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CLINICAL ARTICLE

Evaluation of a New Method for Silver Point Removal

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A new device for removing silver points was evaluated. The instrument consists of a trepan bur to expose the end of the silver point and a hollow tube which fits over the exposed tip and is bonded to it with cyanoacrylate adhesive. Twenty groups with 10 extractors and silver points in each group were tested for adhesive strength with respect to overlap between extractor and silver point, snugness of fit, and setting time of the adhesive. The adhesive strengths were evaluated using the Instron Universal Testing Machine. Adhesive strengths of 2 to 5 kg were readily achieved, and such adhesion should be adequate under typical clinical conditions for silver point removal. The amount of overlap (in the range of 1 to 3 mm) and snugness of fit were significant in relation to adhesive strengths. A setting time of 5 min was adequate for maximum bonding, except when there was loose fit between the extractor and the silver point. Clinically, the device appears to be an effective method for silver point removal.

Retreatment of teeth that have been obturated with silver points is often needed because of recurrent pathosis or for restorative reasons. Occasionally, a dentist will find a tooth with a fractured post or separated instrument contained within the root canal. Removal of these objects can be a problem, and the ability of the dentist to remove the object may be the deciding factor in determining whether the tooth can be saved.

Many techniques have been recommeneded for the removal of silver points, posts, and instruments (1–3). One of the most common techniques is to grasp the exposed end of the object with a hemostat or forceps. This works well if the end is easily accessible and the object is relatively loose fitting in the canal. Ultrasonic devices have also been advocated by some (4, 5). Either using ultrasonic files to bypass broken instruments and floating the fragment out or applying a scaling tip or instrument to the end of the point or post to vibrate it loose has been reported to be effective (6). A technique that utilizes an end-cutting trepan bur to remove tooth structure around the post or silver point has been described (the Masserann technique) (3). The object can then be grasped and removed. Braiding two or three Hedstrom files around a silver point to engage the point and then removing is another popular technique. Although all of these methods can be useful and effective in certain cases, they all have limitations.

Recently, a new device has been introduced for removal of silver points and posts: the Endo Extractor, manufactured by Brasseler USA, Inc., Savannah, GA (Fig. 1). It is similar to the Masserann technique in that an end-cutting trepan bur is used to prepare a space around the post or point. However, this method uses a cyanoacrylate adhesive to bond a hollow tube (extractor) to the exposed end of the point or post for removal. The extractor has the same length and handle as a conventional endodontic file. The purpose of this study was to evaluate the conditions that must be met for the effective use of this instrument. Variables such as length of overlap between the point and extractor, setting time for the adhesive, and snugness of fit were evaluated.

MATERIALS AND METHODS

A total of 200 Brasseler Endo Extractors (120 size 50 and 80 size 35) and 200 silver points (90 size 40, 60 size 35, and 50 size 20) were used for this study. Each Endo Extractor and silver point was used only once. The silver points were cut to 25 mm from the tip with a diamond disc so that the ends were flat with nontapering sides. Each silver point was marked at 1, 2, or 3 mm from the cut end, using a sharp scalpel blade, to control the length of insertion into the Endo Extractor. The Endo Extractor handles had the holes enlarged to a 2 round bur to accommodate a 1-mm diameter pin used to mount the handle in a mounting jig designed for the Universal Testing Machine (Instron Corporation, Canton, MA). One drop of Pacer M-50 adhesive was applied to the end of the Endo Extractor, and the silver point was inserted to the desired length (1, 2, or 3 mm) and allowed to set at room temperature for a specified period of time.

As one unit, the bonded Endo Extractor and silver point were placed in a mounting jig, which was mounted in the Universal Testing Machine. This jig allowed a tensile load to be applied without the problem of preloading. The Endo Extractor was attached to the jig by a loose-fitting pin through

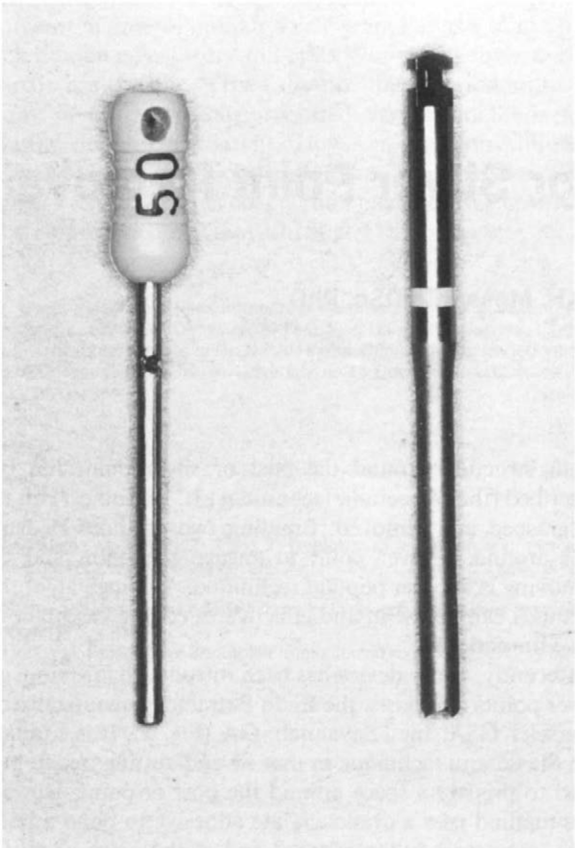

FIG 1. Extractor tube and corresponding trepan bur.

the handle; this was to avoid stress being placed on the adhesive bond prior to testing. The silver point was then grasped by the lower jaw approximately 5 mm below the end of the Endo Extractor. The Endo Extractor and silver point were then pulled apart at a constant crosshead speed of 4 mm/per min to the point of bond failure, and the maximum tensile load (in kg) was recorded.

A total of 20 groups with 10 samples in each group were tested (Table 1). These groups were based on time allowed for the adhesive to set (2.5 to 60 min), length of silver point overlap by the Endo Extractor (1 to 3 mm), and relative snugness of the fit between the Endo Extractor and the silver point (either matching sizes of Endo Extractor and silver point (50/50 and 35/35) or smaller sizes of silver point with each Endo Extractor (50/35 and 35/20). Statistical analysis included two- and three-way analysis of variance using a program available for microcomputers.

Ten individuals from the Division of Endodontics, University of Minnesota School of Dentistry, were tested to determine the amount of force that can be applied by finger pressure in a simulated clinical situation. The extractor handle was mounted in the Instron testing maching and the maximum force that could be exerted when the handle was grasped between the thumb and forefinger was measured by pulling against the load cell.

Internal diameters of randomly sampled extractors were measured using a dissecting microscope, and the external diameter of the silver points was measured with a micrometer.

TABLE 1. Groups tested for adhesive strength

Group	Endo Extractor Size	Silver Point Size	Length of Overlap (mm)	Time to Set (min)
1	50	50	1	2.5
2	50	50	3	2.5
3	50	50	1	5.0
4	50	50	3	5.0
5	50	50	1	10.0
6	50	50	3	10.0
7	50	50	1	60.0
8	50	50	3	60.0
9	35	35	1	5.0
10	35	35	2	5.0
11	35	35	3	5.0
12	50	35	1	5.0
13	50	35	2	5.0
14	50	35	3	5.0
15	50	50	2	5.0
16	35	20	2	5.0
17	35	20	2	10.0
18	35	20	3	5.0
19	35	20	3	10.0
20	35	20	1	5.0

RESULTS

Effect of Setting Time on Adhesive Strength

The time necessary to achieve maximum adhesive strength was determined in a preliminary experiment, using #50 extractors and #50 silver points, with an overlap of 1 or 3 mm. Setting times of 2.5 to 60 min were tested. The mean adhesive strength averaged approximately 2.5 kg with a 1-mm overlap and 7 kg with a 3-mm overlap. No consistent effect of setting time was observed in the range of 2.5 to 60 min, other than some variability in the early setting times (up to 10 min). Based on these findings, subsequent experiments were conducted using a 5-min setting time (except where noted).

Effect of Overlap and Snugness of Fit on Adhesive Strength

Overlap between extractor and silver point of 1, 2, or 3 mm was tested for both #35 and 50 extractor, in combination with silver points of the same size (snug fit) or #15 less than the corresponding extractor size (loose fit). These data are presented in Table 2.

The adhesive strength for snug-fitting silver points was approximately proportional to overlap for both #35 and 50 extractors, ranging from approximately 2 kg for 1-mm overlap to 6 to 8 kg for 3-mm overlap. At 2 and 3 mm, the bond was stronger for #35 than for #50. The internal diameter of the extractor and external diameter of the silver point showed a better fit for #35 (0.69 mm/0.67 mm) than for #50 (0.89 mm/0.81 mm).

The adhesive strength for loose-fitting silver points ranged from approximately 0.5 to 1 kg for the 1-mm overlap groups to 1.5 to 3.5 kg for the 3-mm overlap groups. The difference in adhesive strength for snug and loose fit was less for the #50 extractor (1.5 to 2 times greater adhesive strength) than for the #35 extractor (four to eight times greater).

Three-way analysis of variance showed that both overlap and snugness of fit were highly significant ($p < 0.0001$) in influencing adhesive strength, whereas extractor size was not significant ($p > 0.05$) (Table 3). In addition, a significant interaction between overlap and snugness of fit and between snugness of fit and extractor size was noted.

Adhesive Strength in Relation to Loose Fit

Adhesive strengths in loose fitting combinations were low and inconsistent in the above experiment, especially for the #35 extractor. Because of this, the effect on strength of increased adhesive setting time was assessed, using #35 extractors and #20 silver points. An increase in setting time from 5 to 10 min resulted in a large increase in adhesive strength (from 0.68 ± 0.16 kg to 2.62 ± 0.44 kg for 2-mm overlap and from 1.40 ± 0.13 kg to 3.61 ± 0.52 kg for 3-mm overlap). Two-way analysis of variance indicated that increased setting time was highly significant ($p < 0.001$).

Estimate of Forces Achieved in a Stimulated Clinical Setting

The maximum force exerted by finger grip on the handles obtained from the 10 individuals tested in the simulated clinical setting ranged from 1.42 to 3.61 kg with a mean of 2.89 ± 0.22 kg.

Clinical Case Illustrating Use of the Extractor

Removal of a large silver point from an upper lateral incisor (tooth 10) is illustrated in Fig. 2. Attempts to remove the silver point by other methods were unsuccessful.

DISCUSSION

Adhesive strengths in this study were tested in relation to overlap, snugness of fit, and time for adhesive setting. The

TABLE 2. Effects of extractor size, snugness of fit, and length of overlap on adhesive strength

Overlap (mm)	Adhesive Strength (kg)			
	50/50*	50/35	35/35	35/20
1	2.26 ± 0.42†	0.96 ± 0.33	2.07 ± 0.42	0.48 ± 0.08
2	4.46 ± 0.62	3.03 ± 0.87	5.84 ± 0.85	0.69 ± 0.16
3	5.95 ± 0.80	3.46 ± 0.44	8.43 ± 0.61	1.41 ± 0.13

* The first value refers to size of Endo Extractor and the second to silver point size.
† Mean ± SE for 10 samples per group.

TABLE 3. Three-way analysis of variance

Source	df	SS	Mean Square	F	p
Overlap (A)	2	231.736	115.868	38.944	0.0001
Snugness (B)	1	303.308	303.308	101.944	0.0001
Interaction (A, B)	2	54.878	27.439	9.222	0.0002
Extractor size (C)	1	1.395	1.395	0.469	0.4949
Interaction (A, C)	2	2.988	1.494	0.502	0.6066
Interaction (B, C)	1	59.615	59.615	20.037	0.0001
Interaction (A, B, C)	2	24.769	12.384	4.162	0.0181
Error	108	321.327	2.975		

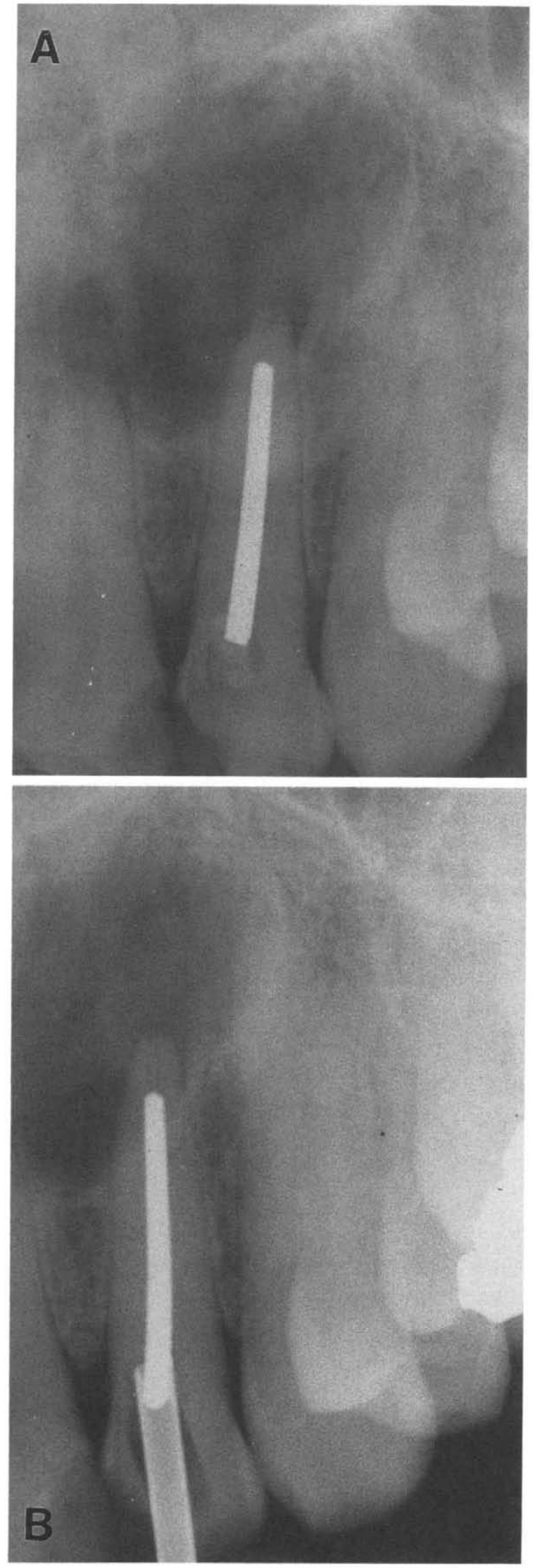

FIG 2. Clinical case demonstrating use of the silver point extractor. Based on the large size of the silver point in tooth 10 (*A*), a #80 extractor was chosen. Overlap of 1.5 to 2 mm was achieved (*B*).

adhesive strengths were approximately proportional to overlap and strongly affected by the snugness of fit between the extractor and silver point. Time proved not to be a factor, except in relation to loose fit. Maximum forces that can be applied in a simulated clinical situation ranged from approximately 2 to 4 kg. Clinically realistic forces are probably less, especially in the posterior regions of the mouth where 1 to 2 kg may be the maximum. Therefore, all except the 1-mm overlap/loose fit (40/35 35/20) and the 2-mm overlap/loose fit (35/20) fall into the range of clinically applicable adhesive strengths. These groups were both weak and inconsistent, with the mean forces being less than 1 kg, ranging from 0.48 kg to 0.96 kg. These groups were tested after 5 min. After reviewing these results, we elected to test the 35/20 groups with 2- and 3-mm overlaps after 10-min setting time to see if any increase in bond strengths occurred. A significant increase was noticed from both groups, well into the range of clinically relevant forces.

The strengths obtained from the 35/35 groups were greater than for the 50/50 groups, even though the greater surface areas of the larger extractor and silver point would be expected to provide greater strengths. However, measurements of the external diameter of the silver points and the internal diameter of the extractor revealed that the 35/35 groups were more closely fitting. This finding is consistent with the overall effect of snugness of fit on strength of the bond.

From the data obtained, a 2-mm overlap between the extractor tube and the object with a snug fit and 5-min setting time for the adhesive to set is adequate for effective use of the instrument. Longer time periods for the snug-fitting extractor/silver point did not significantly increase the bond strength, although increased time for the loose-fitting samples did show an increase in bond strength. Snugness of fit seemed to be the most important factor, so that even 1 mm of overlap showed good bond strength (greater than 2 kg).

The clinical use of this technique is illustrated in a series of radiographs (Fig. 2). Obviously, grasping a silver point or other canal obstruction with a forceps is the initial treatment of choice. If that proves to be ineffective, use of this new instrument should be considered. The trepan burs included in the kit can be used, when necessary, to achieve sufficient overlap. One must use caution when utilizing the burs. They should be used only in the straight portion of the canal. Perforation is a potential consequence, especially in smaller, narrower roots. Each sized extractor has a corresponding bur size. However, we have found that the #25 bur is large enough for any of the extractor tubes, even the #80. Clinically, approximately 10 min of working time is sufficient for preparation, adhesive application and setting time before the object is ready to be removed.

Use of this instrument can be expanded to remove objects other than silver points. Cast posts, amalgam posts, Thermafil files (Tulsa Dental Products, Tulsa, OK), or separated instruments can potentially be removed by this method, as long as they are sufficiently close to the canal orifice. Adhesive strengths achievable with this technique are considerably in excess of the force that can be applied by hand. Thus, any object in a canal that can be accessed and bonded may be removed.

Modification of the instument may provide better clinical usage. Besides reducing the size of the burs, acid etching and/or scoring of the inside of the extractor may increase the adhesive strength by improving the mechanical retention, since most bonds seemed to fail at the extractor-adhesive interface.

In our investigation, the exact size of the silver point was known. This made acquiring a snug fit easy and predictable. Clinically, the exact size of the end of the object to be removed may not be known. Using the smallest size extractor available is, therefore, recommended. If the fit is less than ideal, acquiring additional overlap or a longer setting time may be tried.

Only tensile forces were applied during testing. Torsional or rotational forces could not be readily applied and, therefore, were not tested. Thus, we can recommend only that a pulling action be used when removing an object with this instrument.

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