

Restorative material choices for extensive carious lesions and hypomineralisation defects in children: a questionnaire survey among Finnish dentists



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Abstract

Aim This survey assessed Finnish dentists' treatment decisions and choices of restorative materials in selected paediatric dental patient cases, with special emphasis on stainless steel crowns (SSCs).

Methods A questionnaire with patient descriptions and tooth photographs was e-mailed to members of Finnish Dental Society (n=3,747). The respondents were asked to choose their preferred treatment in cases describing 1) extensive occlusal carious lesion in a primary molar of a cooperative child; 2) an identical lesion, treated under dental general anaesthesia (DGA); and 3) a symptomatic first permanent molar with enamel hypomineralisation (consistent with Molar-Incisor Hypomineralization, MIH) and post-eruptive breakdown. Only responses from dentist treating children were included (final n=765).

Results The majority (47.3%) would have preferred restoration of the extensive primary tooth caries in a normal setting using resin-modified glassionomer cement, and 4.3% by using SSC. The preference of SSC as treatment choice increased to 25.4% upon implementation of DGA. The majority would treat the symptomatic permanent MIH molar with a resin composite restoration (45.0%), while 10.5% suggested SSC. Compared to general dentists, paediatric dentists had a stronger preference for SSCs.

Conclusions Although the respondents emphasised patient cooperation, but also tooth prognosis and material strength behind their treatment decisions, SSC was an uncommon choice.

KEYWORDS Dental caries; Dental developmental defects; MIH; Hypomineralization; Dental treatment; Restorative options; treatment decision.

Introduction

Despite the declining dental caries rates during the last decades, tooth restorations still account for a significant share of dental treatments [Widstrom et al., 2015]. In addition, certain developmental defects of enamel (DDE) require restorative care. Several different treatment options and materials are available, and typically patient- and tooth-related factors determine the optimum choice in each case. In addition, the dentist's own experience and skills may influence the choice of treatment.

Stainless steel crowns (SSC) have long been available as a treatment option and they still constitute a feasible choice to restore primary teeth with extensive caries and after pulpotomy [Innes et al., 2015; Seale and Randall, 2015]. This choice is supported by a recently published Finnish Current Care

Guideline for tooth restoration [Tooth restoration: Current Care Guidelines, 2018]. However, a recent study indicates that in Finland SSCs are predominantly adopted by specialised dentists or during dental general anaesthesia (DGA) [Tseevenjav et al., 2018]. A questionnaire study from Norway found that only 0.4% of dentists working in the public sector would choose SSC as a primary option for extensive primary tooth caries and 7.2% would choose SSC when treating the same patient under DGA [Uhlen et al., 2019]. In comparison, in a German questionnaire study, 34% of the dentists reported using SSCs routinely in their daily practice [Santamaria et al., 2018]. The most common type of DDE is Molar-Incisor Hypomineralization (MIH), where first permanent molars (FPMs) and frequently also permanent incisors contain areas of enamel with reduced mineral content [Weerheijm et al., 2001]. In severe cases, the enamel is broken, and the tooth is prone to piercing and decay. The global prevalence of MIH is estimated at 12.9% [Schwendicke et al., 2019]. Of children with MIH, the proportion of those in need of care, i.e. with symptoms or post-eruption breakdown, is calculated to be 27.4% [Schwendicke et al., 2018].

Evidence supporting the optimal method of managing severely affected MIH teeth is limited [Elhennawy and Schwendicke, 2016]. Full coronal coverage with SSCs of severely affected FPMs can be performed with promising survival rates [Kotsanos et al., 2005; Zagdwon et al., 2003], albeit it is less studied than the use of SSCs in primary molars. However, SSCs may pose a risk for gingival health [Belduz Kara and Yilmaz, 2014]. SSCs in permanent teeth are mainly used as a temporary solution until the permanent treatment can be performed. It has been estimated that SSCs may not be the most cost-effective method to treat MIH-affected teeth [Elhennawy et al., 2017a]. According to the current understanding, SSCs are underused among Finnish dentists.

The present study aims to assess the treatment practices of Finnish dentists using a patient case-based questionnaire. The study hypothesises that among Finnish dentists, SSCs are not the first choice for treating primary tooth caries or MIH. Further, the factors that may affect treatment decisions are evaluated.

Methods

Questionnaire

This is a part of a collaborative questionnaire study of

		N	%
Child patients (< 18 yr)	Full-time	101	13.2
	Weekly	374	48.9
	Occasionally	290	37.9
Gender	Female	618	80.8
	Male	147	19.2
Age, yr	< 30	81	10.6
	30–39	173	22.6
	40–49	134	17.5
	50–59	253	33.1
	60 or older	124	16.2
Region	Åland	2	0.3
	West Finland	170	22.2
	Helsinki Uusimaa area (HU)	224	29.3
	South Finland	149	19.5
	North & East Finland	220	28.8
Year of graduation	Before 1970	16	2.1
	1970–1979	20	2.6
	1980–1989	238	31.1
	1990–1999	180	23.5
	2000–2009	84	11.0
	2010 or later	227	29.7
Country of graduation	Finland	707	92.4
	Other Nordic countries	17	2.2
	Outside Nordic countries	41	5.4
Main occupation sector	Public	578	75.6
	Other (private, university)	187	24.4
Specialty	No	708	92.5
	Paediatric dentistry	10	1.3
	Other specialty	47	6.1
DGA treatments	No	647	84.6
	Yes	118	15.4

TABLE 1 The background characteristics of the dentists who participated in the survey.

Norwegian and Finnish dentists. In February 2019, all active members of the Finnish Dental Society Apollonia, a total of 3,840 dentists, were invited by e-mail to participate in the survey. This covers the majority of Finnish dentists. The survey was conducted using an electronic questionnaire tool Questback Essential (Questback). The questionnaire was translated into Finnish from the original Norwegian version [Uhlen et al., 2019] and then translated into English to ensure equivalent content. The questionnaire was piloted with 10 Finnish dentists and slightly modified considering local circumstances. One reminder was sent two weeks after the first invitation e-mail.

The questionnaire was anonymous and included, as in the Norwegian questionnaire, the following items.

- Questions about clinical work status (Yes/No) and whether the respondent provided basic dental care for children or adolescents. Further questions were limited to those who responded positively to both.
- Background information: Year and country of graduation, age, gender, region of Finland divided into five areas [Nomenclature of territorial units for statistics, 2018], specialisation, and whether the respondent treats patients under dental general anaesthesia (DGA).
- The frequency of recognising DDE in patients, categorised as MIH, dental fluorosis or other: the options were 'Often (weekly or monthly)' or 'Seldom/ Never'.
- Treatment practices were evaluated with three patient cases (Case 1a, 1b, and 2). Each case included a brief description

of a patient and a photograph of a tooth (Fig. 1). Case 1a described a 6-year-old child with normal occlusion and asymptomatic, deep occlusal caries with no progression to pulp in the lower right second primary molar. Case 1b described a similar patient, but the treatment was to be conducted under DGA due to extensive treatment need and lack of cooperation. Case 2 described a 9-year-old child with symptomatic enamel hypomineralisation and post-eruptive breakdown in the lower right FPM. No radiographs were presented. The respondents were asked how they would manage the case. The alternatives included no treatment, treatment, or referral to dentist/specialist. Treatment was further defined by selecting from different material options (resin composite RS, conventional glass ionomer cement GIC, resin-modified glass ionomer cement RMGIC, polyacid modified resin composite or compomer PAMRC, zinc oxide eugenol ZOE, stainless-steel crown SSC) or tooth extraction. Furthermore, the respondents were asked to assess the relevance of the following factors impacting each treatment decision with a 1 (not important) to 7 (very important) according to Likert scale: aesthetics, patient cooperation, experience, available time, available materials, tooth prognosis, and the number of affected teeth.

Statistical analysis

Statistical analyses were conducted using IBM SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Analyses included descriptive statistics of respondent background variables and treatment choices. The associations between background variables and treatment choices were tested with the Pearson Chi-Square test or the Fisher's exact test. In case of ordinal variables, the Mann-Whitney U-test was used. The relevance of the factors impacting the treatment decision was calculated using Likert scale median and interquartile range (IQR). The statistical significance level was set at $p=0.05$ (two-tailed).

Ethical consideration

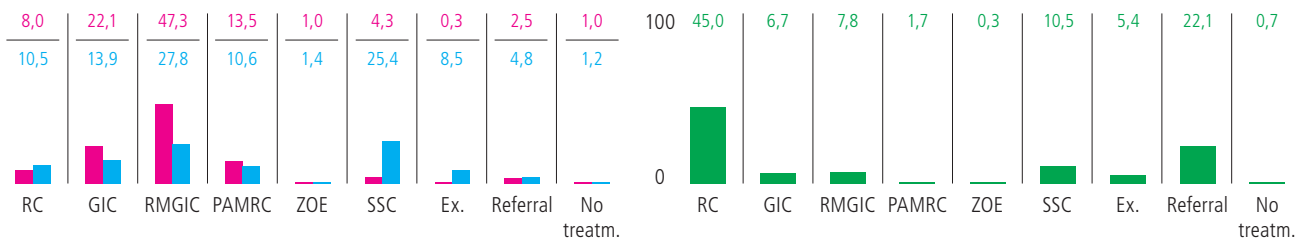
The study participation was voluntary, and no compensation was provided to the respondents. No personal information was gathered, and the anonymity was assured with Questback. The Norwegian Social Science Data Services had approved the original study design.

Results

Of 3,836 (authors excluded) dentist members of the Finnish Dental Society Apollonia, 89 were not reached by e-mail. Thus, a link to the questionnaire was sent to 3,747 dentists. A total of 1,022 dentists replied to the questionnaire, which corresponds to a response rate of 27.2%. After exclusion of those who did not do clinical work ($n=68$), those who did not treat children ($n=168$) and respondents from abroad ($n=2$), the number of participants was 766. Moreover, one response lacked all the case answers probably due to technical problems and was excluded. Therefore, the final number of participants was 765 (20.4%).

Background characteristics of the participants are presented in Table 1. A small number of participants were specialized dentists, 7.4%, and the main specialization fields were the following: prosthodontics 21.1% ($n=12$), paediatric dentistry 17.5% ($n=10$), orthodontics 17.5% ($n=10$), periodontics 15.8% ($n=9$) and cariology / endodontics 12.3% ($n=7$).

MIH was the most often observed DDE, as 69.4% ($n=531$)



RC: Resin composite, GIC: Glass ionomer cement, RMGIC: Resin-modified glass ionomer cement, PAMRC: Compomer, ZOE: Zinc oxide eugenol (IRM), SSC: Stainless-steel crown, Ex.: Extraction, Referral: Referral forward to another dentist or specialized dentist, No treatm.: No treatment



CASE 1 A A 6-year-old child with deep caries on tooth 85. No history of symptoms. No previous operative treatment, pulp is not involved. Normal occlusion and good cooperation. How would you like to treat this tooth? N=765

CASE 1 B A 6-year-old boy is being treated under general anesthesia due to large treatment need and poor co-operation. No history of symptoms on tooth 85 with deep caries. Pulp is not involved. Normal occlusion. How would you treat this tooth? N=765

FIG. 1



CASE 2 A 9-year-old girl with hypomineralisation and post-eruptive breakdown on tooth 46. She complains about discomfort and hypersensitivity. Good oral hygiene, normal occlusion. How would you like to treat this tooth? N=765

Photographs [from Uhlen et al., 2019] are reproduced under the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>).

of the participating dentists reported to recognise MIH frequently (weekly, monthly). Other mineralisation defects were recognised often by 39.5% (n=302) and dental fluorosis by 32.4% (n=248) of the respondents. Those working in the public sector were significantly more likely to recognise MIH frequently than those working in the other (private) sector (74.2% vs. 54.5%, p<0.001, Chi-Square test). Moreover, a significantly higher proportion of female dentists in comparison to male dentists reported to recognise MIH frequently (72.2% vs. 57.8%, p=0.001, Chi-Square test). It is to be also noted that a higher proportion of female dentists than of male dentists were employed in the public sector (80.3% vs 55.8%, respectively, p<0.001 Chi-Square test). Moreover, the older and earlier graduated dentists recognised MIH frequently more likely than the younger and most recently graduated dentists (p<0.001, Mann-Whitney U-test, both), which could not be explained by the distribution of the sample.

Figure 1 shows the respondents' treatment choices in each case. In case 1a, nearly all respondents (96.2%, N=736) chose tooth restoration instead of leaving tooth untreated, referring patient forward or extracting the primary molar. GICs, either RMGIC or conventional GIC, accounted for 72.1% of the material choices (n=531). However, this varied between different regions in Finland. GICs were the least popular choice in the Helsinki-Uusimaa (HU) area (59.0%, significantly less than 78.8% in West Finland and 79.6% in North & East Finland, p<0.001 Fisher's exact test) and among dentists graduated in 2000s (56.3%, significantly less than 77.9% of dentists graduated in 1980s, p=0.009 Chi-Square test). GICs were chosen by 74.6% of the general dentists and by 47.5% of the other specialised dentists, but by none of the paediatric dentists (p<0.001 Chi-Square test). Instead, paediatric dentists had a clear preference for SSC compared to general dentists (40.0% vs 3.6% respectively, p<0.001 Fisher's exact test). Overall, SSC was chosen by 33 dentists, which accounts for 4.5% of the material choices. Most of them would excavate/prepare the tooth before placing the SSC (84.8%). Only three respondents (9.1%) would not excavate/prepare tooth before placing SSC (Hall technique). Two respondents (6.1%) did not know which technique they would adopt with SSC in this case. Moreover, the younger and more recently graduated dentists

chose SSC more likely than the older and earlier graduated dentists (p=0.000 and p=0.001, respectively, Mann-Whitney U-test).

In case 1b, where the patient with an extensively decayed primary molar was treated under DGA, 85.5% of the respondents would restore the tooth (n=654). Nearly one third of them (29.7%, n=194) chose SSC and it was the most popular material option in this case. When asked how they would use SSC, 87.1% (n= 169) reported to excavate / prepare the tooth before placing the SSC. The Hall technique would be used by 5.7% (n=11) and 7.2% (n=14) did not know how they would use SSC. Again, paediatric dentists clearly preferred SSC compared to general or other specialised dentists (80.0% vs 29.0% and 27.0%, respectively, p=0.002 Chi-Square test). The younger and more recently graduated dentists chose SSC more likely than older and earlier graduated dentists (p=0.000 both, Mann-Whitney U-test). Regional differences were seen, such that in West Finland SSC was chosen by 18.0% of the respondents, which was significantly less common than in South Finland and in North and East Finland, where SSC was chosen by 36.7% and 33.0%, respectively (p=0.005 Fisher's exact test). Moreover, those working mainly in the public sector had a clear preference for SSC compared to those working mainly in the private sector (33.9% vs 16.1% respectively, p<0.001 Chi-Square test).

In case 2, 550 study participants (71.9%) chose to restore the symptomatic, severely hypomineralised FPM. Among them, RC was the most preferred material (62.5%, n=344). SSC was chosen by 80 respondents, which accounts for 14.5% of the material choices. Of them, 56.3% (n=45) would prepare the tooth before placing the SSC. Less than one third (28.8%, n=23) would not prepare the tooth and 15.0% (n=12) did not know how they would use SSC in this case. Paediatric dentists and other specialised dentists had a clear preference for SSC compared to general dentists (75.0% and 45.2% vs 11.7% respectively, p<0.001 Fisher's exact test). Like in cases 1a and 1b, the younger dentists chose SSC more likely than the older dentists (p=0.003, Mann-Whitney U-test). Regional differences were seen in treatment decisions, so that in the HU area, 34.8% of the dentists would refer the MIH patient, compared to 15.9%–17.4% of the dentists from other areas in mainland

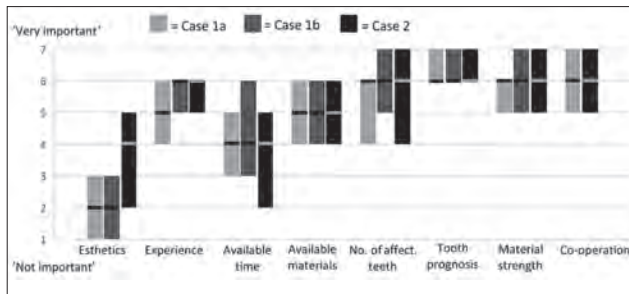


FIG. 2 Relevance of different factors affecting treatment decisions.

Finland ($p < 0.001$ Fisher's exact test). Moreover, women were more likely to refer the MIH patient than men (24.3% vs 12.9% respectively, $p = 0.006$ Fisher's exact test).

The relevance of different factors affecting treatment decisions

The relevance of different factors affecting treatment decisions are shown in Figure 2. In case 1b, co-operation was not considered because the treatment was conducted under DGA. In cases 1a and 1b, which both described the patient with primary molar caries, esthetics was rated the least important factor affecting the treatment decision (median 2, IQR 2). In case 2, which described hypomineralised FPM, aesthetics and available time (median 4, IQR 3, both) were the least important factors, but were ranked 'neutral' (in the middle of the Likert-scale). Tooth prognosis appeared to be the most important factor in all cases (median 6, IQR 1).

Discussion

The results of this survey strengthen the earlier finding that SSCs are not a common choice to manage extensive primary tooth caries or mineralisation defects [Tseveenjav et al., 2018]. However, Finnish dentists seem to adopt SSCs more commonly than Norwegian dentists [Uhlen et al., 2019]. In Finland, new national guidelines were recently published, recommending SSCs for extensively decayed primary teeth [Tooth restoration: Current Care Guidelines, 2018]. This may already have impacted dentists' attitudes toward SSCs. However, in Finland dentists use SSCs less frequently than in Germany, where 34% of the dentists reported to use SSC routinely in their daily practice [Santamaria et al., 2018].

This study included only dentists who meet paediatric patients at least occasionally. In Finland, health care is predominantly publicly funded or subsidised, and dental care is provided free of charge for children under 18 years old in public health centers. Still, some families use private services at their own expense, for which reason participating dentists were not limited to those who work in the public sector. Differences in preferred materials were seen between dentists from the public and private sector. Dentists working mainly in the private sector had a slight preference toward RC, whereas PAMRC and SSCs were more widely used in the public sector.

The study produced responses from both general and specialised dentists, albeit the proportion of specialised dentists was low, 7.4%. This is lower than the overall proportion of specialised dentists in Finland (about 16%), probably because a majority of specialised dentists do not see child and adolescent patients and were not included in the study. However, this study

produced responses from half of the Finnish paediatric dentists, according to the statistics from the Finnish Dental Association [Statistics of Specialized Dentists, 2018]. Nonetheless, treatment practices differed between general and specialised dentists. Paediatric dentists favored SSCs particularly strongly, in line with the results of recent surveys in the United Arab Emirates and the United Kingdom (UK) [Dastouri et al., 2019; Taylor et al., 2019]. Furthermore, according to this study, paediatric dentists do not apply GICs in either extensive primary molar caries or hypomineralised permanent molars.

Over two thirds of the dentists reported to recognise MIH frequently i.e. weekly or monthly. In the Norwegian study, which included only dentists who work in the public sector, nearly all respondents reported recognising MIH frequently [Uhlen et al., 2019]. Similarly, in this study MIH was recognised more frequently in the public sector than in the private sector. A previous study by the authors found prevalence rates that ranged from 8% to 25% in different parts of Finland [Wuollet et al., 2014]. Although no definitive conclusions can be drawn about the prevalence of MIH based on this questionnaire survey, the defect seems to be widely recognised by Finnish dentists.

To date, there is a wide range of alternative treatment options available for MIH teeth. A systematic review reported the lowest failure rates for indirect restorations, SSCs and composite restorations [Elhennawy and Schwendicke, 2016]. However, the authors cautioned that the studies may not be comparable because of heterogenous settings. Thus, the literature does not provide enough evidence for clear management guidelines. According to this survey, among Finnish dentists RC is the most popular material for treating a symptomatic MIH tooth with post-eruptive breakdown. In the Norwegian study, dentists' choices showed more variety, but similarly, RC was the most preferred material for an MIH tooth, followed by GICs [Uhlen et al., 2019]. Although RC is probably the most esthetic material of the given alternatives, esthetics was not rated as an important factor affecting the treatment choice. Tooth prognosis and material strength were rated the most relevant factors. Obviously, dentists consider RC a durable material with a good prognosis. The case patient was nine years old, and RC may also be a temporary choice to restore the tooth before the patient reaches adolescence or adulthood. This study did not provide an option to restore the tooth with indirect restorations such as a ceramic crown, in an effort to keep questions simple and comparable with the Norwegian study. Moreover, amalgam was not an alternative in this survey, since its use in children is restricted in the EU [Regulation (EU) 2017/852 of the European Parliament and of the Council of 17 May 2017 on mercury, 2017].

Among Finnish dentists SSC was a more popular material choice for the MIH tooth than among Norwegian dentists [Uhlen et al., 2019]. SSC appears to be a suitable alternative to restore a permanent tooth temporarily before final treatment. Further research is needed to compare RC and SSC as alternatives to restore MIH teeth. Moreover, the preparation technique requires consideration. An earlier Norwegian study found that dentists prefer minimally-invasive techniques when restoring teeth severely affected by MIH with RC [Kopperud et al., 2016]. Because MIH-affected enamel contains less minerals and more protein than normal enamel and the enamel structure is more irregularly organised [Elhennawy et al., 2017b], its acid-etched patterns are poorer than in normal enamel and result in compromised bonding characteristics [Ekambaram and Yiu, 2016]. The Norwegian authors suggest more traditional preparation for MIH, where RC is bonded to healthy enamel

[Kopperud et al., 2016]. This is supported by the results of a two-year long clinical trial, where RC restorations with conservative cavity preparation (cavity margins reside on hypomineralised enamel resistance to bur), achieved a significantly lower success rate (58.1%) than the RC restorations with more invasive preparation (81.3%, cavity margins are extended to sound enamel) [Sonmez and Saat, 2017]. However, the difference between cavity preparation technique became non-significant when conservatively prepared cavities were treated with 5% sodium hypochlorite. Apparently, deproteinisation of affected enamel with sodium hypochlorite may improve resin adhesive bonding strength [Ekambaram and Yiu, 2016].

Only 5.4% of the participants chose extraction for a symptomatic MIH tooth with post-eruptive breakdown. A recent analysis of cost-effectiveness favored extraction over restoration with RC or SSC for severe MIH molars [Elhennawy et al., 2017a]. However, whether extraction is a suitable treatment depends on multiple patient-related factors, such as co-operation, occlusion and the development stage of the second permanent molar [Cobourne et al., 2014]. Therefore, analyses of cost-effectiveness, where the calculations are based on average estimates, may not apply in every real-life situation. In the MIH case of this survey, the patient had good oral hygiene and occlusion, which is presumably why dentists may have refrained from extraction. However, it can be speculated that in an otherwise intact dentition, a restored FPM with hypomineralisation impacts the overall oral health more than in a dentition with already reduced prognosis due to poor hygiene habits. Therefore, extraction of such tooth would be effective treatment, especially if there is a chance for alignment of adjacent teeth and minimal risk of over-eruption of the opposing teeth. This is, however, more likely for maxillary than mandibular molars [Eichenberger et al., 2015].

Every fifth dentist would refer the MIH patient forward, mainly to a paediatric dentist. Referral rate was significantly higher among dentists from the HU area than the other areas of Finland. This suggests that patients do not possess similar possibilities for dental care across Finland, although specialised dentists are divided rather equally based on population, according to statistics from the Finnish Dental Association [Statistics of Specialized Dentists, 2018]. Documented data shows that regional differences exist for instance in the proportion of children receiving orthodontic care and in adults' perceptions of receiving sufficient oral health services [Finsote Statistics, 2018; Rissanen, 2019]. In this survey, the consultancy practices were not assessed, and it is possible that most of the dentists would discuss the treatment options with colleagues and specialised dentists. Indeed, a United Arab Emirates survey found that only 7.0% of the general dentists would feel confident enough to manage a patient with severely affected MIH molars alone [Dastouri et al., 2019].

According to the present study, SSCs are seldom used among Finnish dentists to restore extensively decayed primary molars, despite the evidence that SSCs exceed other restorative materials in survival rates [Tseveenjav et al., 2018]. Instead, participating dentists favored GICs, both resin-modified and conventional. This is in line with the observational Finnish study from the late 1990s, when GICs were almost exclusively used in primary teeth and SSC had not been adopted [Forss and Widstrom, 2003]. The study setting was different than the current study, but the current findings suggest that the restoration practices in Finland have not markedly changed in two decades. Finnish Current Care Guidelines list GICs as an option to restore primary tooth caries [Tooth restoration: Current Care Guidelines, 2018].

Among the study participants, patient co-operation was rated as an important factor affecting treatment decision, which may be the reason why dentists preferred moisture-resistant and simple-to-use GICs. However, conventional GICs fail in comparison with RMGIC or RC [Toh and Messer, 2007]. For restoring a primary tooth with extensive caries lesions such as in the study case, SSCs are indicated [American Academy of Pediatric Dentistry, 2016].

According to this survey, very few dentists use the Hall technique when treating primary molar caries. The Hall technique (HT) has been developed in the UK [Innes et al., 2006] where the use of SSC has increased after HT has gained popularity [Seale and Randall, 2015]. In HT, the crown is placed on the tooth without preparing the tooth or removing carious tissue, and no local anaesthesia is used [Innes et al., 2006]. It may not be a commonly known treatment in Finland, although it is briefly mentioned in the new guidelines [Tooth restoration: Current Care Guidelines, 2018]. Only recently has HT been taught in the undergraduate dental degree program in Finland. Since this is the first study in Finland assessing the use of SSCs, no comparative data is available, but in the future it can be evaluated whether the use of SSC increases if HT becomes a more commonly known procedure in Finland.

The DGA case was included in the survey to investigate how the patient co-operation affects the decision to choose SSC. It was found that the percentage of restoring a tooth with SSC increased from 4.3% to 25.4% when the treatment was conducted under DGA. However, since all participants do not even provide DGA treatments, it is possible that in this case dentists chose the 'optimal' treatment instead of choosing the treatment according to a real-life situation. This is also supported by the finding that background factors did not affect the treatment options markedly in the DGA case. It can be speculated that dentists appreciate SSCs as treatment options but do not adopt them in practice. Moreover, very few dentists would have extracted the primary molar when the child was treated in normal settings. However, under DGA, 8.5% of the dentists chose extraction to manage symptomless, extensive primary tooth caries. Accordingly, treatment practices are largely based on patient co-operation, which was rated as the most important factor affecting the treatment decision. This shifts the emphasis to behavioral management or use of inhaled or orally administered sedatives so that best practices could be obtained without DGA, which is a burdensome procedure for patient and their family. Also, authors from the UK calculated that the costs of DGA in hospital settings exceed the costs of primary care-based conscious sedation techniques [Jameson et al., 2007].

The survey was addressed to the members of the Finnish Dental Society Apollonia, which covers the vast majority of Finnish dentists. The survey resulted in a reasonable number of responses, although the participation percentage was low. The study population resembles the background population otherwise, but the proportion of respondents from North and East Finland was over-represented (28.8% in the survey vs. 23.4% in the background population, $p=0.001$, z-test) as well as dentists younger than 30 years (10.6% vs. 6.4% respectively, $p<0.001$, z-test), while dentists older than 60 years were under-represented in the survey (16.2% vs 20.4%, $p=0.008$, z-test, statistics from the Finnish Dental Association, which consists of approximately 95% of the Finnish Dentists [Statistics of dentists by hospital districts, 2018]). The latter is probably due to the inclusion criteria which excluded dentists who do not see child patients, emphasising the dentists working in

the public sector which, in turn, favors younger dentists. The number of participants is high enough to yield results that can be generalised to the background population, especially when the most popular treatment choices are concerned. The risk of bias was reduced, since no compensation was offered to participants. The cover letter informed that the survey would assess caries and mineralisation defects and their restorative care practices, and no mention was made to certain methods, such as SSCs, since it could have led to a bias producing responses from those interested in the topic.

Another limit of this study concerns the method of using a self-filled questionnaire, where it is not possible to control how the respondent understands the questions. Some of the respondents may have answered based on their attitudes toward the optimal treatment, although it was instructed that answers ought to reflect the actual situation in their daily practice. In addition, it must be considered that treatment decision should be based on the assessment of the whole dentition and the patient-related factors. However, all those factors were not described in detail in this questionnaire survey. The emphasis was to compare the restorative material choices in common paediatric patient cases.

Conclusion

This survey shows that Finnish dentists are rather homogeneous in their treatment decisions when managing primary tooth caries or a severely affected MIH tooth, although some practices vary between general and specialised dentists. Moreover, the disparity in treatment practices between different areas of Finland is evident. The proportion of SSC as a material choice was low. Patient co-operation plays a big role in treatment decisions and may explain why GICs were the most popular choice for restoring extensive primary tooth caries. The emphasis should be on behavioural management as well as on the evidence-based treatment recommendations.

Conflicts of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References

- » American Academy of Pediatric Dentistry. Guideline on restorative dentistry. Recommendations: Best practises. *Pediatr Dent* 2016;38:107-119.
- » Belduz Kara N and Yilmaz Y. Assessment of oral hygiene and periodontal health around posterior primary molars after their restoration with various crown types. *Int J Paediatr Dent* 2014;24:303-313.
- » Cobourne MT, Williams A, Harrison M. National clinical guidelines for the extraction of first permanent molars in children. *Br Dent J* 2014;217:643-648.
- » Dastouri M, Kowash M, Al-Halabi M, Salami A, Khamis AH, Hussein I. United Arab Emirates dentists' perceptions about the management of broken down first permanent molars and their enforced extraction in children: A questionnaire survey. *Eur Arch Paediatr Dent* 2019;Epub ahead of print.
- » Eichenberger M, Erb J, Zwahlen M, Schatzle M. The timing of extraction of non-restorable first permanent molars: A systematic review. *Eur J Paediatr Dent* 2015;16:272-278.
- » Ekambaram M and Yiu CKY. Bonding to hypomineralized enamel - A systematic review. *Int J Adhes Adhes* 2016;69:27-32.
- » Elhennawy K and Schwendicke F. Managing Molar-Incisor Hypomineralization: A systematic review. *J Dent* 2016;55:16-24.
- » Elhennawy K, Jost-Brinkmann PG, Manton DJ, Paris S, Schwendicke F. Managing molars with severe Molar-Incisor Hypomineralization: A cost-effectiveness analysis within German healthcare. *J Dent* 2017a;63:65-71.
- » Elhennawy K, Manton DJ, Crombie F, Zaslansky P, Radlanski RJ, Jost-Brinkmann PG, Schwendicke F. Structural, mechanical and chemical evaluation of Molar-Incisor Hypomineralization-affected enamel: A systematic review. *Arch Oral Biol* 2017b;83:272-281.
- » Finsote Statistics. Helsinki: Finnish National Institute for Health and Welfare, 2018. Available online at: http://www.terveytemme.fi/finsote/2017-2018/graph/select.php?alue1=01&alue2=1001&osoitin=fs_htc_need_dentist_cr (Accessed: 24 May 2019)
- » Forss H and Widstrom E. The post-amalgam era: A selection of materials and their longevity in the primary and young permanent dentitions. *Int J Paediatr Dent* 2003;13:158-164.
- » Innes NP, Stirrups DR, Evans DJ, Hall N, Leggate M. A novel technique using preformed metal crowns for managing carious primary molars in general practice - a retrospective analysis. *Br Dent J* 2006;200:451-454.
- » Innes NP, Ricketts D, Chong LY, Keightley AJ, Lamont T, Santamaria RM. Preformed crowns for decayed primary molar teeth. *Cochrane Database Syst Rev* 2015;12:CD005512.
- » Jameson K, Averley P, Shackley P, Steele J. A comparison of the 'cost per child treated' at a primary care-based sedation referral service, compared to a general anaesthetic in hospital. *Br Dent J* 2007;203:E13.
- » Kopperud SE, Pedersen CG, Espelid I. Treatment decisions on Molar-Incisor Hypomineralization (MIH) by Norwegian dentists - a questionnaire study. *BMC Oral Health* 2016;17:3.
- » Kotsanos N, Kaklamanos EG, Arapostathis K. Treatment management of first permanent molars in children with Molar-Incisor Hypomineralization. *Eur J Paediatr Dent* 2005;6:179-84.
- » Nomenclature of territorial units for statistics NUTS level 2 Suomi/Finland. European Commission Eurostat, 2018. Available online at: <https://ec.europa.eu/eurostat/documents/345175/7451602/2016-NUTS-2-map-FI.pdf> (Accessed: 24 May 2019)
- » Regulation (EU) 2017/852 of the European Parliament and of the Council of 17 May 2017 on mercury, and repealing regulation (EC) No 1102/2008. The European Parliament and the Council of the European Union, 2017. Available online at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32017R0852> (Accessed: 30 April 2019)
- » Rissanen P, editor. Social and Health-Care Services in Finland. Expert evaluation - Autumn 2018. Helsinki: Finnish National Institute for Health and Welfare (THL). THL Policy Brief 5/2019, pp. 24-25. Available online at: www.julkari.fi
- » Santamaria RM, Pawlowitz L, Schmoedel J, Alkilzy M, Splieth CH. Use of stainless steel crowns to restore primary molars in Germany: Questionnaire-based cross-sectional analysis. *Int J Paediatr Dent* 2018;28:587-594.
- » Schwendicke F, Elhennawy K, Reda S, Bekes K, Manton DJ, Krois J. Global burden of molar incisor hypomineralization. *J Dent* 2018;68:10-8.
- » Schwendicke F, Elhennawy K, Reda S, Bekes K, Manton DJ, Krois J. Corrigendum to "global burden of molar incisor hypomineralization" [*J. Dent.* 68C (2018) 10-18]. *J Dent* 2019;80:89-92.
- » Seale NS and Randall R. The use of stainless steel crowns: A systematic literature review. *Pediatr Dent* 2015;37:145-160.
- » Sonmez H, Saat S. A Clinical Evaluation of Deproteinization and Different Cavity Designs on Resin Restoration Performance in MIH-Affected Molars: Two-Year Results. *J Clin Paediatr Dent* 2017;41:336-342.
- » Statistics of dentists by hospital districts. Helsinki: The Finnish Dental Association, 2018. Available online at: <https://www.hammaslaakariliitto.fi/fi/liiton-toiminta/tutkimukset-ja-tilastot/tilastot/hammaslaakarit-sairaanhoitopiireittain#.XMBHgzaUk> (Accessed: 30 April 2019)
- » Statistics of specialized dentists. Helsinki: The Finnish Dental Association, 2018. Available online at: <https://www.hammaslaakariliitto.fi/fi/liiton-toiminta/tutkimukset-ja-tilastot/tilastot/erikoishammaslaakaritilasto#.XMGUrugzblV> (Accessed: 30 April 2019)
- » Taylor GD, Pearce KF, Vernazza CR. Management of compromised first permanent molars in children: Cross-sectional analysis of attitudes of UK general dental practitioners and specialists in paediatric dentistry. *Int J Paediatr Dent* 2019;29:267-280.
- » Toh SL and Messer LB. Evidence-based assessment of tooth-colored restorations in proximal lesions of primary molars. *Pediatr Dent* 2007;29:8-15.
- » Tooth restoration: Current Care Guidelines. Working group set up by the Finnish Medical Society Duodecim and the Finnish Dental Society Apollonia. Helsinki: The Finnish Medical Society Duodecim, 2018. Available online at: www.kaypahoito.fi
- » Tseevenjav B, Furuholm J, Mulic A, Valen H, Maisala T, Turunen S, Varsio S, Auero M, Tjaderhane L. Survival of extensive restorations in primary molars: 15-year practice-based study. *Int J Paediatr Dent* 2018;28:249-256.
- » Uhlen MM, Valen H, Karlsen LS. et al. Treatment decisions regarding caries and dental developmental defects in children - a questionnaire-based study among Norwegian dentists. *BMC Oral Health* 2019; 19: 80.
- » Weerheijm KL, Jalevik B, Alaluusua S. Molar-incisor hypomineralisation. *Caries Res* 2001;35:390-391.
- » Widstrom E, Linden J, Tiira H, Seppala TT, Ekqvist M. Treatment provided in the public dental service in Finland in 2009. *Community Dent Health* 2015;32:60-64.
- » Wuollet E, Laisi S, Salmela E, Ess A, Alaluusua S. Background factors of molar-incisor hypomineralization in a group of Finnish children. *Acta Odontol Scand* Nov 2014; 72 (8): 963-9.
- » Zagdwon AM, Fayle SA, Pollard MA. A prospective clinical trial comparing preformed metal crowns and cast restorations for defective first permanent molars. *Eur J Paediatr Dent* 2003;4:138-142.