

Peer reviewed paper; submitted October 2020; accepted October 2021

A retrospective audit on the use of glass ionomer cement and stainless steel crown restorations in primary molar teeth within Northland District Health Board Oral Health Service, New Zealand

Croucher N.

Abstract

In 2009 dental and oral health therapists working within Northland District Health Board Oral Health Service anecdotally reported that about one quarter of their clinical time was being spent repairing and replacing Glass Ionomer Cement (GIC) restorations previously placed in primary molar teeth. Clinicians were keen to consider other treatment modalities to improve clinical efficiency and effectiveness, especially the Stainless Steel Crown (SSC) restoration.

This article describes, over a 10-year period between 2009 and 2018, the number of GIC and SSC restorations placed by the Service in primary molar teeth, as well as the number of re-interventions for previously placed GIC and SSC restorations. Relevant retrospective data was extracted using the clinical effectiveness tool within the Service's electronic clinical record system. This data was then further analysed using Microsoft Excel 2010.

During the study period 126,383 GIC and 40,927 SSC restorations were placed in primary molar teeth. Proportionally as the study period progressed, there was a decreasing number of GIC restorations and an increasing number of SSC restorations placed. The overall re-intervention rates were 16% for previously placed GIC restorations and 2% for previously placed SSC restorations.

Stainless Steel Crowns are now routinely used for the treatment of carious primary molar teeth within the Service.

Introduction

Northland District Health Board Oral Health Service provides free comprehensive oral health care to approximately 25,000 children, aged from birth to 13 years, domiciled in the Northland region of New Zealand (NZ). The Service is part of a wider national oral health scheme, that provides publicly funded oral health care to NZ children (Ministry of Health [MoH], 2019).

The Service aims to provide comprehensive high quality oral health care, at or near where children live or attend school. Each child is seen by a dental or oral health therapist annually for an examination, radiographs, preventive care and treatment, as per the Ministry of Health's Oral Health Service Specifications (MoH, 2015).

The Service in Northland has a team of 26 dental and oral health therapists, providing care out of 18 mobile dental clinics and 7 community dental clinics. The fixed community dental clinics are situated in the main towns of Whangarei, Kerikeri, Kaitiaki, Kaikohe and Dargaville, and the mobile dental clinics visit up to 70 school locations each year. The Service is further supported by 3 dentists, who provide dental advice and treatment that is beyond the scope of practice of dental and oral health therapists.

Rationale for Change

A range of restorative care options for primary molar teeth are provided within the Service, including traditional restorative procedures using GIC, amalgam, compomers, composites and SSCs, supported by biological caries management approaches such as partial and stepwise caries removal (Vineet et al., 2015).

Traditional restorative procedures involve operative removal of caries, followed by a restoration to replace lost tooth tissue (Ricketts & Pitts, 2009). This frequently involves the use of local anaesthetic and dental handpieces which can be challenging for very young children to cope with. Durability of such restorations depends on many factors, including the depth and size of the carious lesion, as well as the properties of the dental material used (Soncini et al., 2007; Demarco et al., 2012). For restorative procedures on carious primary molars, dental and oral health therapists in Northland generally preferred GICs over other dental materials, due to favourable aesthetics, handling and preventive properties (Yip et al., 2001; Berg, 2002).

There has been a fundamental shift within the dental profession about the way dental caries is treated and managed; moving from a traditional restorative and interventional approach towards a more caries management approach (Kandiah et al., 2010). Novel biological methods involve 'minimal intervention' techniques which look at incomplete, or even no caries removal (Innes & Evans, 2013).

Although SSCs have been used to treat dental caries in primary molar teeth for quite some time, evidence to support their use continues to grow (Uston & Estrella, 2011). Research is also suggesting that SSCs could be a better alternative for restoring carious primary molar

teeth than directly placed restorations (Innes et al., 2006). However there still seems to be some hesitancy among dental clinicians in adopting SSC procedures more widely (Titley et al., 2001).

SSCs are strong, durable and of relatively low cost. They are known to have good retention rates as compared to other methods of restoration. Full coverage crowns also protect other susceptible surfaces of the same tooth, which is a major advantage over other directly placed restorative materials.

The Conventional Stainless Steel Crown Technique:

Conventional techniques of placing SSCs normally involve a local anaesthetic, operative caries removal and tooth reduction, prior to crown placement and cementation (Kindelan et al., 2008). This technique can take time and requires a good level of compliance from the patient.

The 'Hall' Stainless Steel Crown Technique:

A general dentist in rural Scotland, Norna Hall developed a simplified method for placing SSCs on carious primary molars, which later became known as the 'Hall' SSC technique. The 'Hall' SSC technique involves no caries removal, no crown preparation and no use of local or topical anaesthetic before placing and cementing the SSC restoration (Innes et al., 2015).

Using the 'Hall' technique takes just a few minutes with the child sitting upright in the dental chair, and is considered a more child-friendly technique than conventional SSC placement. Research confirms acceptable success rates for 'Hall' SSCs when compared with crowns that have been prepared conventionally, and are generally more successful than alternative restorative techniques (Ludwig et al., 2014; Boyd & Foster-Page, 2018; Boyd et al., 2020).

The 'Modified' Stainless Steel Crown Technique:

The 'Hall' SSC technique has some limitations, especially when placement of a SSC is required on two adjacent deciduous molar teeth. The 'Modified' SSC technique allows for easier placement of SSCs on two adjacent deciduous molars during the same treatment visit. It involves supra-gingival reduction of the interproximal surfaces of adjacent molars using a tapered diamond bur in a high-speed handpiece, and can eliminate the need for pre-operative teeth-separating techniques. Only topical local anaesthetic is normally required, but with the necessity to use a high-speed handpiece, the 'Modified SSC' technique might be considered a less child-friendly technique than the 'Hall' SSC technique. Children are normally required to be reclined in the dental chair which may add to anxiety, and could compromise patient compliance in the future.

The 'Hall' and 'Modified' SSC treatment modalities are deemed to be more child-friendly than the 'Conventional' SSC technique, through the avoidance or limited use of a fast handpiece and no local anaesthetic injections (Kindelan et al., 2008; Foster-Page et al., 2014).

Background and Objectives

Prior to 2009 most carious primary molar teeth within the Service were restored with GIC. Whilst other dental materials were being used such as amalgam, compomers and composites, GICs were generally the material of choice, due to favourable handling properties, good aesthetics and the ability to place GIC restorations in situations where moisture control was not ideal.

Dental and oral health therapists working within the Service were anecdotally reporting that about 25% of their clinical time was being spent repairing and replacing GIC fillings in primary molar teeth. The clinicians were keen to explore and consider other treatment modalities to improve clinical efficiency and effectiveness, especially SSCs.

In 2009 only 3 of the 26 dental and oral health therapists working within the Service had a SSC scope of practice on their Annual Practising Certificate (APC). In late 2009, the remaining dental therapists were offered the opportunity to receive formal training on the 'Conventional' SSC technique. The training was a NZ Dental Council approved course, which meant that the SSC scope of practice could be added to the APC of the clinicians successfully completing the course. All clinicians who undertook the training during 2009 were successful and had the SSC scope of practice added to their APCs in early 2010.

In 2011, training in the 'Hall' SSC technique was provided. Resources created by a visiting University of Dundee Child Dental Health team included a 'Hall' SSC manual and a video. Over the following few years all clinicians within the Service adopted and incorporated the 'Hall' SSC technique into their routine clinical practice. From 2013 onwards clinicians also adopted the 'Modified' SSC technique. Therefore since 2013 all clinicians have had the option to provide SSCs using a 'Conventional', 'Hall' or 'Modified' SSC technique.

To evaluate the introduction of SSCs into the Service's model of care, a retrospective audit was carried out in 2018 to investigate the number of GIC and SSC restorations placed in primary molar teeth since 2009, as well as the number of re-interventions for the different SSC treatment modalities.

Audit Methodology

The Service uses the Titanium Solutions clinical record system to support the provision of oral health care across Northland. Clinical records used for the study included all enrolled pre-, primary- and intermediate-school aged children (~0 to 13 years). Anonymised data was collected on the types of restorative procedures (GIC or SSC) carried out on primary molars within the Service between 2009 and 2018. In 2013 treatment codes by type of SSC were created ('Conventional', 'Hall', and 'Modified'), which allowed for capturing the number of SSCs placed and re-interventions by SSC treatment modality. Data on the type of SSC placed was therefore available from 2013 onwards.

Parameters within the software clinical effectiveness tool for re-intervention were set up to identify any re-intervention to a primary molar tooth that had

previously received a GIC or SSC restoration. Subsequent re-intervention treatments captured in the data included fillings, pulpotomies, repeat SSC or extractions. All other treatment and base charting codes were excluded such as fissure sealants, fluoride varnish applications and exfoliation. Data on the number of interventions and re-interventions carried out during the study period (2009 to 2018) was analysed using MS Excel 2010.

Limitations

The intervention and re-intervention data sets for both GIC and SSC restorations were not matched for individual patients or individual primary molar teeth. Hence, a direct comparison of treatment intervention and re-intervention was not possible. As the data collected was totally anonymous and not matched to specific individuals, ethical approval and local authorisation was not sought.

Results

Glass Ionomer Cement Restorations

In total 126,383 GIC restorations were placed in primary molar teeth during the years 2009 to 2018 (Figure 1). The number of GIC restorations placed per annum increased from 17,677 in 2009 to 18,233 in 2010. However, since 2010 there has been an on-going and steady reduction, with only 4,432 GIC restorations being placed in primary molars in 2018.

Correspondingly, the number of GIC re-interventions also decreased from 3,842 in 2009 to 772 in 2018, with the proportion of GIC re-interventions decreasing slightly over the study period (18% in 2009 to 15% in 2018).

Stainless Steel Crown Restorations

In total 40,927 SSCs were placed during the years 2009 to 2018 and overall, 2% (832/40,927) required re-interventions (Figure 2). The number of SSCs placed annually increased from 332 in 2009 to 6,227 in 2018, with a rapid rise in SSC restorations placed between 2011 and 2013. The total number of SSC re-interventions remained steady at or around 2% during the entire study period (2009 to 2018).

Since 2013, data on the different types of SSC treatment modalities has been available. Between 2013 and 2018, of the 34,219 SSCs placed, by far the largest proportion of SSCs placed used the 'Hall' SSC technique (48%), followed by 'Modified' (33%) and then 'Conventional' (19%) (Figure 3).

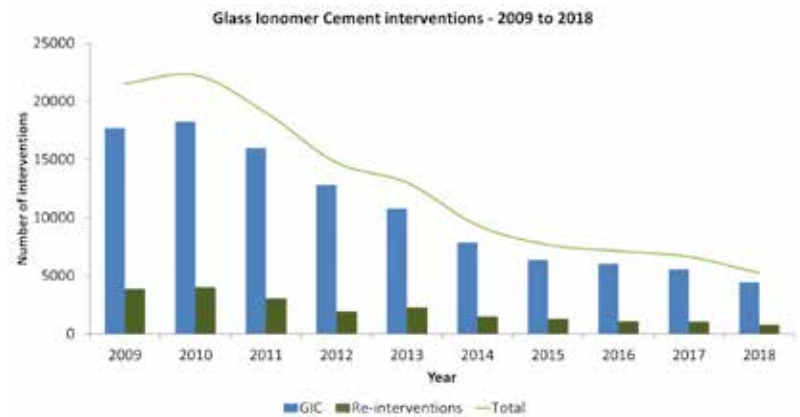


Figure 1. Glass Ionomer Cement interventions 2009 to 2018

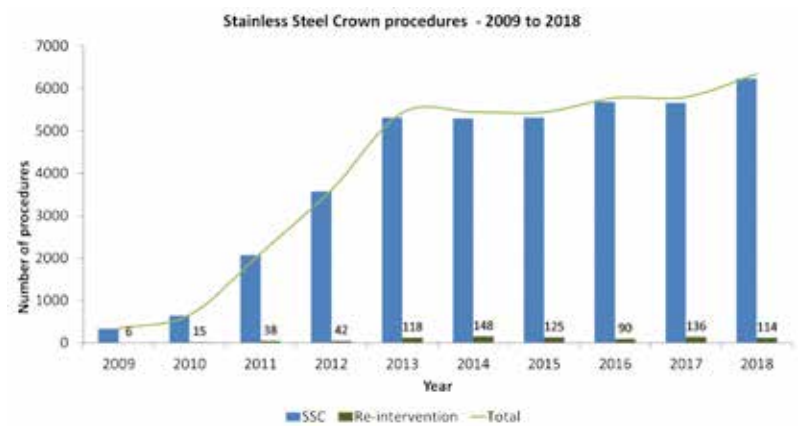


Figure 2. Total Stainless Steel Crown procedures–2009 to 2018

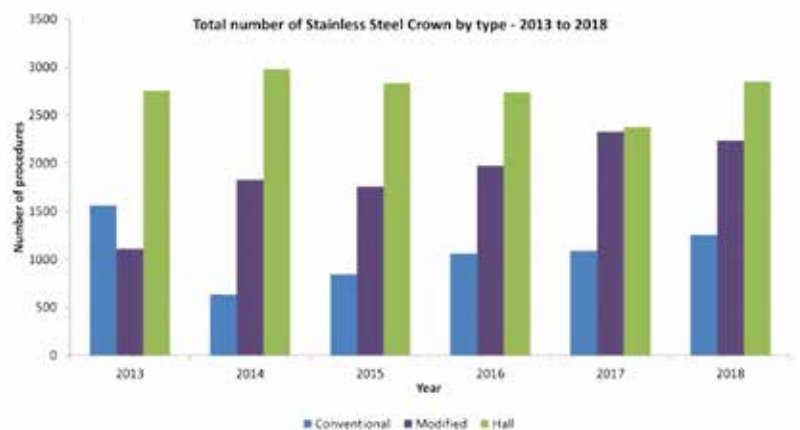


Figure 3. Number of Stainless-Steel Crowns by type–2013 to 2018

Re-intervention rates

The overall re-intervention rates between 2009 and 2018 were 16% for GIC restorations and 2% for SSC restorations (Figure 4).

When comparing the overall re-intervention rates between 2013 and 2018 for the type of SSC treatment modality used. 'Conventional' SSCs had the lowest re-intervention rate at 1%, followed by 'Hall' SSCs at 2.2% and 2.6% for 'Modified' SSCs (Figure 5).

Observations and Conclusion

Re-interventions were 8 times more likely for a GIC restoration (16%) than for a SSC restoration (2%) placed in primary molars over the study period. The increasing number of SSC restorations provided, and the corresponding drop in the number of GIC restorations placed, has resulted in fewer re-interventions overall. Also, the introduction of the more child-friendly 'Hall' and 'Modified' SSC techniques further contributed to the SSC treatment modality becoming more popular with clinicians. Of all the SSC's placed between 2013 and 2018, 81% used either the 'Modified' or 'Hall' SS crown treatment modality.

Although most clinicians within the Service had received formal SSC training in 2009, there was initially a variable rate of adoption of the new SSC technique by clinicians within the Service. However, by 2013, most seemed to have adopted all three SSC treatment types and incorporated them into their clinical practice. This variable rate of adoption by different clinicians was predicted as some clinicians needed more time to build up their confidence and competence with the new SSC techniques (Threlfall et al., 2005; Kowolik et al., 2007). Clinicians also needed opportunities to observe their own, and other's experiences and results: slowly gaining more familiarity with the 'Hall' and 'Modified' SSC techniques and anecdotally observing treatment outcomes over time.

Overall the introduction of the various SSC treatment modalities into the Service has been seen by clinicians, parents and patients, as a very successful model of care change.

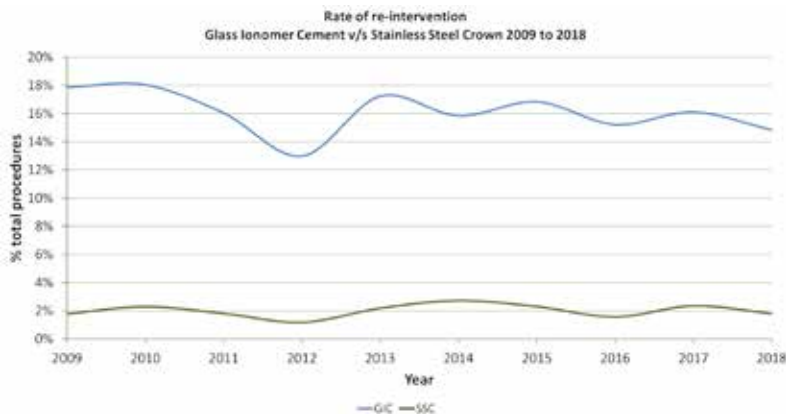


Figure 4. Re-interventions by type of procedure (GIC vs SSC)

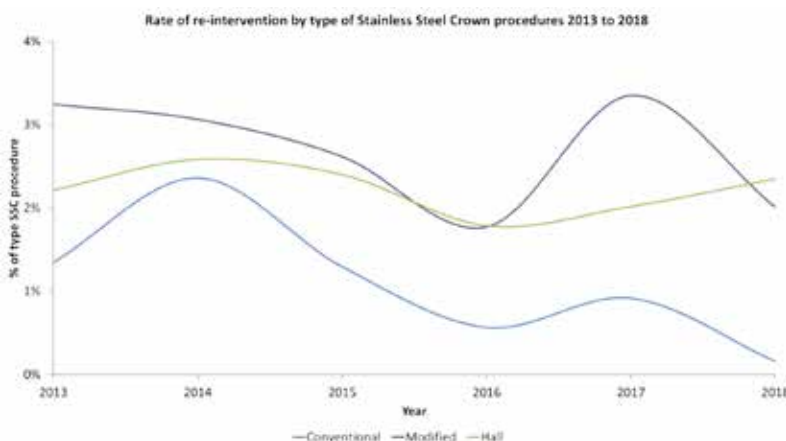


Figure 5. Re-intervention by type of Stainless Steel Crown—2013 to 2018

Acknowledgements

Thank you to every team member who has worked within Northland District Health Board Oral Health Service over the last 12 years. Clinicians, ably supported by their dental assistants, have had to learn new clinical and behavioural management skills on younger and younger children, and have done so competently and enthusiastically.

Thank you to Pip Zammit, Oral Health Service Manager and to Jeanette Wedding, General Manager, who have unwaveringly backed this model of care change: Barbara Anderson and Anil Shetty who assisted with collecting and analysing the data: our practice managers and clinical managers who have provided logistical, operational and clinical support.

To Lyndie Foster-Page and Dorothy Boyd, thank you for developing and running the Dental Council approved SSC training courses in 2009 and 2010. Thank you to Dafydd Evans and Nicola Innes from the Child Dental Health team of the University of Dundee, Scotland, who visited NZ in 2011 and 2012 to share their story, their knowledge, their research and their passion for biological caries management, the 'Hall' SSC technique and child-friendly dentistry.

Finally, grateful thanks to my colleague Ellen Clark: for reviewing the final draft of this paper and providing encouragement along the way.

Author details:

Neil Croucher

Principal Dental Officer and Oral Health Adviser, Northland DHB Oral Health Service
neil.croucher@northlanddhb.org.nz

References

- Berg, J. H. (2002). Glass ionomer cements. *Pediatr Dent*, 24(5), 430-438.
- Demarco, F. F., Corrêa, M. B., Cenci, M. S., Moraes, R. R., & Opdam, N. J. (2012). Longevity of posterior composite restorations: not only a matter of materials. *Dent Mater*, 28(1), 87-101. doi:10.1016/j.dental.2011.09.003
- Innes, N., Evans, D., Keightley, A., & Stewart, M. (2015). *The Hall Technique Guide V4*.
- Innes, N. P., Stirrups, D. R., Evans, D. J., Hall, N., & Leggate, M. (2006). A novel technique using preformed metal crowns for managing carious primary molars in general practice—a retrospective analysis. *Br Dent J*, 200(8), 451-454; discussion 444. doi:10.1038/sj.bdj.4813466
- Innes, N. P. T., & Evans, D. J. P. (2013). Modern approaches to caries management of the primary dentition. *British Dental Journal*, 214(11), 559-566. doi:10.1038/sj.bdj.2013.529
- Kandiah, T., Johnson, J., & Fayle, S. A. (2010). British Society of Paediatric Dentistry: a policy document on management of caries in the primary dentition. *Int J Paediatr Dent*, 20 Suppl 1, 5. doi:10.1111/j.1365-263X.2010.01087.x
- Keith Titley, David Farkouh, & Robert Chernecky. (2001). PAEDIATRICS: The Stainless Steel Crown – An Underused Restoration in Paediatric Dentistry. Retrieved from <https://www.oralhealthgroup.com/features/paediatrics-the-stainless-steel-crown-an-underused-restoration-in-paediatric-dentistry/>
- Kindelan, S. A., Day, P., Nichol, R., Willmott, N., & Fayle, S. A. (2008). UK National Clinical Guidelines in Paediatric Dentistry: stainless steel preformed crowns for primary molars. *Int J Paediatr Dent*, 18 Suppl 1, 20-28. doi:10.1111/j.1365-263X.2008.00935.x
- Kowolik, J., Kozlowski, D., & Jones, J. E. (2007). Utilization of stainless steel crowns by general dentists and pediatric dental specialists in Indiana. *J Indiana Dent Assoc*, 86(2), 16-21.
- Ludwig, K. H., Fontana, M., Vinson, L. A., Platt, J. A., & Dean, J. A. (2014). The success of stainless steel crowns placed with the Hall technique: a retrospective study. *J Am Dent Assoc*, 145(12), 1248-1253. doi:10.14219/jada.2014.89
- Boyd D.H., Page L.F. 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 Mar;28(2):180-188.
- Boyd D.H,et al. A primary care randomised controlled trial of hall and Conventional Restorative Techniques. *JDR Clin Trans Res*. 2020 Jun 19;2380084420933154. doi: 10.1177/2380084420933154.
- Ministry of Health. (2015). *Oral Health Services – Tier One Service Specifications*. Wellington: Ministry of Health. Retrieved from <https://nsfl.health.govt.nz/service-specifications/current-service-specifications/oral-health-service-specifications>.
- Ministry of Health. (2019). *Publicly funded dental care*. Wellington: Ministry of Health Retrieved from <https://www.health.govt.nz/your-health/services-and-support/health-care-services/visiting-dentist/publicly-funded-dental-care>.
- Foster-Page, L. A., Boyd, D. H., Davidson, S. E., McKay, S. K., Thomson, W. M., & Innes, N. P. (2014). Acceptability of the Hall Technique to parents and children. *N Z Dent J*, 110(1), 12-17.
- Ricketts, D. N. J., & Pitts, N. B. (2009). Traditional operative treatment options. *Monogr Oral Sci*, 21, 164-173. doi:10.1159/000224221
- Soncini, J. A., Maserejian, N. N., Trachtenberg, F., Tavares, M., & Hayes, C. (2007). The longevity of amalgam versus compomer/composite restorations in posterior primary and permanent teeth: findings From the New England Children's Amalgam Trial. *J Am Dent Assoc*, 138(6), 763-772. doi:10.14219/jada.archive.2007.0264
- Threlfall, A. G., Pilkington, L., Milsom, K. M., Blinkhorn, A. S., & Tickle, M. (2005). General dental practitioners' views on the use of stainless steel crowns to restore primary molars. *Br Dent J*, 199(7), 453-455; discussion 441. doi:10.1038/sj.bdj.4812746
- Uston, K. A., & Estrella, M. R. (2011). The stainless steel crown debate: friend or foe? *J Mich Dent Assoc*, 93(1), 42-44, 46.
- Vineet, D., Hsu, K.-L., Coll, J. A., Ginsberg, E., Ball, B., Chhibber, S., ... Tinanoff, N. (2015). Evidence-based Update of Pediatric Dental Restorative Procedures: Dental Materials. *The Journal of clinical pediatric dentistry*, 39, 303-310. doi:10.17796/1053-4628-39.4.303
- Yip, H. K., Tay, F. R., Ngo, H. C., Smales, R. J., & Pashley, D. H. (2001). Bonding of contemporary glass ionomer cements to dentin. *Dent Mater*, 17(5), 456-470. doi:10.1016/s0109-5641(01)00007-0