# First Untoward Events and Reasons for Tooth Extraction after Nonsurgical Endodontic Treatment in Taiwan

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## Abstract

In this study, 857 teeth having undergone nonsurgical root canal treatment (NSRCT) in Taiwan in 2000 were evaluated during a 5-year follow-up period for first untoward events and reasons for tooth extractions. First untoward events occurred in 83 (9.7%) teeth during this follow-up period, and nonsurgical retreatment was performed for 20 (24.1%), 4 (4.8%) received apical surgery, and 59 (71.1%) were extracted. By the end of this 5-year follow-up period a total of 64 (7.5%) teeth had been extracted. There were 65 reasons for tooth extraction given by the 56 performing dentists who responded to the extraction reason questionnaires; 6 (10.7%) were attributed to endodontically related diseases, 15 (26.8%) to periodontal diseases, 26 (46.4%) to large decay or unrestorable tooth, and 18 (32.1%) to tooth fracture. The conclusion was that 7.5% of the NSRCT teeth were extracted by the end of the 5-year follow-up period, and only 10.7% of these teeth were extracted as a result of endodontically related diseases. *(J Endod 2008;34:671–674)*

## Key Words

Endodontic outcome, reasons for tooth extraction, untoward events

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Endodontic treatment outcome of human teeth can be assessed by a case-controlled or a follow-up epidemiologic study. A case-controlled study evaluates a relatively small number of endodontic treatment and control cases. Because the criteria used for assessing success and failure might be different, the endodontic treatment outcomes vary considerably among several studies (1). The follow-up epidemiologic study examines a very large number of endodontically treated cases from a general population. There are 3 examples of this type of epidemiologic study that uses an alternative approach to evaluate the nonsurgical root canal treatment (NSRCT) cases from the database of a nationwide health insurance organization (2–4). Because an epidemiologic study assesses a large number of endodontic treatments performed by both general practitioners and endodontists, its yielded success rate might represent outcomes in the general population (2–4).

In Taiwan, a national healthcare plan was implemented in March 1995. This plan covers nearly all medical treatments and a portion of the dental treatments including surgical and nonsurgical endodontic procedures. The National Health Insurance (NHI) is managed by the Bureau of NHI (BNHI), which insures approximately 21 million individuals (95.5% of the total population of 22 million). Because the providers must make a claim for each treatment to the BNHI, a large computerized medical and dental database for each insured individual has been kept since March 1995. Access to BNHI's invaluable national data set makes it possible to study the first untoward events including nonsurgical retreatment, apical surgery, and tooth extraction as well as tooth retention rate after NSRCT nationwide.

Two large epidemiologic studies with a long follow-up period reported very high tooth retention rates (94%–97%) from assessment of a large number of NSRCT cases collected from an insurance company database (2, 3). These results stimulated our group to study the first untoward events and tooth retention rate during a 5-year follow-up period for 1,557,547 teeth receiving NSRCT in Taiwan in 1998. We found that first untoward events occurred in 159,680 (10.3%) NSRCT teeth during the 5-year follow-up period. Moreover, a high 5-year tooth retention rate of 92.9% was discovered (4). In another previous study, we evaluated the technical quality of root canal filling in a total of 1085 NSRCT cases randomly selected from a large representative sample of the Taiwanese population in 2000. We found that only 30.3% of NSRCT teeth had good quality endodontic work (GQEW), and the remaining 69.7% of NSRCT teeth had modest quality endodontic work (MQEW) (5). Because the records of the technical quality of root canal fillings in these 1085 NSRCT teeth were available, we were able to assess the first untoward events and tooth retention rate during a 5-year follow-up period of these teeth. In addition, we compared the incidence of each untoward event, the tooth extraction rate, and the number of teeth extracted each year between teeth with GQEW and teeth with MQEW. We also tried to identify the causes for tooth extraction after NSRCT by sending questionnaires to the dentists who performed the extraction procedure.

## Materials and Methods

The information of each NSRCT tooth was collected from the database of NHI in Taiwan. Each NSRCT tooth was followed for a continuous period of 5 years from the completion date of its endodontic procedure in 2000. The subsequent treatment codes and dates for each NSRCT tooth within the 5-year follow-up period were collected. Of particular interest was the evaluation of the first and the last untoward events, which were defined as nonsurgical retreatment, apical surgery, and extraction in 2 prior

**TABLE 1.** Incidences of First Untoward Events in Teeth with GQEW and in Teeth with MQEW During 5-year Follow-up Period

| All Teeth | First Untoward Events, No. of Cases (%) | | | |
|---|---|---|---|---|
| | Nonsurgical Retreatment | Apical Surgery | Tooth Extraction | Total |
| Teeth with GQEW (n = 220) | 1 (0.5) | 2 (0.9) | 17 (7.7) | 20 (9.1) |
| Teeth with MQEW (n = 637) | 19 (3.0) | 2 (0.3) | 42 (6.6) | 63 (9.9) |
| Total follow-up teeth (n = 857) | 20 (2.3) | 4 (0.5) | 59 (6.9) | 83 (9.7) |

GQEW, good quality endodontic work; MQEW, modest quality endodontic work.

epidemiologic studies (2, 3). The occurrence of untoward events was analyzed by searching the database for specific treatment codes that were then used to identify the specific treatment modality, which included nonsurgical retreatment, apicoectomy, root-end filling, and simple or complicated tooth extraction.

The first subsequent procedure for each NSRCT tooth was analyzed to disclose whether any untoward event occurred to each tooth after the completion of NSRCT. In addition, the total annual number and incidence of each untoward event for all NSRCT teeth were calculated. The last related procedure for each NSRCT tooth was used to calculate how many teeth were extracted and in turn to determine the percentage of teeth retained after completion of the full 5-year follow-up period. In this study, the patients' outcome criteria were applied blindly because the dentists submitting their claims were not aware that the data would be used for future quality evaluation and outcome analysis.

This study used both an adequate filling length and a complete obturation in the apical one third of the root canal as the criteria for defining a GQEW as previously described (5). These criteria are advocated by the European Society of Endodontology (1994), ie, a radiographically dense filling with its end located between 0 and 2 mm from the apex. However, a gutta-percha–filled root canal with either an inadequate filling length or an incomplete obturation in the apical one third of the root canal was defined as an MQEW.

To identify the causes for tooth extraction, a questionnaire was sent to the dentists who performed the extraction procedure. The dentists were asked to fill in the causes for tooth extraction including endodontically related diseases, periodontal diseases, large decay or unrestorable tooth, and tooth fracture. Multiple causes for tooth extraction were allowed.

The $\chi^2$ test was used to compare the incidence of each untoward event, the tooth extraction rate, and the annual number of extracted teeth between teeth with GQEW and teeth with MQEW. A $P$ value of less than .05 was considered statistically significant for all tests.

## Results

### Incidences of First Untoward Events During 5-Year Follow-Up Period

Among the 1085 teeth in which the technical quality of NSRCT was known, we were able to trace the dental treatment records of the 857 teeth by identification number and specific treatment codes in the database of the Taiwan Department of Health. Of these 857 teeth, 220 had GQEW, and 637 had MQEW. The first untoward events were found in 83 teeth (9.7%) during the 5-year follow-up period. Tooth extraction was the most common first untoward event (71.1%) followed by the nonsurgical retreatment (24.1%) and apical surgery (4.8%). There was no significant difference in the incidences of the first untoward events between the teeth with GQEW and the teeth with MQEW ($P = .343$, Table 1).

### Distribution of 83 First Untoward Events in Each of the 5 Follow-Up Years

The distribution of 83 first untoward events in each of the 5 follow-up years is shown in Table 2. There were more untoward events (25 cases, 30.1%) during the first follow-up year and less untoward events (12 cases, 14.5%) during the second follow-up year compared with the number of untoward events during the next 3 years ($P = .068$, marginal significance).

### Tooth Extraction Rates for Anterior Teeth, Premolars, and Molars During 5-Year Follow-Up Period

Sixty-four (7.5%) of 857 follow-up teeth were extracted after completion of the 5-year follow-up period, yielding a 5-year tooth retention rate of 92.5%. Of these 64 extracted teeth, 18 had a GQEW, and 46 had an MQEW; moreover, 59 were extracted at first untoward events, 3 after nonsurgical retreatment, and 2 after apical surgery. In addition, more molars (46.9%) were extracted than premolars (29.7%) and anterior teeth (23.4%). There was no significant difference in tooth extraction rates for anterior teeth, premolars, and molars between the teeth with GQEW and the teeth with MQEW ($P = .698$, Table 3).

### Distribution of 64 Extracted Teeth in Each of the 5 Follow-Up Years

The distribution of 64 extracted teeth in each of the 5 follow-up years is shown in Table 4. Although there were more teeth (16 teeth, 25.0%) extracted during the first year of follow-up and less teeth (9 teeth, 14.1%) extracted during the second year of follow-up compared with the number of teeth extracted during the next 3 years, there was no significant difference in the annual number of extracted teeth between the teeth with GQEW and the teeth with MQEW ($P = .330$, Table 4).

### Reasons for Tooth Extraction After NSRCT

In this study, 64 NSRCT teeth were extracted by 64 different dentists. Questionnaires were sent to the 64 dentists who performed the tooth extractions; 56 gave a response. Of these 56 dentists, 47 gave 1 reason and 9 gave 2 reasons for the tooth extraction. Of these 65 reasons for tooth extraction, 6 (10.7%) were attributed to endodontically related diseases, 15 (26.8%) to periodontal diseases, 26 (46.4%) to large decay or unrestorable tooth, and 18 (32.1%) to tooth fracture (Table 5).

## Discussion

Our previous study and this study assessed the first untoward events and tooth retention during a 5-year follow-up period for

**TABLE 2.** Distribution of 83 First Untoward Events in Each of the 5 Follow-up Years

| Regions | No. of Cases (%) | | | | | |
|---|---|---|---|---|---|---|
| | First Year | Second Year | Third Year | Fourth Year | Fifth Year | Total |
| Nonsurgical retreatment | 6 (30.0) | 5 (25.0) | 4 (20.0) | 1 (5.0) | 4 (20.0) | 20 (100.0) |
| Apical surgery | 4 (100.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 4 (100.0) |
| Tooth extraction | 15 (25.4) | 7 (11.9) | 11 (18.6) | 14 (23.7) | 12 (20.3) | 59 (100.0) |
| Total | 25 (30.1) | 12 (14.5) | 15 (18.1) | 15 (18.1) | 16 (19.3) | 83 (100.0) |