

# Caries and the older patient

## Learning outcomes

- Readers will learn that Irish population demographics are rapidly changing. Dental practitioners will be expected to maintain ageing, heavily restored and compromised dentitions for longer, in the context of a population with a high caries index, compared to our European counterparts.
- Skilful management of dental caries in the older adult starts with accurate caries diagnosis using tools such as Cariogram, CAMBRA and ICDAS. A focus on non-operative caries management strategies is the cornerstone of successful treatment.
- When operative caries management is required, the most minimally invasive excavation techniques are recommended, while repair and refurbishment of existing restorations is advised when managing secondary caries. Readers will see step-by-step clinical photography illustrating contemporary evidence-based, minimally invasive excavation techniques.

## Introduction

Population ageing is global and pervasive in Ireland. We can expect to see the proportion of the population aged over 65 grow to nearly 30% in the next 30 years. Along with this, we have seen a reduction in tooth loss; therefore, we will be managing increasing numbers of partially and fully dentate older adults in dental practice. Older adults in Ireland have high levels of past caries experience, and root caries is almost exclusively a disease seen in this particular cohort. Preventing and managing caries in older adults with heavily restored dentitions will bring both treatment planning and operative challenges to the dental profession.

## Background

Projections by the Central Statistics Office (CSO) for the Pensions Board indicate that life expectancy at age 65 years is expected to increase for both males and females, and the proportion of the population aged over 65 years is projected to rise to 17% by 2026. This is increased from 11% of the population aged over 65 in 2005. This trend is set to continue through to 2056, by which time it is estimated that those aged over 65 years will comprise 29% of the Irish population.<sup>1</sup> This projected pattern of Irish population ageing will have profound consequences for Irish dentistry. Older adults in Ireland have a high caries experience. The most recent National Oral Health Survey (NOHS) reported the mean Decayed Missing Filled Teeth (DMFT) score of those aged 65 or older as 25.9.<sup>2</sup> This was higher than other European countries at the time but, most alarmingly, the proportion of total DMFT score attributable to tooth loss was substantially higher at 88%. By comparison, the UK and Germany were approximately 50% around the same time period.<sup>3</sup>

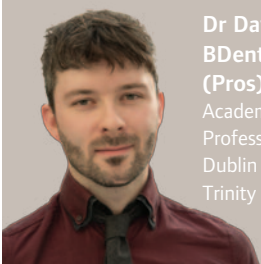
We have not had an NOHS conducted since 2002; however, there have been some recent studies on the oral health of older adults in Ireland. Inclusion of an oral health exam in the TILDA study captured data on 1,286 older adults and reported a mean DMFT of 24.4 and a mean Root Caries Index (RCI) of 9.1.<sup>4</sup> Similarly, a study into root caries in older adults conducted in Cork reported a mean DMFT of 23.5 and a mean RCI of 9.5.<sup>5</sup> It is important to note that both of these studies recruited community-dwelling older adults, and they do not reflect oral disease levels among those in residential care, which may be far higher. From these studies it is clear that older adults in Ireland have a high level of caries experience. In addition to this, the World Health Organisation (WHO) has predicted that existing oral health inequalities are likely to widen as a result of the Covid-19 pandemic, which caused widespread disruption in public-funded oral healthcare delivery.<sup>6</sup> Even without data, it is reasonable to assume that nursing homes in particular were likely to have been affected particularly badly.

## Risk assessment

As caries is not randomly distributed within the older population, many researchers have attempted to identify factors that may predispose an individual to the disease. Caries is a preventable disease; however, access to care, compliance issues, and cost may preclude the use of a preventive intervention on the entire population. As an example, it is known that one-third of the older adult population bears most of the root caries burden.<sup>7</sup> Therefore, if these individuals could be identified prior to developing the disease, targeted prevention measures could be delivered. Two caries risk assessment tools have been validated in a number of older adult populations. The first of these is the Cariogram, which is an interactive computer-based risk assessment model developed in Sweden.<sup>8</sup> The programme contains an algorithm that is expressed in a pie chart, explaining the extent to which different aetiological factors of caries affect the individual's caries risk, and can guide strategies for prevention.

The Cariogram was evaluated in an Irish setting on a group of older adults and was shown to be clinically useful in identifying individuals who would develop caries over a two-year period. Patients categorised as high risk, on average, developed two new root carious lesions, compared to those in the lowest risk group, who had a mean root caries increment of 0.04.<sup>9</sup>

The benefits of the Cariogram are that it is free (the software and manual are free to download to your computer) and the pie chart that is generated can be used as an effective patient education tool to show the impact that dietary or oral hygiene routine changes could have on caries risk. The disadvantages are that it can be time consuming to complete, and involves saliva testing kits, although the model has



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been shown to be a good predictor even when these saliva tests are not entered into the model.<sup>9</sup>

Caries Management by Risk Assessment (CAMBRA) is another well-known caries risk assessment tool. This was developed in the early 2000s in San Francisco, and is a paper-based assessment form, which categorises patient caries risk and suggests a caries management strategy based on that information.<sup>10</sup> CAMBRA includes risk factors that are particularly relevant to older adults including medications with xerostomic potential, removable dental appliances, and exposed root surfaces. However, CAMBRA has not been validated among older populations as frequently as the Cariogram.

### Prevention

Caries is a lifelong, progressive, and cumulative disease that undermines the mechanical integrity of the affected dentition and leads to tooth loss. Thus, non-operative measures aimed at delaying, curtailing, and preventing carious lesion formation are at the heart of caries management strategies. Non-operative measures should be focused towards dietary changes, fluoride exposures, and improvements in oral hygiene.

Dietary free sugar intake is the principal risk factor in carious lesion formation. The evidence base suggests that carious lesion formation follows a dose-response curve, whereby, as free sugar intake increases, so does carious lesion incidence. Therefore, any measures that can be taken at patient level to reduce or restrict both the sugar frequency and sugar quantity consumed can result in effective arrest of carious lesions. To achieve total arrest, sugar intake should ideally be less than 5% of total dietary energy intake. However, diets are habitual and tend to be emotionally comforting; therefore, achieving sustained, patient-level dietary behavioural change can be very difficult. Positively framed and personalised dietary counselling is likely to be the most helpful approach in changing patients' dietary habits.<sup>11</sup> Good dental dietary advice should align with good general health dietary advice. With this in mind, patients should be guided towards diets that are rich in protein, fruits, and vegetables, as well as starchy staple foods, such as wholemeal bread, rice, pasta, potatoes, and unsweetened wholemeal cereals (porridge, Shredded Wheat, or Weetabix). Sugar-laden, fat-laden, and highly processed foods should be minimised. It is not enough to guide patients away from problematic foods; personalised, healthy substitutes should be recommended to patients. Similarly, dietary counselling should occur repeatedly and patient engagement is required for the process to be effective.

Fluorides reduce caries risk but do not eliminate risk completely.<sup>12</sup> Nevertheless, fluorides are one of the most effective tools at a dentist's disposal, which can be used to shift the balance of carious lesion formation from demineralisation towards remineralisation. As with dietary sugar intake, fluoride's effectiveness follows a dose-response curve, whereby increases in fluoride concentration and application frequency result in reduced DMFS scores.<sup>13</sup> Vehicles for fluoride delivery include water, toothpaste, mouth rinses, and professionally applied varnishes. It is sensible to intensify fluoride application in high-risk patients until their caries risk stabilises. Dentists should consider prescribing products such as Duraphat 5,000ppm fluoride toothpaste, where one tube should last the patient one month. Such pastes replace over-the-counter toothpastes and their effect is entirely topical. So long as patients are instructed to expectorate excess paste following use, systemic side effects are negligible. Professionally applied fluoride varnishes reach concentrations of 22,600ppm and are very effective at reducing caries rates when applied at three-month and six-month intervals. The best time to apply such varnishes is during dental examination, as their effect is optimised

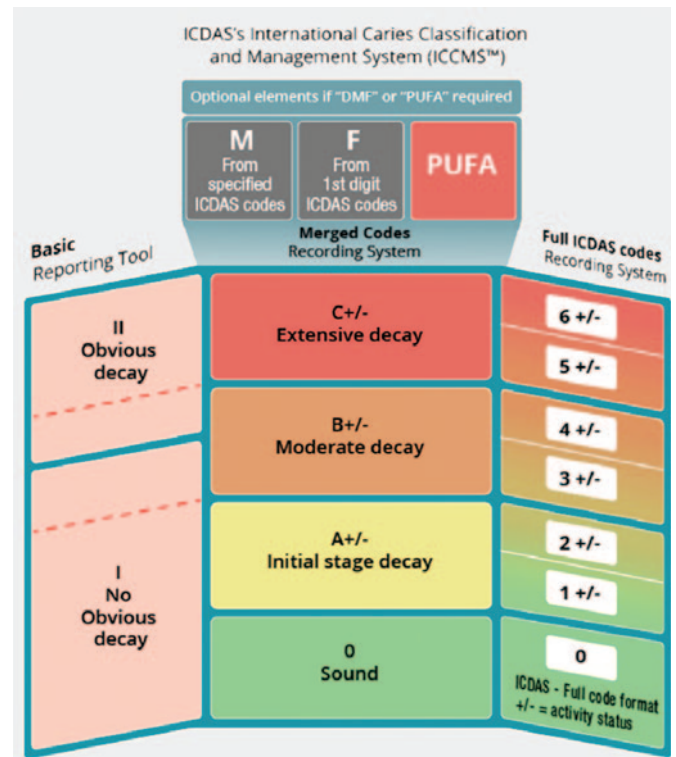


FIGURE 1: At present the majority of dentists are using a Basic Reporting Tool for dental caries diagnosis (left column), which is dichotomous in nature. It would be sensible for clinicians to adopt the ICDAS Merged Codes Recording System (middle column). This means that clinicians will fundamentally have to work harder in their diagnosis of dental caries but, in doing so, will tend towards more conservative management strategies for dental caries, which will ultimately improve patient outcomes.

when applied to clean, dry, and isolated teeth, which concordantly represents the best circumstances to assess a dentition for carious lesions.

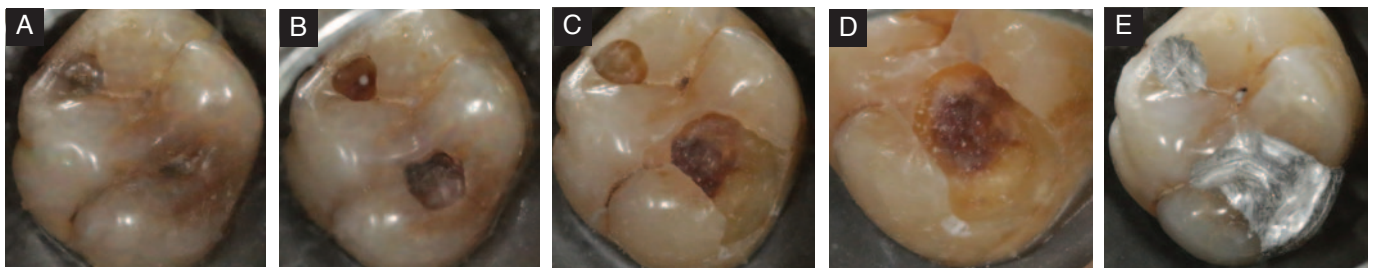
It is impossible to eliminate dental plaque completely; however, optimised oral hygiene practices aimed towards the repeated mechanical disruption of polymicrobial biofilm, such that the biofilm remains immature, results in the curtailment of carious lesion formation. Meticulous toothbrushing with a manual or powered brush, and the use of interdental brushes, such as TePe brushes, remain the most effective measures for dental plaque control.<sup>14</sup> High-caries-risk patients may benefit from supportive periodontal therapy at increased intervals where plaque control can be reviewed and tailored, professional tooth and root surface debridement can be implemented, and professional fluorides can be applied to the dentition. Such approaches have been reported to be effective at controlling caries rate in addition to controlling periodontal disease.<sup>15</sup> The highest risk patients may benefit from such professional interventions as often as every three months.

### Operative management of coronal carious lesions

Prior to operatively managing a coronal carious lesion, it is sensible to precisely diagnose the extent of the carious lesion and to consider if operative intervention is even necessary. At present, the majority of dentists are using a Basic Reporting Tool for dental caries diagnosis, which is dichotomous in nature and surprisingly vague compared to more precise diagnostic algorithms (Figure 1). The International Caries Detection and Assessment System (ICDAS) offers precision



**FIGURE 2 :** In Figure 2A, the pre-operative presentation of the UR5 and UL6 illustrates ICDAS II Code 04 inactive carious lesions. A very common clinical presentation in routine general dental practice, it is questionable whether such inactive, non-cavitated carious lesions require direct filling at all, even when the carious lesion breaches dentine. However, as these teeth were to act as partial overdenture abutments (Figures 2B and 2C), a clinical decision was made to conservatively restore these carious lesions (Figure 2B) in order to create predictable foundation conditions for a partial overdenture. (Treatment completed prior to the Minamata Convention on mercury.)



**FIGURE 3:** Close-up step-by-step documentation of the selective caries excavation technique for tooth UL6 from Figure 2A. Successful restorations rely upon the development of sound enamel and dentine margins at the amelodentine junction, which subsequently create conditions for a hermetic seal. Importantly, so-called caries-infected and caries-affected dentine may be left behind at the pulpal wall without fear of caries progression, pulpitis or pulpal obliteration.

when both diagnosing and understanding the extent of a carious lesion. Where carious lesions remain non-cavitated, as is the case in ICDAS II codes 01-04, or initial to moderate stage decay, there may be little value to operative management strategies (Figures 2A-2C). That is; operative intervention is mainly useful in cavitated situations where the purpose of a direct filling is to simply facilitate oral biofilm control through effective patient-level toothbrushing.

It is important to understand that operative interventions such as direct fillings do not prevent future tooth decay. If anything, direct fillings tend to mechanically weaken teeth and predispose teeth to fractures, which tend to be complicated, time-consuming, expensive, and unpredictable to manage.<sup>16</sup> Unless it is absolutely necessary for facilitating oral biofilm control, for foundation restoration, or to aesthetically improve an unacceptable appearance, the best filling is no filling at all. While this has been well known in the literature for many years, translating such an approach to clinical practice has remained elusive.<sup>17</sup>

When direct fillings are deemed clinically necessary, practitioners should use the most minimally invasive, selective caries excavation techniques, with a view towards preserving pulpal health, as much natural tooth structure as possible, and optimising restoration performance.<sup>18</sup> With this in mind, rubber dam isolation creates ideal moisture control conditions and facilitates aseptic technique, which is beneficial even when the pulp is not directly exposed (Figure 3A). Carious and undermined enamel should be excavated with a diamond fissure-type bur in a high-speed handpiece under copious water coolant (Figure 3B). The peripheral amelodentinal junction should be cleared to hard, sound dentine, using the largest sterile rosehead bur that will fit into the carious cavity at slow speed with copious water coolant (Figure 3C). Subsequent caries excavation should be completed using a sequence of sterile rosehead burs, from largest to smallest. A small bur can seem more conservative, but in fact tends to be more destructive when excavating soft caries, as such instruments tend to gouge into demineralised dentine, risking iatrogenic pulpal exposure. Unsupported enamel may be removed with a diamond

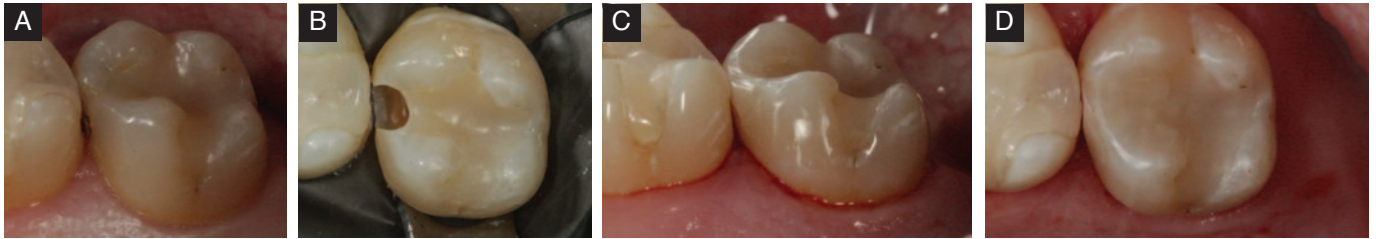
fissure bur. Most importantly, caries at the pulpal walls need not be excavated at all, providing there is sufficient cavity depth to retain a restoration with mechanical integrity (Figure 3D).<sup>19</sup> Indeed, even so-called caries-infected dentine can be left behind if advantageous in preventing pulpal exposure, so long as a hermetic seal is achieved from a well-placed and well-fitted restoration to sound enamel and dentine margins (Figure 3E).

Similarly, when managing secondary coronal carious lesions, practitioners should consider using methods that preserve tooth structure, such as filling repair techniques rather than total filling replacement (Figures 4A-D).<sup>20</sup> Such procedures recognise that it is no longer deemed necessary to entirely remove an existing restoration from a tooth when managing secondary caries. Such procedures only result in an iatrogenic loss of tooth structure to the detriment of the long-term prognosis of the tooth. It is now recognised that so long as sound enamel and dentine margins are developed, such that a peripheral hermetic seal can be created and a restoration with good mechanical integrity can be placed, no further removal of tooth structure or existing filling material need occur.

### Operative management of root carious lesions

Restoration of a cavity that extends onto the root surface is challenging as they may exhibit mixed cavity margins positioned in enamel as well as dentine, and there are few if any restorative materials that bond equally well to both dental tissues. Furthermore, there is a constant flow of gingival crevicular fluid to battle, as well as frequently inflamed gingiva in the area of the cavity, which bleeds easily on probing and manipulation. The cavities themselves tend to be broad, shallow, and saucer shaped, travelling around the circumference of the root. This results in a cavity form with little to no mechanical retention compared to Class I or Class II cavities (Figure 5).

With all this considered, it is unsurprising that restorations placed in root carious lesions perform poorly compared to coronal restorations. A systematic review



**FIGURE 4:** Close-up step-by-step documentation of a filling repair. Class II cavitated caries (ICDAS II 06/extensive stage decay) is visible in Figure 4A. It is no longer deemed necessary to remove an entire existing restoration in order to treat secondary caries. Rather, the filling repair procedure again relies upon the development of sound restorative margins (Figure 4B) and a hermetic seal in the subsequent restoration (Figure 4C–4D).



**FIGURE 5:** A typical root carious lesion with margins in both enamel and dentine and a shallow saucer-shaped form, lacking mechanical retention, with adjacent inflamed gingiva. Restorations placed in such conditions tend to fail mechanically or by debond. It may be better to attempt to arrest certain root carious lesions using non-operative strategies.

reported failure rates of between 17% and 36% at 12 months for restorations placed in carious class V lesions.<sup>21</sup> In fact, only one study had high success rates at the two-year follow up, but this study used amalgam as the restorative material, which is not a long-term option for dentists following the Minamata Convention on Mercury. Overall, the aforementioned systematic review showed that glass-ionomer cements or resin-modified glass-ionomer cements tend to fail mechanically but may confer a protective effect against recurrent caries. Conversely, resin-composite restorations tended to remain present but had a very high incidence of recurrent caries. This is likely reflective of the less predictable bond to dentine and the challenges in isolation when a cavity extends to or beyond the gingival margin level.

Atraumatic restorative technique (ART) may be a particularly useful and attractive approach in the management of root caries lesions. It allows for conservative spoon excavation of any caries-infected dentine, followed by the placement of a high-viscosity glass-ionomer cement and a protective coating or varnish. ART generally does not require local anaesthesia or conventional drilling, and can be performed in a domiciliary setting for patients who cannot attend the general dental practice. The limited data we have in this area has shown that ART restorations may be at a higher risk of failure than conventional restorations of root caries lesions in older adults.<sup>22</sup> We need to balance this, however, against the potential for this approach to deliver dental care to older adults who may not otherwise be able to access it.

## Conclusions

Caries levels among older Irish adults are high. Ideally, we should use a minimal intervention approach of risk assessing our patients and implementing appropriate caries prevention regimes. When operative intervention is deemed necessary, we should consider the use of the most minimally invasive, selective caries excavation techniques, as well as repairing and preserving existing restorations where possible.

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