to reduce population size bias, small (Austin), medium (Seattle), and large (New York City) metropolitan areas were
evaluated. Furthermore, these cities with separation distances of anywhere from 1,750 to 2,900 miles were selected to reduce both geographic and cultural bias. The data presented in this study confirms that in all markets, Periodontists receive fewer Yelp reviews and are rated lower than all other dental specialties. Furthermore, periodontal practices are the most likely to have reviews removed by Yelp’s filtering algorithm and the least likely to receive evaluations by members with Elite Yelp status. These findings were consistent in all metropolitan markets no matter how the data was evaluated. This suggests that the findings of the prior study are not anomalous. Further bolstering these findings is the fact that the results of the current study were again consistent with the prior study in regards to nearly every measured Yelp metric for all other evaluated dental specialties in all metropolitan markets. Concerning the specialty of Periodontics, these results stimulate a number of questions. First and foremost, why are periodontal practices consistently receiving fewer reviews and lower star ratings compared to other dental specialties? Second, why are periodontal practices the least likely to be reviewed by Yelp members with Elite status and is this important? Finally, why are periodontal reviews the most likely to be removed by the Yelp filtering algorithm?

One possible answer to these questions may lie in the age profile of patients at periodontal practices. According to a recently published update to the Prevalence of Periodontitis in the United States: NHANES 2009-2012 study, the highest prevalence of periodontal disease was seen in people aged 50 or more.7 Accordingly, one would expect patients of a periodontal practice to be older than those of other dental specialties. This may explain the lower ratings of periodontal practices on Yelp.

### Table 6: Yelp Metric Data for Periodontists Compared Intra-City

<table>
<thead>
<tr>
<th>Metropolitan Area</th>
<th>Average Yelp Star Rating</th>
<th>Total Yelp Reviews</th>
<th>Yelp Filtering Rate</th>
<th>Average Number of Elite Yelp Reviewers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austin vs New York City</td>
<td>P=0.4467 NS</td>
<td>P=0.7825 NS</td>
<td>P=0.3574 NS</td>
<td>P=0.669 NS</td>
</tr>
<tr>
<td>Austin vs Seattle</td>
<td>P=0.9470 NS</td>
<td>P=0.2055 NS</td>
<td>P=0.4734 NS</td>
<td>P=0.4313 NS</td>
</tr>
<tr>
<td>Seattle vs New York City</td>
<td>P=0.3445 NS</td>
<td>P=0.5364 NS</td>
<td>P=0.8799 NS</td>
<td>P=0.7730 NS</td>
</tr>
</tbody>
</table>

Unpaired student’s T-test: two tailed P values. (SS) statistically significant; (NS) not statistically significant; (VS) very statistically significant; (ES) extremely statistically significant
tal practice to be predominantly represented by this same age cohort. Although no known studies exist documenting the age make-up of the typical periodontal practice, analysis of the author’s personal private periodontal practice in Austin, Texas revealed that 61.4% of the patients in the practice were aged 51 or older. The preponderance of older patients in periodontal practices may have a large influence on the poor performance of Periodontists on the Yelp website compared to other dental specialties. Concerning the high filtering rate of periodontal reviews on Yelp, people aged 55 and older represent the smallest percentage of Yelp users. While people of this age cohort are the smallest minority of Yelp users, they comprise the majority of people who are treated in the typical periodontal practice. Should these patients choose to write a review for their Periodontist on Yelp, statistics indicate that the majority of these patients will not have an established Yelp account and will need to join the website in order to write an evaluation.6 As a new Yelp member, these people will have minimal friends on the Yelp social network and will not have a history of published reviews. Previously published research (Luca, our prior study) indicates that these reviews would be at extremely high risk for filtering.3,6 A higher number of filtered reviews would, in turn, result in a lower number of “recommended” reviews which are the only reviews considered when calculating Yelp star ratings. While a higher number of filtered reviews may negatively affect Yelp star ratings, an older age profile may also do the same. A number of previously published studies have shown age to be negatively associated with consumer propensities to brand innovativeness and variety.8,9 Additionally, increasing age has been associated with heightened perceived risk when choosing brand alternatives.10 As periodontal practices are largely referral based, a large percentage of these patients come from general dental practices.11 Because these General Dentists are their primary provider of dental care, referred patients may consider their General Dentist as their trusted “brand” of choice for dental services. It is well documented that older customers develop brand loyalty over time and have less desire to switch providers of their trusted brands and services.12,13 These older patients may interpret a referral to the periodontist as utilizing an unfamiliar “brand” of dentistry to whom they have no established loyalty and, thus, would be less likely to leave a positive review or any review for that matter. Even if they do leave a review, there is nearly a 50% chance it will be filtered and removed by Yelp according to the findings of the current study. Although other dental specialties also rely on patient referrals from General Dentists, these patients tend to be of younger age cohorts.14,15 Research evaluating consumer purchasing patterns of younger patients indicates that they are less brand loyal, more likely to utilize alternative products, and would therefore be less averse to referrals of outside providers.16 This is evident when examining Yelp users with “Elite” status. Although Yelp does not provide specifics regarding the selection process for the assignment of elite status to its members, studies evaluating the profiles of these select members indicate that they have extremely high social connectivity.17 Recent publications from the Pew Research Center indicate that the most socially connected users are under the age of 30.18 These findings are supported by the current study which found that the majority of Elite Yelp users were associated with younger age profiles. Furthermore, the current
study found that Elite Yelp users tended to write reviews on dental services associated with early adulthood such as third molar removal, exams, cleanings, and bleaching. Accordingly, the dental specialties of Oral Surgery and General Dentistry received significantly more reviews from Elite Yelp users than all other dental specialties in the current study. The high number of reviews from Elite Yelp users may benefit these specialties as research has shown that Elite users are considered “opinion leaders” on Yelp who publish up to 7 times more reviews than typical Yelp users, have fewer reviews filtered, and have more friends on the Yelp social network.\(^{19}\) As periodontists were the least likely to receive Elite Yelp reviews, this may put periodontal practices at a disadvantage in receiving the benefits associated with such reviews including increased exposure to a larger social network of potential customers and fewer reviews removed by the Yelp filtering algorithm.

**CONCLUSION**

The results of our current and prior study show that Periodontists may be at an inherent disadvantage when using the Yelp website due to the advanced age profile of periodontal patients. Findings of low average star ratings, fewer reviews, high filtering rates, and minimal access by Elite Yelp members were consistent for periodontal practices in multiple metropolitan markets. These findings suggest that Periodontists should carefully evaluate their social media strategies and may want to shift their advertising dollars to venues that do not inadvertently discriminate against the age profile of their patients.●

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**Conflicts of Interest**
The authors report no conflicts of interest with anything mentioned in this article.

**References**
SuperLine
Submerged type with tapered body for immediate loading

SimpleLine II
Transgingiva type 1 stage system

Slim Onebody
One body implant for overdenture or provisional

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Analysis of Online Review Characteristics and Filtering Rates for User Generated Yelp Evaluations of Periodontal Practices in a Major Metropolitan Market

Dan Holtzclaw, DDS, MS

Abstract

Background: User generated online reviews of businesses have increased dramatically during the past decade. The ability of these reviews to positively influence business revenues has resulted in occasional fraudulent review manipulation. To combat this, online review websites have begun to employ computer algorithms that identify and remove suspected fraudulent reviews. The purpose of this study was to analyze characteristics and filtering rates for user generated Yelp evaluations of dental practices with a specific focus on periodontal practices.

Methods: A total of 2,035 Yelp reviews were examined for General Dentists, Endodontists, Pediatric Dentists, Oral Surgeons, Orthodontists, and Periodontists in the Austin, Texas metropolitan market. A variety of review characteristics were evaluated for both filtered and non-filtered Yelp evaluations and filtering rates were determined. Additionally, these data were compared and contrasted regarding Periodontists and all other dental specialties. Results: User generated Yelp reviews for dental practices had higher overall average star ratings compared to other businesses. Conversely, dental practices had dramatically higher review filtering rates compared to other businesses on Yelp. When the specialty of Periodontics was specifically compared to other dental specialties, a number of differences were noted. First and foremost, periodontal practices received significantly fewer Yelp reviews than all other dental specialties. Second, periodontal practices were the lowest rated of all dental specialties. Third, periodontal practices were the least likely to be reviewed by “Elite” Yelp members. Finally, and possibly most importantly, nearly half of Yelp reviews submitted for periodontal practices were filtered and removed.

Conclusion: The data presented in this study indicate that periodontal practices lag behind their dental specialty counterparts in nearly all aspects of Yelp metric data. Furthermore, patients of periodontal practices may experience increased difficulty posting non-filtered Yelp reviews in comparison to reviews they may post for other dental practices or businesses. This data should be considered carefully in the marketing and social media strategies of periodontal practices.

KEY WORDS: Marketing of health services, practice management dental, online input, specialties dental
INTRODUCTION
Over the past decade, user generated online reviews have become an increasingly important tool for consumers when making purchasing decisions for goods and services.\(^1\)\(^,\)\(^2\) This is undeniably evident in the fact that more than 100 million reviews currently exist on websites such as Yelp! and TripAdvisor.\(^3\)\(^,\)\(^4\) A number of studies indicate that online reviews may have a direct influence on product sales\(^5\)\(^,\)\(^6\) and that some companies attempt to manipulate these reviews for financial gain.\(^7\)\(^,\)\(^8\) To combat such behaviors in an effort to maintain the integrity of their websites, companies such as Yelp have employed sophisticated computer algorithms to identify and remove suspected fraudulent reviews.\(^3\)\(^,\)\(^9\) While a significant amount of research has been published analyzing online review characteristics and filtering rates of restaurants and hotels,\(^2\)\(^,\)\(^3\)\(^,\)\(^10\)\(^,\)\(^11\) virtually nothing has been published regarding the same for dentists. Accordingly, the purpose of this article is to examine online review characteristics and filtering rates for the dental industry. Moreover, this data is further examined with specific emphasis on the specialty of Periodontics.

MATERIALS AND METHODS
For the purpose of this study, the online review website Yelp was examined. Specifically, search parameters were as follows: City – Austin; Category – Dentists; Category – Endodontists; Category – Orthodontists; Category – Oral Surgery; Category – Pediatric Dentists; and Category – Periodontists. For each query, the top 10 results were examined. In cases where general dentists appeared in query results for dental specialists, the General Dentist listings were ignored. Likewise, if dental specialists appeared in query results for general dentists, the dental specialist listings were ignored. Each result was examined for both “recommended” (non-filtered) and “not-recommended” (filtered) reviews. Each of these reviews was then further examined for star ratings, the number of reviews posted by each reviewer, the number of friends of each reviewer, whether or not

<table>
<thead>
<tr>
<th>Dental Specialty</th>
<th>Total Number of Yelp Reviews</th>
<th>Average Yelp Star Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Dentistry</td>
<td>703</td>
<td>4.81</td>
</tr>
<tr>
<td>Endodontics</td>
<td>231</td>
<td>4.75</td>
</tr>
<tr>
<td>Oral Surgery</td>
<td>266</td>
<td>4.48</td>
</tr>
<tr>
<td>Orthodontics</td>
<td>346</td>
<td>4.84</td>
</tr>
<tr>
<td>Pediatric Dentistry</td>
<td>349</td>
<td>4.54</td>
</tr>
<tr>
<td>Periodontics</td>
<td>140</td>
<td>4.19</td>
</tr>
</tbody>
</table>
the reviewer had a profile picture, and whether or not reviewers were of “Elite” Yelp status. These results were then compared in pairs using unpaired Student’s T test on GraphPad InStat Software (GraphPad Software, Inc, La Jolla, California).

**RESULTS**

For the 60 evaluated dental practices in this study, a total of 2,035 Yelp reviews were examined. The largest number of reviews were for General Dentists, followed by Pediatric Dentists, Orthodontists, Oral Surgeons, Endodontists, and Periodontists. A breakdown of reviews by dental specialty is listed in Table 1. The number of reviews left for General Dentists was dramatically higher than all other dental specialties and was statistically significant when individually compared to each group. The reviewer star rating for dentists evaluated in this study ranged from 4.19 to 4.84 with Periodontists receiving the lowest average star rating and Orthodontists receiving the highest average star rating. In general, the average Yelp star rating for all dentists was 4.59 stars.

Data for filtered reviews is presented in Table 2. Compared to non-filtered Yelp reviews, there were substantial differences in all metric categories for filtered Yelp reviews with one notable exception: star ratings. Filtered Yelp reviews in this study had

<table>
<thead>
<tr>
<th>Dental Specialty</th>
<th>Review Filtering Rate</th>
<th>Average Yelp Star Rating</th>
<th>Average Number of Reviews by Yelp User</th>
<th>Average Number of Friends of Yelp User</th>
<th>Percentage of Yelp Users with Profile Pic</th>
<th>Average Number of Elite Yelp Reviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Dentistry</td>
<td>25.35</td>
<td>4.80</td>
<td>2.06</td>
<td>0.45</td>
<td>11.9</td>
<td>0</td>
</tr>
<tr>
<td>Endodontics</td>
<td>30.53</td>
<td>4.28</td>
<td>2.37</td>
<td>0.89</td>
<td>17.9</td>
<td>0</td>
</tr>
<tr>
<td>Oral Surgery</td>
<td>26.8</td>
<td>4.63</td>
<td>4.27</td>
<td>1.50</td>
<td>9.7</td>
<td>0</td>
</tr>
<tr>
<td>Orthodontics</td>
<td>47.87</td>
<td>4.65</td>
<td>2.39</td>
<td>0.77</td>
<td>19.7</td>
<td>0</td>
</tr>
<tr>
<td>Pediatric Dentistry</td>
<td>39.10</td>
<td>4.35</td>
<td>2.22</td>
<td>1.07</td>
<td>35.1</td>
<td>0</td>
</tr>
<tr>
<td>Periodontics</td>
<td>44.47</td>
<td>4.69</td>
<td>2.48</td>
<td>0.49</td>
<td>19.9</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2: Characteristics of Filtered (Non-recommended) User Generated Yelp Reviews of Dental Practices in Austin, Texas
an average rating of 4.57 stars while those of non-filtered reviews had an average of 4.59 stars. In comparing filtered reviews for all dental specialties, there were no statistically significant differences in measured metrics. However, when these filtered reviews were compared to non-filtered reviews for all dental specialties, very significant differences were noted. Across all dental specialties, the average number of reviewer’s friends seen with filtered reviews was 0.86 compared to 24.35 friends for non-filtered reviews. The average number of reviewer published evaluations for filtered reviews was 2.63 reviews compared to an average of 37.16 reviews for non-filtered reviews. In evaluating the percentage of Yelp reviewers with profile pictures for filtered versus non-filtered reviews, the difference was very statistically significant. While 74.03% of reviewer’s had profile pictures in non-filtered reviews, only 19.02% of reviewers in filtered reviews had profile pictures. Finally, the number of Elite Yelp reviewers was significantly different for filtered and non-filtered reviews. While there were zero Elite Yelp profiles seen with filtered reviews, a total of 70 non-filtered reviews were provided by persons with Elite Yelp profiles.

Data concerning the reviewers that posted the Yelp reviews examined in this study are shown in Table 3. Because Yelp considers filtered reviews to
be potentially fraudulent, only data for non-filtered reviews were considered for evaluating the profiles of a typical Yelp user in this study. On average, the typical Yelp user providing a review for dental services had 24.35 Yelp friends, posted 37.12 reviews, and was 74.03% likely to have a profile picture. While there were some noted differences between dental specialties concerning the characteristics of their typical Yelp reviewers, the most dramatic differences were noted with Elite Yelp reviewers. General Dentists consistently had the most Elite Yelp reviews with statistically significant differences compared to all other dental specialties.

Data for Yelp reviews of Periodontal practices compared to those of other dental specialties are presented in Table 4. Periodontal practices had significantly fewer total Yelp reviews than all other dental specialties. General Dentists had the most Yelp reviews of all dental specialties and had more than five times the total number of Yelp reviews of Periodontists. Even Endodontists, who had the second fewest total number of Yelp reviews, still had 65% more total Yelp reviews than Periodontists. In terms of star ratings, Periodontal practices had the lowest average rating with 4.19 stars while Orthodontists had the highest average rating of 4.84 stars. The lower difference in star ratings for Periodontists was statistically significant compared

<table>
<thead>
<tr>
<th>Yelp Metric</th>
<th>General Dentists</th>
<th>Endodontists</th>
<th>Oral Surgery</th>
<th>Orthodontists</th>
<th>Pediatric Dentists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Yelp Reviews</td>
<td>P=0.0038 VS</td>
<td>P=0.0048 VS</td>
<td>P=0.0046 VS</td>
<td>P=0.0002 VS</td>
<td>P=0.0001 VS</td>
</tr>
<tr>
<td>Average Yelp Star Rating</td>
<td>P=0.024 SS</td>
<td>P=0.0451 SS</td>
<td>P=0.3362 NS</td>
<td>P=0.0214 SS</td>
<td>P=0.2752 NS</td>
</tr>
<tr>
<td>Yelp Review Filtering Rate</td>
<td>P=0.0053 VS</td>
<td>P=0.0340 SS</td>
<td>P=0.0079 VS</td>
<td>P=0.6848 NS</td>
<td>P=0.4252 NS</td>
</tr>
<tr>
<td>Average # of Elite Yelp Reviews</td>
<td>P=0.0290 SS</td>
<td>P=0.4331 NS</td>
<td>P=0.1964 NS</td>
<td>P=1.0 NS</td>
<td>P=0.6601 NS</td>
</tr>
</tbody>
</table>

Two tailed P values. (SS) statistically significant; (NS) not statistically significant; (VS) very statistically significant
to General Dentists, Endodontists, and Orthodontists. Concerning review filtering rates, Periodontists ranked towards the bottom of all dental specialties with only Orthodontists and Pediatric Dentists faring slightly worse. Finally, Periodontists were the dental specialty least likely to receive reviews by Yelp members with designated “Elite” status. While Oral Surgeons and Endodontists were twice as likely to receive Elite Yelp reviews compared to Periodontists, General Dentists were nearly five times as likely to receive Elite Yelp reviews.

**DISCUSSION**

The explosive growth of online social media has empowered individual users to share information to mass audiences with the simple click of a button. Over the past five years, this phenomenon has had a tremendous effect on consumer purchasing decisions for goods and services and represents a significant change from traditional “word of mouth” sharing of information. With more than 80 million posted reviews that are seen by over 165 million unique monthly visitors, Yelp has proven to be one of the most widely used review sites on the internet. Health related business evaluations such as those for medicine and dentistry account for 6% of Yelp reviews. Over 50% of Yelp users are aged 35 or older with a college degree and earnings of $60,000+ per year which makes Yelp a very attractive platform for advertising dental practices.

Studies have shown Yelp’s ability to positively influence business revenue. For example, online consumer review studies of the restaurant industry show that an extra half star rating on Yelp causes restaurants to sell out 19% more frequently while studies of hotel ratings show a one star improvement on Yelp may increase revenue up to 9%. These positive economic benefits have not gone unnoticed by dentists as an increasing number of practices now advertise on Yelp. Furthermore, the positive economic incentives of online reviews has also led to an increase in fraudulent review activity. To fight such fraudulent activity, companies such as Yelp employ proprietary computer algorithms to identify and remove potentially illegitimate reviews. The sophistication of Yelp filtering algorithms and the persistence of fraudulent reviewers is apparent in the fact that the percentage of reviews deemed illegitimate by Yelp has more than tripled to over 20% over the past ten years. In evaluating the top 10 Yelp rated General Dentists, Endodontists, Oral Surgeons, Orthodontists, Pediatric Dentists, and Periodontists in Austin, TX, some interesting trends were observed. First and foremost, the data presented in this study indicates that General Dentists are the dental professionals most likely to be reviewed on Yelp with all other dental specialties, particularly Periodontics, lagging far behind. The total number of online reviews a dental business receives has importance as demonstrated by Grabner-Krauter and Waiguny in 2015 whose study showed that top rated dentists received up to ten times more reviews compared to the bottom 10% of rated dentists. In terms of star ratings, all dental categories had extremely high average ratings with a range of 4.19 to 4.84 stars. With an overall average rating of 4.59 stars, dental practices rated higher than most other businesses on Yelp. While 87% of dental practices in this study achieved Yelp ratings of 4 stars or higher, only 67% of other businesses on Yelp rate 4 stars or higher.

Although dental practices had higher overall star ratings compared to other Yelp reviewed businesses, they also had a higher review filter rate. Review filtering is a strategy employed by Yelp whereby proprietary algorithms are utilized to iden-
tify and remove reviews suspected of being fraudulent. Previous studies have noted that up to 25% of reviews on Yelp may be fraudulent and that Yelp filtering algorithms remove up to 22% of all posted reviews. Overall, dental practices in this study had a review filter rate of 35.69%. This is more than double the 16% Yelp review filtering rate for restaurants as reported by Luca and colleagues. When broken down further and examined more closely, the filtering rate for certain dental specialties is even more dramatic with orthodontic, periodontal, and pediatric dental practices having 47.86%, 44.47%, and 39.01% of reviews respectively filtered. While these dental specialties were plagued by abnormally high review filtering rates, the reasons for Yelp's flagging of these particular reviews may be quite different. Concerning orthodontic and pediatric dental practices, the high review filter rate may be due to the fact that many of the reviews for these specialists are written by parents for treatment actually received by their children. Yelp review guidelines state that reviews should be “first hand consumer experiences.” Many orthodontic and pediatric dental reviews filtered by Yelp appeared to be parents writing about the experiences that their children had with the dentist. Because the verbiage in these reviews technically describes experiences for a third party (i.e. the child), it is possible that Yelp filtering algorithms may recognize these reviews as violating published Yelp review guidelines and thus filter them as being inappropriate. Concerning periodontal practices, the abnormally high filtering rate for reviews on Yelp may be due to completely different reasons. Published studies have shown that the average age of patients treated for periodontal disease is over the age of fifty. According to data published by Yelp, less than 20% of its users meet this age characteristic and people aged 55+ make up the smallest age cohort on the review website. As the majority of patients in periodontal practices are of an age group that is amongst the most under-represented by Yelp users, it is logical to assume that the majority of periodontal patients do not have Yelp accounts. Accordingly, if a periodontal patient joins Yelp to write a review for their Periodontist, there is a high likelihood that the patient will have few established friends on Yelp and will be writing their first Yelp review. The data presented in this study for characteristics of filtered Yelp reviews indicate that such a review would be at high risk for filtering. These findings are supported by the findings of Luca and Zervas’ 2013 evaluation of 316,415 Yelp reviews of 3,625 Boston metropolitan restaurants. In this study, filtered Yelp reviews were predominantly from users that had written few prior reviews, had few friends on Yelp’s social network, and were less likely to have a profile photo associated with their account. While some reviews flagged by Yelp’s filtering algorithm may indeed be fraudulent, the program is not perfect and sometimes affects legitimate reviews. The results of the current study indicate that certain dental specialties with very young or older patient populations may be at higher risk for having legitimate online reviews flagged as “not recommended” by the Yelp filtering algorithm. Because periodontal practices inherently have older patient populations compared to other dental specialties, they may be at a competitive disadvantage when seeking Yelp reviews from their patients. This is evident in the significantly high filtering rate for Yelp reviews of periodontal practices, the lagging total number of Yelp reviews, and the minimal number of “Elite” Yelp reviewers. While these suboptimal results for Yelp metric
data of periodontal practices may potentially be explained by older patient populations, the lower average star rating of periodontal practices compared to all other dental specialties is concerning as this is not related to an older patient population.

CONCLUSION

With 165 million unique monthly users who have posted a total of more than 5 million online reviews for the healthcare industry,11 Yelp is becoming an important component for many dental practice marketing strategies. To utilize this platform effectively, dental practices should evaluate data concerning the publication of these reviews. The data presented in this study indicate that consumers may have increased difficulty posting non-filtered Yelp reviews for dental practices in comparison to reviews posted for other businesses. Moreover, Yelp reviews for certain dental specialties with older patient populations such as Periodontics have dramatically higher filtering rates. As such, it may behoove periodontal practices to consider other options in addition to Yelp for their social media marketing strategies. While the findings of this study are intriguing, they are only representative of a single metropolitan area in one particular area of the country. To corroborate or refute these findings, the same methodology should be employed to evaluate other metropolitan areas in different geographic locations around the United States. Furthermore, the addition of more metropolitan areas to this study will also increase the 'n' of the review analyses which will strengthen the validity of the evaluated data.

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Conflicts of Interest
The author reports no conflicts of interest with anything mentioned in this article.

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