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A study of primary teeth restored by intracoronal restorations in children participating in an undergraduate teaching programme at Cork University Dental School and Hospital, Ireland

ABSTRACT

Aim *To study the outcomes for restored primary molar teeth; to examine outcomes in relation to tooth type involved, intracoronal restoration complexity and to the material used.*

Materials and methods *Design: Retrospective study of primary molar teeth restored by intracoronal restorations. A series of restored primary molar teeth for children aged 6-12 years was studied. The principal outcome measure was failure of initial restoration (re-restoration or extraction). Three hundred patient records were studied to include three equal groups of primary molar teeth restored with amalgam, composite or glass ionomer, respectively. Restorative materials, the restoration type, simple (single surface) or complex (multi-surface) restoration, and tooth notation were recorded. Subsequent interventions were examined. Data were coded and entered into a Microsoft Excel database and analysis undertaken using SPSS v.18. Statistical differences were tested using the χ^2 test of statistical significance.*

Results *Of the 300 teeth studied, 61 restoration failures were recorded with 11 of those extracted. No significant differences were found between outcomes for upper first, upper second, lower first or lower second primary molars. Outcomes for simple primary teeth restored by intracoronal restorations were significantly better than those for complex intracoronal restorations (P = 0.042). Teeth originally restored with amalgam accounted for 19.7% of the 61 failures, composite for 29.5%, while teeth restored with glass ionomer represented 50.8% of all restoration failures. The differences were significant (P = 0.012).*

Conclusions *The majority (79.7%) of the 300 restored primary teeth studied were successful, and 3.7% teeth were extracted. Restorations involving more than one surface had almost twice the failure rate of single surface restorations. The difference was significant. Significant differences in failure rates for the three dental materials studied were recorded. Amalgam had the lowest failure rate while the failure rate with glass ionomer was the highest.*

Keywords *Dental caries, Restored, Primary, Deciduous teeth, Outcomes, Children*

Introduction

Dental caries in children remains prevalent in Ireland even though 71% of the population of Ireland consume fluoridated water supplies. A survey in 2006 of almost 20,000 Irish children, reported that by age 5 years, 37% of children in fluoridated and 54% of children in non-fluoridated areas had at least one tooth with decay into dentine [Whelton et al., 2006].

Earlier studies of caries in primary teeth have raised the question of the efficacy of restoring carious primary teeth [Tickle et al., 2002]. A review of data for over 6,000 children in the Scottish Health Boards' Dental Epidemiological Programme related sepsis to untreated dental decay. That study applied a stepwise logistical regression to identify the most important factors associated with dental sepsis in children [Pine et al., 2006]. Untreated decay was found to be the most important factor, even more dominant than the effect of deprivation. A more recent cohort study of 5,168 carious teeth, from 2,654 children carried out in the UK, reported that 80% of teeth that had been restored survived until natural exfoliation [Stephenson et al., 2010]. None of the above studies would support or advocate a policy of non-intervention for primary teeth. Restoration of carious teeth has the benefits of retaining function, space and improved quality of life through promoting outcomes that limit the potential damage of dental caries.

A number of previous studies have focused on the survival of the restorations in primary teeth by monitoring the integrity of restorations. Some reported

fewer restoration failures for single surface restorations compared to multi-surface restorations [Qvist et al., 2010; Lo et al., 2001] and some finding no significant differences [Foley et al., 2004]. In contrast to that type of study, the principal outcome measure in the present study was the occurrence of any subsequent intervention to re-restore or extract the restored tooth. In so far as the purpose of restoring primary teeth was to maintain them until natural exfoliation, any such intervention was deemed to be a failure of the restoration.

A previous study examining the clinical experiences of undergraduate students at the Cork University Dental School and Hospital found that a mean of 14 primary teeth per student were restored [Stewart et al., 2010]. The present work reports the findings of a study of outcomes for primary molar teeth restored on the undergraduate programme.

The objectives of the present study of primary molar teeth were the following.

- To examine the frequencies of tooth type involved and any subsequent interventions (Intracoronal restorations and extractions).
- To examine the relationships between the intracoronal restoration complexity and the prevalence of subsequent interventions.
- To examine the relationship between the material used and the prevalence of subsequent interventions.

Materials and methods

A series of restored primary molar teeth at Cork University Dental School and Hospital (CUDSH) were studied. Treatment had been provided in an undergraduate clinical teaching programme for children of primary school age (6-12 years in Ireland). The service is integrated with the public dental service for children in Ireland. Intracoronal restorations were carried out by senior clinical students in their 4th and final years of the BDS undergraduate programme. Students were supervised and directed by dentists with extensive paediatric dentistry experience from general dental practice, public health service and hospital dentistry. The local schools served by the programme have catchment areas that include fluoridated (mostly urban) and non-fluoridated (rural) water supplies.

The work comprised of a simple study where the principal outcome measure was the prevalence of a subsequent intervention. The initial restoration was deemed to have failed if there had been any subsequent intervention (re-restoration or extraction) prior to completion of the primary school programme. Patient records were examined retrospectively to include three groups each comprising 100 primary molar teeth that had been restored by intracoronal restoration, using amalgam, composite or glass ionomer respectively. Only primary molar teeth that had intracoronal restorations placed within the undergraduate teaching programme using one of these materials were included. Teeth restored by crowns were not included in the present study and these will be reported in the future. The factors examined along with the restorative materials were, the restoration type, being either a simple (single surface) restoration or a complex (multi-surface) restoration, and the notation of teeth that had been restored. The prevalence of any subsequent intervention for individual restored teeth was recorded. Teeth that received orthodontic extractions were not included.

Data were coded and entered into a Microsoft Excel database and analysis undertaken using SPSS v.18. Statistical differences were tested using the χ^2 test of statistical significance

Results

The distribution of primary teeth included in this study sample is represented in Table 1. There were higher proportions of restored second primary molars compared to first primary molars with almost twice as many second molars involved. In the current study, no significant differences were found comparing outcomes for upper first, upper second, lower first or lower second primary molars.

Of the 300 restored primary teeth in this study sample, 61 restoration failures were recorded with 11 of those teeth having been extracted.

Figure 1 represents outcomes for teeth according to the complexity of the initial restoration, i.e. whether single or multi-surface. Outcomes for simple restorations were significantly better than those for complex restorations, having approximately half of the restoration failures seen with complex restorations. Higher proportions of extractions were recorded for teeth where the initial restoration had involved a complex restoration. The differences in outcomes for

Tooth notation (FDI)	Frequency	Percentage of total sample
54	26	8.7%
55	50	16.7%
64	33	11.0%
65	45	15.0%
74	25	8.3%
75	57	19.0%
84	19	6.3%
85	45	15.0%
Total	300	100.0%

TABLE 1
Distribution of restored primary teeth in sample by tooth notation (FDI).

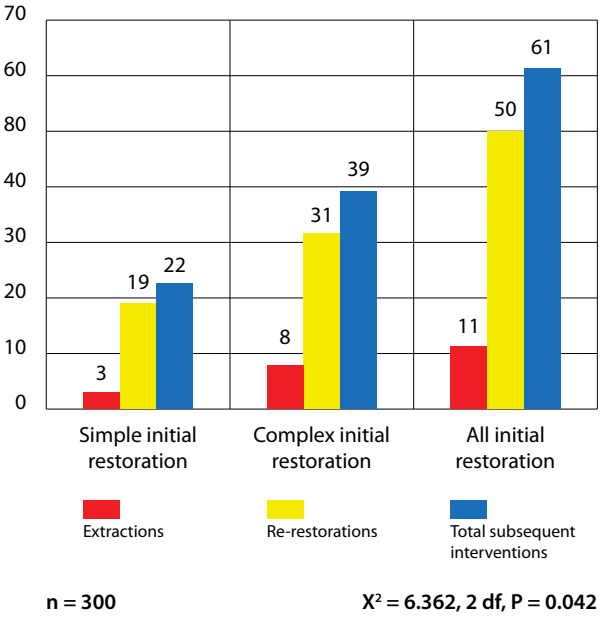


FIG. 1 Frequency of failure of initial restoration by complexity of restoration showing subsequent intervention type.

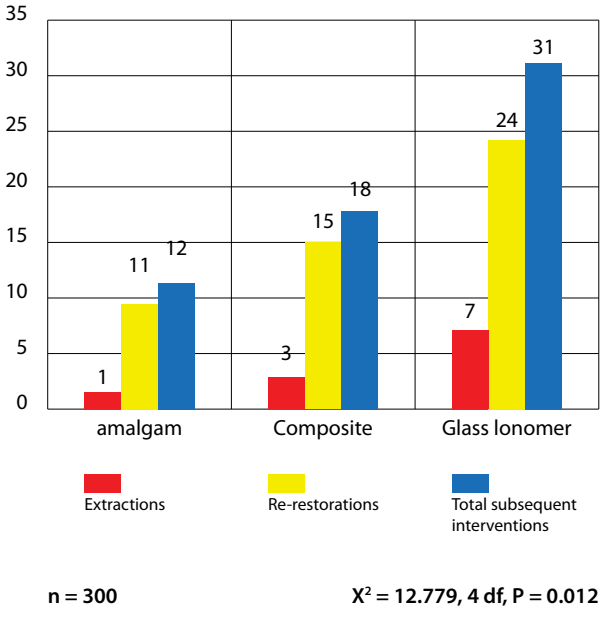


FIG. 2 Frequency of failure of initial restoration by restorative material used, showing subsequent intervention type.

simple and complex restorations were significant (P = 0.042).

The relationship between the initial restoration material used and the outcomes for the primary molars in the sample are represented in Figure 2. Twelve of the 100 primary molars initially restored with amalgam were re-restored. One was extracted. Of the 100 teeth restored with composite resin, 15 were subsequently re-restored and 3 extracted. The teeth that had been initially restored with glass ionomer showed higher rates of failure compared to either amalgam or composite resin. With regard to overall outcomes in this study, teeth restored with amalgam accounted for 19.7% of the 61 failures, composite for 29.5% while teeth that had been restored with glass ionomer represented 50.8% of all restoration failures. The differences in outcomes for the three materials were significant (P = 0.012).

Discussion

The consequences of leaving primary teeth untreated in young children include pain, sepsis, early loss of teeth and increased orthodontic need with space loss. Failure to thrive, disruption to quality of life and intellectual development, higher need for emergency visit and need for general anaesthetic have also been reported [Sheiham, 2006].

Previous studies have looked at survival of restorations, assessment of need, impact of dental caries on the child [Shepherd et al., 1999], but there has been less emphasis on the study of interventions and outcomes of restored primary teeth.

It has been recognised that experienced clinicians routinely make judgment on whether or not a carious lesion in a primary tooth merits intervention based on factors such as the extent of the lesions, the levels of caries activity, the ability of a child to accept treatment and take account of the individual clinical presentation [Tickle et al., 2002]. That work further suggested that two discrete groups of carious primary teeth may need to be considered: those that did not require any restoration and those where restoration was indicated.

The objective of appropriate restoration of carious primary teeth is to protect the underlying pulp and help to preserve the remaining tooth structure until natural exfoliation. Reporting on the findings of a multivariate analysis of a large cohort of primary molar teeth, Stephenson et al. [2010] found that treatment was significantly associated with survival with respect to extraction [Stephenson et al., 2010]. These authors also reported that demographic and other tooth level variables had limited effect on survival.

The findings from analysis of the Scottish Health Boards' data also support restoration of carious primary teeth to protect the pulp, prevent damage from caries and reduce the risk of sepsis [Pine et al., 2006].

As the present study included only teeth that had been restored by intracoronal restoration, and the

outcome measure was the subsequent occurrence of any intervention prior to the natural exfoliation stage, comparison with unrestored carious teeth is not possible.

In relation to the first objective of the present study, Table 1 shows that the sample included smaller numbers of first primary molar teeth compared to second primary molars. This observation must be interpreted within the context of the present study which included only primary teeth that had actually been restored. It is widely accepted that first primary molars are more at risk from proximal caries and extensive lesions as a result of their smaller size. The non-restorative management of such teeth was outside the scope of the present study.

The second objective was to examine the relationship between the original restoration complexity and the restoration failure. It has been established that primary teeth with proximal caries are likely to have pulpal inflammation at an early stage [Duggal et al., 2002]. In addition it has been demonstrated that teeth with proximal caries have much more pulpal inflammation than teeth with occlusal caries of comparable depth [Kassa et al., 2009]. In the present study it can be seen that teeth with an initial single-surface restoration had a lower rate of restoration failure than those with an initial multi-surface restoration. Figure 1 shows the distribution of restoration failures according to complexity of the initial restoration. Teeth initially restored with complex restorations had significantly higher levels of restoration failure than teeth with simple restorations.

Outcomes relating to the 3rd objective of this study are represented in Figure 2. The differences in outcomes for teeth restored with amalgam, composite or glass ionomer are presented. Failure rates for primary molar teeth restored with amalgam were lower than those found in teeth where composite or glass ionomer cement had been used as the initial restorative material. These differences were significant. With failures of restorations of the amalgam group representing less than 20% of all restoration failures, the findings in this study support the position that amalgam performs well in terms of efficacy. As with any dental restorative material, the benefits of amalgam should be considered against any potential health risks. A comparative health risk evaluation of amalgam and resin based restorative materials was presented at the 2013 UN Minamata Convention [Erdal and Orris, 2012]. That work supported the WHO position in advocating a phase down of dental amalgam [Petersen et al., 2009] but also highlights the need for improvements in the quality of alternative materials. Countries where low levels of dental disease have been achieved have had very limited use of amalgam for over a decade now and amalgam is now banned in Norway [Skjelvik, 2012]. This further supports the need for effective dental disease prevention programmes. The findings of this study appear to be consistent with the established global position. The need for development in dental school teaching in relation to the phase down of amalgam has been identified [Lynch and Wilson, 2013a]. In common with all undergraduate teaching programmes, encouraging students to make balanced and informed decisions with regard to their choice of treatment in the best interest of their patients is a priority for Cork University Dental School and Hospital. In a subsequent work, these authors [Lynch and Wilson, 2013b] reviewed findings from Norway where amalgam has already been phased down. An increased incidence of allergic reactions to components of resin based materials is reported. Lynch and Wilson cite the Norwegian dentists' assessment that the newer materials were 'as safe as amalgam'. Clearly all currently available materials have their drawbacks and effective prevention is the optimal way forward. It is likely that factors including the environmental concerns, public concern over potential health risks, poor aesthetics and a need for extensive tooth preparation, will converge to ensure that amalgam usage will be discontinued in the near future.

It is worth noting that the vast majority of restored teeth reached the end of the programme without any requirement for further intervention. Only a relatively small proportion of teeth (20.3%) had a subsequent intervention. This is presented as failure of the initial restoration in the context of this study where the absence of a need to intervene again is the intended outcome. Most of the subsequent interventions were re-restorations and only 3.7% of the 300 restored teeth studied required extraction. The low level of failure is likely to be in part attributable to this methodology which represents a balanced and pragmatic approach to maintenance of the primary dentition.

This work reports the findings of a study of outcomes for intracoronally restored primary molar teeth in children. It is recognised that other factors may influence the outcomes for restored teeth, an independent large scale study and multivariate analysis would be necessary to make valid comparisons between efficacy of filling materials and restoration types. With the progressive phase down of amalgam, the value of such a work would be in comparing performance and safety of the newer materials in primary teeth.

Conclusions

In the current study the majority (79.7%) of restorations in primary teeth were successful in maintaining the tooth without further intervention. In those cases where restorations failed, only 3.7% of the 300 restored teeth were extracted.

Teeth that had been the subject of complex

restorations, involving more than one surface, had almost twice the restoration failure rate of simple single surface restorations. The difference was significant.

Significant differences in failure rates for each of the three dental materials studied were recorded. Amalgam had the lowest failure rate while the failure rate where glass ionomer had been used was the highest.

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