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roots

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A retrospective comparison of the effectiveness of three methods of endodontic therapy of non-vital teeth

case report

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Dear Reader,

Prof. Philippe Sleiman

_It may seem that today, at the start of the third millennium, we have already seen all major revolutions in endodontics, if not in dentistry altogether, with the new breakthroughs and discoveries only detailing the techniques and technologies already in existence. To produce and research a new idea, dental scholars today need to join efforts with engineers, physicists, biologists, geneticists and others; one example of a relatively recent successful collaboration is the development of an NiTi heat treatment and twisting technology, which began a new era in the manufacture of endodontic files.

But do revolutions and advancements actually raise the overall standard and quality of treatment or it is rather the implementation of the gold standard of patient care, based on the established scientific principles and clinical protocols, in the daily work of every practitioner, and not necessarily anything costly (e.g. the use of conventional irrigants and sterile water in a specific sequence to chemically prepare the root canal system, minimise postoperative pain and prevent internal leakage)? This, unfortunately, is yet to be achieved, and it will require overcoming psychological barriers, quasi-scientific bias, and financial limitations.

Inasmuch as we attempt to remain objective in assessing our own work, there are limits to self-criticism, especially when there is literature today supporting almost any technique. It is impossible to over-emphasise the importance of pushing oneself out of one's comfort zone, and full conference halls and hands-on courses are good proof that there are many clinicians who have already embarked on the path of continuous learning and training.

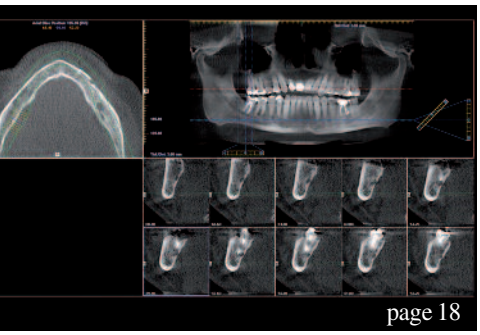
In an ideal situation, manufacturers should have sufficient time to develop, test and verify new technologies before approving a new product. In the past, there were research and development departments that collaborated with reputable scholars and practitioners for about a decade prior to finalising a prototype for clinical trials. However, now it seems that the planet is rotating faster—and the urge to introduce novel ideas has never been stronger. Consequently, the risk of failure is higher than ever. It is absolutely critical that all new developments be deeply rooted in quality research with strict statistical control for significance. This would be the only way to protect clinicians, and ultimately patients, from failure and malpractice.

At present, our task is to achieve this goal in our own daily work in the office and in our communication with colleagues around the world. Our work should be aimed at developing best practice guidelines for the community, which will need to be updated regularly at consensus meetings. Alongside other professional journals, specialist endodontic publications like roots will play an important role in updating the community.

At the end of the day, each and every effort by a scholar, manufacturer, practitioner or assistant should uncompromisingly be aimed at patients' health. Endodontic treatment too should be conducted in the interest of the patient, whose immediate well-being and long-term health should be seen as the utmost priority above all personal and corporate ambition.

Yours faithfully,

Prof. Philippe Sleiman, DDS, MSc, DDSc
Adjunct Associate Professor, University of North Carolina
Assistant Professor, Lebanese University dental school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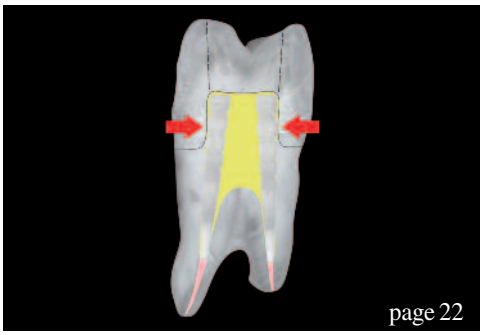
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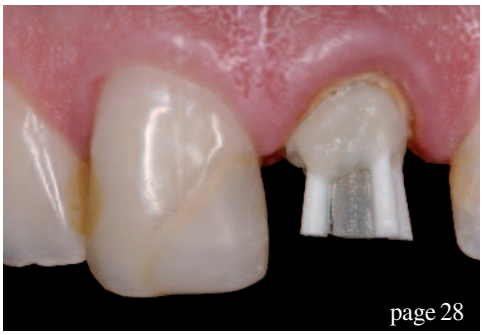
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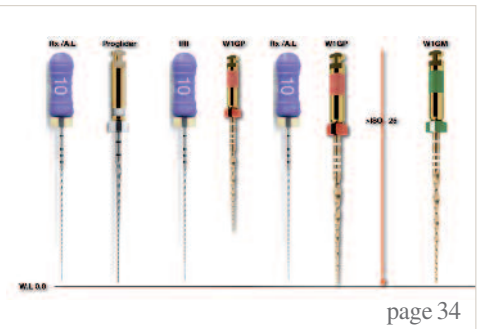
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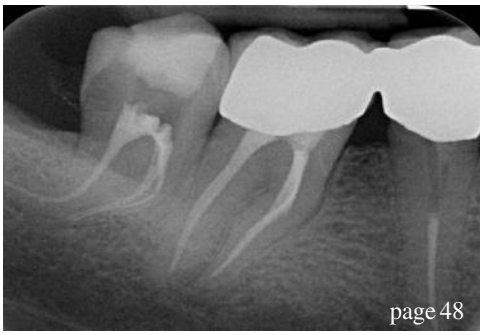
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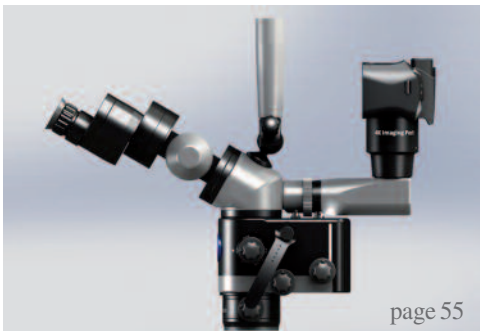
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A retrospective comparison of the effectiveness of three methods of endodontic therapy of non-vital teeth

Author_ Dr Robert Teeuwen, Germany

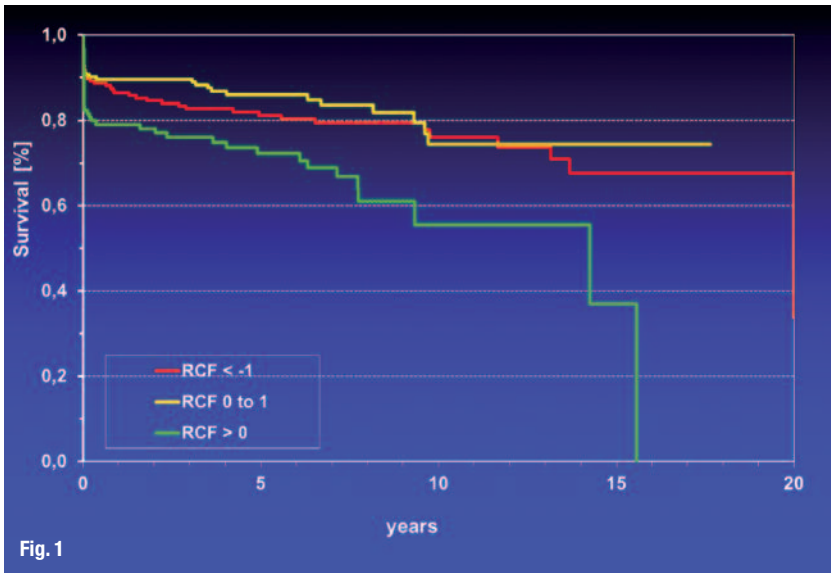

Fig. 1

Fig. 1_Success depending on root filling length of nsRCT. The influence of RCF length in nsRCT on survival. In the case of Failure 2 only, no statistically significant differences ($p = 0.56$) were found. Thus, a survival difference among the three therapy types was only based on a different Failure 1 rate.

_Abstract

The endodontic treatment of 1,720 non-vital anterior teeth and premolars was observed in the author's general practice during 1985–1999 until December 2005. The analysis included success or failure and survival after non-surgical root canal treatment, root end resection or trephination with regard to various criteria. The failure analysis distinguished between clinical failures (acute exacerbations) that occurred within the first nine months of treatment only and failures with a follow-up radiograph. Operator, sex and age of patient, number of appointments, or initial or second treatment did not have a significant impact statistically. Regarding the results, the degree of root canal filling was of minor importance, only found to be of statistical significance regarding the development of an acute exacerbation after overfilling of conservatively treated teeth. Statistically significant factors were apical periodontitis before endodontic treatment, the homogeneity of a root canal filling and the restoration type. Posts were found to impair the treatment results. An increased extraction rate was observed among the patients in the lowest socio-economic group compared with those in the higher socio-economic groups. Ten years post-endodontic treatment, 15.6% of the non-surgically treated cases, 23.8% of the cases treated with root end resection and 23.7% of the trephination cases were available for analysis without preceding re-intervention.

_Introduction

Primarily conservative therapy is recommended for therapy of non-vital teeth,[1] as the endodontic literature reports a high success rate. Another therapy is root end resection (RER); however, this indication has been limited in the course of time. In connection with apical periodontitis (AP), root canal filling (RCF) is performed before or during treatment with or without retrograde RCF. During the last 15 years, RER studies have only dealt with RER in connection with retrograde RCF. However, RER guidelines emphasise that an RER is not an alternative to an exact RCF and it is regretted that there are no epidemiological studies on RER, although, based on accounting data from health insurance providers in western Germany, payments for RER increased nearly threefold from 1984[2] to 2011[3]. Payments for Schröder aeration (synonyms: apical aeration, artificial fistulation, trephination [TR]), a possible alternative therapy for conservative non-surgical root canal treatment (nsRCT) and RER,

have more than halved. Based on a scientific report,[4] the prognosis of success for nsRCT is as follows:

_vital extirpation and pulp necrosis of teeth without associated AP: 85–95%
_retreatment or revision treatment (RV) of teeth without AP: 89–95%
_pulp necrosis of teeth with AP: 70–85%
_RV of teeth with associated AP: 50–70%.

The definition of success is essential for evaluating the success of treatment. This is defined based on the radiograph and the clinical findings (pain, fistula, swelling), and possibly on the examined teeth remaining in asymptomatic function regardless of the radiographic findings. A benchmark regarding strict or loose criteria is determined radiographically. Strict criteria imply complete AP healing, whereas classification according to loose criteria means that the reduction of AP is sufficient for confirmation of success. Ng et al.[5] evaluated individual factors for success and classified these into strict or loose criteria; for example, regarding vitality before RCT: a vital success rate of 82.5% and 89.6%, respectively; and a non-vital success rate of 73.1% and 84.7%, respectively; or regarding evaluation of the technical quality of an RCF: a homogeneous success rate of 82.9% and 87.0%, respectively; and an inhomogeneous success rate of 61.1% and 64.2%, respectively. Using insurance data, Lazarski et al.[6] checked the data of 110,000 insurants over an average observation time of 22 months. A negative incident (extraction [EX], RER, RV) occurred after an average of 14.7 months. During this time, 3.56% of the teeth treated with RCF were extracted, 1.84% underwent RV and 1.00% underwent RER.

Chen et al.[7] looked at more than 1.5 million non-surgical endodontic treatments covering a period of five years. During this time, 6.70% of the teeth were extracted, 0.29% underwent RER and 3.20% underwent RV. After five years, the survival rate for anterior teeth was 95.4% and 93.6% for premolars. The EX rate remained constant with 20% p.a., and 81% of all RERs and 40% of all RVs were performed in the first year post-RCT. During a ten-year observation period in Lumley et al.,[8] 74% of all teeth that had undergone RCF remained without re-intervention (EX, RER, RV). After one year, the percentage of teeth without re-intervention was 96%; after five years, it was 84%. Of those that failed 70% ended up in EX. The central incisors and the first premolars had the longest survival time; the lateral incisors and the canines the shortest. Salehrabi and Rotstein[9] evaluated 4,744 cases of non-surgical RV. During a five-year observation period post-RCT, 11.0% were extracted and 5.2% underwent RER.

Ng et al.[10] evaluated survival rate based on 14 studies. The observation time ranged from one to 11.5 years, and 74–85% of the teeth treated with RCF survived to the end of observation time without re-intervention. In their review of 63 studies published between 1922 and 2002, Ng et al.[11] found a success rate in the studies of 31–96% (a pooled and weighted rate of 74.7%) according to strict criteria and of 60–100% (a pooled and weighted rate of 85.2%) according to loose criteria. In the same study, they analysed the practitioner's influence on the treatment result differentiated according to strict and loose criteria. General practitioners achieved a success rate of 65.7–86.2%, postgraduate students 77.2–93.1%, and specialists 84.8–87.6%.

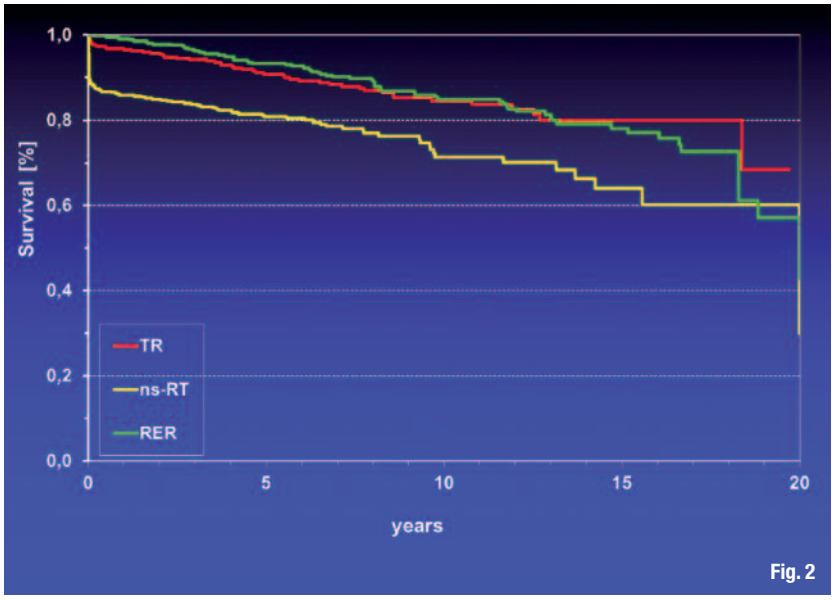

Fig. 2_Success with respect to the total failure rate by therapy type. The initial Diagnosis 1, 2 ($n = 757$) showed 6.1% ($n = 46$) flare-ups, the initial Diagnosis 3, 4, 5 ($n = 963$) 4.3% ($n = 41$) flare-ups thus influencing the total failure rate.

Cross-sectional studies and epidemiological studies permit a survey of the quality of practitioners' endodontic treatment results. Eriksen[12] compared the success and failure of 14 clinical studies—with RCT by specialists and supervised students—and 28 epidemiological studies—with RCT by general practitioners. The success rate of the clinical studies varied from 77 to 94% (average: 86% were successful, 6% were uncertain and 8% failed) and of the epidemiological studies from 35 to 78% (average: 63% were successful and 37% failed).

Friedman[13] consolidated data from 39 cross-sectional studies performed between 1976 and 2006. The rate of AP was 20–65%. RCFs were found to be inadequate in 48–87%. Alley et al.[14] found a five-year survival rate of 89.7% for endodontically treated teeth for cases treated by general practitioners and of 98.1% by endodontists.

The figures mentioned prove that there is a discrepancy between learning and success in practice. Hülsmann and Snezna[15] conclude that an optimal success rate cannot be achieved under practice con-

Table 1

Therapy		Sex		Operator		Average observation period	Average time to follow-up radiograph	Follow-up rate	
		Male		*Author*					
	n	*n*	*%*	*n*	*%*	*Years*	*Years*	*n*	*%*
NsRCT	453	234	51.6	322	71.1	6.08	6.33	322	71.1
RER	524	287	54.8	301	57.4	5.27	5.02	353	67.4
TR	743	359	48.3	435	58.8	5.97	6.24	487	65.5
TOTAL	1,720	880	51.2	1.058	61.5	5.59	5.90	1,162	67.6

Table 1_Cases of non-vital teeth in relation to sex, operator, and average observation period and time to follow-up radiograph.

ditions because technical deficits (length, homogeneity, unfilled canals) lead to a high AP rate. In their study, they mention that continuous development from 1976 to 1993 could not be verified.

In 1973, 1983, 1993 and 2003, Frisk et al.[16] examined 500 patients each in order to determine possible developments in endodontic performance. Over the years, RCF quality and quantity, especially in molars, increased. In contrast, RER quantity remained significantly unchanged statistically (21.1–24.8 %).

Skudutyte-Rysstad and Eriksen[17] observed the endodontic status of 35-year-old patients from Oslo in Norway over three decades. In 1973, 18 % (*n* = 100) of the examined RCF teeth exhibited AP; in 1984, 26 % (*n* = 133); in 1993, 38 % (*n* = 42); and in 2003, 43 % (*n* = 61). From 1984 to 2003, the percentage of adequate RCF lengths increased from 41 % to 61 %, whereas RCF quality (homogeneity) remained unchanged. Frisk and Hakeberg[18] arrived at different results in evaluating women's dental status in 1968, 1980 and 1992. AP rate in endodontically treated teeth remained at a level of 41.9 % from 1968 to 1980, and decreased to 31.1 % from 1980 to 1992.

Eckerbom et al.[19] observed an increase in RCTs from 13.9 % to 17.7 % within 20 years. Although RCF quality improved significantly, the diagnosis of AP in teeth that had undergone RCT increased from 17.3 % to 21.4 %, and 28.8 % of the teeth had to be extracted.

In 1984,[2] 5,148,000 canal preparations were performed in western Germany, and 7,882,000 in 2011[3], an increase of 53.1 %. RCF procedures amounted to 4,287,000 in 1984 and to 6,195,000 in 2011, an increase of 44.5 %. This shows that 83.3 % of prepared canals were filled in 1984 versus 78.6 % in 2011.

The results of the various studies led Torabinejad et al. to remark as follows:[20] "The older endodontic literature recorded the highest overall quality rating and included the most high-level studies. Changes in treatment that have occurred over time may have introduced biases favouring the discipline with the most recent papers."

Hepworth and Friedman[21] stated in 1997 that the majority of the RER studies do not reflect current RER techniques, which are used in the prospective Toronto study.[22] According to this study, 74 % of 134 RER cases could be judged as healed and 94 % were indicated as "functional". In the case of an inadequate RCF level (underfilling or overfilling), the healing result of 84 % was more favourable than that of 68 % with proper RCF levels. A tabular survey of 12 studies performed in 1968–1991 by simultaneous RCF and RER without post-RCF showed a healing rate of between 55 % and 90 % (average: 81 % were successful and 7 % failed), and another table of 22 RER studies performed in 1968–1995 with RER and retrograde RCF showed a healing rate of between 43 % and 89 % (average: 59 % were successful and 19 % failed).

Friedman[23] found that a combination of orthograde RCF and RER had a better prognosis of success than did a combined RER and retrograde RCF; however, he mentions this for academic interest only because of the high success of the current RER methods. Essentially, alternative therapies have to be considered for saving a tooth, one of which should be RER.

Rud et al.[24] compared the treatment results of 763 cases of orthograde gutta-percha RCF with 237 cases of RER and retrograde amalgam RCF. After one to ten years, the following radiographic findings were made: 83 % complete healing, 8 % incomplete healing, 6 % indeterminate findings and 3 % failed after orthograde RCF; compared with 72 % complete healing, 11 % incomplete healing, 8 % indeterminate findings and 9 % failed after RER and retrograde RCF.

Grung et al.[25] compared the treatment outcomes of 397 cases of RER with 76 cases of periapical curettage after an average of 2.3 years. Complete healing of 78.3 % was achieved with RER versus 78.9 % with curettage. In order to obtain a failure rate, the authors listed unsatisfying and uncertain healing in the failure group. These failures amounted to 13.3 % after RER and to 5.2 % after curettage, while those after orthograde RCF (312 of 477) were lower (4.9 %) than those after RER and retrograde RCF (27.9 %).

According to Friedman and Mor,[26] the results of 57 RER studies between 1966 and 2004 are not consistent. The authors found complete healing of between 37 % and 85 % in these studies. It could be concluded that 86–92 % would remain asymptomatic.

Kirchen[27] evaluated 185 RER cases, treated from 1983 to 1995. Pre-RER, 45 % were diagnosed with AP. Of the cases, 171 were filled with N2 or gutta-percha. A clinical check-up was done after an average of 5.6 years. A radiographic check-up was performed after an average of 6.2 years. Complete healing was observed in 154 cases (83.2 %), scar formation in eleven cases, incomplete healing in 15 cases, and uncertain healing in three cases. Only two cases were regarded as failures. Nine teeth were extracted after an average of six years.

To a large extent, the literature accepts TR as an emergency measure only. However, studies[28–35] do exist that systematically used TR as the final step of RCT of non-vital teeth. Sargenti[36,37] has called RER obsolete and recommended replacing RER with TR. He states that TR is a therapy alternative equal to RER for endodontic treatment of non-vital teeth, whereas nsRCT should be regarded as a less successful method.

_Materials and methods

The author, who started as a dental practitioner in 1969, used the 1,790 endodontic treatment cases of non-vital anterior teeth and premolars registered in his patient files from 1985 to 1999. Of these, 70 cases (3.9 %) had not returned to the practice after RCT. Thus, 1,720 cases remained for analysis. Of these, 743 teeth had been treated by RER, 453 by TR and 524 by nsRCT. The observation period ended in December 2005. The patients came to the practice on their own accord without intentional recall.

All of the teeth were treated with a simplified endodontic technique following Sargenti's N2 method,[36,37] which included relative drying, manual canal preparation with reamers in the crown-down technique, optional radiographic measuring, no canal rinsing, lentulo application of N2 RCF material (paraformaldehyde component in powder, allowing a gaseous canal disinfection), and gutta-percha point concentration of RCF. The target was RCF to the apex. Normally, overfilling was followed by TR or RER. Periapical curettage was only performed in the case of massive overfilling. TR and RER were done in the premolar area by flap (angle or trapeze cut). A cross-cut