



Analysis of an administrative database of half a million restorations over 11 years

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Summary *Aim:* This paper describes the analytical approach used to extract empirical distributions of the interval from the date of placement of a direct restoration to the date when the next intervention took place on the same tooth, that is, an estimate of restoration survival.

Methods: Data, based on the complete attendance and treatment history, over the eleven years from 1991 to 2001, of a statistically representative sample of 82,537 General Dental Services' patients in England and Wales, all of whom received at least one directly placed restoration during the observation period, have been analysed. The patients on the database received a total of 719,009 courses of treatment, and there were 503,965 occasions when a tooth was directly restored.

The method of analysis involved, first, the estimation of the probability that the patient will eventually return, given an interval without attending, by analysing the observed patterns of re-attendance. This estimated probability of re-attendance was then used to modify the standard Kaplan-Meier procedure to produce realistic estimates of the hazard of re-intervention.

Results: The results demonstrate that the newly developed methodology has produced robust estimates of the distribution of survival intervals to next intervention on the same tooth. Regarding attendance patterns, re-attendance probability varies with length of interval since last attendance. There is also a strong association with patient age. The older the patient, the more likely it is that a gap in attendance is indicative that the patient will never return. The detailed cumulative survival curve over eleven years has been plotted and forty-seven per cent of restorations, overall, survived without re-intervention for at least ten years. The entire analysis was then successfully replicated on a second, independently selected, sample of attendance and treatment records, confirming the ten-year survival estimate.

Conclusions: This newly developed methodology has produced robust estimates of the distribution of survival intervals to next intervention on the same tooth.

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Patient re-attendance probability varies with length of interval since last attendance and with patient age. The ten-year overall survival rate to next intervention on the same tooth for direct restorations placed within the GDS in England and Wales is *circa* 47%.

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Introduction

Satisfactory life expectancy of dental restorations, while central to the achievement of patient satisfaction, may have a different meaning to groups such as researchers, patient representatives and third party funders. Nevertheless, good restoration performance is essential for the fostering of confidence in the dental profession, to fulfilling the rigours of clinical governance and to satisfying third party funders that they are receiving value for money. While longevity of restorations may vary through different publications, what may be assumed is that the tooth is never as strong, and can never be whole, once it has been restored.

The manufacturers and/or suppliers of restorative materials may have an interest in restoration longevity, as also may organizations responsible for the training of dentists and the advancement of dental science. University dental schools, the Department of Health in England and its equivalents in Wales, Scotland and Northern Ireland, and the UK General Dental Council could be included in this category.

A potential measure of the performance of a dental restoration is the time interval from placement until the next intervention on the same tooth, possibly with some restriction as to type of subsequent intervention.¹ Other things being equal, the longer the interval, the better the performance. For any particular individual case it may be argued that the re-intervention was unrelated to the original restoration, or that the need for re-intervention was questionable. Randomised controlled clinical trials have been used, such as reported by Mair in 1998² and Letzel and co-workers, also in 1998³ to overcome this objection. Calibrated observers, using standard examination protocols such as the USPHS criteria (described by Jokstad and co-workers in 2001⁴ on carefully matched patients using randomised treatment regimes), may provide evidence of the relative efficacy of alternative treatments in the particular controlled conditions of the trial. However, such trials are hampered by recruitment and drop-out bias and it has been argued that the results, which are often obtained from a self-selected population

in a dental hospital, cannot be readily generalised to the high street dental practice environment.⁵ Examples of the contrasting views can be found in Downer et al.⁶

The Dental Practice Board (DPB) holds administrative data for dental treatments provided in the General Dental Services (GDS) of England and Wales. These records cover every course of dental treatment—about 35 million each year and the GDS forms part of the UK National Health Service (NHS). Within each course of treatment each individual treatment item is recorded, together with the position of each tooth treated. Also recorded for each course are the identity of the dentist, that of the patient, and the dates of start (acceptance) and end (completion).

An essential feature of the data set is that it contains incomplete intervals, where a tooth has been restored, but it is not known when that tooth was, or will be, subject to re-intervention. Standard Kaplan-Meier analysis⁷ copes well with incomplete intervals which have known dates of censoring, provided that censoring can be regarded as a random process. A cut-off date such as 31st December 2001 would be suitable for such analysis, provided there were assurance that the restoration was still available for re-intervention at that date. Unfortunately, such an assurance is not available, so unmodified Kaplan-Meier analysis is not appropriate.

The start of the life of a restoration is well defined as a point of time when the restoration is actually placed in the tooth. This date is not explicitly recorded in the administrative records provided to the DPB. In this project, the date of restoration placement was taken to be the last date recorded in the payment claim in respect of the course of treatment. In most cases this is the date of completion, when the dentist discharged the patient at the end of the course of treatment.

The end of the life of a filling is conceptually more difficult, and it also strays into the issue of censoring. An observation of a life is said to be censored if the time of the start, or the time of the end, is not known exactly, but can be placed within a time interval. Where the end time is known to be after a specified time, but without further limit, then the case is described as 'right-censored'.

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