Point of Care

The "Point of Care" section answers everyday clinical questions by providing practical information that aims to be useful at the point of patient care. The responses reflect the opinions of the contributors and do not purport to set forth standards of care or clinical practice guidelines. Readers are encouraged to do more reading on the topics covered. If you would like to submit or answer a question, contact editor-in-chief Dr. John O'Keefe at jokeefe@cda-adc.ca.

QUESTION 1

Can partial dentures work in patients with a depleted dentition?

Background

The swing-lock denture is an excellent design for use in patients with a depleted dentition. Conventional partial dentures are often unretentive because clasping and bracing capabilities are limited, which results in an inability to resist rotational forces. The swing-lock design allows multiple teeth to be clasped, but this can lead to an unesthetic display of metal.

Partial dentures are designed to resist movement along a specific path of displacement (conventionally taken as perpendicular to the occlusal plane). In most cases, clasps, guiding planes and frictional contact of abutment teeth with the saddles will provide resistance to rotational displacement of the denture. However, in a patient with a depleted dentition and molar teeth on only one side, conventional clasping will often not prevent rotation and displacement of the denture away from the tissues.

The swing-lock denture provides retention and stability in clinical situations where the number of remaining teeth is insufficient for a conventional partial denture or the teeth are mobile. Swing-lock dentures may stabilize the remaining mobile teeth, but whether this effect lasts over the long term is unknown.

In view of the increased masticatory loads that are applied to the depleted dentition with a swing-lock denture, the remaining teeth should lack excessive mobility. No large-scale, long-term studies have investigated the success of the swing-lock design, but reports so far available indicate that most patients find this a well-tolerated and successful design.

Management of the Issue

A 61-year-old patient complained of inability to eat and continual discomfort with her present dentures. The patient had a history of heart and circulatory problems, including a leaky heart valve, and the anticoagulant warfarin had been prescribed. Oral examination revealed that only an upper left canine, premolar and molar were present (**Fig. 1**). These teeth were not mobile but had undergone severe periodontal bone loss (**Fig. 2**). A conventional cobalt chromium denture had been constructed, but it lacked retention and

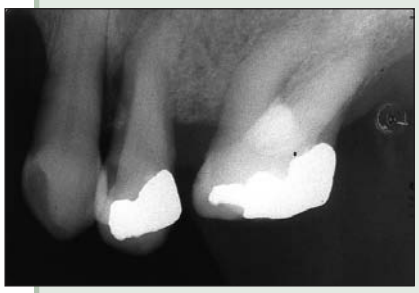


Figure 1: Periapical radiograph of the remaining maxillary teeth in a patient with depleted dentition shows severe periodontal bone loss.

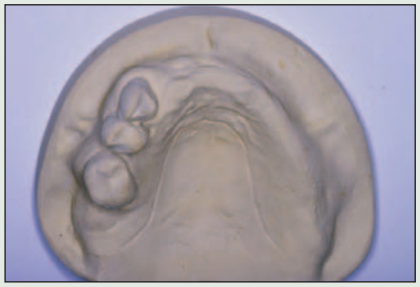


Figure 2: The few remaining natural teeth had severe gingival recession.

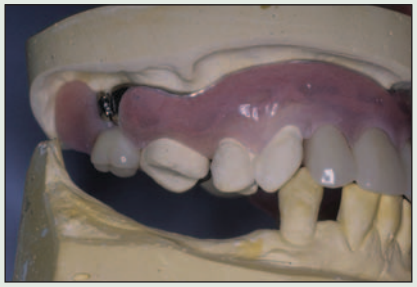


Figure 3: The swing-lock denture was constructed with gingival acrylic contacting the upper teeth for resistance to rotational and vertical displacement.

Table 1 Benefits and contraindications for the swing-lock partial denture

Benefits	Contraindications
Stable and retentive denture suitable for depleted, unilateral dentition	Limited mouth-opening or poor manual dexterity
Teeth can be added to the prosthesis as the remaining natural teeth fail	Shallow sulcus (less than 7 mm)
Gingival recession can be disguised	Poor oral hygiene

stability. The denture had caused visible dam lines in the palate. The patient smoked tobacco and was advised to stop.

The treatment options were discussed with the patient. One option was implant therapy, but the patient's physician strongly advised against any surgery, and this option was therefore discounted.

Another option consisted of placement of a milled gold crown on the molar tooth and precision attachment on the canine crown to support a partial denture. In this way, parallel vertical surfaces would be provided to resist vertical and rotational displacement. However, the periodontal condition of the teeth was considered inadequate to support the additional masticatory load. This left the swing-lock denture as the only viable treatment option (**Fig. 3**).

Summary of Features (Table 1)

This type of denture is indicated when there is an unfavourable unilateral distribution of the natural teeth. If the natural teeth lose further periodontal bone support, teeth can be added to the denture as necessary. Because all of the natural teeth contribute to retention of the denture, loss of one tooth has little effect on overall retention. Gingival recession can be disguised using an acrylic veneer attached to the bar.

The swing-lock design is contraindicated if the patient has limited mouth-opening, a shallow labial sulcus or poor manual dexterity. Each of these conditions can affect the optimal design, the insertion of the denture or the rotational movement of the bar. It can be difficult to assess a patient's manual dexterity, but inquiries about whether any of the patient's hobbies require manual skills can give some indication. Prominent, fleshy frenal attachments can also limit placement of the bar. The swing-lock denture can be time-consuming to construct, and therefore expensive, but may be cheaper than implant therapy. As with any prosthodontic treatment, long-term success depends on good oral hygiene. Regular recall for maintenance (e.g., relining) and preventive advice is essential.

THE AUTHOR

Dr. Hugh Devlin *is senior lecturer in restorative dentistry, The Dental School, University of Manchester, Manchester, UK. Email: Hugh.Devlin@Manchester.ac.uk.*

Further Reading

Chan MF, Adams D, Brudvik JS. The swing-lock removable partial denture in clinical practice. *Dent Update* 1998; 25(2):80–4.

Lynch CD, Allen PF. The swing-lock denture: its use in conventional removable partial denture prosthodontics. *Dent Update* 2004; 31(9):506–8.

QUESTION 2

Do occlusal schemes and occlusal loading affect the survival of dental implants?

Background

The scope of prosthodontic treatment has been broadened considerably through the widespread application of osseointegrated dental implants. The predictable and stable anchorage for prosthetic tooth replacements afforded by implants has increased treatment options but has also made treatment planning and execution more complex.

The concepts about occlusion that underpin the use of implant-supported restorations have largely been extrapolated from natural-tooth or complete-denture occlusion because no convincing scientific or empirical theories of occlusion specific to implant-supported restorations have been proposed.

The literature relating to complete-denture occlusion indicates that various materials and various occlusal forms and arrangements have been used over the years, but the superiority of one particular occlusal form or arrangement has not been scientifically proven.

Management of Occlusion

Many authors have stated the need to avoid applying nonaxial forces to implants supporting prostheses. The absence of a periodontal ligament to support the implants and the observation that nonaxial forces will create areas of high stress concentration instead of uniform compression along the bone–implant interface are the main reasons for this concern.

However, the shape and surface texture of cylindrical endosseous implants make it impossible for a vertically applied load to be transmitted to the bone exclusively through compressive loading. It should also be recognized that occlusal forces are rarely vertical. Mastication is a side-to-side action that does not lend itself to axial loading of teeth or implants in the jaws.

Nonaxial loading of a mechanical device assembled with screw joints, such as an implant-supported prosthesis, puts those components at greater risk of failure through fatigue or recurrent loosening of screws. These mechanical failures can be observed clinically (**Fig. 1**) and have been reported in the literature, but the limited evidence available does not demonstrate any detrimental effect of nonaxial loading on the osseointegrated interface between the bone and the implant surface.

Numerous authors have written about the concept of progressive occlusal loading of dental implants, but the available evidence does not support this idea. Several studies have indicated that the type of occlusal material used does not affect the force transmitted through the prosthesis or implant to the surrounding bone. There is no published evidence that modifying the dimensions and occlusal contacts or anatomy of provisional restorations reduces loading of implant prostheses.

Full occlusal loading of an integrated implant at the time of abutment connection does not seem to be a problem. In fact, in some animal studies, purposeful overloading did not generate any deleterious effects on initial function. Extreme differences in tactile sensibility between natural teeth and implants, due to the lack of periodontal

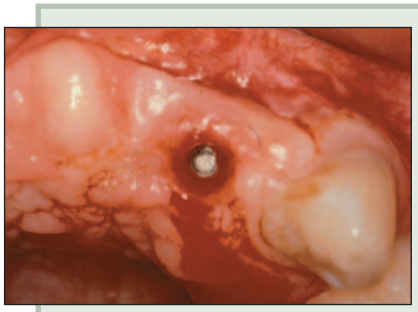


Figure 1: A patient presented with a failed 4-unit fixed partial denture 7 years after placement. Nonaxial loading of the prosthesis resulted in fatigue failure at the level of implant abutment connection.

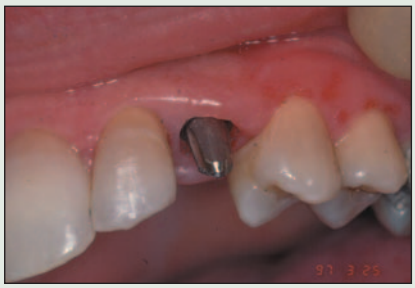


Figure 2a: This 27-year-old female patient had a missing left maxillary canine. Implant placement with a cementable abutment is shown here.

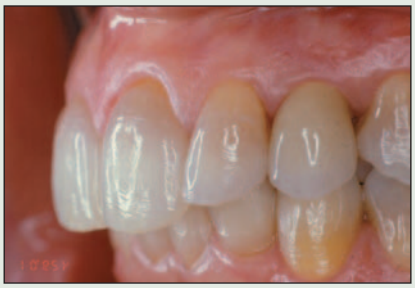


Figure 2b: The final restoration of the missing canine (4 year after placement) restored into full canine guidance reflecting the occlusal scheme of the contralateral canine.

ligaments surrounding implants, have been demonstrated. Nonetheless, patients seem to have adequate masticatory function without the benefit of periodontal proprioceptive nerve endings around implants. Perhaps the presence of such nerve endings in the periosteum, the muscles of mastication, the oral mucosa and the temporomandibular joints compensates for those that are missing around dental implants (**Figs. 2a** and **2b**).

Conclusions

There is little evidence to support a direct cause-and-effect relationship between occlusal factors and deleterious biological outcomes for osseointegrated implants. Evidence supporting specific occlusal theories for implant-supported prostheses consists of expert opinion, in vitro studies and animal studies. In spite of a general lack of knowledge about the loading of dental implants, they have a high survival rate.

THE AUTHOR

Dr. Thomas D. Taylor *is professor and head of the department of oral rehabilitation, biomaterials and skeletal development, University of Connecticut School of Dental Medicine, Farmington, Connecticut. Email: ttaylor@ nso.uchc.edu.*

Dr. Taylor's session at the CARDP meeting is titled "Occlusion and dental implants: where's the science".

Further Reading

Ogiso M, Tabata T, Kuo P, Borgese D. A histologic comparison of the functional loading capacity of an occluded dense apatite implant and the natural dentition. *J Prosthet Dent* 1994; 71(6):581–8.

Taylor TD, Wiens J, Carr A. Evidence-based considerations for removable prosthodontic and dental implant occlusion: A literature review. *J Prosthet Dent* 2005; 94(6):555–60.

On behalf of members of the Canadian Academy of Restorative Dentistry and Prosthodontics (CARDP), I would like to extend a cordial invitation to all dentists to attend this year's annual meeting, from September 28 to 30 in Halifax, Nova Scotia. This year's meeting will take place at the Halifax Marriott Harbourfront Hotel, a spectacular venue located adjacent to the Historic Properties in downtown Halifax.

Once again, CARDP will showcase its commitment to education and professional development. Dr. Michael Roda has assembled a comprehensive and stimulating scientific program with international status. There will be another strong showing from our sponsors, along with interesting topics in our table clinic program.

A hands-on, digital photography course featuring Rita Bauer, a senior medical photographer and educational media specialist at the University of Toronto, will be offered. This particular course has received rave reviews in the past.

The meeting's social program includes a welcoming reception and buffet at the Maritime Museum of the Atlantic, the oldest and largest maritime museum in Canada; golf at the world class Glen Arbour golf course; a tour of Citadel Hill, Canada's most visited natural historic site; a tour of the world's second largest natural harbour; and a Lobster Ceilidh at Pier 21, a national historic site located on the Halifax waterfront. The President's Gala will provide an elegant evening of fun on Saturday night to conclude the meeting.

Please come and enjoy yourselves at our annual meeting in Halifax. Visit our website for further details at www.cardp.ca.

Dr. Gorman Doyle
CARDP president

JCDA is pleased to feature CARDP program speakers in this month's "Point of Care" section. See pages 401, 403 and 405 for articles by Drs. Thomas Taylor, Clark Standford and Robert Roda.

QUESTION 3

What factors must be considered in planning placement of a crown supported by a single-tooth implant?

Background

The placement of dental implants has become a standard method for replacing missing teeth. Dentists considering this treatment modality should understand the vital role that planning plays in achieving predictable outcomes, especially in areas of the mouth where esthetic considerations are important. Various factors should be considered when planning for a crown to be supported by a single-tooth implant, and the potential for success with alternative therapies should be considered and discussed with the patient.

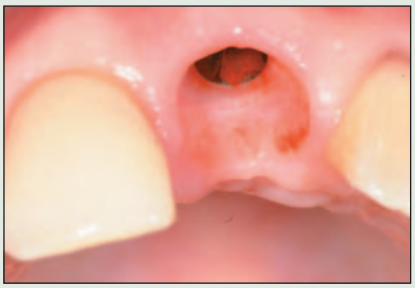


Figure 1a: The mucosal architecture differs dramatically between the facial and lingual aspects of an implant (Astra Tech AB, Mölndal, Sweden) placed into an extraction socket as a replacement for tooth 21. The implant was allowed to heal for 8 weeks before restoration.

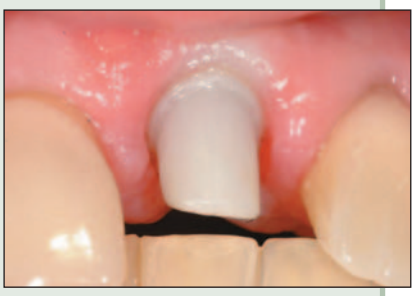


Figure 1b: A transmucosal ceramic abutment (yttria-stabilized tetragonal polycrystal zirconia) was positioned in the implant. A provisional crown was made and a period of 6 weeks was allowed for mucosal adaptation before the final impression was taken and the crown fabricated.

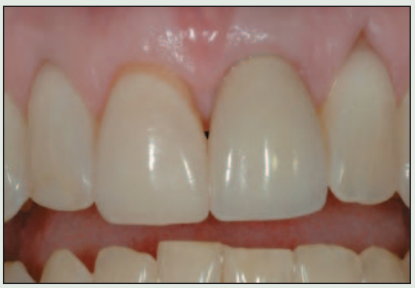


Figure 1c: Appearance of the all-ceramic crown (Procera NobelBiocare, Göteborg, Sweden) replacing tooth 21 at the 5-year recall appointment. There is mucosal stability at the restorative margin, with good soft-tissue health.

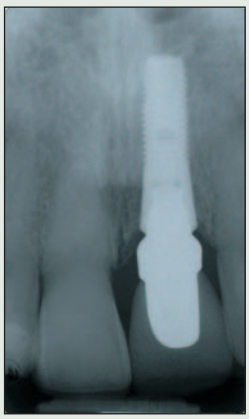


Figure 1d: Five-year post-insertion periapical radiograph demonstrates bone adaptation to the head of the implant.

Criteria

Evaluation should start with a careful assessment of gingival health and architecture (both biotype and position), proximal contacts and tooth position (**Fig. 1a**). The volume of bone at the implant site must also be considered. Because peri-implant bone is continuously turned over by the body, at least 1.0 mm of cortical bone is needed on both the facial and the lingual sides of the implant to maintain hard- and soft-tissue function and esthetics. This often means that the implant is placed slightly to the palatal aspect of the ridge, especially in the case of an extraction socket. In addition, 2.0 mm of bone is typically required between the alveolar crest and the root apices on each side. The presence of resorptive clefts, undercuts or other bony or soft-tissue features could necessitate pre-implant osseous or soft-tissue grafting. Furthermore, in evaluating the existing dentition, be aware that it tends to be positioned more facial relative to the central axis of the alveolar ridge. Thus, the implant surgeon and restorative dentist should discuss the need for pre-implant site development.

Bone volume and resorption of the facial plate can also affect the type of crown (screw-retained or cement-retained) used for restoring the implant. For example, to create access in the cingulum area for a screw-retained crown on a central incisor implant, the implant must be placed in a more vertical direction than if a cemented crown is planned. If the facial plate of bone is resorbed, the apex of the implant could perforate the remaining cortical plate, which could necessitate osseous grafting before or at the time of implant placement. Consequently, removal of natural teeth before implant placement requires techniques to minimize the loss of the facial plate of bone.

Soft-tissue evaluation is critically important, especially for patients who show their teeth and gingival tissues while at rest or during speech produc-

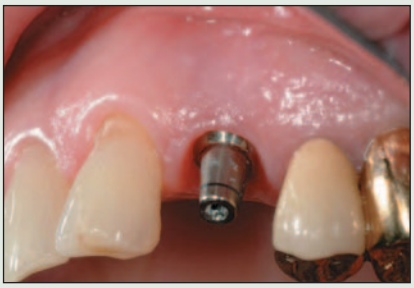


Figure 2a: A prefabricated implant abutment (Direct Abutment, Astra Tech AB) replacing tooth 24 in a situation where the mucosa is at the same uniform thickness. This allows placement of the implant and restoration with a single-unit crown.

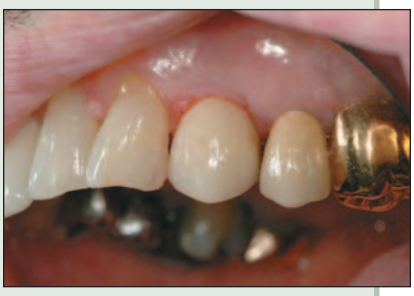


Figure 2b: Porcelain-fused-to-metal crown restoring tooth 24.

tion. Patients with thick periodontal tissue biotypes typically have thick, flattened osseous plates that offer higher resistance to recession than is the case for patients with thin tissue biotypes. The size, shape, zenith and colour of the interdental papilla on adjacent and contralateral teeth are important. Surgical approaches that save or enhance tissue papillae, such as orthodontic extraction, periotome-based tooth removal and flapless implant placement, are preferred. Gingival response following tooth extraction and implant placement can be difficult to predict and should be discussed with the patient before treatment. In situations that pose a high risk for gingival recession, a screw-retained crown rather than a cemented crown may be considered. A screw-retained crown can be removed later and the contours modified without remaking the entire crown. In patients with thin biotypes, a ceramic abutment (e.g., yttria-stabilized tetragonal polycrystal zirconia) (**Fig. 1b**) or scalloped titanium abutments should be considered to facilitate ease of margin placement relative to the contours of the presenting gingival architecture (**Figs. 1c** and **1d**).

The patient's occlusion and occlusal scheme must also be evaluated. In maximum intercuspation, the occlusal contacts should direct vertical loading down the long axis of the implant. Large lateral sliding contacts may create elevated bending or torsional loads that can lead to premature failure of the abutment or crown components. Patients who exhibit bruxing must be cautioned about the associated risks.

Limited vertical opening could pose a problem. The patient should be able to open 35.0 mm or more to allow access for surgical instruments during osteotomy otherwise implant placement location and angle could be in jeopardy.

Mesiodistal tooth size (and the size of the edentulous space) is an additional factor. The space size may need to be altered (for esthetic reasons) through pre-implant prosthodontic treatment. Care in evaluating the mesiodistal space of the central incisors (70% of the incisogingival dimension) and the presence of balanced and symmetric lateral incisors assist in obtaining a predictable result (**Figs. 2a** and **2b**).

There may also be anatomic limitations, such as the location of the maxillary sinus or the contents of the neurovascular bundle. Some of these limitations can be altered through preimplant surgery.

Conclusions

The use of restorations supported by single-tooth dental implants has expanded dentists' ability to provide predictable replacement teeth without resorting to conventional fixed prostheses. The ultimate outcome — the best possible functional and esthetic result — is determined by careful assessment of the patient and teamwork among the restorative dentist and his or her surgical colleagues.

THE AUTHOR

Dr. Clark M. Stanford *is the Centennial Fund Professor for Clinical Research, Dows Institute for Dental Research, College of Dentistry, The University of Iowa, Iowa City, Iowa. Email: clark-stanford@uiowa.edu.*

Dr. Stanford's session at the CARDP meeting is titled "State of the art: predictability and esthetics in restoring dental implants".

Further Reading

Fradeani M. Esthetic rehabilitation in fixed prosthodontics. Volume 1. Esthetic analysis: a systematic approach to prosthetic treatment. Chicago: Quintessence Publishing; 2004.

Rodoni LR, Glauser R, Feloutzis A, Hammerle CH. Implants in the posterior maxilla: a comparative clinical and radiologic study. *Int J Oral Maxillofac Implants* 2005; 20(2):231–7.

Sclar A. Soft tissue and esthetic considerations in implant therapy. Chicago: Quintessence Publishing; 2003.

Stanford CM. Application of oral implants to the general dental practice. *J Am Dent Assoc* 2005; 136(8):1092–100; quiz 1165–6.

Stanford CM. Issues and considerations in dental implant occlusion: what do we know, and what do we need to find out? *J Calif Dent Assoc* 2005; 33(4):329–36.

Zadeh HH. Implant site development: clinical realities of today and the prospects of tissue engineering. *J Calif Dent Assoc* 2004; 32(12):1011–20.

QUESTION 4

How large should the apical diameter of the root canal preparation be?

Background to the Issue

The ideal endodontic preparation is a cleaned and disinfected continuously tapering funnel with the apical diameter kept as small as possible to prevent root-filling materials from entering the periradicular tissues. Not only should the canal be cleaned, but it must have a shape appropriate to receive the root-filling materials. Although there is significant disagreement among endodontic specialists about the ideal apical diameter of the root canal preparation, there is universal agreement that the ideal size of the apical preparation coronal to the apical constriction varies from tooth to tooth and depends on anatomic, microbiological and mechanical factors.

Understanding the anatomy of the root end of the tooth is critical to answering this question. The apical foramen is at the mouth of a wide funnel that tapers inward toward the apical constriction, which is commonly described as being located at the cementodentinal junction. Most canal preparation techniques describe the target working length (i.e., the apical opening) as extending to the apical constriction, but the apical constriction can be difficult to find as a landmark and in some cases does not exist as a discrete entity. The position of the apical opening is usually within 0.1 to 1.2 mm of the radiographic apex of the root (**Figs. 1a** and **1b**), and the diameter of the opening will be a factor in determining the ultimate size of the apical preparation. The apical opening varies in diameter between 0.25 and 0.40 mm, which is the size of a #25 to #40 ISO tip instrument, such as a K file. Also, in many cases the apical opening is oval rather than round. Thus, to ensure removal of as much pulp tissue and remnants as possible, the apical extent of the canal should ideally be mechanically cleaned to the equivalent of at least a size #35 instrument. This seems to agree with research indicating that mechanical cleaning with larger files is better for removing bacteria from canals than cleaning with smaller instruments, although this finding has been disputed. Overall, the literature consensus favours larger apical preparation sizes over smaller ones.

Management of the Issue

The use of irrigants, notably 6% sodium hypochlorite, is critical to the cleaning and disinfection of the canal space. Proponents of a smaller diameter for the apical canal frequently state that even if there has been no mechanical cleaning of the apical area, irrigants will clean the canal, thus permitting use of smaller file sizes. To allow for penetration of irrigants into the apical end (1 to 2 mm) of the preparation, however, an apical preparation diameter of 0.35 mm is needed, and increasing taper only seems to enhance cleaning when at .10 which is many times too large for curved canals. Thus, it seems that the minimum acceptable size for the apical preparation is that of a #35 K file (**Figs. 2a** and **2b**).

Apical gauging has been advocated for determination of apical preparation size. This technique involves placing .02 taper nickel–titanium instruments with progressively larger tip diameter to the working length and then pushing them slightly beyond the constriction. The first file to bind at working length is considered to represent the apical diameter and, according to this technique, should be the final apical preparation size. One disadvantage of this technique is the potential for pushing infected debris from the canal into the periradicular tissues. As a technique for measuring apical

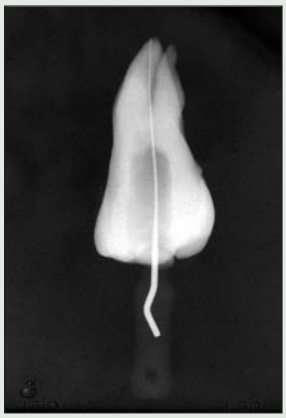


Figure 1a: Radiograph showing a working length file extending to the radiographic apex and apparently contained within the root canal.

Figure 1b: Photograph showing that the file in Fig. 1a actually extends beyond the apical foramen; the canal exits distant from the anatomic root end.

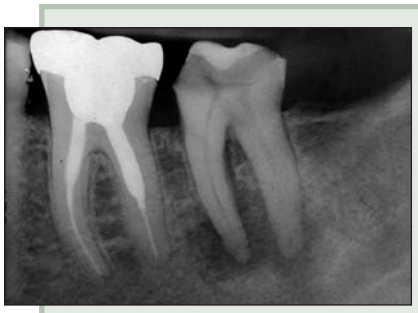
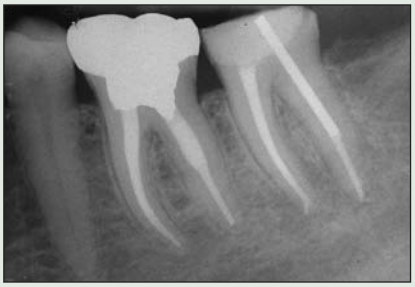


Figure 2a: The canals on the first molar were prepared to an apical size that was inadequate to prevent post-treatment endodontic disease, despite being obturated to ideal working length.



Figures 2b: After retreatment of the first molar, the canals in the mesial root were enlarged to an apical diameter of #35; the tooth is asymptomatic.

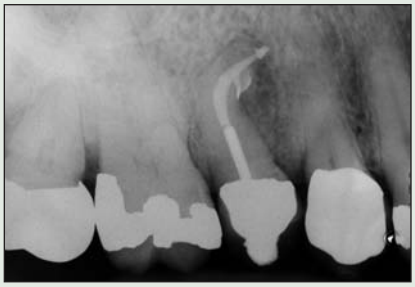


Figure 3: A combination of hand and rotary nickel–titanium instruments was used to clean, shape and 3-dimensionally fill the canal to apical size #35 around a severe curvature.

diameter, apical gauging may be inadequate if the canal apex widens abruptly just coronal to a very narrow constriction or if there is a significantly ovoid shape to the apical opening. Necrotic pulp remnants and bacteria may remain in an adequately gauged canal.

Instrumentation to apical size #35 and larger can be a difficult task in thin, severely curved roots, since many stainless steel hand instruments of that size cannot be placed to the apical extent of the canal without causing damage to the tooth (e.g., ledge formation or perforation). Several studies agree with the findings of the Toronto Study that there is no difference in clinical treatment outcomes between large and small preparation sizes. This congruence of results may relate to the use of hand instrumentation in all of these studies; the greater risk of canal aberrations with larger sizes could outweigh any positive effects of enhanced apical cleaning. This problem can usually be overcome by skilled application of one of many hybrid techniques using a combination of hand and nickel–titanium rotary instrumentation (**Fig. 3**).

It seems clear that the diameter of the apical preparation in any given case will vary with patient-specific factors, but it should probably never be smaller than a #35 instrument and in many instances should be larger.

THE AUTHOR

Dr. Robert S. Roda *is an adjunct assistant professor in the department of endodontics, Baylor College of Dentistry, Dallas, Texas. Email: azendo@aol.com.*

Dr. Roda's session at the CARDP meeting is titled "Keeping the tooth!: Endodontic possibilities vs. probabilities".

Further Reading

Baugh D, Wallace J. The role of apical instrumentation in root canal treatment: a review of the literature. *J Endod* 2005; 31(5):333–40.

Friedman S, Abitbol S, Lawrence HP. Treatment outcome in endodontics: the Toronto Study. Phase 1: initial treatment. *J Endod* 2003; 29(12):787–93.

Peters O, Peters C. Cleaning and shaping of the root canal system. In: Cohen S, Hargreaves KM. Pathways of the pulp. 9th ed. St. Louis: Mosby-Elsevier; 2006. p. 290–357.

Schilder H. Cleaning and shaping the root canal. *Dent Clin North Am* 1974; 18(2):269–96.

Walsch H. The hybrid concept of nickel-titanium rotary instrumentation. *Dent Clin North Am* 2004; 48(1):183–202.