The increased demand for esthetic restorations has spurred technologic advances in the field of dental restorations aiming at producing durable restorations capable of withstanding the patient’s intraoral environment and masticatory forces, while at the same time striving for maximum esthetics for patient satisfaction.1

The use of implant-supported single crowns,2 as well as fixed dental prostheses (FDP) with conventional preparation designs, have been the standard for replacement of a single posterior missing tooth.3,4 Although implants do not require the destruction of dental tissues, their use requires surgical intervention and in some cases is limited by anatomical and/or medical factors.5,6 On the contrary, conventional full-crown preparation designs for FDPs have been reported to require a removal of up to 67.5% to 75.6% of coronal tooth structure, which in many cases is sound and unaffected.7,8 After tooth cutting for a full-crown preparation, severe acute pulp reactions have been observed adjacent to the cut dentinal tubules, which may lead to loss of pulp vitality in the short or long term.9–11 The literature also points to the effects of tooth preparation, in that it further weakens teeth and increases the likelihood of tooth

Purpose: To assess the short-term outcomes of two different conservative preparation designs for posterior zirconia inlay-retained fixed dental prostheses (IRFDPs) and to analyze the marginal integrity of such restorations. Materials and Methods: Thirty patients with a missing maxillary first molar participated in this study and were divided randomly into two groups: one that received abutment preparations for inlay retainers (ID group, n = 20), including a proximal box and an occlusal extension, and one that received only proximal box preparations (PB group, n = 10). Zirconia IRFDPs were bonded in position and followed up after 2 weeks, 6 months, 1 year, and then annually. The in situ restorations were duplicated utilizing a single-step putty/wash impression technique at the 2-week and 2-year follow-up visits. Restoration margins were evaluated under scanning electron microscopy, and marginal continuity was calculated as a percentage of the whole margin at the tooth-cement (TC) interface and the zirconia-cement (ZC) interface. Results: After a mean observation period of 26.2 months, all restorations were still in function. The only complication encountered was debonding of restorations; however, they were re-bonded back in place without issue. The cumulative Kaplan-Meier 2-year survival rate for the IRFDPs was 86.6%. There was a significant difference between the two groups regarding percentage of continuous margins (P < .05) after 2 years, with the percentage of continuous margins in the ID group at 92.8% and 91.5% at the TC and ZC interfaces, respectively, and in the PB group at 84.1% and 78.6%, respectively. Conclusion: Zirconia-based monolithic IRFDPs can be recommended for short-term replacement of a single maxillary molar. Int J Prosthodont 2021;34:324–333. doi: 10.11607/ijp.7081
fracture in the long run. This all indicates the need for a more conservative approach in replacing lost or missing dentition.

With the advances in bonding technologies and a call for more conservative methods of restoring missing teeth, resin-bonded inlay-retained fixed dental prostheses (IRFDPs) have been proposed as a means for single-tooth replacement. The first encouraging attempt for using a metal IRFDP in replacing posterior teeth was reported by Stokholm and Isidor in 1996; however, patient demands for esthetic restorations have steered clinicians toward using metal-free materials for fabrication of IRFDPs.

Even though the use of fiber-reinforced composites in the fabrication of IRFDPs has shown encouraging initial in vitro and clinical results, over time, they suffer from discoloration, severe wear, and loss of the composite veneer. They have therefore been recommended as short-term provisional restorations. Likewise, the use of lithium disilicate in the fabrication of IRFDPs has proven unsuccessful, with a high rate of clinical failure.

Zirconia-based IRFDPs with a ceramic veneer have demonstrated higher survival rates in the literature when compared to other all-ceramic and fiber-reinforced composite IRFDPs. The main problems encountered in vivo with this design were the loss of retention of one or both retainers and delamination of the ceramic veneer.

Several dental companies have introduced new high-translucency zirconia materials for the fabrication of monolithic restorations that match the patient’s esthetic requirements without compromising the strength of the original material. These monolithic restorations also help in the elimination of the ceramic veneer, thus limiting the need for the extra tooth preparation and getting rid of the chipping and delamination known to occur in veneered restorations, which was reported to be as high as 20% and 35% in FDPs after 5 and 10 years, respectively.

Due to the inertness of zirconia, several surface treatment methods have been considered to obtain reliable adhesion with resin cements. However, the use of 10-methacryloyloxydecyl dihydrogen phosphate (MDP)–containing resin cements combined with airborne-particle abrasion has shown durable bond strengths.

Clinical data on the use of monolithic zirconia for fabrication of IRFDPs are needed, so the aim of the current clinical trial is to assess the short-term outcome of two different conservative preparation designs (occlusoproximal inlay and proximal box designs) for posterior zirconia IRFDPs and to analyze the marginal integrity of such restorations after a period of 2 years in functional occlusion. The null hypothesis of this study is that there will be no difference between these two restoration designs.

MATERIALS AND METHODS

Study Design

Ethical approval was obtained from the research ethics committee at the Faculty of Dentistry, Alexandria University, Alexandria, Egypt (IRB No: 00010556–IORG: 0008839), in accordance with the 1964 Declaration of Helsinki.

A minimum sample size of 10 cases per group (number of groups = 2) was determined to be enough to detect a standardized effect size of 0.615 (minimum difference in the mean percentage of continuous adapted margins in enamel = 2.766, pooled SD = 4.498) for the primary outcome and was statistically significant with 82% power and at a significance level of 95% (accepted error = .05).

In a randomized clinical trial, 30 participants were recruited from patients visiting the Department of Conservative Dentistry at the Faculty of Dentistry, Alexandria University, and divided randomly into two groups. The randomization was performed by the statistician using a coin flip for each patient, where every patient had a 50/50 chance of being assigned to either group. All patients had to fit the following inclusion criteria: having a missing maxillary first molar tooth opposed by a natural tooth or an FDP; aged between 18 and 45 years; presenting good oral hygiene with a maximum of grade 1 tooth mobility in the abutment teeth; and showing no history or clinical signs of parafunctional habits (clenching or bruxism), including the presence of wear facets on teeth, visible cracks, and fractured teeth and/or restorations. The exclusion criteria included: signs of periapical pathology or periodontal disease in abutment teeth; carious lesions or old restorations in abutments larger than the dimensions of the determined cavity preparations; and short abutment teeth with less than 4-mm length at the proximal wall.

The patients were informed verbally about the research methodology, risks, benefits, and alternative treatments. Informed consent was given to each patient and signed before starting the treatment.

Abutment Preparation

All clinical treatment of the patients included in the study were performed by one operator (M.H.). To ensure standardization, prior to conducting any preparations in vivo, the same procedures were performed repeatedly on simulation models and measured to be within the required dimensions.

After clinical diagnosis, the patients were assigned randomly to one of the two study groups. All teeth cavity preparations were made using a high-speed contraangled handpiece with diamond stones #1014, #2133, and #2133F (Microdont) having rounded cutting angles to obtain internal rounded cavity walls.
All patients received a proximal box cavity preparation cut into the distal side of the maxillary second premolar and the mesial side of the maxillary second molar with an axial depth of 1.5 mm at the gingival step and a buccolingual width wider than the contact area of the tooth, with a minimum extension of 4 mm. The gingival step was placed in enamel, 1 mm occlusal to the free gingival margin.

In group 1 (inlay design [ID], n = 20), an occlusal extension with a depth of 1.5 to 2 mm and a width approximate to one-third the intercuspal width was also cut in both teeth (Fig 1).

In group 2 (proximal box design [PB], n = 10), no extra preparation was made in the teeth (Fig 2).

An immediate dentinal sealing procedure was then performed. First, the exposed dentin was primed using Clearfil Liner Bond F Primer (Kuraray Noritake) for 20 seconds and then air dried. After that, Clearfil Liner Bond F Bond (Kuraray Noritake) was applied and distributed evenly on the surface using the air syringe and then light cured for 10 seconds. The enamel margins were then redefined and finished to remove traces of the bonding agent.

**Fabrication of Restorations**

After preparations, impressions for both arches were made using a polyvinyl siloxane impression material (Express STD, 3M ESPE). After impressions were made, the cavities were restored using a temporary composite material (Luxatemp Inlay, DMG). The stone casts were poured using type IV stone (Elite Rock, Zhermack) and then scanned using a CAD/CAM 3D extraoral scanner.
The restorations were designed using KaVo multiCAD software, with a minimal connector design of 9 mm². The restorations were milled from translucent zirconia blocks (Zenostar Zr Translucent, Wieland Dental) using a milling unit (M1 Soft, Zirkonzahn) and sintered using a conventional cycle with a maximum temperature of 1,500°C. The restorations were then externally shaded using external stains (IPS Ivocolor Shade, Ivoclar Vivadent) to match the patient’s tooth shade.

Cementation of the Restorations
Before cementation, the fitting surface of the zirconia FDP in all groups was airborne-particle abraded using 50-μm aluminum oxide (Al₂O₃) particles at 3-bar pressure for 10 seconds at a distance of 10 mm. The zirconia FDPs were then cleaned using 96% ethanol alcohol for 5 minutes in an ultrasonic cleaner and then air dried.

After complete isolation using a rubber dam and retraction cord, the cavities of the teeth were cleaned using airborne-particle abrasion to obtain a fresh bonding surface. Selective etching of enamel margins in the tooth preparations was performed utilizing 37% phosphoric acid for 15 seconds, which was then rinsed and dried. The cementation was done using an MDP-containing self-adhesive resin cement (PANAVIA SA Cement Plus Automix, Kuraray Noritake) according to the manufacturer’s recommendations.

Follow-up
Patient recall was scheduled 2 weeks after cementation, which was considered as baseline for further visits, after
Marginal Integrity Under SEM
The in situ restorations were duplicated utilizing a single-step putty/wash partial impression technique using Express STD putty and light-body PVS impression material (3M ESPE). The impressions were made for each FDP after 2 weeks (as a control) and 2 years to evaluate the marginal adaptation.\textsuperscript{47}

The impressions were then poured using epoxy resin and gold sputtered. The specimens were analyzed under a tungsten thermionic emission scanning electron microscope (SEM; TESCAN VEGA3, TESCAN ORSAY Holding). The full length of the tooth/restoration margin was measured using SEM under a low magnification of ×50. Restoration margins were evaluated under SEM for gaps, cracks, or loss of continuity of the margins. The length of defects was summed and calculated as a percentage of the whole length of the tooth/restoration margin. The percentage of continuous margins was then calculated using the following equation:

\[
\text{Percentage of continuous margins} = \left(\frac{\text{full length of margins} - \text{summation of defect[s] length}}{\text{full length of margins}}\right) \times 100
\]

The operator working on the SEM was blinded to the assigned group numbers.

Statistical Analysis
Kaplan-Meier survival curves\textsuperscript{48} were used to demonstrate cumulative survival rates. Survival time was described by the distance between the date of cementation and the date of the last follow-up examination or date of failure. Complications including secondary caries, endodontic pathology, debonding of retainer from one or both abutments, and/or fracture of restoration were considered as failure of the restoration.

Comparison of the marginal continuity in both groups was conducted utilizing Student t test. Paired t test was used to analyze the degradation of the margins over the 2-year study period by comparing the marginal continuity before and after 2 years.

RESULTS
A total of 30 patients were included in this study and gave their written consent (19 women and 11 men, with a mean age of 34.5 years). In total, 30 IRFDPs replacing a missing maxillary first molar were inserted. Twenty of the IRFDPs received the ID design, and 10 received the PB design. Table 1 shows the patient number and allocation in the study groups.

After a mean observation period of 26.2 months (with a range of 23.9 to 29.3 months), all restorations were still in function. Four cases (13.3%) debonded and were recemented in place using the same bonding procedure. In the ID group, only one case (5%) debonded; however, in the PB group, three cases (30%) debonded. All four cases showed an adhesive failure at the cement/restoration margin.

During the entire follow-up period, no secondary caries or endodontic problems were recorded for any of the cases, and no framework fractures occurred in any of the restorations. Table 2 shows the distribution and number of complications in both groups. It was noted that marginal discoloration after the first year was evident in five (16.7%) of the cases and increased to eight (26.7%) cases after 2 years of follow-up, with some cases exhibiting signs of wear at the cement interface. However, no signs of marginal deterioration or catch with the dental explorer were detected.

The cumulative Kaplan-Meier 2-year survival rate for the IRFDP was 86.6%. For the ID group, the Kaplan-Meier survival rate was 95%, and for the PB group was 70%, as shown in Fig 3. Log-rank test comparing the Kaplan-Meier survival of the two study groups showed no statistical significance between the two groups ($\chi^2 = 3.709, P = .054$).

SEM Analysis
Marginal adaptation and marginal defects were analyzed under SEM along both the tooth-cement interface (TC) and the zirconia-cement interface (ZC) of the margin. The percentages of continuous margins in the restorations (means and SDs) are shown in Table 3 and Fig 4. With regard to the continuity of the margins, statistical significance ($P < .05$) was noted when comparing the two study groups whether before or after the 2-year...
follow-up. For the control specimens (at 2 weeks), no statistical significance was found when comparing the TC to ZC in either group; however, there was a significant difference \( (P < .05) \) after 2 years, with the ZC showing more percentage of defects than the TC. All margins (TC and ZC in both groups) showed a significant decrease in continuity after the 2-year period compared to their values at the 2-week baseline. In the ID group, after 2 years of function, the percentage of continuous margins at the TC and ZC dropped to 92.8% and 91.5%, respectively; however, the drop was higher in the PB group, to 84.1% and 78.6%, respectively. An example of continuous margins is shown in Fig 5.

Marginal defects observed in the restorations were mostly either areas of microgaps at the TC or ZC resulting in loss of adaptation (Figs 6 to 8) or wear of the resin cement (Fig 9), which resulted in a microscopic overhanging of the restorations, especially at the occlusoproximal line angles. However, in some instances, there were microfractures in the zirconia next to areas of microgap or areas of cement abrasion (Fig 10).

**DISCUSSION**

The present prospective randomized clinical trial was conducted to assess the outcome of the most conservative designs proposed for IRFDPs and to evaluate the marginal integrity of such restorations. The null hypothesis of the study was rejected.

Multiple finite analysis studies of IRFDPs have shown that IRFDPs are subject to higher forces of mastication compared to FDPs with a full-coverage retainer, as the full-coverage retainer has a more favorable stress distribution pattern due to the added bulk of material.\(^4^3\),\(^4^9\) In a 3D finite element study, Zhang et al reported that the fracture loads in the IRFDP were much lower than that of an onlay FDP, with the connector area the most susceptible to initiation of cracks.\(^5^0\) This might explain the low survival rates of IRFDPs constructed from lithium disilicate in the clinical trial conducted by Harder et al,\(^2^3\) with only 57% and 38% survival rates after 5 and 10 years, respectively.

**Table 2** Different Types of Failures and Complications During Patient Observation Period

<table>
<thead>
<tr>
<th>Marginal discoloration</th>
<th>Recurrent caries</th>
<th>Debonding</th>
<th>Fractures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlay design (n = 20)</td>
<td>2 wk (baseline)</td>
<td>2 y</td>
<td>2 y</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>2 (10)</td>
<td>4 (20)</td>
</tr>
<tr>
<td>Proximal box (n = 10)</td>
<td>1 (10)</td>
<td>3 (30)</td>
<td>4 (40)</td>
</tr>
<tr>
<td>Total</td>
<td>1 (3.3)</td>
<td>5 (16.7)</td>
<td>8 (26.7)</td>
</tr>
</tbody>
</table>

Data are reported as n (%).

**Table 3** Mean ± SD Percentage of Continuous Margin Before and After 2 y in Functional Occlusion at the Tooth/Cement (TC) and Zirconia Cement (ZC) Interfaces

<table>
<thead>
<tr>
<th></th>
<th>Inlay design</th>
<th>Proximal box</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC 2 wk (baseline)</td>
<td>96.8 ± 1.9</td>
<td>94.9 ± 2.6</td>
</tr>
<tr>
<td>2 y</td>
<td>92.8 ± 5</td>
<td>84.1 ± 7.6</td>
</tr>
<tr>
<td>ZC 2 wk (baseline)</td>
<td>96.3 ± 1.8</td>
<td>94.6 ± 2.1</td>
</tr>
<tr>
<td>2 y</td>
<td>91.6 ± 6</td>
<td>78.8 ± 9.7</td>
</tr>
</tbody>
</table>

\( * \)Statistically significant.
8 years, respectively, with fracture of the restorations reported as one of the main causes of failure. Zirconia FDP restorations have been shown in in vitro studies to possess a favorable fracture resistance with 16 mm² as well as 9 mm² connector designs. The smaller connector area proves to be an important advantage in the case of IRFDPs, which usually have a more limited space for connectors in comparison to full-coverage retainers because of the smaller size of the inlay design.

In previous clinical studies conducted by Tara et al. and by Chaar and Kern on IRFDPs constructed from veneered zirconia, the authors reported a higher incidence of chipping and delamination of the ceramic veneers (8.7% and 11.1% for both studies, respectively) than loss of retention in such restorations. Therefore, the use of a translucent zirconia to construct monolithic restorations in the current study proved a successful alternative to veneered zirconia restorations, as it overcame the problems of chipping or delamination of the ceramic veneer, with no reported cases of bulk fractures or chipping in any of the cases.

The use of airborne-particle abrasion with Al₂O₃ particles followed by bonding with an MPD-containing
resin cement has proven to provide a durable bond to zirconia, as the MDP can bond strongly to airborne particle-abraded zirconia through hydrogen bonds that may be formed between hydroxyl groups in the MDP monomer and hydroxyl groups on the zirconia ceramic surface.\textsuperscript{38,39} Although all restorations were bonded according to the recommended procedures, the design of the cavity proved to be a decisive factor in retention, with the ID group exhibiting only 5% loss in retention compared to the 30% in the PB group.

The 2-year Kaplan-Meier survival rate of 95% for the ID group is well within the 3-year survival rate of 90% for conventional zirconia FDPs reported in a systematic review.\textsuperscript{36} The values in this group are comparable to the 5-year survival rates of 95.8% reported by Chaar and Kern\textsuperscript{27} with a modified inlay design with wings. Nevertheless, another clinical study conducted by Rathmann et al\textsuperscript{26} with a comparable observation period reported lower survival rates (80%); however, this might be due to the high incidence of chipping, delamination, and framework fracture in this study because of the use of veneered zirconia.

Although slot and tub preparation designs have been recommended by some authors conducting in vitro studies, the PB group did not show such promising results in the current study, with a low survival rate of 70% after 2 years.\textsuperscript{13,16} This can be attributed to the loss of a significant portion of the opposing walls, which are crucial for resisting torsional forces causing the more rapid failure of cement.

This was even more evident with the SEM analysis, as it showed a higher degradation at the margins of the PB group, which showed a significantly lower percentage of continuous margins (84.2% and 78.6% at TC and ZC, respectively) than the ID group (92.8% and 91.5% at TC and ZC, respectively). The loss of continuity at the margin with the appearance of marginal gaps can be considered as the first sign pointing toward a future loss in retention or even secondary caries.

The main defect seen in the ID group was the attrition of the cement margin due to faster wearing of the cement in comparison to both zirconia and tooth enamel. Even though the space created may harbor bacteria, with no deep grooving or prominent overhang created, this problem can be controlled with proper oral hygiene measures.

Care was taken to place all restoration margins in enamel, as reports in the literature point to a faster marginal degradation in cervical dentin when compared to enamel.\textsuperscript{47} With all the restoration margins placed in enamel, the ZC was significantly more prone to degradation and loss of continuity than the TC in both study groups. However, this difference was less evident when a more retentive cavity design (ID) was used, which might have decreased the forces at the margins of the restoration, resulting in less microgap formation and a more durable bond between the zirconia and resin cement.

It should be noted that one of the main restrictions of the current study is the small sample size (n = 30); however, due to the mixed results in the literature regarding the survival of IRFDPs with different designs, care was taken not to increase the number of patients unless the designs proved successful.

\begin{figure}[h!]
\centering
\includegraphics[width=\textwidth]{Fig9.png}
\caption{SEM image showing wear of resin cement at the restoration margin in the ID group after 2 years (x206 magnification).}
\end{figure}

\begin{figure}[h!]
\centering
\includegraphics[width=\textwidth]{Fig10.png}
\caption{SEM image showing micro-fracture at the edge of zirconia with the presence of an overhang due to wear of cement and appearance of a microgap in the PB group after 2 years. (x1,640 magnification).}
\end{figure}
CONCLUSIONS

Within the limitations of this clinical study and with regard to sample size, the short-term survival of zirconia-based monolithic IRFDPs with an inlay design, including a proximal box and occlusal extension, is promising and can be recommended for replacement of a single maxillary molar. Using monolithic zirconia eliminated the chipping and delamination complications encountered in veneered restorations. The marginal continuity of the restorations showed significantly better results when fabricated with a more retentive cavity preparation. The use of a box design cavity without occlusal extension should not be recommended for long-term prostheses due to the high rate of debonding of the restoration.

ACKNOWLEDGEMENTS

The authors report no conflicts of interest.

REFERENCES


Teeth extracted because periodontal indications conceivably could have been maintained. This study suggests that, strictly based on RPL, a large number of teeth extracted because of periodontal indications could have been maintained. When RPL cut-off limits of ≥ 40% or ≥ 50% are applied, \( P \leq .001 \). When considering teeth with an RPL ≥ 30% as possible to maintain, 189 (76%) of the teeth extracted because of periodontal indications vs 79.5% for other indications (\( P \leq .001 \)).

Comparisons of RPL between teeth extracted because of periodontal vs other indications were made using Mann-Whitney test. RPL averaged 34.8% for teeth extracted because of periodontal indications vs 39.6% for other indications. The percentage of RPL was determined for each tooth. The participants were asked to provide indications for extraction, which were later coded by two independent examiners.

The aim of this study was to evaluate the residual periodontal ligament (RPL) with respect to indication for extraction in a sample of teeth from a Brazilian Public Health Service district. All teeth extracted within the Public Health Service district of Santa Maria, Brazil, over a 5-month period were requested for analysis. A total of 414 teeth eligible for measurement were stained and evaluated for RPL using a stereomicroscope. Participating Public Health Service dentists completed a questionnaire detailing demographic variables and an indication for each extracted tooth. The percentage of RPL was determined for each tooth. Comparisons of RPL between teeth extracted because of periodontal vs other indications were made using Mann-Whitney test. RPL averaged 34.8% for teeth extracted because of periodontal indications vs 79.5% for other indications (\( P < .001 \)). When considering teeth with an RPL ≥ 30% as possible to maintain, 189 (76%) of the teeth extracted because of periodontal indications could have been maintained. When RPL cut-off limits of ≥ 40% or ≥ 50% are applied, 93 (37%) and 43 (17%) teeth, respectively, could have been maintained. This study suggests that, strictly based on RPL, a large number of teeth extracted because periodontal indications conceivably could have been maintained.


## Literature Abstract

### Association or Causation? Exploring the Oral Microbiome and Cancer Links

Several epidemiologic investigations have found associations between poor oral health and different types of cancer, including colorectal, lung, pancreatic, and oral malignancies. The oral health parameters underlying these relationships include deficient oral hygiene, gingival bleeding, and bone and tooth loss. These parameters are related to periodontal diseases, which are directly and indirectly mediated by oral bacteria. Given the increased accessibility of microbial sequencing platforms, many recent studies have investigated the link between the oral microbiome and these cancers. Overall, it seems that oral dysbiotic states can contribute to tumorigenesis in the oral cavity, as well as in distant body sites. Further, it appears that certain oral bacterial species can contribute to carcinogenesis—in particular, *Fusobacterium nucleatum* and *Porphyromonas gingivalis*—based on results from epidemiologic as well as mechanistic studies. Yet, the strength of the findings from these investigations is hampered by the heterogeneity of the methods used to measure oral diseases, the treatment of confounding factors, the study design, the platforms employed for microbial analysis, and the types of samples analyzed. Despite these limitations, there is an overall indication that the presence of oral dysbiosis that leads to oral diseases may directly and/or indirectly contribute to carcinogenesis. Proper methodologic standardized approaches should be implemented in future epidemiologic studies, as well as in the mechanistic investigations carried out to explore these results.


### Literature Abstract

#### Residual Periodontal Ligament in Extracted Teeth—Is it Associated with Indication for Extraction?

Periodontal disease is a major cause of tooth loss. Few studies have evaluated the residual area of the periodontal ligament in extracted teeth, and, to the best of the authors' knowledge, none from Latin America have done so regarding indications for extraction. The aim of this study was to evaluate the residual periodontal ligament (RPL) with respect to indication for extraction in a sample of teeth from a Brazilian Public Health Service district. All teeth extracted within the Public Health Service district of Santa Maria, Brazil, over a 5-month period were requested for analysis. A total of 414 teeth eligible for measurement were stained and evaluated for RPL using a stereomicroscope. Participating Public Health Service dentists completed a questionnaire detailing demographic variables and an indication for each extracted tooth. The percentage of RPL was determined for each tooth. Comparisons of RPL between teeth extracted because of periodontal vs other indications were made using Mann-Whitney test. RPL averaged 34.8% for teeth extracted because of periodontal indications vs 79.5% for other indications (\( P < .001 \)). When considering teeth with an RPL ≥ 30% as possible to maintain, 189 (76%) of the teeth extracted because of periodontal indications could have been maintained. When RPL cut-off limits of ≥ 40% or ≥ 50% are applied, 93 (37%) and 43 (17%) teeth, respectively, could have been maintained. This study suggests that, strictly based on RPL, a large number of teeth extracted because periodontal indications conceivably could have been maintained.