

Use of the Hall technique by specialist paediatric dentists:

A global perspective.

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Hussein I^{1*}, Al Halabi M¹, Kowash M¹, Salami A¹, Ouatik N², Yang Y³, Duggal M⁴,
Chandwani N⁵, Nazzal H^{6,7}, AlBadri S⁸, Roberts A⁸, Al-Jundi S⁹, Nzomiwu C¹⁰, El Shahawy
O¹¹, Attaie A¹², Mohammed O¹³, Al-Sane M¹⁴

¹ Hamdan Bin Mohammed College of Dental Medicine, Mohammed Bin Rashid University of
Medicine and Health Sciences, Dubai, United Arab Emirates

² Faculty of Dentistry - McGill University, Montréal, Canada

³ Chonbuk National University, Jeonju, Republic of Korea

⁴ Faculty of Dentistry, National University Health System, Singapore, Singapore

⁵ Developmental Biology, Harvard School of Dental Medicine, Boston, United States of America

⁶ Leeds Dental Institution, Leeds, United Kingdom

⁷ Hamad Medical Corporation, Doha, Qatar

⁸ University of Liverpool, United Kingdom

⁹ Faculty of Dentistry, Jordan University of Science and Technology, Irbid, Jordan

¹⁰ University of Calabar, Calabar, Nigeria

¹¹ Cairo and Future universities, Cairo, Egypt

¹² The Mount Sinai Hospital, New York, United States of America

¹³ Armed Forces Hospital, King Abd Al Aziz Airbase, Al Khubar, Saudi Arabia

¹⁴ Faculty of Dentistry, Kuwait University, Kuwait

***Corresponding author: email: iyad.hussein@mbru.ac.ae**

Abstract:

Background: The Hall Technique (HT) is popular with United Kingdom paediatric dentists (PDs). Global PDs perception/use of HT is unknown. **Aim:** To investigate global PDs opinions/utilisation of HT. **Materials and Methods:** A cross-sectional questionnaire of 26 questions was sent to specialist PDs across the globe. **Results:** Responses of 709 PDs from six continents were obtained. The majority (n=654, 92.32%), had heard about HT but only 50.6% (n=358) used it, with wide country variations. Respectively, 37.5%, 31.5% & 31% were neutral, against or supportive of HT when initially heard about it. Only 17% of HT users said it was always the treatment of choice for non-pulpal asymptomatic carious primary molars (NPACPMs), 62% would take a pre-operative radiograph, 65% would consider using high speed drills prior to HT, 63% would never consider HT under general anaesthesia, 56% would use HT under N₂O sedation. Finally, in a clinical scenario of a NPACPM in a cooperative 6-year-old, 75% of PDs would choose conventional restorative methods over the HT. **Conclusion:** The HT is recognised, but not used, by an outright majority of PDs across the globe. Identifiable barriers such as lack of training, perception as substandard dentistry and perceived lack of evidence reduced its use.

Key points

Examines treatment planning involving Hall technique preformed metal crowns by global specialists in paediatric dentistry.

Declaration of Interest

The authors declare no conflict of interest. This research received no funding.

Introduction

Single or multi-surface, *non-pulpal asymptomatic caries of primary molars* (NPACPMs) in high risk children have been managed historically by paediatric dentists (PDs) and many general dental practitioners (GDPs) by using preformed metal crowns (PMCs), a superior option in terms of longevity and success rates when compared to plastic restorations.^{1,2} However, the invasive and demanding conventional process, required for placing PMCs, was challenged by the development of the child-friendly non-invasive Hall Technique (HT or HTPMC) in the United Kingdom (UK).^{3,4} Once an appropriate NPACPM is identified clinically and radiographically in a suitable patient, an appropriate PMC is sized and luted on the NPACPM with glass ionomer cement (GIC).³⁻⁵ This usually takes place after a five-day period of placement of elastomeric orthodontic separators (EOSs) used to create space mesially and distally to the tooth.³ HTPMCs prevent sugary substrate from reaching the sealed isolated carious lesion thus arresting it without any need for injections nor tooth mechanical preparation.⁵

Originally developed in a GDP environment,³ the HT was formally introduced to British GDPs in 2006 by the *British Dental Journal*.⁴ However, in 2018, an article in the same journal by Roberts *et al.*⁶ highlighted that almost all UK specialist PDs use HTPMCs. After initial resistance to using the HT in children in the UK, its perception with British dentists changed so dramatically that it had recently been described as the “gold standard” treatment for NPACPMs⁷ owing to a high success rates (up to 93%).³ Despite the strong global evidence supporting the HT (for example from New Zealand⁸ Germany⁹ and the United States of America [USA]¹⁰), strong international scepticism and even opposition towards the HT remained.¹¹⁻¹⁴ Nevertheless, it became apparent that a clinical paradigm shift from conventional surgical methods to more biological modalities (represented by the HT) in treating primary molar dental caries in children had become established.³⁻¹⁰ While the vast

majority of UK children have always been managed and treated by GDPs in the primary dental services, the development of the HT led to the use of PMCs no longer having exclusivity to the specialist PD arena. Thus, emphasising the important complementing role of GDPs and PDs in battling childhood caries, especially in the UK where children's dentistry is generally provided by public health services, and where there are no competing financial interests between GDPs and PDs. While the stance of British PDs in relation to the HT is known,⁶ to our knowledge, no formal study has yet surveyed views and usage of the HT by PDs from all over the world, hence this paper. The aim of this research was to assess global PDs awareness and use of the HT, practical aspects of its use when/if used, the reasons behind the lack of HT utilisation and finally the HT's perceived place in paediatric dentistry.

Materials and methods

This study was a cross-sectional online survey questionnaire comprising of 26 multiple-choice questions developed using the online *Survey Monkey*TM survey tool. The questionnaire was based on a previously ethically approved, validated and published survey.⁶ The original 22 question survey was slightly modified, and other questions based on another published survey¹⁵ were added. The authors of the two aforementioned surveys, also part of this paper's team, had approved the modified use of their questions in this research.

Without alluding to the HT in the survey's title of "*management of carious molars in young children amongst specialists in paediatric dentistry*", the questions covered; a) *demographics*: [country of practice, place/type of practice, job title, year graduated from dental school, years of practice as a PD]; b) *general awareness, opinion and practice of HT*: [have you heard about the HT? do you use the HT? What was your initial opinion when you heard about the HT?]; c) *use of the HT -for those who practice it*: [how long have you been using the HT for? The treatment of choice/conditions for the HT, HT as a treatment option

for different types of carious lesions (cavitated, non cavitated, class I and II lesions), do you place HTPMCs under N₂O inhalation sedation (IHS) and/or general anaesthesia (GA), The HT and the use of EOSs and high speed drills, radiographs and medical contraindications; d) *definitive treatment options using a validated clinical scenario*.¹⁵ [A cooperative six-year-old child with a cavitated non-pulpal distal caries on a lower primary first molar -radiograph provided]; e) *environments suitable for the HT*: [treatment or teaching settings for use of HTPMCs] and finally f) *reasons for lack of use*, if any for those who were aware of the HT. Room for comments were made in some of the open ended questions to add a qualitative component to the study.

The sample size was calculated based on the average ratio of PDs to population based on USA standards. The USA has a population of 325 million with around 2913 PD specialists.¹⁶ Based on global proportions, therefore, expected number of PDs globally would be around 68,000. Using the formula of Cochran's sample size calculation for cross-sectional design (at 95% confidence interval and a margin of error of 5%), the calculation yielded a sample size of 384 and adding 20% of nonresponse the sample size was determined to be 460 participants. Through the authors of this paper, located in various areas around the globe, the online questionnaire was sent to their respective PD specialists' societies/groups. For example, the secretary of the European Academy of Paediatric Dentistry (EAPD) sent out the survey to its members. As the number of PDs in different societies is not in the public domain, we estimated that the survey was sent out to around 1000 PDs. This was an anonymous opt-in survey; therefore, no consent was required. To prevent duplication, the online survey was designed to restrict its completion from the same *Internet Protocol* address to a single time. The only inclusion criterion was that the participant was a practicing specialist PD. The survey was open from the 1st of May 2018 to 28th February 2019. Descriptive data analysis was carried out using the *Survey Monkey*TM analysis tool.

Results

The survey was completed by 709 PDs resulting in a response rate of 70.9%, however it exceeded our power calculation. The results that are presented below are descriptive results only.

Demographics

Fifty six percent of the respondents (n=400) worked in private practice, with the rest in universities, dental teaching colleges, and government health services. Eighty-five percent (n=603) were specialists, with the rest being consultants/professors/chairs. The respondents were from 65 different nations spread across the six continents (Asia: 347, Europe:158, North America: 132, South America 17, Africa 48 and Australia/ Oceania: 7) with the highest number of respondents hailing from USA (117), followed by the Republic of Korea (66) and United Arab Emirates (65); See Table 1. Most of the PDs (63.7%) graduated in 2001 or after, with 56% practicing for less than 10 years.

General awareness, use and opinion of the HT (see Figure 1)

Ninety two percent of respondents reported (n=654) hearing about HT, while only 50.6% (n=358) reported using HT. This was distributed almost equally between those working in the private sector and those working in academia/teaching institutions government health services. When asked about the initial opinion when they first heard about the HT, 37.6% (n=266) reported being neutral, followed by 31.4% (n=223) against/strongly against and 31% (n=220) supportive/strongly supportive of the HT.

Use of HTPMCs.

Out of the 358 participants who reported using HT, the majority (76%, n=272) had been using the HT for less than 5 years. Only 17% (n=61) reported using HT as the gold standard

treatment for NPACPMs, while 54% (n=193) reported using HT as a one treatment option out of many others. In Class I lesions, 68% (n=243) would “never or rarely” use the HT for non-cavitated lesions, while 57% (n=204) would consider using the HT for Class I cavitated lesions. Most HT users would consider HT use in Class II non-cavitated and cavitated lesions (51% and 78% respectively).

When asked about EOSs prior to the HT, a majority (84%, n=300) said they used them with 44% using them “sometimes” and 18% “always”. Many stated that there may not be a need for EOS if spaces are present with qualitative comments like “*if there are tight contacts*” or “*I use EOS always wherever possible but cut slice of enamel when not possible and no space*”. The use of high speed mesial and distal preparations (or both prior) to fitting HTPMCs was also considered acceptable by the majority (69%) with only 31% saying they would never use drills for the HT. The latter point was emphasised with comments like “*it defeats the purpose of the HT as it is meant to be with no drilling*” or “*if done then it is not the HT*”.

Taking pre-HT radiographs were considered acceptable practice by 62% (n=221). In addition, a majority of those who would take radiographs prior to the HT (60%) believed that they should be recent (within a month of fitting the PMC). Qualitative explanatory comments were reported such as: “*as much as possible. If it's not possible I have to make sure that there is no infection or no indication for a pulpotomy*”; “*because two criteria have to be met as per the Innes guidelines a) no periradicular infection b) clear dentine band between cavity and pulp*” and “*ideally yes, but if x-rays not possible, and HTPMC is indicated, then I would provide the treatment regardless*”.

More than a half (52%) thought that there were no medical contraindications to the use of HT. The remaining 48% suggested medical contraindications such as nickel allergy, immunosuppression, immunodeficiency and patients at risk of infective endocarditis.

When asked about the use of the HTPMCs under GA, 64% responded “no” and provided many explanatory qualitative responses such as: *“my usual practice under GA is to prepare the tooth”*; *“long term well conducted studies are needed before this treatment is considered under GA”*; *“why add occlusal interference to the list of problems the child will face when they wake up!?”* and *“if the patient has any problems after GA, no dental committee will support me if I use this option”*. In addition, 59% said they would not place HTPMCs on NPACPMs in a patient prior to a planned exodontia GA. Explanatory comments were provided such as: *“because I have a controlled ideal environment I can do ideal dentistry”*; *“GAs are usually for full dental rehabilitation and not extractions only”* and *“usually no. But it could make sense to decrease operating time”*.

When asked about the use of HTPMCs under IHS (N₂O), 57% responded “yes” and provided explanatory comments such as *“we slice with highspeed and use fluoride (SDF) with a HT under IHS”* or *“we routinely do this when indicated to complete all the needed treatment efficiently”*; *“one of the indications of HT is behaviour of children. If any kind of sedation is used, then better to do a conventional PMC if indicated”* and *“I prefer conventional techniques. but can plan for HT in very limited cases, since inhalation sedation is very safe where indicated”*.

Clinical scenario responses

The users of HT were given a clinical scenario (See figure 3) and were asked what their final choice restorative choice would be. The majority (75%) chose a conventional restorative

approach (composite, GIC, conventional-PMC, amalgam, Zirconia crowns) over the HTPMC approach.

Settings for HTPMCs use

With regards to the setting most appropriate for HTPMCs, the highest responses were 62% for the specialist practice setting and 59% for postgraduate training, as opposed to 33% for the GDP setting and 28% for undergraduate training. Four percent of the participants said that it should never be used in dentistry, with qualitative statements such as “*poor, inappropriate or substandard dentistry*” or that “*the HT does not meet with any standard of current dentistry*”. Those who taught paediatric dentistry (n=288) were asked if they taught the HT and to whom; 43% said to postgraduate dental residents, 33% to GDPs while 32% said they would never teach the HT.

Reasons for lack of use of the HT

The final question of the survey aimed to assess the barriers to the use of HTPMCs. Out of the total sample (n=709), around a third of PDs (27.4%) reported lack of sufficient evidence supporting the effectiveness of the HT, with qualitative comments like “*difficult to revisit when failure occurred*” or “*it is sloppy dentistry, and the research published was biased comparing crowns with restorations... never was published a long term study of longevity of those crowns while there is a large bibliography of the performance of conventional stainless steel crowns with a success of over 95% after 5 years*”. On the other hand, 22% reported not being confident in using the HT, due to it not being taught in undergraduate or postgraduate courses with repeated comments like “*I heard about the HT and would like to use it but was never taught it in my residency*”. On the other hand, 17% believed the HT was substandard dentistry. Very strong emotive qualitative comments were noted here such as “*Hall crowns are an absolute joke-If you cannot properly place a stainless-steel-crown on a child you*

either chose the wrong profession or your speciality program needs to stop handing out certificates” and “I’ve seen overtreatment, were tiny interproximal cavities were treated with the HT. I’ve seen overestimation of the possibilities of HTPMC, where teeth were treated which needed pulpotomies. I believe that if a child is cooperating enough to perform a HTPMC, there probably is a possibility to do a normal treatment as well”. A small proportion (11.73%), reported reasons such as lack of payment from insurance companies, parent preference, and non-acceptance of metal crowns with comments like *“many insurance companies only pay for PMCs providing a pulpotomy of pulpectomy was carried out”.*

Discussion

Our study aimed to assess the perception of the HT by a sample from the global PDs community. The survey’s response rate exceeded our calculated sample size which may have been the result of the multi-author team approach in which authors were geographically distributed across the globe thus increasing the number of participants. Nevertheless, we only report the results that we have as a tiny sample from the global PD community. We acknowledge that this sample size is unrepresentative of the countries surveyed; as the number of PDs per country, or even continent was inadequate and unequal. This was a limitation of this study. However, to our knowledge, this is the largest survey involving PDs from all around the world and had a fair mixture of private and public sector PDs. Such mixture represented the working systems in different geographic area as PDs in the USA mostly work in the private sector,¹⁶ while most PDs in the UK work in the public sector of the UK’s National Health Service (NHS).⁶

The results of this study suggested that almost all the global PDs surveyed knew about the HT, but its use did not match that knowledge, which was similar to other reports.¹⁵ While

only half of our sample said they used it, this pattern varied from country to country. For example, 60% of the 117 USA PDs surveyed used it compared to only 10% of 66 PDs from South Korea; both figures were below that reported by the UK component in our study (84%) and that of other UK studies (96% of PDs).⁶

The current study showed that HTPMCs were not considered the “gold standard” choice when dealing with NPACPMs, which was a similar finding to Roberts *et al.*⁶ and fits with current guidance¹⁷ that places it as a tool out of many in the armamentarium to restore the primary molar. This finding was further emphasised in the given clinical scenario (Figure 3.), as it was clear that only 25% of HT users would choose the HTPMC over conventional restorative methods in a case deemed ideal for the HT. Similar results were reported in 150 dentists treating children in the Gulf Cooperation Council area in the Middle East.¹⁵ Our findings suggest a lack of confidence in the HT in the global PD community, as almost a half of them reported insufficient evidence supporting the use of the HT as the main barrier. Moreover, more than a third believed that the HT should be used only in remote areas where there is no access to full dental facilities, despite the studies showing a success rate of 92% or higher when using HT.^{3,8-10,17} The survey highlighted many unfavourable comments about the HT, despite the strong supportive evidence of this technique. This may reflect the fact that those opposed to the HT were more vocal in tabling their opinions, than those who were in favour of it. It was disappointing that so many respondents had such incomplete understanding of contemporary cariology⁵ and existing literature regarding the various methods of managing the carious primary molar of which the HT is only but one.^{3,10,17} Indeed, to date there has not been any evidence to suggest that the HT has a success rate below 90%.

In addition, the lack of enthusiasm or support for HTPMCs as a treatment prior to or under GA in children was evident in our survey which shows the exact opposite results of the

finding of Roberts *et al.* 2018.⁶ It was apparent, from many of the qualitative responses received that GA was used globally for “comprehensive restorative care” only, and the category of GA lists for “exodontia only” did not really exist,¹⁴ as is the case in the UK.¹⁸ Therefore, global PDs felt that the best approach for restoring primary teeth under GA was the conventional restorative method of removing all caries. It is important at this point to highlight that, in the absence of studies supporting the use of HT under GA, this is a grey area at present. The HT manual¹⁹ does not suggest that HTPMCs should be placed under GA, leaving its use to personal interpretation and future research.

Our study showed that most HT users, had confidence in the HT when using N₂O IHS. While this is also not one of the recommendations,^{17, 19} this finding was in line with the outcome found by Roberts *et al.* 2018.⁶ Interestingly, using the HT in combination with N₂O IHS is not new, and indeed was found to be highly successful in a retrospective study in the USA.¹⁰ This suggested that there was a belief that unlike GA, taking a risk with the HT and IHS was an acceptable option. Any complications that may arise could be managed without exposure to a relatively higher risk procedure such as GA.

Innes *et al.* 2009,²⁰ detailed the types of cavities appropriate for HTPMCs. They stated that these included *a*) Class I lesions, non-cavitated (if patient unable to accept fissure sealant, or conventional restoration), *b*) Class I lesions, cavitated (if patient unable to accept partial caries removal technique, or conventional restoration), *c*) Class II lesions, cavitated or non-cavitated.²⁰ This current study showed that using the HT in non-cavitated and cavitated NPACPMs drew different results, with a tendency for PDs to prefer using the HT in cavitated lesions compared to non-cavitated lesions, and also approximal lesions compared to occlusal ones. For example, 68% of HT users would “never” or “rarely” use it in non-cavitated Class I lesions. This agreed with current guidelines¹⁷ that suggested that Class I non-cavitated lesions, although treatable by the HT, are best treated by other methods such and prevention

alone or fissure sealants. On the other hand, a smaller proportion of HT users (21%) would “never” or “rarely” use it in Class II cavitated lesions. This suggested that the majority were more inclined to use the HT in such case, which was in direct agreement with the guidelines¹⁹ and previous studies.^{3,6,8}

Regarding radiographs, many PDs in this study would, unless the child is uncooperative, obtain a pre-operative radiograph prior to the HT and ideally within one month of the proposed treatment. Taking bitewing radiographs increases the sensitivity of diagnosis of caries between 167% to 800%.²¹ Our results are in line of the HT manual¹⁹ and relevant guidelines,¹⁷ although as qualitative assessment of the comments pointed out, obtaining these images can somewhat be tricky. Some PDs would even provide the treatment based on their clinical judgment alone in such cases where cooperation was not forthcoming, an outcome similar to that of Roberts *et al.* 2018 study.⁶

One additional finding was that most HT users in our study did not think there was a medical contraindication for using the HT. This is somewhat concerning, as the HT manual¹⁹ clearly stated that some patients, like those at risk from infective endocarditis, were not to receive HTPMCs. This highlighted a need for supportive education.

Finally, the majority PDs in our study were inclined to consider or use EOSs prior to the HT to create sufficient space, which is in line with Roberts *et al.* 2018 study.⁶ While this is a recommended norm,^{17,19-20,22} and the use of EOS should be pragmatic,⁶ many researchers stated that they did not use EOSs at all,²³ instead employing high speed preparations to open the spaces.¹⁰ Indeed only 31% of those PDs surveyed in our study would “never” use high speed instrumentation prior to the HT, suggesting a tendency for global PDs to use high speed instrumentation or a “modified version of HT”. Although this intervention contradicts

the HT manual instruction,¹⁹ the “modified HT” has recently been reported in Germany to be as successful as the conventional HT.²⁴

It was disappointing to see such opposition to the HT. Despite it entering its second decade of use in practice,²⁵⁻²⁷ being found to be effective as,²⁸ and more economical than,²⁹ conventional methods, the global controversy of HT remains.³⁰ As highlighted above, the HT may be used by GDPs or PDs. It may be suggested that PDs, especially in the private sector, may be against the HT because they were protecting their “closed shop” financially and were concerned that approving the HT will mean they will lose income to GDPs, therefore justifying their position. Our research did not investigate the financial side of the HT, found elsewhere to be more economical than conventional methods,^{29,31} but almost half of those surveyed in our study -whose work was in the private sector- did not use the HT. From private discussions of the authors with many PDs around the world, this point had been anecdotally noted. What was interesting in this research that some of most vocal opposing comments came from academics and senior teachers in paediatric dentistry in some parts of the world. Nevertheless, the HT had been introduced to the undergraduate³² and postgraduate^{9,33-34} curricula in dentistry in some parts of the world and had been shown to be successful for the lifetime of the primary molar³⁵ -even up to eight crowns in one single patient.^{22,36}

The evidence continues to mount in favour of the HT. In June 2019, a newly published randomised control trial in Sudan showed that the HT and conventional PMCs have very successful outcomes (over 90%) over 2 years³¹. Until the HT achieves strong endorsement rather than a mere mention in the online published guidance³⁷ of eminent societies (followed by global PDs- such as the *American Academy of Pediatric Dentistry*³⁷), the controversy as shown by this paper will continue. Even then, and despite the evidence and guidelines, barriers to moving knowledge to action in managing the carious lesion will remain.³⁸

Conclusion

The HT is recognised by an outright majority of PDs across the globe, but only over a half of those surveyed use it. Barriers such as lack of training, perception as substandard dentistry and perceived lack of evidence were identified. The use of conventional restorations remains preferred even amongst HT users.

“In brief”:

- The very successful Hall Technique is popular with UK dentists for managing caries in children.
- Albeit highly aware of the HT, only half of global specialist paediatric dentists use it.
- Most global PDs favour conventional drill/fill restorations over the HT.

| | Countries | Total (%) |
|---------------|---|------------|
| Asia | South Korea (66), UAE (65), India (37), Saudi Arabia (34), Jordan (34), Kuwait (28), Syria (24), Singapore (22), Qatar (11), Israel (6), Turkey (5), Indonesia (3), Bahrain (3), Lebanon (3), Pakistan (2), Nepal (2), Georgia (1), Malaysia (1) | 347 (49) |
| Europe | Greece (29), UK (20), Belgium (18), Netherlands (9) Germany (8), Italy (7), Spain (5), Romania (6), Ukraine (5), Cyprus (4), Portugal (4), France (4), Norway (4), Slovenia (4), Poland (3), Switzerland (3), Bosnia & Hertz (3), Czech (2), Serbia (2), Austria (2), Sweden (2), Russia (2), Croatia (2), Bulgaria (2), Lithuania (2), Ireland (1), Denmark (1), Ireland (1), Finland (1), Latvia (1), Hungary (1) | 158 (22.3) |
| North America | USA (117), Canada (8), Mexico (6), Honduras (1) | 132 (18.6) |
| Africa | Nigeria (25), Egypt (22), Sudan (1) | 48 (6.8) |
| South America | Peru (5), Brazil (4), Chile (2), Ecuador (2) Venezuela (2), Columbia (1), Uruguay (1) | 17 (2.4) |
| Australia | Australia (5), New Zealand (2) | 7 (0.9) |
| | | 709 |

Table 1. The geographic distribution of the participant paediatric dentists.

Figure captions:

Figure 1. The perception of the Hall Technique amongst global paediatric dentists (N=709). Abbreviations in the text.

Figure 2. The opinions and practice of users of the Hall Technique (n=358). Abbreviations in the text.

Figure 3:

Scenario: A fit and healthy cooperative 6-year-old has asymptomatic non-pulpal DO caries on tooth 74. What would your final treatment choice be for this tooth? (Options given: HTPMC, amalgam, composite, GIC, conventional PMC, zirconia crown) (scenario and image adapted from Hussein *et al.*¹⁵)

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