

CLINICAL ARTICLE

A Statistical Analysis of Surgical and Nonsurgical Endodontic Retreatment Cases

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A total of 1300 endodontic patient charts were analyzed for factors that may have contributed to the failure of the original treatment or the success of the retreatment. Of those surveyed, 667 had recall information of 6 months or more and were used to consider success rates. The remaining cases were analyzed for other information. The findings were tabulated and analyzed by computer for significant relationships. The overall success rate for retreatment was 65.6% with an additional category of "uncertain" of 18.3%. Surgical treatment was necessary to retreat 53.5% of the cases.

Reports of successful endodontic treatment have varied greatly, with the success rate ranging from 7 to 97% (1-6). When treatment fails, retreatment rather than extraction is usually indicated and often it is the role of the endodontist to provide this service (7). Although the causes of failure have been investigated with some frequency, the success of endodontic retreatment has been studied less often.

Engstrom et al. (8) reviewed 192 retreatment cases that had been followed for 4 and 5 yr. Cases with radiolucencies greater than 5 mm in diameter that were retreated conventionally had a failure rate of 50%. Those with radiolucencies of less than 5 mm failed 24.9% of the time, and those with no lesion had a failure rate of 11.8%.

Bergenholtz et al. (9) examined 556 retreatment cases at the 2-yr recall period. They found that if a tooth did not have a radiolucency and retreatment was due to mechanical difficulties, such as a short fill or void in the fill, a success rate of 94% could be expected. For teeth with radiolucencies, a success rate of 48% was obtained if the tooth was refilled short of the apex and 81% if full length could be gained. In another study Bergenholtz et al. (10) discussed the influence of over-instrumentation and overfilling on 410 retreatment cases. At 2-yr recall there was a 62% success rate if cases were not overfilled, and an additional 22% of the radiolucencies were reduced in size without complete resolution. Overfilling of the root canal reduced the success rate.

The literature indicates that success of retreatment is higher

if nonsurgical techniques can be performed and that success of surgery is higher when it supplements nonsurgical retreatment (9, 11-14).

This article reports recall information collected from 1300 retreated cases.

MATERIALS AND METHODS

Records of 1300 patients who had undergone endodontic retreatment were examined. Data were collected on all cases of retreatment, regardless of the type of retreatment or the availability of recall information. Information was limited to that contained in the patient records. Radiographs were viewed without magnification by one evaluator on a standard viewbox. Specially designed sheets were used for recording.

The location in which each patient was treated was recorded. Cases were selected from the Indiana University School of Dentistry (IUSD) Endodontic Graduate Department, the IUSD Undergraduate Department, and from two private practices limited to endodontics.

Age and sex of patients were recorded. Ages were recorded in the following categories: 1 to 10, 11 to 20, 21 to 30, 31 to 39, 41 to 50, and 51 to 60. Patients older than 60 were recorded as one group.

Retreated teeth were identified and recorded using 1-32 system. For statistical purposes, teeth were grouped by positional identification; for example, maxillary second molars were considered together, as were mandibular first bicuspids. This provided larger groups for analysis.

Whether patients were symptomatic at the time of retreatment was recorded as a yes or no. Clinical signs and symptoms included as positive responses were sensitivity to percussion, painful response to thermal changes, pain to palpation or mastication, and presence of a sinus tract.

Also recorded was any radiographic evidence of periapical pathosis before retreatment was performed. Any periapical radiolucency or detectable apical thickening of the periodontal ligament was recorded as positive. Also, radiolucencies present after retreatment were recorded using the same criteria. Groups were divided into (a) no lesion; (b) new lesion; and (c) persistent lesion.

In an attempt to determine whether changes in endodontic treatment philosophies affected the success of retreatments,

the year of original treatment was recorded and grouped as follows: (a) cases treated before 1970; (b) cases treated between 1971 and 1975; and (c) cases treated between 1976 and 1980. It was thought that there might have been a relationship of success between the silver point era that existed before 1970, the stronger interest in gutta-percha and standardized preparation techniques of the early 1970's, and the later period in which tapering preparations, fewer appointments, and heated gutta-percha filling techniques were used.

The interval between original endodontic treatment and retreatment was recorded thus: (a) less than 1 yr; (b) from 1 to 2 yr; (c) from 2 to 5 yr; (d) greater than 5 yr; and (e) and unknown.

The type of original treatment was recorded. This information was obtained from radiographs and patient records. If the type of filling could not be confidently determined, it was classified as undetermined. Groups recorded were: gutta-percha, silver points, broken instrument, paste fill, surgical treatment alone, and combined treatment. Gutta-percha, silver points, paste fills, and surgical only treatments were recorded as such; the broken instrument category was used if a broken instrument was present regardless of the type of filling present in addition to the instrument. The "combined treatment" category was used for all cases in which more than one type of treatment was used in the same tooth, such as when silver points were used to fill one root and gutta-percha used for another.

The reasons for retreatment were judged from patient records and radiographs and were separated into seven categories: (a) failing cases with short endodontic fills (these cases had to be greater than 1 mm from the radiographic apex); (b) failing cases with overextended endodontic fills (extending beyond the apex); (c) failing cases with an unfilled canal (noted either in patient records or evident in postoperative radiographs); (d) perforations noted either in patient records or postoperative radiographs; (e) cases requiring retreatment for restorative reasons (including teeth with silver root canal fills requiring post space and teeth with paste fills requiring permanent cast restorations); (f) failing previous retreatment cases (cases being treated for at least the third time); and (g) unknown cases where fillings were radiographically acceptable and no apparent reason was discernible.

Methods of retreatment were divided into four categories: (a) cases retreated conventionally with gutta-percha only; (b) cases retreated with an apicoectomy and no retrograde filling; (c) cases retreated with an apicoectomy and a retrograde filling; and (d) cases retreated by intentional replantation.

Whether or not the tooth had a permanent restoration placed after retreatment was judged from the recall radiographs.

Recall periods were judged from the dates of the preoperative and postoperative radiographs and divided into three groups: less than 6 months, 6 months to 1 yr, and greater than 1 yr.

The histological diagnosis was recorded in those cases that had periapical surgery and biopsy information was found in the chart. The diagnoses were grouped into granulomas, cysts, any other diagnosis, and information not available.

Success or failure of retreatment cases was judged from recall radiographs and patient records of clinical examination. Only cases which had recall examinations of 6 months or

longer were evaluated in this group. If no recall radiographs were available, success or failure could not be judged and was not included in this section. However, these cases were used for data collection in all other areas considered in this study. The radiographic criteria for success were (a) complete resolution of the radiolucency if one was present at the time of retreatment, or no formation of a radiolucency if none was evident at the time of retreatment; (b) no detectable thickening of the periodontal ligament; and (c) an intact lamina dura. Cases with a radiolucency at the time of retreatment that was reduced in size at the time of recall were placed in the uncertain category. All other cases were considered failures. These criteria are modifications of evaluation procedures used by Rud et al. (15) and Strindberg (2).

All information in each category and group was analyzed and cross-referenced in all possible two-by-two combinations. Chi-square analysis was done to determine whether any factors affected the success or failure rates of retreated cases and if any of the factors affected each other.

RESULTS

Demography

Of the 1300 cases reviewed, there was no significant difference between the numbers retreated by graduate students and endodontic specialists. Undergraduate students retreated only 2.8% of the cases.

The largest age group was 21 to 30 yr at 34.3%; the next group was 31 to 40 yr at 23.5%. Only five cases were 1 to 10 yr of age (Table 1). Females represented 57.2% of the cases surveyed.

Distribution of teeth is illustrated in Tables 2 and 3. Maxillary teeth occurred more frequently in the study with maxillary centrals and laterals being the most common.

Signs and Symptoms

Of the cases surveyed, 59.2% presented with symptoms at the time of retreatment and 87.5% had radiolucencies.

Treatment Period

Table 4 illustrates the time periods in which original treatment was performed. The period between 1976 and 1980 had the largest number of cases, 26.9%. Concerning length of time

TABLE 1. Cases by age

Age	Cases	%
1-10	5	0.3
11-20	139	10.7
21-30	446	34.3
31-40	305	23.5
41-50	181	13.9
51-60	139	10.7
61 and over	85	6.5
	1300	99.9

TABLE 2. Teeth grouped with contralaterals

Teeth	No. of Cases	% of Total	% of Maxillary
1, 16	1	0.1	0.1
2, 15	11	0.8	1.2
3, 14	155	11.9	18.3
4, 13	113	8.7	13.3
5, 12	81	6.2	9.6
6, 11	66	5.1	7.8
7, 10	172	13.2	20.3
8, 9	249	19.2	29.4
	848	65.2	100.0
			% of Mandibular
17, 32	1	0.1	0.2
18, 31	50	3.9	11.1
19, 30	166	12.8	36.7
20, 29	45	3.5	10.0
21, 28	45	3.5	10.0
22, 27	37	2.8	8.2
23, 26	40	3.1	8.8
24, 25	68	5.2	15.0
	452	34.9	100.0

TABLE 3. Distribution of anteriors, premolars, and molars by arch

Tooth	Cases	% of Total
Maxillary anterior	487	37.5
Maxillary premolars	194	14.9
Maxillary molars	167	12.8
	848	65.2
Mandibular anterior	145	11.2
Mandibular premolars	90	6.9
Mandibular molars	217	16.7
	452	34.8

TABLE 4. Cases by year of original treatment

Year of Original Treatment	Cases	%
Before 1970	207	15.9
1971-1975	289	22.2
1976-1980	349	26.9
After 1980	267	20.5
Unknown	188	14.5
	1300	100.0

TABLE 5. Cases by length of time between the original treatment and retreatment

Length of Time from Original Treatment to Retreatment	Cases	%
Less than 1 yr	285	21.9
1-2 yr	485	37.3
2-5 yr	178	13.7
Greater than 5 yr	164	12.6
Unknown	188	14.5
	1300	100.0

between original treatment and retreatment, the statistically largest group was retreated 1 to 2 yr after the original treatment, followed by those treated less than 1 yr after original treatment (Table 5).

Filling Materials

Of the three largest groups of original filling material, 53.6% was gutta-percha, 20.6% was paste fillings, and 9.5% was silver points (Table 6). Retreatment was indicated most often because of short fillings, 46.5%; fillings which appeared to be adequate but failed, 22.6; and overextended fills, 13.4% (Table 7).

Method of Treatment

Concerning method of retreatment, 45.8% of the cases were retreated conventionally, 28% had periapical surgery only, and 25.5% had periapical surgery with retrograde filling (Table 8). A total of 53.8% received permanent restoration after the initial retreatment.

TABLE 6. Cases by type of original treatment

Type of Original Treatment	Cases	%
Gutta-percha	697	53.6
Silver points	253	19.5
Broken instruments	29	2.2
Paste fills	268	20.6
Surgical alone	7	0.5
Combined type of treatment	31	2.4
Undetermined	15	1.2
	1300	100.0

TABLE 7. Cases by reason for retreatment

Reason for Retreatment	Cases	%
Failing short fill	605	46.5
Unknown—adequate but failing	294	22.6
Failing long fill	174	13.4
Missed canal	114	8.8
Restorative reason	48	3.7
Failing previous retreatment	41	3.2
Perforation	24	1.8
	1300	100.0

TABLE 8. Cases by method of retreatment

Method of Retreatment	Cases	%
Gutta-percha alone	596	45.8
Apicoectomy only	331	25.5
Retrograde filling	364	28.0
Intentional replant	9	0.7
	1300	100.0

TABLE 9. Distribution of success and failure

Success or Failure	Cases	% of Total	% of Those with Recall
Success	415	31.9	65.6
Uncertain	116	8.9	18.3
			83.9 (combined)
Failure	102	7.9	16.1
No recall available	667	51.3	100.0
	1300	100.0	

Recall Information

Of the total cases, 51.3% had recall information of less than 6 months. These were not used for determining success. There were 34.7% cases with recall information of 6 months to 1 yr and 14% with greater than 1 yr.

Histology

A total of 132 cases had been diagnosed histologically: 66.2% of these were granulomas, 27.8% were cysts, and 6.0% had other diagnoses.

Success

Of the cases which had recalls of more than 6 months, 415 were judged successful, 116 were considered to be uncertain, and 102 failed. A total of 667 cases did not have recalls of more than 6 months and were not considered (Table 9).

Success and failure rates of various teeth were grouped with

their contralaterals. There was no significant difference between the success of maxillary and mandibular molars. There was a significant difference between the success rate of maxillary teeth, 70.3%, and mandibular teeth, 56.9%.

Cases with preoperative symptoms had no significant differences in their success rate. No significant difference in success rates was noted relative to varying time intervals between original treatment and retreatment.

Of the three major types of original treatments (gutta-percha, silver points, and paste fillings), retreatment of paste fills had a significantly lower success rate. Results of the success-failure rate concerning original treatments are illustrated in Table 10.

When divided by reasons for retreatment, those retreated for restorative purposes alone succeeded 96.2% of the time, followed by 81.7% for missed canals, 66.4% for short fills, and 62.2% for overextended fills. The lowest success rate of 47.1% was for those with a previously failing retreatment. Perforation retreatment showed a 62.5% success rate (Table 11).

In regard to methods of retreatment, conventional retreat-

TABLE 10. Type of original treatment versus success or failure

Type of Treatment	Total Cases	No. with Recall	No. S*	No. U	No. F	Success Rate (%)	Uncertain (%)	Failure Rate (%)
Gutta-percha	697	316	200	66	50	63.3	20.9	15.8
Silver point	253	143	99	29	15	69.2	20.3	10.5
Broken instruments	29	15	12	2	1	80.0	13.3	6.7
Paste fill	268	131	87	15	29	66.4	11.5	22.1
Surgery only	7	3	1	1	1	33.3	33.4	33.3
Combined treatment	31	17	10	3	4	58.8	17.7	23.5
Undetermined	15	8	6	0	2	75.0	75.0	25.0
	1300	633	415	116	102			

* S, success; U, uncertain; F, failure.

TABLE 11. Reason for retreatment versus success or failure

Reason for Retreatment	Total Cases	No. with Recall	No. S*	No. U	No. F	Success Rate (%)	Uncertain Rate (%)	Failure Rate (%)
Short fill	605	280	186	42	52	66.4	15.0	18.6
Long fill	174	74	46	19	9	62.2	25.6	12.2
Missed canal	114	60	49	6	5	81.7	10.0	8.3
Perforation	24	8	5	0	3	62.5	0.0	37.5
Restorative	48	26	25	0	1	96.2	0.0	3.8
Failing previous retreatment	41	17	18	2	7	47.1	11.7	41.2
Unknown	294	168	96	47	25	57.1	28.0	14.9
	1300	633	415	116	102			

* S, success; U, uncertain; F, failure.

TABLE 12. Method of retreatment versus success or failure

Method of Retreatment	Total Cases	No. with Recall	No. S*	No. U	No. F	Success Rate (%)	Uncertain (%)	Failure Rate (%)
Gutta-percha	596	315	229	38	48	72.7	12.1	15.2
Apicoectomy	331	136	78	37	21	57.4	27.2	15.4
Retrograde	364	175	105	40	30	60.0	22.9	17.1
Intentional replant	9	7	3	1	3	42.9	14.2	42.9
	1300	633	415	116	102			

* S, success; U, uncertain; F, failure.

ment (nonsurgical) had a success rate of 72.7%. Those with periapical surgery (apicoectomy) were successful 57.4% of the time and for those with periapical surgery with retrograde filling, a success rate of 60.0% was found. Differences were not significant (Table 12).

Teeth which were permanently restored after retreatment exhibited significantly more success than those which were not: 68.7% and 51.3%, respectively. No significant difference was found in the successful retreatment of granulomas, 53.2%, and cysts, 35.7%.

DISCUSSION

Retreatment of endodontic failures is a valid alternative to extractions. A greater desire of patients to retain their natural teeth and advances in endodontic therapy have resulted in endodontists becoming more aggressive in retreatment procedures. Although there has been increased interest in the use of implants, it can be observed that endodontic retreatments are more biocompatible, less complicated, less expensive, and offer a reasonable prognosis.

In this study, the success categories were divided into those cases which were considered definitively successful and those which showed healing (uncertain) toward success, 65.6% and 18.3%, respectively. Bergenholtz et al. (10) reported 73% when these two categories were combined.

Although this success rate reinforces our belief that aggressive retreatment procedures are worthwhile, it should be stressed that the outcome of these procedures depends upon many factors, including some not examined in this study. These include individual operator's ability, degree of difficulty of the cases, variation in techniques, and difference in criteria for success and failure when dependent upon radiographic interpretation.

Failures occur despite rigid adherence to basic principles and clinical predictors of success. Conversely, successful results sometimes occur in spite of flagrant violations of these same principles. The role of the host certainly is an important variable in the success or failure of endodontic therapy.

Although many comparisons can be made and differences may appear obvious in this study, valid conclusions would require an analysis of the effects of all factors, in all possible combinations. To provide adequate sample size for even the factors considered here in a multivariable analysis would require tens of thousands of cases. The raw data comparing each factor to all other factors in this study produced 113 tables alone.

Nonetheless, it is interesting to note, as an example, that retreatment because of broken instruments showed a high success rate. This might suggest that the instrument separation was the indication for retreatment or surgery and not signs or symptoms of clinical failure. This is supported by the low report of symptoms and the high rate of success. A higher success rate of retreatment for restorative reasons suggests that a prediction of possible future failure must be considered as a reason for retreatment, although many of these were and could continue to be clinical and radiographic successes.

Younger patients with larger canals showed a lower success rate when treated with silver points, and canals were missed more often during treatment of older patients. The latter may

explain why more retrograde fillings were placed in patients over 40 yr of age.

Silver points and paste fills were found more in mandibular molars, and the most frequently missed canals were in maxillary first molars. Second molars showed more short fills. These differences may be attributed to canal anatomy and degree of difficulty in treatment.

If a lesion was present at the time of treatment, there was an increased chance that the case was managed surgically, although there was no difference in the success rate between surgical and nonsurgical retreatment.

A comparison of the year of original treatment with the type of treatment suggests that use of gutta-percha increased in percentage after 1975 and silver points decreased after 1970. The percentage with paste remained constant.

Silver points and paste fillings consistently showed delayed failure compared with gutta-percha, suggesting that an extended recall period could be indicated.

A comparison of the type of original treatment with the method of retreatment showed that gutta-percha and silver points were treated both surgically and nonsurgically but broken instruments required more surgical retreatment and more paste fills could be retreated nonsurgically. Choices for method of retreatment reflected logical clinical judgment, but it is noteworthy that every failing previous retreatment was treated surgically. This indicates operator opinion that there is low probability of success when retreating a failing previous retreatment nonsurgically.

We suspect that the domain of the endodontist will become oriented more toward retreatment and surgery. Over 50% of all of these cases retreated required some type of surgical procedure to complete. Developing retreatment and surgical endodontic skills and confidence is an absolute requisite for a successful endodontic practice today.

CONCLUSION

Retreatment of endodontic failures is a valid alternative to extraction. Success rate can be considered good; however, additional information is needed to more accurately predict the outcome of this treatment. A study in which multifactorial analysis could be performed would be extremely valuable.

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