The Chamfer Finish Line: Preclinical Student Performance Using Different Bur Designs


Abstract: The primary purposes of this investigation were to evaluate sophomore dental student performance in the production of a chamfer finish line using two diamond bur types—a round-ended bur and a torpedo-shaped bur—and to gain student feedback about their preferences for bur type. Fifty students took part in the study, each of whom prepared the buccal surfaces of two mandibular molar typodont teeth, producing chamfer finish lines. Students prepared both teeth in the same laboratory session and were randomly assigned to two groups that were required to prepare the first of the two molars with a specific bur type. The prepared chamfer finish lines were scored and the data analyzed using the Wilcoxon signed-rank test. Student performance was significantly better when the round-ended bur was used (p=0.005). Student feedback was collected with a survey that consisted of four questions and the opportunity to provide write-in comments. In response to the question “Overall, was one bur type better?” 58 percent of the students preferred the round-ended bur for creating a chamfer finish line. The most frequent write-in comment, made by twelve of the fifty students, criticized the torpedo-shaped bur for creating finish lines that were too shallow or too long.

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The chamfer is considered the ideal finish line for complete veneer preparations for metal crowns.1-7 The chamfer is easy to produce, provides space for an adequate bulk of restorative material, allows for a slip-joint effect, and is distinct and readily identifiable to both the dentist and the laboratory technician. More than possessing sound mechanical properties, the chamfer finish line design exhibits low stress levels in photoelastic studies,8 which may reduce stress-induced cement failure.1 A drawing of a classic chamfer finish line can be seen in Figure 1.

For decades, instruction in tooth preparation called for the creation of chamfer finish lines with round-ended, tapered diamond burs.3,4,9-12 Years later, others advocated the use of torpedo-shaped, pointed burs for the fabrication of the chamfer.5,13-15 The torpedo bur design was believed to be less likely to create a “butt joint,”11 the undesirable outcome of overpreparation with round-ended burs.

Bur types used in tooth preparation are often a matter of operator preference. Research scientifically supporting the use of either the round-ended or torpedo bur types for the preparation of chamfer finish lines is lacking. Over time, some respected authorities have changed their published bur preferences, but again without evidence to support the change.5,9

The purposes of this investigation were to evaluate sophomore dental student performance in the production of a chamfer finish line using two diamond bur types—a round-ended bur and a torpedo-shaped bur—and obtain student feedback about bur type preferences. Performance results may support the preferential use of one bur type for the production of chamfer finish lines.

Materials and Methods

Fifty sophomore students from the University of Texas Health Science Center at San Antonio (UTHSCSA) Dental School participated in the study. All participants volunteered, were modestly financially compensated for their time from a grant received from Brasseler USA (Savannah, GA), and received no grading or coursework consideration for their involvement. The study was completed in one laboratory session in 2008 that followed the end of a regularly scheduled course. Prior to tooth preparation, the participants received individual verbal
instructions on the study’s methods and were given an instruction sheet to read. This sheet contained a review of the testing methods, a description of the ideal chamfer and its location with regard to the free margin of the gingiva, a drawing of an ideal chamfer for a mandibular molar shown in cross-section, and a photo of a prepared molar showing a chamfer finish line being assessed with the use of a periodontal probe (Figure 2).

Each student prepared the buccal surfaces of two #30 melamine typodont teeth (Kilgore International, Coldwater, MI). The tooth was screwed in place in a fourteen-tooth, complete-arch typodont (Kilgore International, Coldwater, MI), and the preparations occurred on the laboratory bench top. Teeth were reduced only axially, creating chamfer finish lines. For a randomly selected group of twenty-five students, the first tooth preparation was completed using a round-ended, medium grit, tapered diamond bur (856.31.016, Brasseler USA, Savannah, GA) (Figure 3). The second #30 was inserted into the typodont directly following the first preparation. The second preparation was completed with a torpedo-shaped, medium grit, parallel-sided diamond bur (878.31.012, Brasseler USA, Savannah, GA) (Figure 3). The preparation sequence was reversed for the second set of twenty-five students: the first

Figure 1. Shape of a classic chamfer finish line


Figure 2. Assessment of a chamfer finish line

Note: A photographic example of chamfer finish line assessment was given to each participant in the study prior to tooth preparation.
preparation was completed with the torpedo-shaped bur, and the second preparation was accomplished with the round-ended bur. Only high-speed dental handpieces were used to prepare the teeth. The burs were new, used directly following package opening. No time limits were imposed, but all students completed both preparations and the required survey in thirty minutes or less.

Following tooth preparation, participants completed a four-question survey and were provided the opportunity to offer additional written feedback about their experiences with both burs. Completion of the survey was a required element of the experiment; provision of additional feedback was optional.

Results

Prepared teeth were collected and scored independently by two calibrated evaluators. Both evaluators were dentists with less than five years of
experience who were enrolled in a preceptorship in prosthodontics at UTHSCSA. Scoring was accomplished using the standards shown in Table 1. Each evaluator’s data were analyzed using the Wilcoxon signed-ranks test; no combination of evaluators’ scores occurred. The histograms in Figure 4 show the scores assigned by each evaluator. Student performance with the round-ended bur was statistically better (p=0.005).

Table 2 displays the results of the students’ survey responses. Fifty-eight percent of the students indicated that it was easier to make a chamfer with the round-ended bur. Students’ responses to the other questions revealed no clear preference for one bur over the other.

Optional statements from the students supported the use of the round-ended bur. Thirty-eight students wrote comments, which were categorized into seventeen topic areas. Ten students submitted multiple statements. Table 3 provides a summary of the most frequently provided comments organized into categories. A majority of the students’ responses dealt with the difficulty in properly shaping the chamfer while using the torpedo-shaped bur. Students perceived that the torpedo-shaped bur was more prone to damage the gingiva apical to the finish line.

Table 1. Chamfer finish line scoring criteria
The finish line will be scored on a three-point scale: 1, 2, or 3, with “3” representing the ideal outcome.

A score of “1” will be awarded when the finish line:
• at mid buccal is a knife-edge design.
• at mid buccal is a “heavy” chamfer design, measuring 1 mm or greater in axial reduction.
• at mid buccal is a shoulder design, measuring 1 mm or greater in axial reduction.
• within 1.5 mm to the mesial or distal of the mid buccal, is distinctly irregular with a fluctuation(s) of 0.5 mm or greater.

A score of “2” will be awarded when the finish line:
• at the mid buccal is a thin chamfer design, axially deeper than a knife edge, but less than 0.3 mm in axial depth.
• at mid buccal is a “heavy” chamfer, measuring greater than 0.6 mm to less than 1 mm in axial depth.
• is a shoulder design, measuring less than 1 mm in axial depth.
• within 1.5 mm to the mesial or distal of the mid buccal, is distinctly irregular with a fluctuation(s) less than 0.5 mm.

A score of “3” will be awarded when the finish line:
• is a chamfer design, measuring 0.3 mm to less than 0.6 mm in axial reduction.
• within 1.5 mm to the mesial or distal of the mid buccal, is regular with no significant fluctuations.

Figure 4. Scores given on student performance
Note: The histograms show the scores assigned by each evaluator for each bur type. Via analysis using the Wilcoxon signed-ranks test of both evaluators’ scores, student performance with the round-ended bur was statistically better (p=0.005).
Discussion

Because there is little scientific support for the bur type used to create the chamfer finish line in tooth preparation for complete veneer metal crowns, the bur type selected is usually the operator’s preference. Hooper et al.\textsuperscript{16} reported that this situation also exists in dental schools in the United Kingdom. Though bullet (round-ended) and torpedo-shaped burs were used in student instruction for the creation of chamfer finish lines, there was no consensus in their study on the optimal bur type among the fifteen UK dental schools.

Early-in-training, first-semester sophomore dental students were selected as test subjects in our study. Since there are no fixed prosthodontics or tooth-preparation hand skills courses offered in the first-year curriculum at the UTHSCSA Dental School, selection of sophomores at this stage in their training attempted to minimize bias based on prior tooth preparation experiences and/or prolonged exposure to the preparation philosophy espoused at the university. However, the bur used in the preparation of the chamfer finish lines at the UTHSCSA Dental School is a round-ended diamond. Though efforts were made to minimize biasing effects, the school-endorsed methods could have impacted student performance.

The participants were randomly divided into two groups by the sequence of their volunteering to participate in the study. Each group was assigned a different bur type to use for the first tooth preparation. Though not statistically analyzed, this alternating preparation method attempted to minimize effects resulting from practice, repetition, etc. during the study.

The two bur types used in this study were dissimilar in their taper: the torpedo-shaped bur was parallel-sided. Bur taper could be a significant factor in the preparation’s outcome if complete axial or occlusal reductions were elements in the experimental design. Since this study only measured chamfer finish

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Table 2. Survey results: sophomore dental students’ perceptions of using round-ended and torpedo-shaped burs for creating a chamfer finish line during tooth preparation, by number and percentage of total respondents

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Question</th>
<th>Round-Ended Bur Better</th>
<th>Torpedo-Shaped Bur Better</th>
<th>No Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Was it easier to make a chamfer with one bur type?</td>
<td>29 (58%)</td>
<td>18 (36%)</td>
<td>3 (6%)</td>
</tr>
<tr>
<td>2</td>
<td>Did one bur type make more regular finish lines?</td>
<td>25 (50%)</td>
<td>21 (42%)</td>
<td>4 (8%)</td>
</tr>
<tr>
<td>3</td>
<td>Did one bur type cut more smoothly (less chatter)?</td>
<td>13 (26%)</td>
<td>23 (46%)</td>
<td>14 (28%)</td>
</tr>
<tr>
<td>4</td>
<td>Overall, was one bur type better?</td>
<td>25 (50%)</td>
<td>19 (38%)</td>
<td>6 (12%)</td>
</tr>
</tbody>
</table>

Table 3. Optional statements: summarized student statements more frequently cited undesired outcomes when the torpedo-shaped bur was used

<table>
<thead>
<tr>
<th>Summary of Optional Statements</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Torpedo-shaped bur: hard to make a chamfer, too thin/long of an outcome</td>
<td>12</td>
</tr>
<tr>
<td>2 Torpedo-shaped bur: greater risk of damaging the gingiva</td>
<td>6</td>
</tr>
<tr>
<td>3 Torpedo-shaped bur: difficult to tell where the chamfer would terminate</td>
<td>6</td>
</tr>
<tr>
<td>4 Torpedo-shaped bur: nice finish line</td>
<td>6</td>
</tr>
<tr>
<td>5 Torpedo-shaped bur: easier to control</td>
<td>5</td>
</tr>
<tr>
<td>6 Torpedo-shaped bur: works great</td>
<td>3</td>
</tr>
<tr>
<td>7 Round-ended bur: works great</td>
<td>3</td>
</tr>
<tr>
<td>8 Torpedo-shaped bur: chamfer created was too steep</td>
<td>3</td>
</tr>
<tr>
<td>9 Round-ended bur: easier to use since tip contacts the tooth</td>
<td>2</td>
</tr>
<tr>
<td>10 Round-ended bur: too easy to make a shoulder finish line</td>
<td>2</td>
</tr>
</tbody>
</table>
line placement, not axial wall reduction, dissimilar bur taper was not believed to be an impacting factor. Since the bur’s tip is used in chamfer preparation, bur-tip diameter is important in comparisons of chamfer placement techniques. The burs selected for this study, therefore, had similar bur-tip diameters.

Chamfer finish lines were assessed at one point per preparation: the mesio-distal middle of the buccal surface. A matrix was used to identify the location where each evaluator was to assess the student’s preparation. The relative smoothness and regularity of the finish lines were also assessed by the evaluators over a 3 mm length, 1.5 mm on each side of the midpoint.

Chamfer scoring was accomplished using techniques commonly employed to evaluate student preparations both preclinically and clinically. In addition to dental loupes magnification of 2.5 power, the primary measurement tool was a periodontal probe with 1 mm markings and of known diameter at the probe’s tip. In addition to the evaluators, students were instructed to use similar periodontal probes to support the proper sizing of the chamfer during this study. The probe’s tip makes a quick reference for assessment of chamfer size and shape. Without sophisticated measurement methods, it was anticipated that small differences in evaluator’s scores would be encountered. Two evaluators were thus used, and no combination of evaluator data was attempted. Statistical analysis indicated that the assessments of the two evaluators were not significantly different.

Conclusions

Within the context of this study, student performance in the preparation of a chamfer finish line was statistically better (p=0.005) when a round-ended bur type was used compared to results attained with the use of a torpedo-shaped diamond bur of similar bur-tip size. Fifty-eight percent of the students indicated that it was easier to make a chamfer with the round-ended bur. Optional write-in comments by thirty-eight of the fifty students also tended to support the use of the round-ended bur for the creation of chamfer finish lines.

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REFERENCES