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Clinical performance of resin-bonded composite strip crowns in primary incisors: a retrospective study

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Summary. *Aim.* The purpose of this study was to assess retrospectively the longevity of resin-bonded composite strip crowns placed in primary maxillary incisors.

Design. Records for 200 out of 387 children, aged 22–48 months, treated in a private paediatric dental practice and who presented for follow-up after at least 24 months were included in the study. The parameters recorded at baseline and/or at follow-up were: habits, the number and location of the decayed surfaces, colour, texture, and chipping of the restoration. Radiographic evaluation of the restorations, the quality of the margins, and the presence of pulpal and/or periapical pathoses were recorded.

Results. More than 80% of the restorations were judged to be successful at the final follow-up examination. Only the number of carious surfaces of the tooth at baseline influenced the treatment outcome. The failure rate was higher in central incisors with four affected surfaces ($P = 0{\cdot}005$), and in lateral incisors with four carious surfaces ($P = 0{\cdot}0003$), than in those presenting one or two carious surfaces in both central and lateral incisors ($P = 0{\cdot}002$).

Conclusion. The high success rate of resin-bonded composite strip crowns with a 2-year follow-up seen in this study suggests that this treatment modality is an aesthetic and satisfactory means of restoring carious primary incisors in young children. The retention rate is lower in teeth with decay in three or more surfaces, particularly in children with a high caries risk.

Introduction

Full coronal restoration of carious primary incisors is indicated when: (1) caries is present on multiple surfaces; (2) the incisal edge is involved; (3) there is extensive cervical decalcification; (4) pulpal therapy is indicated; (5) caries may be minor, but oral hygiene is very poor (high-risk patients); or (6) the child's disruptive behaviour makes placing Class III restorations difficult [1].

Patients with early childhood caries have a greater predisposition for developing new and recurrent caries. For example, it has been demonstrated that children who were treated under general anaesthesia and who were likely to have high levels of disease showed significantly higher subsequent caries rates than a control group who were initially caries-free [2].

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The use of composite strip crowns to restore primary incisors is very popular in some countries, and better aesthetics can be achieved with this than any other kind of restoration [3].

Resin-bonded composite strip crowns are the first choice restoration for many clinicians, mainly because of the superior aesthetics and the ease of repair if the crown subsequently chips or fractures. However, it is the most technique-sensitive option. Moisture contamination with blood or saliva may interfere with the bond, and haemorrhage can alter the shade or colour of the material. Additionally, adequate tooth structure must remain after caries removal to ensure that there is sufficient surface area for bonding [4].

Very few data exist in the literature on the longevity of these restorations in a clinical setting. Moreover, few clinical treatment outcomes have been assessed to determine whether this technique is indeed successful.

Therefore, the purpose of this study was to assess retrospectively the longevity of resin-bonded composite strip crowns placed in primary maxillary incisors in a private paediatric dental practice.

Table 1. Preoperative and follow-up clinical parameters.

Preoperative and immediately after treatment		At last follow-up	
Habit:	No habits Nursing at night	Habit:	Persistence of the habits Non-persistence of the habits
Caries:	Number of decayed surfaces Location of decayed surfaces	Caries:	Number of decayed surfaces Location of decayed surfaces
Behaviour:	Cooperative Uncooperative	Chipping:	Yes No
Colour:	Acceptable Unacceptable	Colour:	Acceptable Unacceptable
Texture:	Smooth Pitted		

Materials and methods

Data were derived from the files of 387 children, aged 22–48 months, who had received treatment in a private paediatric dental practice between 1 January 1994 and 1 January 1998. These children had at least one carious maxillary incisor restored with a composite strip crown. Records of children who had been followed up after more than 24 months were selected from the total, and the first 200 of these patients, selected in alphabetical order, were retrieved and used for the study. Of these 200 cases, 103 were boys (51·5%) and 97 were girls (48·5%). The baseline parameters (before and immediately after treatment) which were obtained from the clinical records are summarized in Table 1.

The numbers of carious surfaces present before treatment as well as the location of decayed surfaces in the treated tooth were recorded: (only one) mesial, distal, buccal or palatal; (two) mesial or distal with buccal or palatal; and (more than two) mesial, distal, and buccal or palatal.

The colour immediately after completion of the procedure was defined as acceptable when it was a perfect match or unacceptable when there was a slight difference.

Radiographic evaluation of the restorations was carried out separately by both authors, and the quality of the margins and the presence of pulpal and/or periapical pathoses were recorded. When there was a disagreement in the assessment, the two examiners reviewed the radiograph and a consensus was reached.

Treatment procedures

All the parents were present in the operating theatre during treatment, and no Papoose Board was used; when necessary, the parents helped to restrain their children physically by holding their hands and/or legs. All children were sedated with hydroxyzine and nitrous oxide, and treatment was carried by the principal author (D.R.). All cases received a local anaesthetic (conventional buccal infiltration), and treatment was carried out under a rubber dam. The teeth were restored with Single Bond and Z100 using strip crowns (all by 3M ESPE Dental Products, Seefeld, Germany).

Clinical and radiographic success over time was established for each restored tooth according to the criteria mentioned above. The crown was considered to be successful if the surface appeared smooth, without chipping or caries, the colour remained good or acceptable, and radiographically, the margins were properly adapted, without overhangs, and there was no pulpal or periapical pathosis.

Data were analysed using a two-way analysis of variance, Student's *t*-test, the McNemar test and the NPar test. Significance was set at $P < 0{\cdot}05$.

Results

One hundred and seventy-nine children (90%) were cooperative during treatment (even if some crying occurred, they did not move, and the treatment was not disrupted), while 21 (10%) were uncooperative (movement made the restorative procedure difficult). However, no treatment was aborted, and all the planned treatments were completed.

The total number of decayed surfaces present at baseline (before treatment) ranged between one and 36 (mean ± standard deviation = 13·34 ± 7·55); 12% of the incisors had three or more carious surfaces, 66% had two affected surfaces, and 22% had only one carious surface (Table 2).

Table 2. Treated incisors by site and number of caries surfaces.

Site of caries	Lateral incisors (n = 241)	Central incisors (n = 390)	Total incisors (n = 631)	Total percentage
Mesial, distal, buccal or palatal	79	58	137	22%
Mesial and distal	143	278	421	66%
Mesial, distal, and buccal or palatal	19	54	73	12%

Table 3. Number of treated teeth and follow-up time.

	Follow-up time			
Variable	24–32 months	33–40 months	41–74 months	Total
Number of children	127	58	15	200
Number of treated teeth:				
central incisors	252	108	30	390
lateral incisors	164	67	10	241

Table 4. Chipping and caries in central and lateral incisors.

	Central incisors (n = 390)		Lateral incisors (n = 241)	
Variable	Number	Percentage	Number	Percentage
Chipping	42	11%	18	7·5%
Caries	43	11%	38	15%

One hundred and ten children (55%) had four incisors restored with strip crowns, 13 children (6·5%) had three of these crowns, 73 (36·5%) had two incisors treated and four (2%) had only one incisor restored.

Since no statistically significant difference was observed between boys and girls for any of the parameters examined, the data were pooled and are presented together.

Thus, the data of 631 resin-bonded composite strip crowns placed in 390 maxillary central incisors and 241 maxillary lateral incisors belonging to 200 children, who were followed up between 24 and 74 months after treatment, are presented in this preliminary report (Table 3).

More than 80% of the restorations were successful at the final follow-up examination.

Forty-two central incisors (11%) and 18 lateral incisors (7·5%) presented chipping, and caries was found in 43 central incisors (11%) and 38 lateral incisors (15%) ($P > 0{\cdot}05$) (Table 4).

The mean number of actively decayed surfaces present at the follow-up examination (at least 2 years after treatment) was 3·48 (range = 0–18), a decrease from a mean of 13·34 at baseline (range = 1–36).

The colour and texture of the restorations remained either good or acceptable (Fig. 1a), with no pitting or discoloration that compromised the aesthetic results in 96% of the central incisors and 98% of the lateral incisors.

Similarly to the other parameters, the child's behaviour had no influence on the clinical and radiographic findings ($P > 0{\cdot}05$).

Of all the parameters evaluated, only the number of carious surfaces of the tooth at baseline influenced the treatment outcome. Thus, the failure rate was higher in central incisors, with four affected surfaces ($P = 0{\cdot}005$), and in lateral incisors, with four carious surfaces ($P = 0{\cdot}0003$), than in those presenting one or two carious surfaces, both in the central and lateral incisors ($P = 0{\cdot}002$).

At the baseline visit, prior to the restorative treatment, 121 children (60·5%) used to sleep with a nursing bottle containing a sweet beverage (juice or milk) while 79 children (39·5%) did not have this habit. One year after treatment, only three (5%) children persisted with a nursing bottle habit, while 190 (95%) had no habit.

Follow-up radiographic assessment revealed good marginal adaptation of the resin and a healthy periodontal ligament (Fig. 1b) without any pulpal nor periapical pathosis in 378 (96%) central incisors and 238 (98%) lateral incisors. Twelve central incisors and three lateral incisors presented with periapical involvement and endodontic treatment was provided.

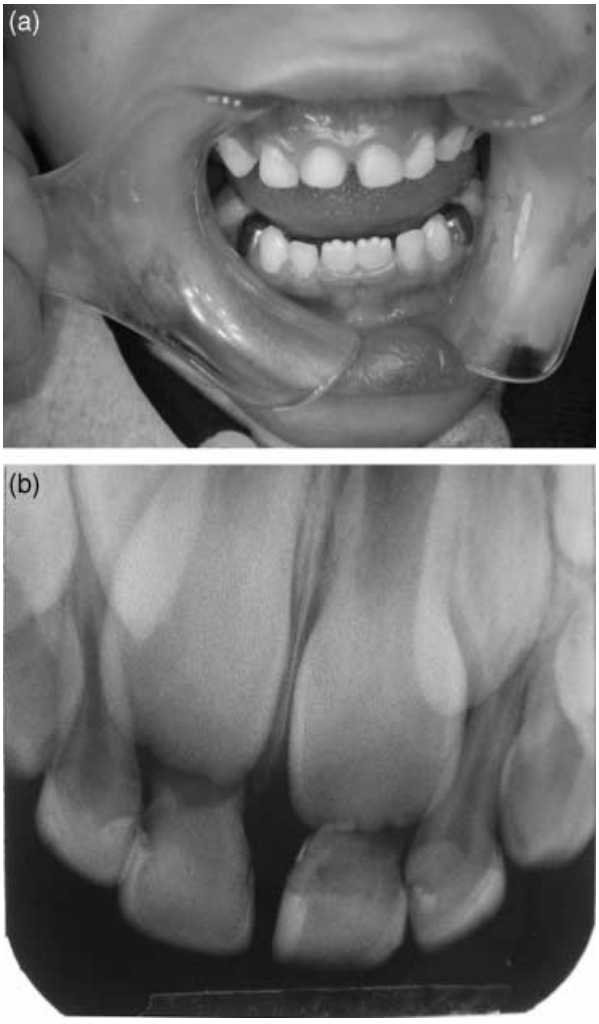

Fig. 1. (a) Clinical appearance of four strip crowns at follow-up after 52 months. (b) Radiographic examination of the same crowns at follow-up after 52 months.

Discussion

The scarcity of controlled studies assessing restorations in primary incisors has been identified in a literature review by Lee [3] and in a position paper by Waggoner presented at the Pediatric Restorative Dentistry Consensus Conference, Texas, USA, April 2002 [4]. The latter author pointed out that most clinicians believe that the method they use to restore primary incisors is best, but in reality, there is little scientific evidence to support these claims [4]. Waggoner described the difficulty of designing clinical studies to evaluate restorative options for primary incisors. Children who exhibit caries in the primary incisors are usually very young, lack cognitive abilities, and often have to have treatment carried out under sedation or general anaesthesia; thus, few clinicians would consider providing these young children with any form of 'experimental' treatment, where failure of a restoration could result in a problem for replacement. Waggoner also pointed out that, for a study of this type to be valid, the behaviour of the children should be similar when the restorations are placed, which may limit its use in children having treatment under general anaesthesia [4].

Retrospective studies have the disadvantage that the data are usually obtained from charts and frequently do not follow a standardized protocol. Conversely, these studies are closer to the 'real life' findings than prospective studies, and can be useful, particularly when prospective clinical trials are difficult to implement. A recent retrospective study utilized radiographic and photographic evaluations of 112 restorations placed in 40 children [6]. Photographic evaluation can be more objective than data from charts, but it was not possible in this study.

The success rate of strip crowns in this study (80%) was better than that described by Tate *et al*. [7], and similar to that reported by Kupietzky *et al*. [6] (88%), if we take the longer follow-up time and the larger study sample into consideration. As described above, only crowns with more than 2 years of service were included in this report, and some of them had been in place for 4 or 5 years. These figures might also be related to the type of practice and to the socioeconomic level of the parents. Most of these parents were highly motivated, and were willing to bring their children for check-ups after 3–6 months as well as for periodical fluoride applications. These factors might have influenced both the decrease in the number of children who continued with the nocturnal nursing habit and the decline in the number of new carious lesions found in the follow-up examinations.

Patient management is critical to success. In this study, the children's uncooperative behaviour had no effect on the treatment outcome. There was also a high success rate that might be attributed to the fact that the operator is an experienced paediatric dentist, and not just to the use of sedation. Eidelman *et al*. [5] reported better results for strip crowns placed by graduate students under general anaesthesia than for those done under sedation.

As described above, the number of carious surfaces of the tooth at baseline was the only parameter that influenced the treatment outcome. Thus, the failure rate was higher in central incisors with four affected surfaces ($P = 0{\cdot}005$), and in lateral incisors

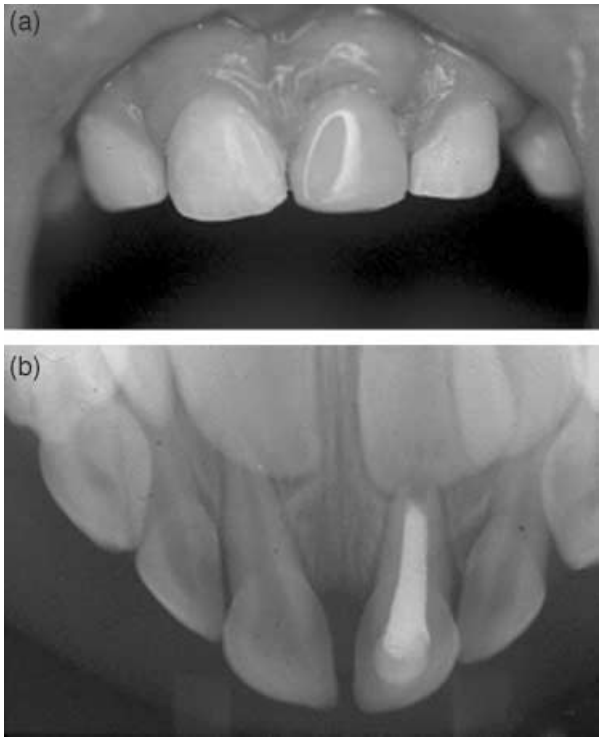

Fig. 2. (a) Unacceptable aesthetic result observed in an endodontically treated incisor. (b) Radiographic appearance of a root-treated incisor.

Fig. 3. Acceptable colour of restorations presenting caries in the gingival margin (arrows).

with four carious surfaces ($P = 0{\cdot}0003$), than in those presenting with one or two carious surfaces in both the central and lateral incisors ($P = 0{\cdot}002$). The longevity of the crown is likely to be jeopardized if a considerable amount of tooth structure is missing, since the composite crown relies on dentin and enamel adhesion for retention [3]. Nor *et al*. [8] found that the dentine of primary teeth is more reactive to acid than that of the permanent teeth. These authors also reported lower bond strength in the primary teeth, and attributed this finding to a thicker hybrid layer that is not completely penetrated by the bonding agent. They recommended using a shorter etching time for primary dentine to reproduce the hybrid layer seen in etched permanent dentine. Based on this recommendation, Araujo *et al*. [9], using scanning electron microscopy, reported the formation of a resin-reinforced hybrid layer in primary teeth when utilizing a 15-s etching time. Although these were *in vitro* findings, it might be worth while using a 15-s etching time when placing composite strip crowns in multisurface decayed primary incisors.

As described by Kupietzky *et al*. [6], unacceptable aesthetic results were observed in this study in teeth which had been endodontically treated (Fig. 2a,b). The colour was still acceptable for vital teeth, even when the restorations were chipped or caries was present in the gingival margin (Fig. 3). Endoflas (Sanlor Laboratories, Bogota, Colombia), an iodoform containing paste that is extensively used in Israel and was also employed in this report, has the disadvantage of badly discolouring root-treated teeth. Endodontic treatment was carried out only after disclosure of periapical lesions on radiographs at follow-up since only teeth without signs of pulp involvement at baseline were included in the evaluation. The principal author (D.R.) routinely adopts a policy of a very careful caries removal so as to prevent mechanical pulp exposure and utilizes an indirect pulp treatment whenever possible. The high percentage of pulpal health observed in this study (97%) surpasses that described by Kupietzky *et al*. [6] (91%) and reinforces these authors' conclusions that resin-bonded composite strip crowns can be a durable and aesthetic restoration for vital carious primary incisors.

What this paper adds

- This paper adds knowledge about the clinical outcome of strip crowns after more than two years of follow up.
- The results prove that aesthetic treatment could be performed with great success in clinical conditions.
- The paper remarks the importance of recall visits and bottle weaning, oral hygiene and fluoride in order to improve the success of the crowns.

Why this paper is important for paediatric dentists

- It is important for paediatric dentists because it proves that a long-term and high success can be achieved in this kind of restorations if habits are changed and parents are active partners.

Conclusion

The high success rate of resin-bonded composite strip crowns with a long-term follow-up time observed in this study suggests that this treatment modality is an aesthetic and satisfactory means of restoring decayed primary incisors in young children.

The retention rate is lower in teeth with decay in three or more surfaces, particularly in children with a high caries risk.

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