

Do we know enough about root-canal therapy?

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SUMMARY

There is an almost total lack of documented clinical findings of procedures carried out daily in general dental practices. This paper records the findings noted over an 11 year observation period of 673 teeth requiring root-canal treatment. The collected data were computer analysed and some of the findings have been described. The purpose of this exercise was an attempt to stimulate clinicians to publish some of their clinical findings in whatever sphere of dentistry they find most interesting. In endodontics, there is unfortunately, a large amount of subjective data utilized which requires better defined parameters. One method to do this is to assimilate large numbers of cases and then to compare the various findings at a suitable post-operative time.

OPSOMMING

Daar is amper 'n algehele gebrek aan dokumentasie aangaande kliniese prosedures wat daagliks in die algemene tandheelkundige praktyk uitgevoer word. In hierdie referaat word aantekeninge wat oor 'n tydperk van 11 jaar gemaak is op 673 tande wat wortelkanaal behandeling nodig gehad het, uiteengesit. Die versamelde gegewens is met 'n rekenaar ontleed en sommige van die bevindings word beskryf. Die doel van hierdie referaat is om 'n poging aan te wend om klinici aan te moedig om hul kliniese waarnemings in enige vertakking van tandheelkunde wat hulle die meeste in belang stel, te publiseer. In endodontsie word daar ongelukkig gebruik gemaak van 'n groot hoeveelheid subjektiewe gegewens wat beter beskryf behoort te word. Een manier om dit te bereik is om 'n opname van 'n groot aantal gevalle te maak en die verskillende gegewens dan na 'n geskikte tyd te vergelyk.

INTRODUCTION

Techniques used today in dentistry by general practitioners or specialist clinicians have evolved from the experiences of yesterday. These experiences have been passed on by word of mouth and in written form because some clinicians have documented their observations. Much has been learned from the mistakes and successes of the past, but because dentistry is a dynamic art and science, today's clinicians should pause to consider the future. Writing down one's observations is the most practical method for relaying information to other clinicians, but before such observations can be relayed, they must be documented. Documentation is the nucleus of any therapeutic study in dentistry which includes preventive, surgical, restorative, radiological and prosthetic forms of therapy. Root-canal, or endodontic therapy is a small part of the dental therapeutic spectrum.

Both *in vivo* and *in vitro* studies have been carried out on aspects of root canal therapy (Davis, Brayton and Goldman, 1972; Larder, Prescott and Brayton, 1976; Friedman, *et al*, 1977; Allison, Weber and Walton, 1979). *In vivo* studies can be divided into histological investigations in animals (Stewart, 1958; Rappaport,

Lilly and Kapsimalis, 1964; Erausquin and Muruzabal, 1968; Langeland *et al* 1969; Ham, Patterson and Mitchell, 1972; Newton, Patterson & Fafrawy, 1980; Crane *et al* 1980); human histological responses (Rappaport, Lilly and Kapsimalis, 1964; Bender, Seltzer and Soltanoff, 1966; Andreasen and Rud, 1972; Block *et al*, 1976); or epidemiological studies. The latter have been documented in teaching hospitals (Strindberg, 1956; Storms, 1969; Harty, Parkins and Wengraf, 1970; Heling and Tamshe, 1970; Makinson and Heithersay Smales, 1974; Adenub and Rule, 1976), in specialist endodontic practices (Seltzer, Bender and Turkenkopf, 1963; Bender, Seltzer and Turkenkopf, 1964; Fox *et al*, 1972), but seldom in general dental practices (Wasliroff and Maurice, 1976; Barbakow, Cleaton-Jones and Friedman, 1980, a, b). Although there are more general practising dentists doing endodontics than there are endodontists, general practitioners seem to be reluctant to publish the results of their treatments. This applies, not only to endodontics, but to all types of dental therapy. The purpose of this paper is to demonstrate one method of data collection employed in a general dental practice, and to show general practitioners just how much useful information is available when those aspects of clinical dentistry which interest them are recorded accurately and regularly.

MATERIALS AND METHODS

This paper records some of the findings of 673 endodontically treated teeth. This number of 673 teeth represents an increase of an earlier reported series of 566 cases (Barbakow, Cleaton-Jones and Friedman, 1980 a,b). The pre-operative, operative and post-operative data was noted on the record sheets shown in Fig. 1. The data from the record sheets was transferred onto computer sheets and later onto computer punch cards which were analysed in an IBM 370/158 computer using the Statistical Package for the Social Sciences (Nie, *et al*, 1975).

get of ethyl chloride-moistened cotton wool. Maxillary incisors were the most frequently treated teeth, whilst the mandibular incisors and the canine teeth in both jaws were the least frequently treated. The maxillary and mandibular premolars were almost equal in number as were the corresponding molar teeth.

Pain of varying descriptions was a presenting symptom in 527 (78 per cent) of the cases, only 146 (22 per cent) were free of pain. Of the 527 cases presenting with pain, 346 (66 per cent) had experienced pain for up to one week with the remainder varying from 7 days to 2 years. Thermal responses were exaggerated in 282 (42

Figure 1

Endodontic Therapy Record Sheet

CASE NO:

Patient's Name: Age Tooth No

Vitality Percussion Periapical Radiolucency

Present

Absent

Subjective Symptoms.

Pain Duration:
 Type: Sharp, Dull, Throbbing, Localized, Diffuse.
 Aggravated by: Heat, Cold, Pressure, Percussion.
 Relieved by:

Objective Signs

Swelling: Extra-oral, Intra-oral, Mobility, Fistula.

Medical History

Rheumatic Fever, Heart Condition, High Blood Pressure, Diabetes, Hepatitis, Nephritis, Pregnancy, Other.

Drug Allergy.

Local Anaesthesia, Penicillin, Other.

Drug Therapy

Antibiotic, Corticosteroid, Other.

Clinical Diagnoses: No. of Canals _____

Treatment Record*

Date _____

* Indicate medicaments used — Intracanal, Systemic.
 Sequelae and complications (if any) how handled.
 Reason for, and description of surgical intervention.
 Prognosis:

Pre-Op	Diag. Meas.	Canal Filled	Follow Up	Follow-Up
Date:	Date:	Date:	Date:	Date:

RESULTS

The 673 teeth were equally divided between the sexes, but 420 (62 per cent) were maxillary teeth, whilst 253 (38 per cent) were mandibular teeth. The ages of the patients at presentation are given in Table 1. The types of teeth involved in this series are indicated in Table 2. These teeth have been further subdivided into vital and non-vital groups by assessing their reactions to a pled-

per cent) of the 673 teeth examined, whilst varying degrees of tenderness to percussion were recorded in 461 (69 per cent) of the cases. Radiographic interpretation indicated that periapical radiolucencies were present in 207 (31 per cent) of the 673 teeth.

The various diagnoses made are listed in Table 3. Acute conditions in teeth with vital or non-vital pulpal reactions accounted for 462 (69 per cent) of the 673

Table 1. Frequency distribution of the patient age in decades

	Decade	n	%
1	0-10	5	<1
2	11-20	57	9
3	21-30	231	34
4	31-40	138	21
5	41-50	83	12
6	51-60	101	15
7	61-70	56	8
8	71-80	2	<1

diagnoses made. In Table 4 the number of root canals per tooth are indicated. A more detailed analysis showed that in 4 molar teeth only 1 canal per tooth could be located, in 19 other molar teeth 2 canals each were located and in 5 maxillary first premolars, only one canal each was located.

Of the 673 teeth examined, 13 (2 per cent) were not root-filled, or the patients did not return for or were not given a second appointment. Thus in 81 (12 per cent) teeth (including the above 13), treatment was completed in one visit, whilst the majority of teeth (316 or 47 per cent) were root-filled after 2 visits, usually one week apart. Of the remainder 163 (24 per cent) and 73 (10 per cent) were root-filled at the third and fourth appointment respectively with 40 (7 per cent) teeth being filled after 5 or more visits. Cresenol^{R1} and Cresetene^{R2} were the most commonly used intermedi-

Table 2. Frequency distribution of teeth by number of root canals treated.

Number of root canals treated per tooth.	n	%
1	351	52
2	120	18
3	197	29
4	5	1
TOTAL	673	100

Table 3. Frequency distribution of the clinical diagnoses made for individual teeth.

Diagnosis	n	%
Acute infection associated with an apical granuloma	152	23
Acute pulpitis	138	21
Chronic pulpitis	95	14
Necrotic pulp with no obvious periapical radiolucency	82	12
Asymptomatic granuloma or cyst	62	9
Acute pulpitis and acute periodontitis	61	9
Traumatic crown fracture	29	4
Traumatic pulp exposure	23	3
Endodontic therapy to facilitate crowning of tooth	22	3
Pulp-horn abscess	6	1
Replantation	3	<1
Total	673	100

Table 4. Frequency distribution of tooth type treated by non-vital and vital teeth.

Tooth type	Non Vital		Vital		Total	
	n	%	n	%	n	%
Maxillary incisor	99	31	55	15	154	23
Maxillary canine	17	5	6	2	23	3
Maxillary premolar	51	16	83	23	134	20
Maxillary molar	41	13	68	19	109	16
Mandibular incisor	16	5	7	2	23	3
Mandibular canine	7	2	4	1	11	2
Mandibular premolar	31	9	60	17	91	14
Mandibular molar	55	17	73	21	128	19
TOTAL	317	100	356	100	673	100

Table 5. Terminal Position of the Root-Canal Fillings in the Maxillary and Mandibular Incisors, Canines, Premolars, and Molars estimated from radiographs following root canal filling. The percentages are given in parenthesis.

Tooth Type	Root-Filling Position	Short of the Apex	At the Apex	Through the Apex	Combinations	Never Filled	Totals
MAXILLARY	Incisors	25 (3.7)	109 (16.2)	15 (2.2)	0 (0)	5 (0.7)	154 (22.8)
	Canines	7 (1.0)	15 (2.2)	1 (0.2)	0 (0)	0 (0)	23 (3.4)
	Premolars	35 (5.2)	93 (13.8)	3 (0.5)	2 (0.3)	1 (0.2)	134 (20.0)
	Molars	41 (6.7)	16 (3.0)	5 (0.7)	38 (5.6)	1 (0.2)	109 (16.2)
MANDIBULAR	Incisors	10 (1.5)	7 (1.0)	6 (0.9)	0 (0)	0 (0)	23 (3.4)
	Canines	5 (0.7)	4 (0.6)	2 (0.3)	0 (0)	0 (0)	11 (1.6)
	Premolars	14 (2.1)	72 (10.7)	1 (0.2)	0 (0)	4 (0.5)	91 (13.5)
	Molars	57 (8.5)	31 (4.6)	11 (1.6)	26 (3.9)	3 (0.5)	128 (19.1)
		198 (29.4)	351 (52.1)	44 (6.6)	66 (9.8)	14 (2.1)	673 (100)

R₁ Premier Dental Products, Philadelphia, U.S.A.

R₂ Premier Dental Products, Philadelphia, U.S.A.

R³ Kieper's Pharmacy, Allentown, Pennsylvania, U.S.A.

ary dressings in this series, whilst Grossman's Paste^{R3} and gutta percha cones were used to root fill 461 (69 per cent) teeth. Kerr's Sealer^{R4} and gutta percha cones were used in 95 (14 per cent) of the cases, while the remaining 117 (17 per cent) teeth were filled with Kri Paste^{R5}, Dickey^{R6} or Oxpara^{R7} alone, or with gutta percha and/or silver points.

Radiographic interpretation of terminations of the root-canal fillings in relation to the radiographic apices for each tooth is shown in Table 5. This has been further subdivided into the 4 major tooth types i.e. incisors, canines, premolars and molars. Irrespective of distances, the root-canal fillings were assessed to be either short of, through or at the radiographic apices. In multi-rooted teeth, a subheading termed combinations was used when the root-canal fillings terminated at various points. The treatment objective was to fill to or just short of the radiographic apices. Maxillary incisors and mandibular molars accounted for half the overfilled root canals. Maxillary molars and mandibular incisors, canines and molars showed the least favourable results in the group filled to the radiographic apices.

A prognosis was assessed for each root-filled tooth using criteria previously described (Barbakow, Cleaton-Jones and Friedman, 1980 a). Of the 673 teeth, 532 (79 per cent) were assigned a good prognosis, 121 (18 per cent) a fair prognosis and 20 (3 per cent) a poor prognosis. The latter group included the unfilled teeth. Success rates were assessed for each case one or more years post-operatively based upon criteria previously described (Barbakow, Cleaton-Jones and Friedman 1980 b). Follow up was not possible in 313 (47 per cent) cases because these had either not yet completed the one year cut-off time, teeth had not been root filled or the patients had been lost to follow up. Of the remainder, 312 (46 per cent) were assessed to be successful 27 (4 per cent) unsuccessful and 21 (3 per cent) uncertain. Surgical details show that apicectomy was carried out in 8 teeth, hemi-section in 6 teeth and 25 (4 per cent) of the 673 had been extracted during the 11 year observation time for varying reasons.

In addition, 20 teeth had to be retreated.

DISCUSSION

A detailed discussion of the results described is not exactly indicated and in principle, has been discussed in the previous publications (Barbakow, Cleaton-Jones and Friedman, 1980 a, b). The purpose of detailing some of the results obtained was to try to demonstrate the type of information which could be obtained and documented. However, it is important to point out that a great deal of subjective information becomes documented in such a study. The ideal whereby only objective results are listed is extremely difficult to attain. Treatment of any condition requires that a differential or specific diagnosis be made. Diagnoses in endodontics and in many other branches of dentistry and medi-

cine are made by interpreting collected data. These data include the patients' subjective descriptions (pain, its locality, duration and type) and the assessment of various clinical tests (thermal and percussion). Objective data include the clinical appearance of the tooth (caries, exposed pulpal cavity, mobility) and the supporting structures (swelling, pus, sinus tracts). Finally, radiographic interpretation is used to determine amongst others, the absence or presence of periapical involvement and root-canal lengths. Both during and after treatment, the clinician discusses the possible prognosis and success eventually obtained. In the same way that happiness means different things to different people, so too do the numerous subjective terms listed above.

Improved parameters and better definitions for these subjective terms and findings could reduce the uncertainty of clinicians and facilitate comparative studies. The vast majority of case reports and analyses are carried out by students in teaching hospitals (Storms, 1969; Smales, Makinson and Heithersay, 1974; Molven, 1976; Adenub and Rule, 1976) and by staff members or postgraduate students in teaching hospitals (Strindberg, 1956; Harty, Parkins and Wengraf, 1970). Data from specialist practices (Seltzer, Bender and Turkenkopf, 1963; Fox *et al*, 1972) and from different combinations (Kerekes, 1978) are all helpful, but only up to a point. There is, perhaps, too much variation between the different "types of operators" with different goals. Perhaps what is needed is a standardised record form which could be used by groups of clinicians who could pool their findings, provided their therapeutic techniques have sufficient similarities. Accumulation of such results between different groups could possibly serve as the first stepping stone out of the "troubled waters" of subjective endodontics. A simple example is in the diagnosis itself. Various studies have shown how incorrect it is to assign histological terms to clinical diagnoses because the clinical diagnosis seldom corresponds to the histological pictures (Seltzer, Bender and Zienitz, 1963; Pilz, 1969; Tyldesley and Mumford, 1970; Baume, 1970; Block, *et al*, 1976). A possible solution could be to limit the diagnoses to clinical and observed forms with only vital and non-vital pulps being described.

The form described in Fig. 1 is suggested for possible acceptance or modification. A great deal of information will accumulate and computer analysis will become necessary. This should not discourage any clinicians as, once the data collection has begun, there will always be staff at the South African Dental Faculties only too willing to give assistance, guidance and help. As computers become used more frequently in individual practices, data analysis will become even easier. The necessary factor is the clinician to do the initial documentation. Another possible discouraging factor is that 2 or more years are required for the first meaningful results to be examined. This "waiting period" could be well utilised by reading, using the references listed as a starting point. Retrospective studies with sufficient numbers can also be useful, especially as a stimulus. (Mühlemann, (1956) has discussed some ideas on statistics collection, applied to endodontics, but which could be utilized in other branches of dentistry. A typical example

⁴ Kerr, Sybron Corp. Romulus, Michigan, U.S.A.
⁵ Kri 3 & Kri Paste, Pharmachemie Ap., 8053, Zurich, Switzerland
⁶ Espe GMBH, Seefeld Oberbay., D8031, West Germany
⁷ Ransom and Randolph, Toledo, Ohio, U.S.A.

of what is being suggested has recently been published by Powter and Cleaton-Jones (1980).

Finally, an excellent paper by Stanley (1980) describes very clearly the necessity for better observation, documentation and analysis of even extracted teeth. The question put to the clinician is — why not give yourself only one good reason for not beginning today?

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