



PRELIMINARY ESTIMATES OF THE INCIDENCE AND CONSEQUENCES OF TOOTH FRACTURE

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Neither the incidence nor the outcomes of tooth fracture has been well-established in the literature. Thus, decisions to initiate treatment for the prevention of tooth fracture are not grounded in knowledge of the actual probability that a fracture will occur.¹ Further, it is not possible to predict whether a fracture will require more extensive treatment than that required to prevent the fracture.¹

The absence of information describing the incidence of tooth fracture is rooted in the difficulties of enumerating both the numerator and denominator of the incidence calculation (that is, the number of fracture events and the number of people at risk of experiencing tooth fracture). For accuracy, dentists must identify fractures in dental offices, rather than identifying them through patient self-reports. However, gaining access to practices, recording events and identifying the population at risk of experiencing tooth fracture for such a study are all problematic.

One study reported 62 complete and partial fractures among 2,628 adult patients in one year, an annual incidence

ABSTRACT

The authors studied all tooth fractures identified within a two-week period among adult enrollees in a dental health maintenance organization to determine the incidence and severity of this condition. They found complete fracture rates of 5.0 and 4.4 per 100 adults per year for all teeth and for posterior teeth, respectively, with 15 percent of fractures resulting in pulpal involvement or extraction. These estimates, the first to be reported, provide information that is potentially useful to patients and dentists making decisions about treatment intended to prevent tooth fracture.

rate of 2.4 per 100 patients.² However, this rate was calculated by dividing the number of patient record entries that noted a posterior tooth fracture during one year in a dental practice by the number of patients treated in that practice during

the year. This method biases the incidence estimate by excluding from the at-risk population all patients who would seek treatment at the practice if a fracture occurred, but who did not visit for any reason during the recording period. Further, in relying on treatment records, the author acknowledged that "obviously, some cases were missed." In another study, dentists estimated that they treated a mean of 3.2 complete fractures per week in their practices, but no information was available to describe the population at risk.¹ Other descriptive studies of tooth fracture³⁻⁶ also have not estimated the size of the population at risk.

The literature is almost completely silent concerning the severity of tooth fracture and the immediate outcomes of treating it. The small amount of information that is available usually is found as a casual observation in a paper's discussion section. No attempts to characterize the severity of tooth fractures in terms of the proportion of fractures that expose dentin or pulp have been reported. One study did indicate that 13 per-

cent of fractures extended below the gingival crest.³ With the exception of a description of the treatments associated with 100 "crown-root fractures" in which simple cusp fractures were excluded,⁵ no distribution of treatment procedures performed after tooth fracture has been reported. Perhaps most important, the literature has not addressed the short- and long-term outcomes of fracture assessed as survival of the tooth and pulp.

Clearly, we need to know the incidence and severity of tooth fracture as well as outcomes data for any evidence-based consideration of prevention and treatment. Dentists and patients need better information to make decisions regarding preventive treatment,⁷ and the profession requires sound determinations on which to base assessments of the appropriateness and development of guidelines.⁸ We report the results of a preliminary study of the incidence and severity of tooth fracture that was conducted to demonstrate the feasibility of collecting these types of epidemiologic data in dental practice.

METHODS

This study involved identifying all instances of fractured teeth occurring during a single two-week period in April 1994 among adults enrolled in the Kaiser Permanente Dental Care Program, a staff-model health maintenance organization that operates in the Portland, Ore., metropolitan area. (Permanente Dental Associates, a group of approximately 100 providers, has exclusive arrangements to provide care in Kaiser-owned facilities for patients enrolled in

Kaiser Dental Care Plans.) Studying fracture incidence in an HMO population reduces the difficulties associated with enumerating the population at risk because the population eligible for treatment is known, and the likelihood of out-of-plan treatment is presumed to be low. For this preliminary study, we considered all adult enrollees to be at risk of experiencing tooth fracture, regardless of their dentate status.

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Nine of the HMO's 12 multi-provider dental offices participated in this study, seven directly and two indirectly. In the seven directly participating offices, a dentist volunteer ("fracture captain") supervised the collection of data after being briefed by the study coordinator. One of these seven offices also had an urgent care service for all patients needing emergency care from the two indirectly participating offices that did not have fracture captains. All dentists in the seven directly participating offices who were likely to encounter patients with fractures received a supply of the single-page data collection form.

The participating dentists recorded data for all fractured teeth encountered for the first time during the data collection period. They were instructed to

record fractures both during urgent care visits involving the fracture and during routine appointments if the fracture had not been noted and/or treated previously. Both complete coronal fractures, defined as a "cusp or piece of tooth completely broken away," and incomplete fractures were recorded. Incomplete fractures, which could be either "suspected" or "diagnosed," were included as a separate category principally to reduce contamination of the complete fracture category. For each fracture, the dentist identified the tooth, noted its filled status, and recorded two dichotomous measures of severity (that is, a fracture margin below the gingival crest and the pulp or pulp chamber exposed). The dentists did not record endodontic status, but did note any fracture-related treatment provided during the visit.

We calculated the population at risk by adjusting the HMO's April 1994 enrollment figure, which represented the total number of adults (aged 21 years or older) eligible for treatment in the HMO offices. This figure was adjusted in two ways. First, we subtracted the number of enrollees living in Salem, Ore., because two of the three non-participating HMO offices are located in Salem and no other HMO offices are nearby. The geographic isolation of these two offices made it unlikely that Salem residents would seek treatment in other HMO offices. Second, the number of remaining enrollees was reduced by 10.7 percent, which represented the proportion of all April 1994 visits to the HMO's 10 Portland-area offices that were made to the one non-participating office in that area.

TABLE 1

INCIDENCE RATES FOR COMPLETE TOOTH FRACTURE.	
TOOTH TYPE	CRUDE INCIDENCE RATE PER 100 PATIENT-YEARS*
All teeth	5.0
Posterior teeth	4.4
Molars	3.1
Premolars	1.3

*Based on 143 complete fractures identified during 14 days from a candidate population of 74,503 adults, who were included regardless of their dentate status. The calculation for the incidence estimate for all teeth is as follows:

$$100 \cdot 143 \cdot \frac{365.25}{74,503 \cdot 14} = 5.0$$
where 143*(365.25/14) is the number of fractures expected in one year. This rate can be interpreted as five fractures occurring among 100 patients during one year.

RESULTS

During the two-week period, HMO dentists recorded 174 fractured teeth. Of these, 143 (82 percent) were categorized as complete fractures. Of these complete fractures, 125 (87 percent) involved posterior teeth. The adjusted adult enrollment figure for this period was 74,503. Table 1 shows crude incidence rates calculated from these data. With respect to the measures of severity, 25 percent of complete fracture margins extended below the gingival crest and 8 percent involved the pulp or pulp chamber. Eighty-eight percent of teeth with complete fractures had been previously restored. Table 2 shows the distribution of immediate treatment for teeth with complete fractures. Of the 10 teeth extracted (7 percent), six were premolars, four of which had pulp exposures. The remaining four extracted teeth included two first and two second molars. Both first molars had exposed pulps; neither second molar did. All but one of the extracted teeth had fracture margins below the gingival crest.

DISCUSSION

The results of this preliminary study must be regarded only as initial estimates of the incidence and outcomes of tooth fracture in one adult population. A number of factors could limit our confidence in generalizing the actual rate and outcomes distribution to other settings. Because we believe that this type of practice-based clinical research is necessary if the epidemiology of dental diseases and treatments is to be fully understood,⁹ our discussion focuses principally on these threats to internal and external validity.

Underestimation of the incidence rate could have occurred if an enrollee sought treatment from a non-HMO dentist or if a participating dentist failed to record a fracture during the two-week data collection period. Plan administrators indicate that out-of-plan care is minimal in the enrolled population and is associated principally with travel. Dissatisfied enrollees have an annual opportunity to disenroll, and with the exception of out-of-area care, treatment not provided by HMO

dentists is not reimbursed. However, it is likely that some small number of fracture events were not recorded because of oversight or time constraints. Fractures that could be identified during routine appointments at the two indirectly participating clinics were the most likely to have gone unrecorded since dentists in these offices received no local encouragement to report them. Nevertheless, we believe that non-recording was infrequent because most fractures were detected during urgent care appointments at which surveillance and behavioral reinforcement were strong (that is, by the office fracture captains who promoted compliance among their colleagues during the two-week data collection period).

Overestimation of the incidence rate could have occurred only through false-positive diagnoses or because enrollees not represented in our denominator (that is, the number of people at risk of experiencing tooth fracture) sought treatment for a fractured tooth in the participating clinics. While actual false-positive diagnoses are improbable, the count might have included some teeth for which prevention of fractures would not be the most pressing treatment need. The most likely examples are a badly decayed "shell crown" that caused unsupported enamel to collapse, or a tooth opened for endodontic access but not completely treated. Since only 12 percent of all fractured teeth were unrestored or had an indeterminate restoration status, the possible effects of the first source of overestimation are limited. The prevalence of incomplete endodontic treatment is unknown.

TABLE 2

IMMEDIATE TREATMENT FOR FRACTURED TEETH.	
TREATMENT	PERCENTAGE OF TEETH WITH COMPLETE FRACTURES*
Smoothing/nothing	4
Temporary restoration	18
Permanent restoration	62
Foundation for crown	6
Initiation of endodontics	2
Extraction	7
Other	1
Total	100

*Based on the initial treatment for 143 completely fractured teeth.

It is also possible that fractures among HMO enrollees not in our population at risk were included in the incidence calculation. If enrollees with fractures from Salem or the one Portland-area office that did not participate were seen in a participating office, inclusion of the fracture event would inflate the estimate. Since a large majority of the fractured teeth in this study were identified during urgent care appointments at patients' usual offices, the possible extent of this inflation is small.

The incidence rate itself, whether or not it is accurately estimated, will depend on several factors that may vary from population to population. While sociodemographic factors may be important in their own right, arguably the most influential factors relate to dental care that was previously received, including both restorative treatment and exodontics. Populations with large proportions of fully or partially edentulous people or those with high numbers of people with cast restorations presumably will have lower per-

patient fracture incidence rates, while populations with a high proportion of teeth receiving intracoronal fillings or endodontic treatment without subsequent cusp protection might be expected to have elevated per-patient fracture incidence rates. It is not likely that local selection bias has operated on the HMO population because enrollment is based on a variety of employee groups.

However, to the extent that Portland-area residents reflect regional treatment idiosyncracies or the previous treatment received as an HMO enrollee has affected these factors, our confidence in generalizing the results is diminished. Finally, the distribution of outcomes identified in this preliminary study also may be affected by the patients' HMO enrollee status if current treatment patterns among HMO dentists reflect systematic differences from those of other providers for patients with and without dental insurance.

Given the estimated incidence rates calculated for pa-

tients in this study, the chances of experiencing a fractured tooth are about one in 20 in a given year, with the chances of a posterior tooth being fractured about one in 23. We can adjust the estimated rates to account for edentulousness by using the most recent data for the proportion of edentulous adults in the United States.¹⁰ Such an adjustment raises the chances of fracture slightly to one in 19 and one in 22, respectively, for all teeth and for posterior teeth among adults with one or more teeth. This preliminary estimate of the incidence of tooth fracture is the first to be reported based on an enumerated population at risk. It should help both dentists and patients appreciate the magnitude of risk involved when teeth are judged to be at risk of being fractured. While 4.4 posterior tooth fractures per 100 patients in one year might seem to be a sufficiently high incidence rate to warrant preventive efforts, we need to consider fracture incidence in the context of its predictability as well as its outcomes compared with outcomes associated with preventive treatment.

Such considerations will reveal that identification of teeth at risk of fracture is subjective and that there is less than strong agreement among dentists about which teeth are at risk.¹ Further, no study has examined the accuracy of these at-risk determinations. Finally, the most common preventive treatment is not without its own risks, with the incidence of pulp death following crown placement generally conceded to be at least 5 percent.¹¹ These possibilities must be weighed

against outcomes such as those reported above.

In this study, 8 percent of posterior fractures (10 teeth) resulted in pulp or pulp-chamber exposure. Because the dentists in this study routinely placed either crowns or protected cusp restorations in endodontically treated teeth, it is unlikely that any of these teeth received complete endodontic treatment. For three of these teeth, endodontic treatment was initiated, while six teeth were extracted. The remaining three teeth received either temporary or permanent restorations. We do not know whether the pulp exposure or concomitant difficulties in producing a successful restoration were a principal factor in deciding to extract the six teeth. Informal comments from dentists at the centralized urgent care clinic indicated that a majority of extractions involved teeth previously opened for pal access where endodontic treatment was incomplete.

It was not possible to investigate these factors in this preliminary study, but clearly the information is necessary in

evaluating alternative approaches to assessing the risk of fracture. The decision to initiate preventive treatment will remain less than clearcut until better information becomes available. Again, this information must be obtained through practice-based studies, and dentists must participate in gathering the needed data.

CONCLUSION

These data suggest that one in 23 people will fracture a posterior tooth each year, with consequences ranging from none to loss of the tooth. These preliminary findings are the first to be reported for this relatively common condition. They foreshadow the usefulness of more precise information based on specific tooth and patient characteristics. ■

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