

The Hall Technique: An Innovative Method for Managing Primary Carious Molars- A Longitudinal Study

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ABSTRACT

Aim: To investigate clinical and radiographic outcomes of Hall Technique (HT) in primary molar occlusoproximal carious lesions in dentin in 4 to 8 years old children in secondary care.

Methodology: This was a longitudinal study conducted on 50 children aged between 4-8 years with occlusoproximal caries of primary molar into dentin affecting one or more than one surface and ICDAS scoring 4 and 5. In Hall Technique (HT), preformed stainless steel crown (SSC) were used to restore children's carious primary molars and these crowns were cemented with no caries removal, tooth preparation, or local anaesthesia. The outcome of the treatment in this longitudinal study was categorised into three main categories: clinical, radiographic, and final outcome. Clinical and final outcomes were further categorised as success, minor, and major failure.

Results: Mean age of sample of 50 children were 5.80 ± 1.088 years. At nine-months follow up, three teeth were lost to follow up and two minor failures and one major failure were observed. Both minor failures were due to dislodgement of Hall crown and major failure was due to clinically abscess formation in buccal vestibule with interradiolar radiolucency visible radiographically, so there was overall 92.5% clinical and 97.5% radiographic success rate was depicted.

Conclusion: The Hall technique can be an effective addition to the clinician's range of treatment options for the carious primary molar. It is strongly supported that crowns placed by the Hall Technique treatment option have promising results, showing high acceptability and longevity; and low failure rate.

Keywords: Hall Technique (HT), Stainless steel crown (SSC), Preformed metal crown (PMC), Plastic restorative material (PRM), International caries detection and assessment system (ICDAS).

INTRODUCTION

According to the World health organization (WHO), dental caries (tooth decay) is defined as the destruction of the enamel layer of the tooth by acids produced by the action of bacteria on sugar [1]. It is widely known that dental caries is one of the preventable oral health problems and the most common chronic infectious, childhood diseases [2]. Dental caries is highly prevalent and has a negative impact on children's quality of life, and is a major public health problem in the whole world [3]. Dental caries leads to tooth pain, discomfort, eating impairment, affects children's functions, body growth, imposes a financial burden on their families, loss of tooth, delayed language development, affects the growth and maturation of secondary dentition in children [4,5].

According to Global Oral Health Data Bank, prevalence varies from 49% to 83% across different countries (6). According to World Health Organization reports, dental caries affects 60–90% of schoolchildren in both developing and developed countries (7,8). Furthermore, studies have shown that the prevalence of dental caries was up to 83.3% among Middle-Eastern schoolchildren (9,10). More than 530 million of children lose their primary teeth due to dental caries (11). A recent systematic review concluded overall caries prevalence of 54.16% in India, with 62% in patients above 18 years and 52% among 3–18 years of age. Maximum overall prevalence was noted in mixed dentition that is 58% (12).

Dental caries is a biofilm-mediated, diet modulated, multifactorial, non-communicable, dynamic disease resulting in net mineral loss of dental hard tissues. It is determined by biological, behavioural, psychosocial, and environmental factors (13). Dental caries is highly increasing among children due to the excessive consumption of sugary substances, poor oral hygiene, lack of fluoride exposure, and inadequate health service utilization (14). Dental caries has many complications like toothache, pulpitis, tooth loss, dental discoloration, and Ludwig angina (15). Children with dental caries have difficulties in sleeping, playing, eating, performing academic activity and communication problems due to missing, discoloured, or damaging teeth. Generally, it affects children's physical growth, self-esteem, and social development (16).

The management of multisurface carious primary molars in children is challenging. In contrast to treatment in adults, paediatric dentistry has to consider factors such as age, cognitive development, pain perception, type of treatment, and so on. In primary teeth, the approximal surfaces experience caries most commonly, with around 80% of restorations occlusoproximal (17). There has been a paradigm shift in what is considered effective management of carious primary teeth. Conventional restorative or surgical approaches to caries, where carious dentine is totally excised, then a restoration is placed, is being challenged by more biological, less invasive approaches where emphasis is on biofilm alteration to arrest carious lesions (18). Various biological techniques for caries management are selective or stepwise carious tissue removal, non-restorative cavity control, sealing technique with no carious tissue removal using preformed stainless-steel crowns (Hall Technique) (19).

The Hall Technique (HT) is a method for restoring children's carious primary molars uses a preformed stainless steel crown (SSC) cemented with no caries removal, tooth preparation, or local anaesthesia.¹⁹ This biologically based concept aims to control the carious lesion through influencing the biofilm's environment (20). This technique was devised by a general dental practitioner from Scotland, Dr. Norna Hall in 1980S. SSC are the most durable restorations for primary teeth and the HT achieves lower failure rates than traditional plastic restorations in both primary care and secondary care and with similar outcomes to conventionally placed SSC observed in a recent retrospective study (17,21,22). HT is preferred to conventional restoration by 77% of children, 83% of carers and 81% of general dental practitioners (23). The Hall Technique has been shown to be a durable (being likely to last the lifespan of the primary molar) and economical management option for primary molars with carious lesions, which in addition offers the benefit of full coronal coverage, reducing the risk of future carious lesion development (24).

Considering the effectiveness of HT, this study was undertaken to investigate clinical and radiographic outcomes of HT in primary molar occlusoproximal carious lesions in dentin in 4 to 8 years old children in secondary care.

MATERIAL AND METHODS

The study was conducted in the Department of Pediatric and Preventive Dentistry, PGIDS, Rohtak, Haryana. Informed consent was taken from all the parents or legal guardians of studied subjects. The patients were provided detailed information regarding the treatment, advantages or risk, if any. A brief history was taken along with the oral examination and a preoperative intraoral radiograph evaluation.

Inclusion criteria of the study were as follows: -

Children aged between 4 to 8 years, occlusoproximal caries of primary molar into dentin affecting one or more than one surface, ICDAS code 4 and 5, restorable crown, healthy pulp, more than half root remaining and no complicating medical history.

Exclusion criteria of the study were as follows: -

Signs or symptoms of irreversible pulpitis, or dental abscess/fistula, radiographic signs of pulpal involvement, or peri-radicular pathology, lack of a clear band of dentin between the lesion and the dental pulp on a radiograph, tooth near exfoliation and tooth with internal and/or external resorption.

A total of 50 children were recruited for study as per inclusion and exclusion criteria's and reviewed periodically and clinical and radiographic evaluation of all the subjects were done at 3rd, 6th and 9th month respectively. All clinical and radiographic work in children were done by single paediatric specialist dentist, specialised in Hall Technique.

Two paediatric specialist dentists, experienced in ICDAS use and assessing IOPA radiographs of children evaluated all baseline and follow-up radiographs. Baseline radiographic assessment included the depth of the carious lesion as 'deep' or 'shallow'. 'Deep' was recorded when the carious lesion radiolucency extended more than halfway through the dentine, and 'shallow' was recorded when it extended to or less than halfway through the dentine. Radiographs were analysed by using a standard illuminated radiograph viewer, screened off, in a darkened room and using magnifying lens. Investigation of inter- and intra-examiner reproducibility and repeatability to be carried out using a computer-generated randomisation table to select 10% of individual radiographs, which were then reassessed by two of the paediatric specialist dentists.

Placement of Hall crown (SSC) sometimes required additional appointment of separator placement for 2-3 days for closed contacts. No carious tissue removal, tooth preparation, or local anaesthesia was undertaken. Pre-formed, pre-crimped stainless-steel crowns were supplied by 3M and cemented with type II luting glass ionomer cement and child was instructed to bite down firmly on the crown (or cotton wool) for 2-3 min until the cement set. Rubber dam was not routinely used. The last step was to go around the teeth with a hand excavator to remove any excess cement and floss between the contacts. It was important to inform parents that the child would notice the crown as being high in the bite, which should resolve within 1 day, with the occlusion fully re-establishing within a few weeks. After treatment, the children were told not to eat or drink for 30 mins (**Figure 1**).

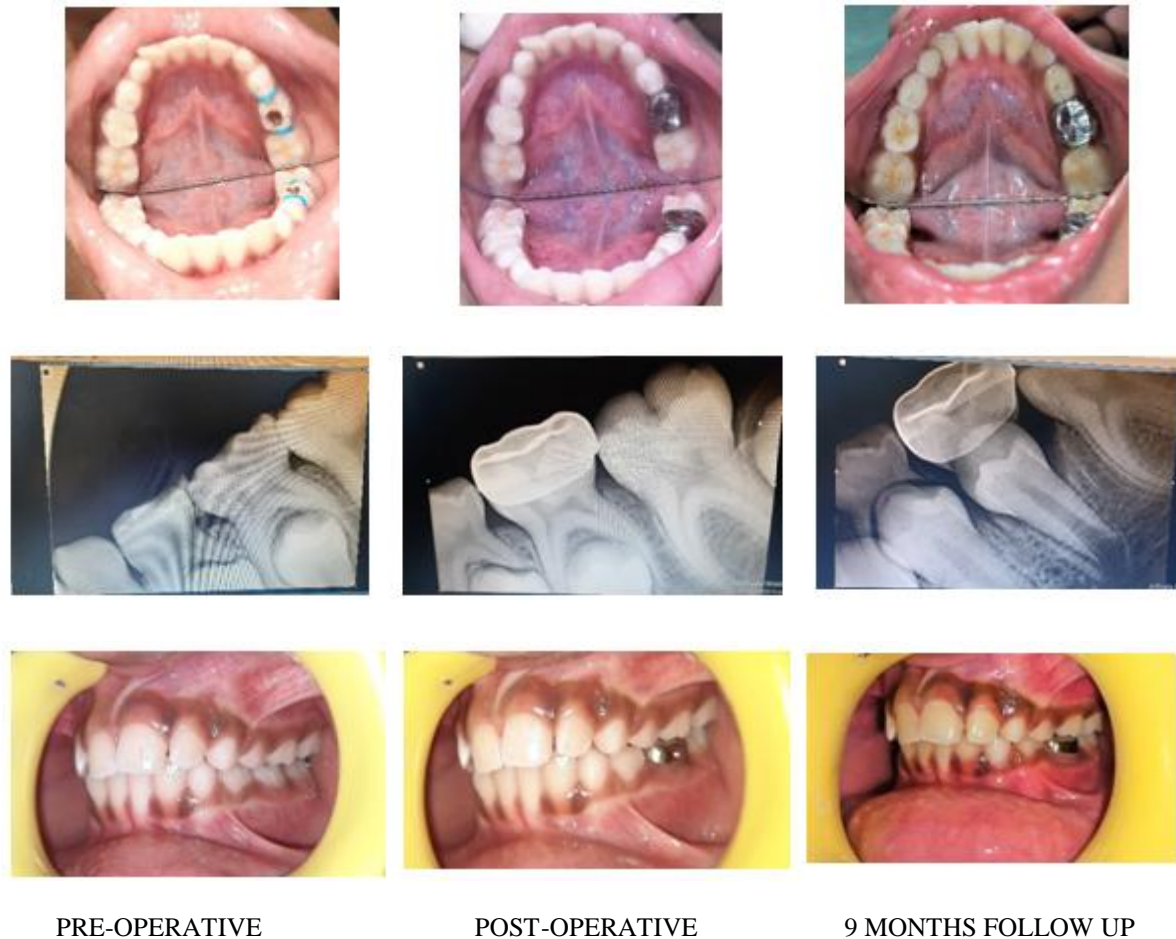


Figure 1- Hall Crown placed on lower left second deciduous carious molar

Follow-up radiographic assessment included the presence or absence of the restoration, signs of pulp pathology such as pathological inter-radicular radiolucency, and pathological root resorption. Outcomes for each child were categorised using the combined clinical and radiographic findings.

Outcome categories were 'success', 'major failure', and 'minor failure'.

Success	Restoration appears satisfactory, no intervention required No clinical signs and symptoms of pulpal pathology No pathology visible on radiographs
Major failure	Irreversible pulpitis/abscess requiring pulp treatment or extraction Pathological inter-radicular radiolucency Restoration lost, pulpally involved, and tooth unrestorable
Minor failure	Restoration lost but tooth restorable Secondary or new caries lesion requiring treatment Restoration worn and needing intervention Ectopic 6s adjacent to crowned tooth

OBSERVATIONS AND RESULTS

Mean age of sample of 50 children were 5.80 ± 1.088 years. Out of these 50 children, 35 were males and 15 were females. The number of mandibular and maxillary primary molars teeth were 36 and 14 respectively. 24 carious primary molars were with ICDAS code 4 and 26 were with ICDAS code 5, 26 carious primary molars were without marginal ridge breakdown (MRB) and 24 were with marginal ridge breakdown, 19 carious primary molars were radiographically shallow and 31 were deep. Out of 50 primary carious molars available for evaluation, 14(28%) sample have occlusal and 36(72%) have proximal caries.

At three months follow up, there was no loss to follow up and all 50 teeth were followed up and there is 100% successful outcome clinically and radiographically. At six months follow up, there were five teeth lost to follow up due to unknown reasons and one minor (proximal caries, deep and MRB present) and one major (proximal caries, deep, MRB present) failure were observed. Minor failure was due to dislodgement of Hall crown and Major failure was due to clinically irreversible pulpitis pain and interradicular radiolucency radiographically, hence, overall clinical success rate was 95.5% and overall radiographic success rate was 97.7% at six months follow up. At nine months follow up, three teeth were lost to follow up due to unknown reasons and two minor (proximal caries, deep, MRB absent and proximal caries, deep, MRB present) and one major (proximal caries, deep, MRB present) failure were observed. Both minor failures were due to dislodgement of Hall crown and major failure was due to clinically abscess formation in buccal vestibule with interradicular radiolucency visible radiographically, so there was overall 92.5% clinical and 97.5% radiographic success rate at nine months follow up. A success rate of 100% were depicted in children with occlusal caries and 96.7% success rate were observed in children with proximal caries. A success rate of 88.5% were seen in the deep carious lesions with marginal ridge breakdown.

DISCUSSION

This study's principal finding was that this HT approach was highly successful in managing occlusoproximal caries in dentin in primary molars. The large number of teeth remained asymptomatic without exhibiting minor or major failures at the last follow-up visit. This is consistent with recent evidence on the high success of HT in the restoration of primary molar carious lesions (17,20,21). HT is preferred to conventional restoration by 77% of children, 83% of carers and 81% of general dental practitioners (23). Schwendicke F et al compared the cost effectiveness of HT, NRCT, conventional restoration (CR) and pulpotomy and concluded that HT was more cost-effective than CR, NRCT and pulpotomy for managing cavitated caries lesions in primary molars, significantly fewer retreatments, yielding better dental health outcomes at lower costs (24,25). Ludwig KH et al and Clark W et al retrospectively compared HT with conventionally placed SSC and concluded 97% HT and 94% conventional SSC were successful and concluded high clinical and radiographic success rates for SSCs placed on primary molars with the Hall technique (22,26). Boyd DH et al compared the HT (biological technique) with plastic restorative material (PRM) (Conventional technique) in New-Zealand primary oral health care with follow up of 24 months and concluded that failure was observed significantly more in PRM group (32%) than the HT group (6%) (20). Banihani A et al retrospectively compared the biological techniques (HT, Indirect pulp capping) with conventional technique (complete carious tissue removal, pulpotomy) delivered in two specialist paediatric hospitals and concluded success rate of 95.8% in biological and 95.3% in conventional technique (27). Araujo MP et al concluded that both ART and the HT were acceptable to child participants and their parents and all parents thought both restorations, both treatments can be performed in a non-clinical setting and have the advantage of being non-aerosol generating procedures (non-AGPs) (28). The fit of the crown plays an important role in the success of the Hall Technique. Since no tooth structure is removed, the SSC increases the height of the tooth, which causes a temporary increase in vertical dimension which is reequilibrated within weeks without complains of signs of occlusal problems and TMJ dysfunctions, or difficulty during eating (29-31). This was consistent with our study also as no children and parent complaints of pain, difficulty in eating and completely satisfied with fit of crown and greatly acceptable by children and parents (Figure 2).



Figure 2: - A seven-year-old boy treated with preformed Hall metal crowns (PMCs) showing: (a) A pre-treatment lateral photograph showing the patient's occlusion, (b) a post-treatment lateral photograph showing the patient's occlusion (taken immediately after cementation of the PMC), and (c) a one-month-recall photograph showing correction of the OVD.

Some studies reported reasons for not using SSCs was because not aesthetically acceptable to parent or child, technique complexity, lack of knowledge, low reimbursement, time consuming etc. although most dentist recognized that crowns are the most durable restoration for primary molar teeth and once dental practitioners explained all the advantages to the parents, they agreed with the treatment (32-34). This was consistent with our study also as some parents were concerned about aesthetics but agreed for treatment when explained about advantages of SSC for their children oral health management.

CONCLUSION

The Hall technique can be an effective addition to the clinician's range of treatment options for the carious primary molar. It is strongly supported that crowns placed by the Hall Technique treatment option have promising results, showing high acceptability and longevity; and low failure rate for managing carious primary molars compared to conventional treatment options commonly applied in primary and secondary care settings. In addition, the survival of SSCs is high, whether provided using the Hall technique or traditional preparation by a paediatric dentist. The HT is an effective and less invasive management option for asymptomatic carious primary molars.

BIBLIOGRAPHY

- [1]. WHO, Sugars and Dental Caries, World Health Organisation, Geneva, Switzerland, 2017.
- [2]. S. Syreen, A. Anwar, G. Ahmad, and M. Z. Rahman, "Prevalence of dental caries among children residing in muslim dominated area of Laheriasarai, Darbhanga," *Journal of Medical Science and Clinical Research*, vol. 6, no. 12, 2018.
- [3]. L. P. Dixit, A. Shakya, M. Shrestha, and A. Shrestha, "Dental caries prevalence, oral health knowledge and practice among indigenous chepang school children of Nepal," *BMC Oral Health*, vol. 1320 pages, 2013.
- [4]. J. Wulaerhan, A. Abudureyimu, X. L. Bao, and J. Zhao, "Risk determinants associated with early childhood caries in Uygur children: a preschool-based cross-sectional study," *BMC Oral Health*, vol. 14, no. 1, p. 136, 2014.
- [5]. J. T. van der Tas, L. Kragt, M. E. C. Elfrink et al., "Social inequalities and dental caries in six-year-old children from the Netherlands," *Journal of Dentistry*, vol. 62, pp. 18–24, 2017.
- [6]. Frencken JE, Sharma P, Stenhouse L, Green D, Lavery D, Dietrich T. Global epidemiology of dental caries and severe periodontitis – a comprehensive review. *J Clin Periodontol*. 2017;44:S94–105.
- [7]. P. E. Petersen, D. Bourgeois, H. Ogawa, S. Estupinan-Day, and C. Ndiaye, "The global burden of oral diseases and risks to oral health," *Bulletin of the World Health Organization*, vol. 83, no. 83, pp. 661–669, 2005
- [8]. L. P. Dixit, A. Shakya, M. Shrestha, and A. Shrestha, "Dental caries prevalence, oral health knowledge and practice among indigenous Chepang school children of Nepal," *BMC Oral Health*, vol. 13, no. 1, p. 20, 2013.
- [9]. M. Jessri, M. Jessri, B. Rashidkhani, and S. M. Kimiagar, "Oral health behaviours in relation to caries and gingivitis in primary-school children in Tehran," *Eastern Mediterranean Health Journal*, vol. 19, no. 6, pp. 527–534, 2008.
- [10]. A. A. Al-Akwa and S. A. Al-Maweri, "Prevalence of dental caries among Yemeni schoolchildren: a large school-based survey," *Global Journal of Health Science*, vol. 9, no. 5, pp. 1–9, 2017
- [11]. WHO, Oral Health, World Health Organisation, Geneva, Switzerland, 2020
- [12]. Pandey P, Nandkeoliar T, Tikku AP, Singh D, Singh MK. Prevalence of dental caries in the Indian population: A systematic review and meta-analysis. *J Int Soc Prevent Communit Dent* 2021;11:256-65
- [13]. Pitts NB, Zero DT, Marsh PD, Ekstrand K, Weintraub JA, Ramos-Gomez F, et al. Dental caries. *Nat Rev Dis Primers*. 2017 May;3(1):17030.
- [14]. A. Amit, N. Manohar, and J. R. John, "Factors associated with dental caries in primary dentition in a non-fluoridated rural community of new South Wales, Australia," *International Journal of Environmental Research and Public Health*, vol. 14, pp. 141444, 2017.
- [15]. K. Yadav and S. Prakash, "Dental caries: a review," *Asian Journal of Biomedical and Pharmaceutical Sciences*, vol. 6, pp. 1–7, 2016
- [16]. B. J. Turton and C. S. Durward, "Management of early childhood caries—a comparison of different approaches," *AI Dental Public Health Journal*, vol. 22, 2017
- [17]. Santamaria RM, Innes NP, Machiulskiene V, Evans DJ, Splieth CH: Caries management strategies for primary molars: 1-yr randomized control trial results. *J Dent Res* 2014; 93: 1062–1069.
- [18]. Schwendicke F, Meyer-Lueckel H, Dörfer C, Paris S (2013). Failure of incompletely excavated teeth: a systematic review. *J Dent* 41:569-580.
- [19]. Santamaria, R., & Innes, N. (2018). Sealing Carious Tissue in Primary Teeth Using Crowns: The Hall Technique. *Monogr Oral Sci*. Basel, Karger, 2018, vol 27, pp 113– 123 (DOI: 10.1159/000487835)
- [20]. Boyd DH, Page LF, Thomson WM: The Hall technique and conventional restorative treatment in New Zealand children's primary oral health care – clinical outcomes at two years. *Int J Paediatr Dent* 2018; 28: 180–188.
- [21]. Innes NPT, Evans DJP, Stirrups DR. Sealing caries in primary molars: randomized Control Trial, 5-year results. *J Dent Res* 2011; 90: 1405–1410

- [22]. Ludwig KH, Fontana M, Vinson LQA, Platt JA, Dean JA. The success of stainless steel crowns placed with the Hall technique: a retrospective study. *J Am Dent Assoc* 2014; 145(12): 1248–125312.
- [23]. Innes NP, Evans DJ, Stirrups DR: The Hall technique; a randomized controlled clinical trial of a novel method of managing carious primary molars in general dental practice: acceptability of the technique and outcomes at 23 months. *BMC Oral Health* 2007; 7: 18.
- [24]. Schwendicke F, Krois J, Splieth CH, Innes N, Robertson M, Schmoekkel J, Santamaria RM. Cost-effectiveness of managing cavitated primary molar caries lesions: A randomized trial in Germany. *J Dent*. 2018 Nov;78:40-45. doi: 10.1016/j.jdent.2018.05.022. Epub 2018 May 30. PMID: 29859224.
- [25]. Schwendicke, F.; Stolpe, M.; Innes, N.P. Conventional treatment, Hall Technique or immediate pulpotomy for carious primary molars: A cost-effectiveness analysis. *Int. Endod. J.* 2015, 49
- [26]. Clark W, Geneser M, Owais A, Kanellis M, Qian F: Success rates of Hall technique crowns in primary molars: a retrospective pilot study. *Gen Dent* 2017; 65: 32–35.
- [27]. BaniHani A, Duggal M, Toumba J, Deery C: Outcomes of the conventional and biological treatment approaches for the management of caries in the primary dentition. *Int J Paediatr Dent* 2018; 28: 12–22.
- [28]. Araujo MP, Innes NP et al Atraumatic restorative treatment compared to the Hall Technique for occluso-proximal carious lesions in primary molars; 36-month follow-up of a randomised control trial in a school setting . *BMC Oral Health* (2020) 20:318
- [29]. van der Zee V, van Amerongen WE. Short communication: Influence of preformed metal crowns (Hall technique) on the occlusal vertical dimension in the primary dentition. *Eur Arch Paediatr Dent*. 2010 Oct;11(5):225-7. doi: 10.1007/BF03262751. PMID: 20932395.
- [30]. Gallagher S, O'Connell BC, O'Connell AC. Assessment of occlusion after placement of stainless steel crowns in children - a pilot study. *J Oral Rehabil*. 2014 Oct;41(10):730-6. doi: 10.1111/joor.12196. Epub 2014 Jun 10. PMID: 24913609.
- [31]. Abu Serdaneh S, AlHalabi M, Kowash M, Macefield V, Khamis AH, Salami A, Hussein I. Hall technique crowns and children's masseter muscle activity: A surface electromyography pilot study. *Int J Paediatr Dent*. 2020 May;30(3):303-313. doi: 10.1111/ipd.12611. Epub 2020 Jan 24. PMID: 31894621.
- [32]. Santamaria RM, Pawlowitz L, Schmoekkel 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 Nov;28(6):587-594. doi: 10.1111/ipd.12415. Epub 2018 Aug 1. PMID: 30066455.
- [33]. Threlfall, A.G.; Pilkington, L.; Milsom, K.M.; Blinkhorn, A.S.; Tickle, M. General dental practitioners' views on the use of stainless steel crowns to restore primary molars. *Br. Dent. J.* 2005, 199, 453–455; discussion 441.
- [34]. Innes NP, Ricketts D, Chong LY, Keightley AJ, Lamont T, Santamaria RM. Preformed crowns for decayed primary molar teeth. *Cochrane Database Syst Rev*. 2015 Dec 31;2015(12):CD005512. doi: 10.1002/14651858.CD005512.pub3. PMID: 26718872; PMCID: PMC7387869.