Dentists' Perception and Clinical use of Preformed Metal Crowns to Restore Primary Molar Defects in Chengdu City, China: A Cross-Sectional Study

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Abstract

Background: Preformed metal crowns (PMCs) are recommended for the enduring restoration of primary molar defects. However, the PMC technique is not implemented in China as well as that in Western countries.

Aim: This study aimed to assess the clinical use of the PMC technique and its effective factors among dentists in Chengdu, China.

Methods: The questionnaires were distributed among 1000 dentists practicing in Chengdu via an online questionnaire platform. Data, including sociodemographic characteristics of the respondents and their perception and use of PMCs, were collected.

Results: The response rate was 45%. Most respondents (69.6%) did not use PMCs. Academic qualification, working specialty and working experiences were associated with dentists' use of PMCs. The lack of knowledge about PMCs technique was the main obstacle for the dental practitioners using PMCs (41.7%). The lack of understanding of the rationale of PMCs was the main reason for parents accepting PMC restorations(43.6%). Attending continuing education programs was the main approach to learn the PMC restorative technique(59.1%).

Conclusion: The clinical use of PMCs was not very popular in Chengdu city. To promote the use of this restorative technique, the knowledge and practical training should be incorporated into routine courses of undergraduate dental education.

1. Introduction

Dental caries, a worldwide oral health burden, affects 60–90% of children and an overwhelming majority of adults in most industrialized countries.¹ Early childhood caries (ECC) is an aggressive form of dental caries in preschoolers, which, left untreated, can give rise to the rapid development of extensive lesions in primary teeth, causing pain, complicated systemic infections, and financial burden. According to the report of the Fourth National Oral Health Epidemiological Survey in mainland China, the prevalence of ECC in children aged 3, 4, and 5 years was 50.8%, 63.6%, and 71.9%, respectively. However, the constituent rate of filled teeth was only 1.5%, 2.9%, and 4.1%, respectively.²

Maintenance of the primary dentition in a nonpathological condition is vital for oral health, craniofacial development, and the overall well-being of children. Therapeutic strategies of the ECC are different from those of the permanent dentition because of the specific characteristics of the anatomical morphology and histological structures of primary teeth, and even the children's psychological behavior.³ Therefore, the treatment of extensively damaged primary teeth poses a challenge for the paediatric dentists as three critical considerations have to be kept in mind: children's behavioral management, preservation of the tooth structure, and parental satisfaction. In contemporary dentistry, the defects of primary molars are mainly treated with restorative treatments, which include direct filling and full coronal restorations.⁴

Preformed metal crowns (PMCs), also known as stainless steel crowns (SSCs), are recommended for the enduring restoration for primary molars and the temporary restoration of the newly erupted first permanent molars in different occasions, including severely decayed or fractured teeth, hypoplastic or hypomineralized teeth, primary molars after pulpotomy or pulpectomy procedures, teeth with extensive wear, abutments for space maintainers, and children with a high risk of caries treated under local anesthesia.⁵ Compared with conventional therapeutic materials, PMCs prevent the development of caries by covering the entire dental crown surfaces and isolating the tooth structure from the oral microorganisms. Also, they exhibit greater longevity and fewer retreatment needs; thus, they constitute a preferred option for the restoration of primary molars.^{5–7} PMC restoration is extensively accepted by dentists, children, and their parents in some developed countries, such as the UK and New Zealand.^{8,9} However, to the best of our knowledge, reports on dentists' perception, clinical use as well as knowledge of PMCs are considered inadequate in China.

Chengdu, located at the western edge of the Sichuan Basin, is the provincial capital of Sichuan Province. According to a cross-sectional study in Sichuan Province in 2016, the prevalence of dental caries in children aged 3–5 years was 63.55%, and the mean DMFT (decayed, missing, and filled teeth) was 3.28. The significant caries index reached 8.05, and this value was higher in urban areas than in rural areas. Relative to the high rate of decayed teeth, the prevalence of restored teeth was only 0.97% in this group.¹⁰ The prevalence of caries and health risks due to dental caries in children and adolescents in Sichuan is an essential factor not only in governmental investment and planning for dental services but in public health practitioners' and dentists' delivery and practice of dental services. Therefore, the aim of this present study was to assess the clinical use of PMCs and its effective factors in Chengdu, China.

2. Methods

2.1 Study Design

The present study was conducted on the general dental practitioners, paediatric dental specialists and other general dentists practicing in Chengdu, China, who are members of the Sichuan Society of Stomatology. The relevant questionnaire was presented to the participants via SO JUMP (<https://www.wjx.cn/>), an online questionnaire platform.

2.2 Questionnaire Development

The multi-item questionnaire (21 questions) consisted of two main sections, including single-choice and multiple-choice questions. One section dealt with the sociodemographic characteristics of the participants, including gender, age, academic qualification, working specialty, professional qualification, years of practice, nature of work units, and the number of children treated per week. The other section consisted of questions on their use and perception of PMCs, including months of applying PMCs, the charge of PMC restorations, the number of PMCs used per week, the age of young patients treated with

PMCs, approaches to learning this technique, indications of using PMCs, and the reasons for dentists and young patients to reject PMCs.

Pilot testing was conducted on 10 dentists contacted by WeChat, a mobile text and voice messaging communication service developed by Tencent in China, to make sure it was comprehensible and acceptable to the participants. Neither the questions nor the answers were modified after the pilot study.

2.3 Data Analysis

The data from the questionnaire were analyzed with SPSS (Version 24, SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to analyze respondents' demographic characteristics and approaches used by dentists to learn the PMC restorative technique. Logistic regression analysis was used to reveal the association between demographic characteristics and the use of PMCs. Multiple responses were used to analyze the reasons why dentists and patients rejected PMCs, as well as dentists' reported indications to use PMCs. The multivariate logistic regression model was performed with the variables with a univariate test of $P < 0.05$. A t -test was applied to compare the mean number of children treated and the number of PMCs used by general and paediatric dentists per week, respectively. The level of significance was defined at $P < 0.05$.

3. Results

The questionnaire return ratio was 45%, with a total of 450 complete samples obtained. Table 1 shows the demographic characteristics of the studied dentists and the association with the use of PMCs. 60.2% of the respondents were female dentists. 49.3% of them were between 30 to 39 years old. 66.9% had bachelor degrees. The majority (80.2%) of respondents were general dentists. More than half of dentists (54.9%) were resident doctors. 183 (40.7%) of them had worked for 10 to 19 years. And about half of them (52.4%) worked in private dental clinic/hospital.

Table 1
Demographic characteristics of the studied dentists and the association with the use of PMCs

		Univariate		Multivariate	
		OR (95%CI)	<i>P</i>	OR (95%CI)	<i>P</i>
Gender				—	
male	179 (39.8)	0.716 (0.471 ~ 1.088)	0.117		
female	271 (60.2)	1.000			
Age (year)				—	
< 30	91 (20.2)	1.156 (0.376 ~ 3.554)	0.801		
30–39	222 (49.3)	1.300 (0.447 ~ 3.784)	0.630		
40–49	119 (26.5)	0.876 (0.288 ~ 2.663)	0.816		
≥ 50	18 (4.0)	1.000			
Academic qualification					
Junior college degree and below	71 (15.8)	0.149 (0.061 ~ 0.367)	< 0.001***	0.094 (0.033 ~ 0.267)	< 0.001***
Bachelor degree	301 (66.9)	0.648 (0.389 ~ 1.080)	0.096	0.674 (0.385 ~ 1.181)	0.168
Master degree and above	78 (17.3)	1.000		1.000	
Working specialty					
General dentist	361 (80.2)	0.307 (0.171 ~ 0.550)	< 0.001***	0.299 (0.158 ~ 0.565)	< 0.001***
Other dental specialist	35 (7.8)	0.200 (0.075 ~ 0.537)	0.001**	0.434 (0.144 ~ 1.307)	0.138

OR: odds ratio

95%CI: 95% confidence interval

P* < 0.05; *P* < 0.01; ****P* < 0.001

		Univariate		Multivariate	
Paediatric dental specialist	54 (12.0)	1.000		1.000	
Professional title				—	
Resident doctor	247 (54.9)	0.894 (0.393 ~ 2.032)	0.789		
Attending doctor	171 (38.0)	1.529 (0.666 ~ 3.507)	0.317		
Association senior doctor and above	32 (7.1)	1.000			
Working experiences (year)					
0–9	164 (36.4)	3.756 (2.026 ~ 6.964)	< 0.001***	3.807 (1.994 ~ 7.271)	< 0.001***
10–19	183 (40.7)	2.276 (1.224 ~ 4.234)	0.009**	2.244 (1.174 ~ 4.289)	0.015*
≥ 20	103 (22.9)	1.000		1.000	
Nature of working units					
Private dental clinic/hospital	236 (52.4)	0.566 (0.292 ~ 1.097)	0.092	1.242 (0.577 ~ 2.676)	0.579
Dental department in public general hospital	171 (38.0)	0.451 (0.226 ~ 0.901)	0.024*	0.670 (0.313 ~ 1.436)	0.303
Public specialized dental hospital	43 (9.6)	1.000		1.000	
OR: odds ratio					
95%CI: 95% confidence interval					
* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$					

According to the survey, most dentists (69.6%) in Chengdu city didn't use PMCs to restore primary molar defects. Logistic regression analysis was used to analyze the association between dentists' demographic characteristics and the use of PMCs. The multivariate logistic regression model showed that junior college degree and below, general dentist and longer working years were negatively associated with the dentists' use of PMCs.

As showed in Table 2, dentists' reluctance to use PMCs was because of a lack of knowledge to use PMCs (41.7%), low charges/low input-output ratio (14.9%), other technical limitations (e.g., local anesthesia) (9.3%), a lack of compliance by children (5.6%), aesthetic concerns (5.4%), unawareness of PMCs (4.2%), and other reasons (18.9%). Parents rejected PMCs restoration because of a lack of knowledge of the merits (43.6%), the price (24.2%), aesthetic concerns (22.0%), and children's non-compliance (10.2%).

Table 2
Reasons for rejecting the use of PMCs by dentists and parents

		n	Percent of responses(%)	Percent of cases(%)
Reasons for rejecting the use of PMCs by dentists	Lack of knowledge to use PMCs	210	41.7	67.1
	Low charges / low input-output ratio	75	14.9	24.0
	Other technical limitations	47	9.3	15.0
	Non-compliance of children	28	5.6	8.9
	Aesthetic concerns	27	5.4	8.6
	Unawareness of PMCs	21	4.2	6.7
	Other reasons	95	18.9	30.4
	Total	503	100.0	160.7
Reasons for rejecting the use of PMCs by parents	Incomprehension of merits	103	43.6	82.4
	Prices	57	24.2	45.6
	Aesthetic concerns	52	22.0	41.6
	Non-compliance of children	24	10.2	19.2
	Total	236	100.0	188.8
PMCs: Preformed metal crowns				

In this study, 30 paediatric dentists and 100 general dental practitioners used the PMCs restorative technique. The mean number of children treated by paediatric dentists per week (63.70) was almost three times that by general dental practitioners (20.56) ($P < 0.001$). Accordingly, the mean number of PMCs used by paediatric dentists per week (7.73) was nearly three times that used by general dental practitioners (2.92) ($P < 0.05$) (Table 3).

Table 3

The comparison between general and paediatric dentists in terms of the number of children treated and PMCs used per week

Mean				
	General dentists	Paediatric dentists	<i>t</i>	<i>P</i>
Number of children treated per week	20.56	63.70	5.615	< 0.001***
Number of PMCs used per week	2.92	7.73	2.736	0.010*
PMCs: preformed metal crowns				
* <i>P</i> < 0.05; *** <i>P</i> < 0.001				

Table 4

Dentists' reported main indications to use PMCs for primary molars restoration.

Main indications of using PMCs	n	Percent of responses(%)	Percent of cases(%)
With multi-surfaces caries	123	20.5	94.6
After endodontic treatment	113	18.8	86.9
Form anomalies (e.g. enamel aplasia)	97	16.2	74.6
Dental tissues with large defects and fractures	97	16.2	74.6
High carious risk	92	15.3	70.8
Infra-occlusion	78	13.0	60
Total	600	100.0	461.5
PMCs: preformed metal crowns			

This questionnaire also showed that most children who received PMCs restorations were 3–6 years of age (57.1%). However, children younger than 3 years (8.8%) seldom received PMCs restorations. 59.1% of the respondents gained the PMCs restorative technique through attending continuing education programs. Besides, 29.9% learned it by themselves, and only 10.9% were educated in college.

4. Discussion

ECC has become a worldwide disease, affecting both the oral and general health of children. PMCs have been demonstrated to be the most reliable and durable restorations for multiple lesions in primary molars, particularly for the children at high risk for caries.^{11–13} The PMCs restorative technique is not as popular in China as that in the US. This study investigated the use and views of the PMCs technique among general dental practitioners and paediatric dentists in Chengdu, China.

The results showed that approximately one-third of the respondents (30.4%) used PMCs to restore the defects in primary molars in their clinical practice, consistent with the results of previous studies in Germany and the UK.^{14,15} In the study conducted in Germany, general and paediatric dentists were investigated, and only 34% of the respondents routinely used the PMCs technique. Additionally, in the study conducted in the UK, 3% of the participants routinely used PMCs, with 15% infrequently, and 82% never. According to the present study, the main deterrent to the use of PMCs was a lack of knowledge of dental practitioners to place PMCs (41.7%), consistent with the results of a previous study in Indiana.¹⁶ The results also showed that the application of PMCs was associated with the academic qualification, working specialty and working experiences of dentists. Dental practitioners with higher academic qualifications were more likely to implement the PMCs restorative technique, which might be attributed to the training of the PMCs technique in different education stages. Besides, paediatric dental specialists treated more children and used more PMCs than general dental practitioners, which was consistent with a recent study.¹⁷ This might be explained by the fact that paediatric dental specialists have a higher professional understanding of children's oral problems, treat more young patients, and are more familiar with the PMCs technique. Additionally, dentists with less working experience were more likely to use PMCs, which might be due to a higher success rate of PMCs restoration and more and more experts' recommendation in recent years.^{13,18} Therefore, to promote the implementation of this technique, the importance and the knowledge of the PMCs technique should be imparted during the undergraduate education, encouraging dental undergraduates to learn and practice it systematically when they participate in resident training in paediatric dentistry. For those who have not participated in this training, especially the general dental practitioners, continuing education programs could be a preferred approach. Santamaria et al¹⁴ showed that the use of PMCs was taught as a restorative procedure in 96% of German dental schools, but 27% of dental schools did not provide this practical training. The training of the PMCs restorative technique in Chinese dental schools, however, is not clear. Future studies could investigate the use and teaching of the PMCs technique in dental schools in different regions in China.

The perceived technique complexity also appeared to be associated with practitioners' reluctance to use PMCs, with 28.9% of the respondents believing that it was one of the obstacles to implementing the PMCs technique.¹⁴ In the present study, however, only 9.3% of respondents thought so. The low economic benefit was reported as the second leading limitation to the use of PMCs in the present study, with 14.9% of respondents believing that it was a reason for their reluctance to apply this technique. This issue was also analyzed in a previous study, which investigated general dental practitioners' views on using PMCs.¹⁵ In that study, some general dental practitioners believed that they would develop the use of PMCs in their daily practice if the charge could increase. On the other hand, the cost was also the second leading reason (24.2%) for patients' hesitation to choose a PMCs restoration. In addition, non-compliance of children and the unaesthetic appearance of PMCs were other limitations for dentists to use them.^{14,19,20} The Hall Technique has been demonstrated to exhibit a high success rate (97%) over five years in the UK and is regarded as one of several caries biological management options.²¹ It can restore carious primary molar teeth by seating a correctly sized PMCs over the tooth and sealing the carious

lesion in, using the glass-ionomer cement. The Hall Technique could be accepted by general dental practitioners quickly given no requirement of local anesthesia, tooth preparation, or removal of the carious tissue. Moreover, BaniHani et al²² reported that the Hall Technique only cost about half of the conventional approach. Therefore, general and paediatric dentists could apply the Hall Technique to appropriate cases in their clinical practices, especially when young children accepted. However, we believe that it also poses some challenges for the dentist to select the correct size of the PMCs at first sight.

Apart from dentists' perception, the use of the PMCs technique was also affected by the views of children and their parents. The results showed that the main reason for patients' refusal was a lack of understanding of the merits of PMCs restorations (43.6%). Therefore, dental practitioners should attach importance to explaining the rationale of the PMCs restorative technique to the parents before treatment. The dentists' attitudes and effective communication are crucial to gaining the trust and understanding of children and their guardians.²² Moreover, it is necessary to popularize children's oral health knowledge and raise public awareness of the importance of childhood dental health.

Almost all (94.6%) dentists thought primary molars with multi-surfaces caries as the main indication for using PMCs, consistent with the results of a previous study in Germany.¹⁴ Ebrahimi et al²³ showed that PMCs kept the lowest failure rates after 12 months in terms of restoration of primary molars with multi-surfaces defects. Besides that, PMCs are also indicated in the following situations: primary molars after pulpectomy or pulpotomy procedures, molars with developmental defects (e.g. dentinogenesis imperfecta, amelogenesis imperfecta and enamel hypoplasia), teeth fracture or with extensive surface loss, high carious risk and infra-occlusion, etc.²⁴ In clinical practice, however, not only the indications, but also dentists' experiences, the appearance, the prices, the compliance of young patients and the contra-indications should be considered for the choice of PMCs restoration.

The current study showed that the majority (57.1%) of patients who received PMCs treatment were 3–6 years of age, and only 8.8% of patients were younger than 3 years of age. The ECC prevalence for children aged 1, 2, and 3 years in mainland China was 0.3%, 17.3%, and 40.2%, respectively.²⁵ PMCs restoration has a high success rate in ECC treatment^{18,26}. However, the conventional method to place crowns is more complicated than the Hall Technique, requiring more cooperation of the young patients,^{19,21} which might be an obstacle preventing children under 3 years from receiving PMCs restorations. The Hall Technique is considered more comfortable for children to tolerate.²⁷ Therefore, it should be incorporated into the routine treatments, especially for young children, who are reluctant to tolerate complicated treatments and local anesthesia. On such occasions, the dentist would be prompted to improve the ability to select the right size of PMCs immediately.

One of the limitations of the present study was the nonresponse bias. The response rate of the present study was only 45%, a little bit higher than that in other studies focusing on dentists.^{14,19} The low response rate might partly be due to the fact that some dentists were unfamiliar with PMCs, which could

lead to an overestimation of the rate of implementing PMCs restoration. Another limitation was the selection bias. All the participants were members of the Sichuan Society of Stomatology, who were not the optimum representatives of the whole population of dentists in China.

Overall, the present study showed that most dental practitioners did not implement the PMCs technique in Chengdu, China. The main reasons included a lack of knowledge to use PMCs, low charge/low input-output ratio, other technical limitations (such as local anesthesia), and children's non-compliance. Knowledge and practice of the use of PMCs should be incorporated into the routine educational curriculum of dental students during their undergraduate studies, which could enhance their understanding of this technique and encourage them to implement it to treat primary molars in their future clinical practice. Continuing education programs are also required to provide general dental practitioners with the means to learn the PMCs restorative technique. Moreover, the Hall Technique can be considered as a routine method to place PMCs, reducing the complexity of the practice, and increasing children's cooperation. Further studies should focus on the views of dental school teachers and students on the teaching of the PMCs technique.

5. Conclusion

Based on the results of this study, the PMCs restorative technique was used at a low rate in Chengdu, China. The main obstacles include dentists' lack of knowledge to use PMCs appropriately and patients' lack of knowledge about their merits. Dental undergraduate education and continuing education programs are responsible for promoting the use of PMCs.

Abbreviations

PMCs
Preformed metal crowns
ECC
Early childhood caries
DMFT
decayed, missing, and filled teeth

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Research Ethics Committee of West China School of Stomatology, Sichuan University, under the code WCHSIRB-D-2019-085. A cover letter, listing the aim, scope of the questionnaire, guarantee of participant's anonymity, and the option to withdrawal from the study, was sent along with the survey. After a dentist choosing the agreed option to take part in the study, the questionnaire would display.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

QZ designed the study. QJ and YW collected and analyzed the data, drafted the manuscript. JZ and QZ revised the manuscript. QZ finalized the manuscript and acts as guarantor. All authors read and approved the final manuscript.

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