



Determination of proper band size for stainless steel crowns of primary second molars: A cross-sectional study

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Abstract

BACKGROUND AND OBJECTIVES: Fixed space maintainers are often used following primary tooth loss. In this process, selection of a proper band size for stainless steel crowns (SSCs) is often performed by trial and error, which increases the chairside time and risk of contamination of the tried bands with saliva, blood, and gingival crevicular fluid, necessitating their subsequent sterilization. This study is aimed at determining the proper size of prefabricated bands for all SSCs of primary second molars.

MATERIALS AND METHODS: In this cross-sectional study, seven examiners, including three orthodontists and four pediatric dentists attempted to select the proper band size for 24 primary second molar SSCs (3M). They selected the proper band size for each size of SSC six times in three sessions. The significance of all selected choices was carried out using the test of proportions.

RESULTS: The most commonly selected bands for EU2, EU3, EU4, EU5, EU6, and EU7 SSCs were sizes 31+, 32+, 34, 35+, 37, and 38, respectively, and the proper bands for EL2, EL3, EL4, EL5, EL6, and EL7 SSCs were sizes 30, 31+, 32+, 33+, 35 and 36+, respectively. The difference in the frequency ratio of different choices for all sizes of SSCs was significant ($P < 0.05$).

CONCLUSION: The current study determined the proper band size for all SSCs of primary maxillary and mandibular second molars. This information can help dental clinicians in selecting the proper band size for SSCs without trial and error.

Keywords:

Band, chairside time, pediatric dentistry, space maintainer, stainless steel crown, trial and error

Introduction

Primary teeth play an important role in growth and development of children. They also have a fundamental role in speech, mastication, facial appearance, and prevention of unhealthy habits, and they serve as a guide for eruption of permanent teeth.^[1] Early childhood caries is a type of highly prevalent dental caries in infants and children, which is a major health problem. The prevalence of dental caries in primary teeth of Iranian children under the age of

six years was 62.8% in 2018.^[2] Stainless steel crowns (SSCs) have been recommended for restoration of pulpotomized primary teeth or severely damaged teeth with extensive loss of tooth structure. SSCs have high clinical success rate and optimal strength and durability.^[3]

Mesial and distal drifting of the adjacent teeth into the empty space, impaction of permanent successor, dental midline shift, decreased arch length, and occasional over-eruption of the opposing teeth are among the consequences of early loss of primary teeth.^[4] Use of space maintainers

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How to cite this article: Moradnia M, Sarlak H, Mohammad-Rabei E, Almasi-Hashiani A, Shamsi A. Determination of proper band size for stainless steel crowns of primary second molars: A cross-sectional study. J Orthodont Sci 2022;11:45.

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Submitted: 04-Feb-2022
Revised: 28-Apr-2022
Accepted: 03-Jun-2022
Published: 24-Aug-2022

is the most reliable method for space maintenance following early primary tooth loss, which can decrease the complexity of future orthodontic treatments and prevent future extraction of permanent teeth to compensate for space shortage in dental arch.^[1,5] Fixed space maintainers are commonly used following unilateral or bilateral loss of primary teeth.^[1] In the process of space maintenance, an appropriate band is often selected by trial and error.^[6] However, this process is time-consuming, and errors in this method of band selection increases the chairside time and risk of contamination of tried bands with saliva, blood, and gingival crevicular fluid necessitating their subsequent sterilization.^[7] However, pediatric dental visits should be as short as possible, as increased chairside time can increase the risk of poor cooperation of patients and compromise the quality of care.^[8-10] Thus, knowledge about the proper band size for each size of SSC can greatly help in reduction of chairside time, increasing patient comfort, and eliminating the need for repeated sterilizations.^[7]

Considering the disadvantages of the trial and error technique for band selection, and the fact that bands and SSCs are prefabricated in certain sizes, determination of the proper band size for each prefabricated SSC can eliminate the need for the trial and error technique and subsequently decrease the chairside time. Moreover, by doing so, the need for sterilization of the tried but not selected crowns decreases. Thus, this study is aimed at determining the proper size of prefabricated bands for prefabricated SSCs of primary second molars. The study hypothesis was that increasing the crown size (for example, from size 2 to size 3) would increase the size of the respective band by one unit (equal to two half sizes; for example, from #30 to #31).

Materials and Methods

Three orthodontists and four pediatric dentists participated in this cross-sectional study in 2020 to determine the most appropriate band sizes for primary second molar SSCs. After participating in a calibration session, the examiners were requested to select the proper band size for primary second molar SSCs (sizes 2–7 in all four quadrants) by trial and error in three sessions (steps 1, 2, and 3) and record the results in a datasheet. In order to eliminate the confounding effect of examiner memory or examiner fatigue on selections made in the second and third sessions, the second and third sessions were scheduled with a two-week interval from the previous session.

Mounting of crowns

To simulate the clinical setting, 24 prefabricated SSCs (3M ESPE, St. Paul, MN, USA), including 12 primary mandibular second molar SSCs (ELL2, ELR2,

ELL3, ELR3, ELL4, ELR4, ELL5, ELR5, ELL6, ELR6, ELL7, and ELR7) and 12 primary maxillary second molar SSCs (EUR2, EUL2, EUR3, EUL3, EUR4, EUL4, EUR5, EUL5, EUR6, EUL6, EUR7, and EUL7) were mounted on a wooden board using 2.5-inch screws and cold-cure acrylic resin (Acropars, Tehran, Iran) [Figure 1]. For this purpose, first 24 points were marked on the wooden board in two rows of 12, with equal distance from each other. The screws were then fixed in place, and the crowns were randomly mounted on the screws [Figure 2].

Calibration session

A calibration session was held prior to the study onset with the presence of all examiners for the purpose of standardization of the selection technique of the bands, and selection of bands with maximum fit. The results and the agreements reached in this session were transcribed verbatim in the form of an instruction (as follows) according to the explanations provided in pediatric dentistry and orthodontics reference books.^[11-13] The instructions were provided to the examiners at the onset of each session.

The agreed protocol in the calibration session

According to the agreement reached in the calibration session, the principles of selection of prefabricated bands based on the available references were determined as follows:

- (I) A proper band should completely cover the cervical part of the crown.
- (II) The occlusal margin of the band should be positioned at least 1 mm below the mesial and distal marginal ridges.
- (III) The smallest band with maximum adaptation should be selected.
- (IV) The fitted band should not be retrievable by normal hand pressure; at the same time, it should be retrievable by a band remover.
- (V) The notch should be located in the buccal aspect of maxillary crowns and lingual aspect of mandibular crowns.

Blinding

The identification marks of all mounted crowns were faded such that the examiners were blinded to the size of crowns [Figure 2]. This was done to eliminate the effect of any bias related to the examiners on their band size selection.

Instruments and tools

The examiners were provided with the following instruments and tools:

- (a) Mounted crowns
- (b) Complete kit of maxillary and mandibular prefabricated bands (3M ESPE, St. Paul, MN, USA) from size 29 to size 42

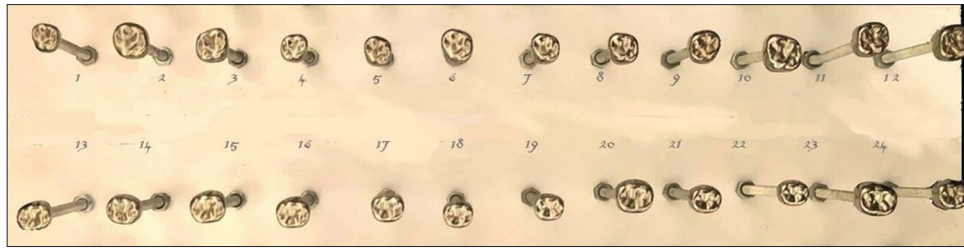


Figure 1: Mounting board including SSCs and metal screws

- (c) Band pusher: To apply gentle load on the bands and ensure their adaptation on the crowns
- (d) Band remover for removal of bands from the crowns
- (e) Band crimping pliers for contouring and crimping of deformed bands
- (f) A predesigned checklist to write down the selected bands

Appropriate band size selection sessions

In this study, each examiner selected the appropriate band sizes for the mounted crowns according to the instructions provided in the calibration session and by trial and error three times in three different sessions (steps 1, 2, and 3) [Figure 3]. The most appropriate band size for each crown was recorded in the respective table of the predesigned checklist. The three sessions had two-week interval from each other in order to prevent the confounding effect of fatigue or memory of the examiner on selections. At each step, each examiner selected the appropriate band for each crown size twice (once for the left direction and once for the right direction of the respective size). Accordingly, the appropriate band size for each crown was selected by each examiner six times in three consecutive steps (sessions). In total, all examiners selected the proper band size for each crown size 42 times.

Statistical analysis

The results were reported as frequency and percentage with 95% confidence interval. The test of proportions was applied for statistical analysis, such that the selected band sizes for each crown were converted to dummy variables and their ratio was compared. Since we aimed to find the most commonly selected band sizes, the size with maximum frequency of selection was statistically compared with the second most common size. All statistical analyses were carried out using STATA version 13 at 0.05 level of significance.

Ethical considerations

The study was approved by the ethics committee of Arak University of Medical Sciences (IR.ARAKMU.REC.1398.035). The objectives of the study were explained to all participants and written informed consent was obtained from all those willing to participate in the study.

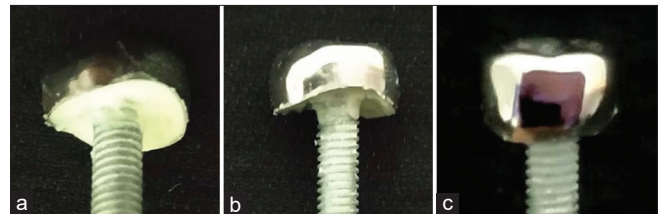


Figure 2: Mounting of SSCs on metal screws: (a) internal view of crown; (b) proximal view of crown; (c) buccal view of crown with faded "identification mark"



Figure 3: Selecting and adapting the proper band size on mounted crown: (a) lingual view of crown; (b) proximal view of crown; (c) occlusal view of crown

Results

Primary maxillary second molar SSCs

Table 1 compares the frequency of selected bands by the examiners for primary maxillary second molar SSCs. The examiners selected two different band sizes for crown sizes 2 and 7, and three different band sizes for crown sizes 3, 4, and 5. In all 42 selections, one size of band was selected for crown size 6. Comparison of ratios for selection of an appropriate band for all six sizes of maxillary second molar SSCs revealed a significant difference ($P < 0.05$). The examiners selected three band sizes of 32, 32+, and 33 for size 3 maxillary second molar SSC; the frequency of band size 32+ (69.04%) was significantly different from other selected sizes ($P = 0.002$).

Primary mandibular second molar SSCs

Table 2 compares the frequency of selected bands by the examiners for primary mandibular second molar SSCs. The examiners selected three different band sizes for crown sizes 2, 3, 4, and 6, and four different band sizes for crown sizes 5 and 7. Comparison of ratios for selection of an appropriate band for all six sizes of mandibular second molar SSCs revealed a significant difference ($P < 0.05$). The examiners selected three band sizes of 29+, 30, and 30+ for size 2 mandibular second molar SSC; the

Table 1: Significant results for the analysis of selection of an appropriate-size band for primary maxillary second molar SSCs

Crown size	Band size	Frequency	Percentage	P
EU2	31+	41	*97.61	0.001
	32	1	2.38	
EU3	32	1	2.38	-
	32+	29	69.04*	
EU4	33	12	28.557	0.04
	34	25	59.52*	
	34+	16	38.09	
EU5	35	1	2.38	-
	35+	2	4.76	
EU6	36	4	9.52	0.001
	37	42	100*	
EU7	38	26	61.90*	0.029
	38+	16	38.10	

*significant results in each crowns size demonstrated by bold font

Table 2: Significant results for the analysis of selection of an appropriate-size band for primary mandibular second molar SSCs

Crown size	Band size	Frequency	Percentage	P
EL2	29+	4	9.52	-
	30	26	61.90*	
	30+	12	28.57	
EL3	31	14	33.33	0.008
	31+	26	61.90*	
EL4	32	2	4.76	-
	32	2	4.76	
	32+	35	83.33*	
EL5	33	5	11.90	0.001
	33	1	2.38	
	33+	34	57.14*	
	34	12	28.57	
EL6	34+	5	11.90	-
	35	35	83.33*	
	35+	6	14.29	
EL7	36	1	2.38	0.001
	36	5	11.90	
	36+	32	76.19*	
	37	4	9.52	
	37+	1	2.38	-

*significant results in each crowns size demonstrated by bold font

frequency of band size 30 (61.90%) was significantly different from other selected sizes ($P = 0.002$).

Discussion

Not using space maintainers following primary tooth loss leads to space shortage in dental arch, and it complicates future orthodontic treatments. An appropriate band should be selected in use of different space maintainers. Despite the recent advances, the process of band selection is still performed by trial and error,^[10] which is time consuming. Thus, knowledge about the appropriate

band size for each crown can greatly help in reduction of chairside time and elimination of the need for sterilization of tested bands for their reuse. Short chairside time is an important parameter in behavioral control of pediatric dental patients since most children can only tolerate treatment sessions shorter than 30 minutes.^[6,9] Considering the standard size of prefabricated SSCs and bands, finding a one-to-one relationship between each crown size and its corresponding band size can pave the way to overcome the existing challenges in treatment of pediatric dental patients.

In the present study, considering the absence of similar previous studies and limited number of specialized dentists, we selected seven examiners and increased the repetition of selections by each examiner to three sessions to increase the power of study. By doing so, the appropriate band size for each size of crown was selected for 42 times. Considering the popularity of use of space maintainers by pediatric dentists and orthodontists, the examiners were selected among pediatric dentists and orthodontists. Also, randomization and blinding were performed to ensure maximum accuracy.

Determining the proper-size prefabricated band for different sizes of prefabricated primary maxillary second molar SSCs (sizes 2 to 7)

According to the present results, the appropriate band sizes for crown sizes EU2, EU3, EU4, EU5, EU6, and EU7 were 31+, 32+, 34, 35+, 37, and 38, respectively. It appears that high similarity between the selection of each examiner in the three sessions and also high similarity in selections made by the seven examiners resulted in significant differences between the first choice, with maximum frequency, and other choices. The current results could not confirm our hypothesis of the study for all crown sizes, since per each one-size increase in crown size, the size of corresponding band increased by two or three half sizes.

Determining the proper-size prefabricated band for different sizes of prefabricated primary mandibular second molar SSCs (sizes 2 to 7)

According to the current results, the appropriate band sizes for crown sizes EL2, EL3, EL4, EL5, EL6, and EL7 were 30, 31+, 32+, 33+, 35, and 36+, respectively. Due to high similarity between the selection of each examiner in the three sessions and also high similarity in selections made by the seven observers, significant differences were noted between the frequency ratio of the first choice, with maximum frequency, and other choices for all crown sizes. Similar to the results obtained for primary maxillary second molar SSCs, the results for mandibular second molar SSCs showed that per each one-size increase in crown size, the size of corresponding

band increased by two or three half sizes. Thus, our hypothesis for the primary mandibular second molar SSCs was also rejected.

In conduction of this study, the authors hoped to find a formula for a correlation between the crown size and corresponding band size (for example, a numerical regression model) to enhance the process of band size selection for dental clinicians; however, it could not be achieved due to wide dispersion of data.

Despite extensive advances in dentistry and related science, which have resulted in higher quality of dental care and higher satisfaction level of patients, dental treatment of pediatric patients is still a challenge for most parents and many dental clinicians.^[9] Also, despite great advances in behavioral control techniques for pediatric dental patients, it appears that decreasing the chairside time remains a fundamental factor to achieve patient comfort and satisfaction, which has been less commonly addressed. Thus, researchers and dental manufacturers should focus on strategies to decrease the chairside time. The results of the present study can be directly generalized to the clinical setting to enhance the clinical process of placing space maintainers, which was a strength of this study.

In conclusion, we tabulated the current results [Table 3] and recommend pediatric dentists and orthodontists to use data provided in this table in their practice for selection of appropriate size band for SSCs in the shortest time possible and without trial and error. By doing so, the chairside time decreases, and the need for disinfection of tried, but not selected, bands is obviated. The time and cost are also saved as such and the quality of treatment improves. Last but not least, complete and accurate documentation of dental records of all patients and the size and brand of selected SSCs and bands is a prerequisite for clinical use of the current results.

Financial support and sponsorship

This study was derived from a DDS thesis supported by the Research Deputy of Arak University of Medical Sciences.

Table 3: Suggested band number for primary maxillary and mandibular second molar SSCs

Crown size	Suggested band size	Crown size	Suggested band size
EU2	31+	EL2	30
EU3	32+	EL3	31+
EU4	34	EL4	32+
EU5	35+	EL5	34
EU6	37	EL6	35
EU7	38	EL7	36+

Conflicts of interest

There are no conflicts of interest.

References

- Setia V, Pandit IK, Srivastava N, Gugnani N, Sekhon HK. Space maintainers in dentistry: Past to present. *J Clin Diagn Res* 2013;7:2402-5.
- Vaisi Raygani AA, Jalali R, Ghobadi A, Salari N. The prevalence of dental caries in deciduous and permanent teeth in Iranian children: A systematic review and meta-analysis. *Res Dent Sci* 2018;3:180-9.
- Seale NS, Randall R. The use of stainless steel crowns: A systematic literature review. *Pediatr Dent* 2015;37:145-60.
- Singh D, Singh M, Singh N, Subash S. Sannruds space maintainer: A case report. *J Appl Dent Med Sci* 2018;4:1.
- Laing E, Ashley P, Naini FB, Gill DS. Space maintenance. *Int J Paediatr Dent* 2009;19:155-62.
- Vasamsetty P, Pss T, Kukkala D, Singamshetty M, Gajula S. 3D Printing in Dentistry - Exploring the New Horizons. *Materials Today: Proceedings*. 2020. p. 26.
- Sudhan VM, Hasan S. Is autoclave an effective method for sterilizing contaminated molar bands: An *in vitro* study. *J Indian Orthod Soc* 2013;47:371-6.
- Appukuttan DP. Strategies to manage patients with dental anxiety and dental phobia: Literature review. *Clin Cosmet Investig Dent* 2016;8:35-50.
- McDonald and Avery's *Dentistry for the Child and Adolescent-E-Book*. Second south Asia edition. Elsevier Health Sciences; 2019.
- Yilmaz H, Aydin MN. Digital versus conventional impression method in children: Comfort, preference and time. *Int J Paediatr Dent* 2019;29:728-35.
- Pediatric Dentistry-E-Book*. Infancy through Adolescence: Elsevier Health Sciences; 2018.
- Bahreman A. Early-age orthodontic treatment. 2013:174-93.
- Proffit W, Fields, Larson B, Sarver D. *Contemporary Orthodontics*. Hardcover; 2018. 325p.