

Minimum intervention dentistry for the management of caries in older adults: a review of the literature

Précis

This literature review presents evidence supporting aspects of minimum intervention dentistry (MID) for older adult patients.

Abstract

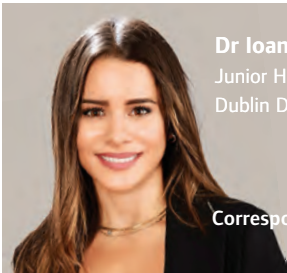
Statement of the problem: The population is ageing and the proportion of older adults retaining their natural teeth is increasing. This means that there are increasing numbers of older adults at risk of and from dental caries for longer. This challenges traditional concepts of care delivery for older adults. With advances in the understanding of the pathogenesis of dental caries, there is increasing evidence to support a shift from traditional mechanical 'drill and fill' techniques to the management of dental caries biologically as a complex ecological process. Minimum intervention dentistry (MID) has become an increasingly mainstream model of caries management, which minimises the need for treatment that destroys dental tissues. In contrast to traditional management of caries, MID focuses on prevention and risk reduction, while surgical intervention is limited to cases where it is absolutely necessary. This paper reviews the evidence to support adoption of MID, particularly for older adults in Ireland.

Purpose of the study: To review the evidence regarding aspects of MID for caries management among older adults.

Materials and methods: A structured search strategy was undertaken using PubMed, Google Scholar and the Cochrane Library, with additional searching of reference lists. A total of 25 articles were deemed relevant to this literature review. The data was extracted and tabulated. The outcomes and quality of the studies were reported narratively. Weaknesses and clinical implications are discussed.

Conclusions: MID can be recommended for older adults. This review supports the use of topical fluorides in varnish, rinses and high-fluoride toothpaste to prevent dental caries in older adults, and the restoration of caries adopting the atraumatic restorative technique (ART). There was insufficient evidence regarding the effectiveness of oral health education. No studies were identified looking at the effectiveness of caries removal techniques, the resin infiltration technique, or the repair rather than replacement of restorations for older patients.

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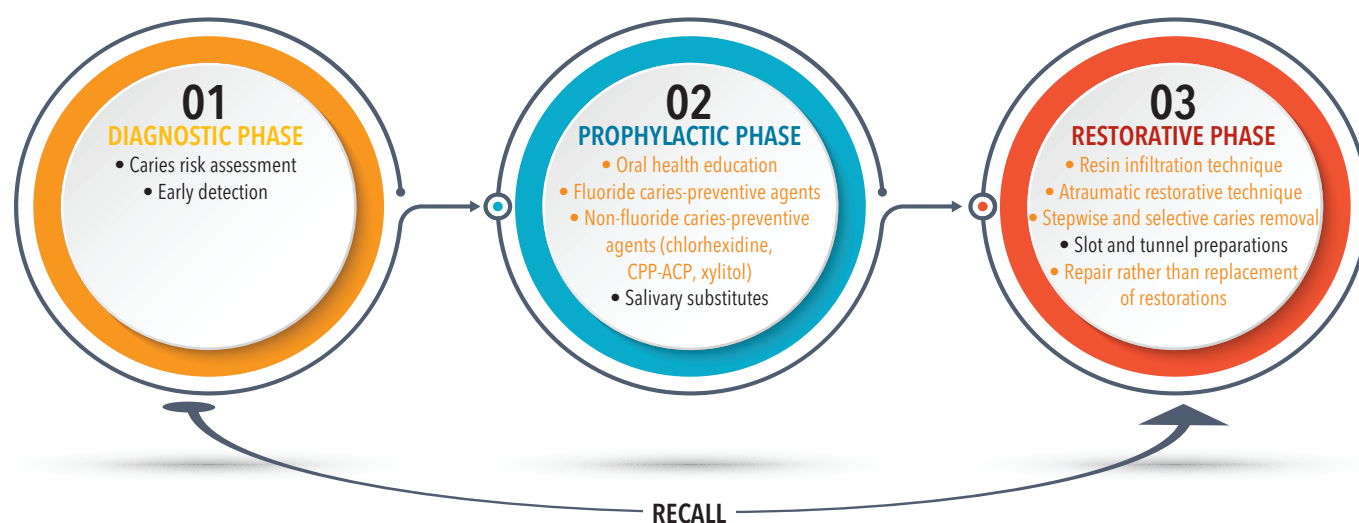


FIGURE 1: MID phases [Elements of MID reviewed in this article highlighted].

Introduction

Old age is often defined as having a chronological age of 65 or older.¹ Over the last 15 years, the proportion of the Irish population over 65 years of age has increased by 19.1%, the greatest increase of any demographic over this time.² This proportion is predicted to continue to rise for the foreseeable future. The World Health Organisation (WHO) estimates that by 2050, two billion people will be aged 60 and over.³ These statistics represent massive societal change, and challenge traditional social and economic structures, particularly as families reduce in size and the age dependency ratio shifts towards higher numbers of dependent people compared to those of working age.

Older people may be at increasing risk of the biopsychosocial consequences of age-related syndromes such as multimorbidity, polypharmacy, frailty and increasing dependency. For the dental profession, such issues may impact communication, consent and access to dental care, while complicating safe and effective treatment of oral disease. Readers are encouraged to explore the Seattle Care Pathway, which considers the implications of these issues in depth.⁴ In addition, the number of older adults retaining their natural teeth is increasing.⁵ Older people who may not have been expected to survive, let alone prosper for long periods, are at ongoing risk of common oral diseases such as dental caries, periodontal disease and tooth loss for potentially extended periods of old age.⁶⁻⁹ This means that the dental profession is increasingly tasked to support growing numbers of older patients to maintain their dentitions, in increasingly complex social and medical contexts.

Caries management is currently in the grip of a paradigm shift from traditional mechanical 'drill and fill' techniques towards the treatment of dental caries biologically as a complex ecological process.¹⁰ Our improved understanding of caries as a dynamic process of demineralisation and remineralisation has led, over the last 40 years, to the development of concepts, procedures and materials that can assist clinicians in the prevention, early identification and conservative management of caries.

Minimum intervention dentistry (MID) has become an increasingly mainstream model of caries prevention and management, which minimises the need for treatment that destroys dental tissues. In MID the emphasis is on preventing disease, while surgical intervention is limited to cases where it is necessary.¹¹ Similar concepts can also be applied to the management of periodontal disease.¹²

MID can be considered across three phases: diagnostic, prophylactic and restorative (Figure 1).¹³

With the rise of evidence-based practice, dental professionals and the public are increasingly aware of the ethical and professional obligation for use of best evidence to support patients.²⁶ Despite growing recommendations of the use of MID techniques,^{13,27,28} there is evidence that MID is not being widely adopted by dentists.²⁹⁻³¹ To encourage dental professionals in Ireland to consider MID as a viable treatment philosophy, particularly for older adults, we review the literature that supports this approach. Our research question asks: 'Does MID work for the management of caries in older adults?'

Methods

A literature search was undertaken using the following databases: PubMed; Google Scholar; and, the Cochrane Library. The terms used to guide the search were: "minimum intervention", AND "dentistry OR dental", AND "older adults OR elderly", along with more specific terms such as "fluoride", "preventive measures", "remineralisation of tooth structure", "oral health education", "non-fluoride caries preventive agents", "chlorhexidine", "casein phosphopeptides-amorphous calcium phosphate", "xylitol", "minimally invasive operative interventions", "atraumatic restorative technique", "minimal caries removal techniques", "stepwise excavation technique", "partial excavation technique", "selective caries removal", "resin infiltration technique", and "repair rather than replacement of restorations". Identified studies were reviewed and data was tabulated. The outcomes and quality of the studies were reported narratively. This section reports the findings of this review based on the stages of MID (Figure 1).

Results

A total of 25 articles from the search of the databases and associated reference lists were deemed relevant to this literature review. In all, 13 studies related to topical fluorides, five related to chlorhexidine and five related to the atraumatic restorative technique (ART). A Cochrane review related to oral health education and a systematic review related to silver diamine fluoride (SDF) were also included.

Table 1: Studies reporting on effectiveness of fluoride for prevention and/or arrest of caries in older adult patients.

Author	Study design (n)	Intervention	Duration	Outcome
WATER FLUORIDATION				
Hunt <i>et al.</i> , 1989 ⁷⁷	Prospective cohort (520)	The effect of long-term residence in fluoridated vs non-fluoridated water communities	18 months	Coronal and root surface DFS
FLUORIDATED MILK				
Petersson <i>et al.</i> , 2011 ⁷⁸	Double-blinded RCT (160)	The effect of standard milk vs milk with 5ppm F and probiotic bacteria vs milk with probiotic bacteria vs milk with 5ppm F	15 months	RCI and ERM
FLUORIDATED TOOTHPASTES				
Jensen and Kohout, 1989 ³⁵	Double-blinded RCT (810)	Effects of 1.1ppm fluoridated toothpaste vs <1ppm fluoridated toothpaste	1 year	DMFS
Ekstrand <i>et al.</i> , 2008 ³³	Double-blinded RCT (28)	5,000ppm fluoridated toothpaste vs brushing by a dental hygienist and Duraphat application once a month vs 1,450ppm fluoridated toothpaste	8 months	Texture, contour, location and colour of root caries
Ekstrand <i>et al.</i> , 2013 ³⁴	Double-blinded RCT (176)	5,000ppm F vs 1,450ppm F toothpaste	8 months	Texture, contour, location and colour of root caries
FLUORIDE IN MOUTHRINSES				
Wallace <i>et al.</i> , 1993 ³⁷	RCT (466)	Semi-annual applications of topical APF gel + placebo mouthrinse vs fluoridated (NaF) mouthrinse daily vs placebo mouthrinse daily	48 months	DMFS
Fure <i>et al.</i> , 1998 ³⁶	RCT (164)	Rinsing twice daily with 0.05% NaF vs sucking twice daily on 1.66mg NaF tablet vs brushing three times daily using slurry rinsing technique vs brushing using usual manner (control) (all 4 groups used 0.32% NaF toothpaste twice daily)	2 years	DFS
Wyatt and MacEntee, 2004 ³⁸	Double-blinded RCT (369)	Rinsing with 0.2% NaF solution daily vs 0.12% CHX solution daily	2 years	Caries incidence (per surface)
Petersson <i>et al.</i> , 2007 ³⁹	Double-blinded RCT (100)	250ppm F mouthwash twice daily vs placebo mouthrinse	1 year	ERM
FLUORIDE IN VARNISHES/GELS/SOLUTIONS				
Li <i>et al.</i> , 2006 ⁷⁹	RCT (83)	OHI + soda water (placebo) vs OHI + SDF vs OHI + SDF + KI	30 months	Arrest rate of carious root surfaces; assess colour of arrested carious lesions
Fure <i>et al.</i> , 2009 ⁴¹	Single-blinded RCT (40)	Carisolv and Duraphat varnish (2.23% F) vs Duraphat varnish (2.23% F) vs stanous fluoride solution (8%)	1 year	DMFS, DFRS
Tan <i>et al.</i> , 2010 ⁴⁰	Double-blinded RCT (306)	OHI vs OHI + SDF solution (38%) annually vs OHI + 5% NaF varnish every 3 months vs OHI + 1% CHX varnish every 3 months	3 years	Development of new caries on the exposed sound root surfaces
Zhang <i>et al.</i> , 2013 ⁴²	Double-blinded RCT (266)	OHI vs OHI + SDF vs OHI + SDF + OHE programme	2 years	Prevention and arrest of new carious surfaces on exposed roots
ABBREVIATIONS: APF = acidulated phosphate fluoride CHX = chlorhexidine DFRS = decayed filled root surfaces DFS = decayed filled surfaces DMFS = decayed missing filled surfaces ERM = electric resistance measurements F = fluoride KI = potassium iodide N = sample size NaF = sodium fluoride OHI = oral hygiene instructions RCI = root caries index RCT = randomised controlled trial SDF = silver diamine fluoride				

Comments

Coronal and root caries were consistently lower among long-term residents of the fluoridated communities than among residents of non-fluoridated communities

Significantly higher number of root caries reversals in participants drinking milk with fluoride +/- probiotic lactobacilli compared to participants drinking standard milk

Significant decrease in coronal and root caries incidence for participants using a 1.1ppm fluoridated toothpaste compared to <1ppm fluoridated toothpaste

Significant improvement in root caries status in participants using a 5,000ppm fluoridated toothpaste or brushing by a dental hygienist and Duraphat application monthly compared to participants using 1,450ppm fluoridated toothpaste

5,000ppm fluoridated dentifrice is significantly more effective in remineralising root caries in elderly disabled participants when compared to 1,450ppm fluoridated toothpaste over eight months

Number of incremental DMFS was lower in participants using 0.05% NaF rinse daily compared to patients having semi-annual applications of APF gel + placebo mouthrinse daily. Both were lower than participants using only a placebo mouthrinse daily

Statistically less coronal and root caries developed in patients rinsing with 0.05% NaF twice daily compared to control

A daily mouthrinse with 0.2% NaF solution is significantly better than either a 0.12% CHX solution or a placebo rinse at reducing caries incidence

Statistically significantly more reversals of root caries in the group rinsing twice a day with a 250ppm F solution containing amine fluoride and potassium fluoride (1:1) compared to rinsing with a fluoride-free placebo mouthwash

The arrest rate in SDF and SDF + KI groups were statistically significant compared to placebo

Majority of initial root lesions were arrested during one year, irrespective of fluoride treatment used

Significantly less new root caries in SDF and NaF groups compared to control group

Significantly less new active root caries surfaces developed in SDF group and oral health education group compared to the control group

Prophylactic phase

Oral health education

This review found no evidence for oral hygiene education for older adults in the community. Regarding older adults in nursing homes, a Cochrane review reported that there is insufficient evidence to support oral health education for nursing home staff and residents.³²

Topical fluorides

A total of 13 studies (**Table 1**) evaluating the effectiveness of topical fluorides were identified: water (n=1); milk (n=1); toothpastes (n=3); mouthwashes (n=4); and, gels/varnishes/solutions (n=4). All topical fluorides led to significant caries reduction in these studies. Three double-blinded, randomised controlled trials (RCTs) with a follow-up of eight months to one year looked at the effectiveness of fluoridated toothpastes in older patients.³³⁻³⁵ All studies had low dropout rates, groups were similar at baseline and had a single examiner. Good-quality evidence is available to support the use of fluoridated toothpastes in the management of caries for older adults. While 1,100ppm and 1,450ppm fluoridated toothpastes were effective, evidence suggests that caries arrest was maximised with the use of 5,000ppm fluoridated toothpastes.³³⁻³⁵ Four RCTs reviewed effectiveness of fluoridated mouthwashes,³⁶⁻³⁹ two of which were double-blinded.^{38,39} However, three trials had large loss to follow-up³⁷⁻³⁹ and two did not report clearly regarding blinding.^{36,37} Available evidence seems to favour fluoride mouthrinses for caries prevention among older patients. Four high-quality, double-blinded RCTs verified the effectiveness of fluoride in varnishes/solutions.⁴⁰⁻⁴² A recent systematic review also highlighted the effectiveness of SDF in the prevention and arrest of root caries and remineralisation of deep occlusal lesions in older adults.⁴³ Good evidence is available to support the use of topical fluoride in the form of varnishes/gels/solutions for caries prevention in older patients. Due to the small number of studies available, evidence for the effectiveness of water and milk fluoridation among this population was limited.

Non-fluoride caries-preventive agents (chlorhexidine, CPP-ACP, xylitol)

Five studies measured the effectiveness of chlorhexidine as a caries-preventive topical agent for older adults.^{38,40,44-46} Based on these studies of double-blinded RCTs, it can be concluded that chlorhexidine mouthwash was not very effective in reducing caries in older patients, whereas chlorhexidine varnish application can be effective (**Table 2**). Further studies with larger sample sizes, lower dropout rates and longer duration are needed to draw firm conclusions.⁴⁷⁻⁴⁹ High-quality studies verifying the effectiveness of casein phosphopeptides-amorphous calcium phosphate (CPP-ACP) and xylitol with elderly patients are lacking.⁵⁰

Restorative phase (minimally invasive operative interventions)

Atraumatic restorative technique

Five studies evaluating the effectiveness of the ART are summarised in **Table 3**: one case series measuring the success of ART restorations;⁵¹ three double-blinded RCTs measuring the success of ART versus conventional restorations;⁵²⁻⁵⁴ and, one double-blinded RCT looking at the success rate of ART versus ART and Carisolv.⁵⁵

The success rate of ART restorations in older adults reported in the literature varies from 63% to 86.4%. None of the studies showed a statistically significant difference in the success rate of the ART against conventional restorations. An

Table 2: Studies evaluating the effectiveness of chlorhexidine for the prevention and/or arrest of caries in older adult patients.

ARTICLE / Author	Study design (n)	Intervention	Duration	Outcome	Comments
CHLORHEXIDINE MOUTHRINSE					
Wyatt and MacEntee, 2004 ³⁸	Double-blinded RCT (369)	Rinsing with 0.2% NaF solution daily vs 0.12% CHX solution daily	Two years	Coronal and root DMFS	A daily mouthrinse with 0.2% NaF solution is significantly better than either a 0.12% CHX solution or a placebo rinse at reducing caries incidence
Wyatt <i>et al.</i> , 2007 ⁴⁵	Double-blinded RCT (1,101)	0.12% CHX solution vs placebo	Five years	Decayed, filled, extracted (per tooth)	Regular rinsing with 0.12% CHX didn't have significant effects on the preservation of sound tooth structure
CHLORHEXIDINE VARNISH					
Brailsford <i>et al.</i> , 2002 ⁴⁴	Double-blinded RCT (102)	Fluoride varnish vs fluoride + chlorhexidine varnish	12 months	Lesion width, height, distance from gingival margin and length of exposed root	The combination of a F-containing varnish and a CHX-containing varnish significantly improved the clinical status of existing root caries lesions compared to F-containing varnish application only
Baca <i>et al.</i> , 2009 ⁴⁶	Double-blinded RCT (68)	CHX varnish group vs placebo group	12 months	Incidence of root caries	Incidence of root caries was significantly lower in CHX varnish group compared to the placebo group
Tan <i>et al.</i> , 2010 ⁴⁰	Double-blinded RCT (306)	OHI vs OHI + SDF solution (38%) annually vs OHI + 5% NaF varnish every three months vs OHI + 1% CHX varnish every three months	Three years	Root DFS	Significantly less new root caries in SDF and NaF groups compared to OHI and OHI + 1% CHX groups
ABBREVIATIONS		DFS = decayed filled surfaces DMFS = decayed missing filled surfaces DMFT = decayed missing filled teeth		F = fluoride N = sample size NaF = sodium fluoride	OHI = oral hygiene instructions RCT = randomised controlled trial SDF = silver diamine fluoride
CHX = chlorhexidine					

exception to this was a double-blinded RCT reporting a statistically significant difference in success rate in favour of conventional restorations.⁵⁴ However, the follow-up period was only six months, there was a 15% dropout rate, and two different operators placed the restorations. Therefore, caution is recommended when generalising these results.

One RCT looked at the success rate of ART restorations versus ART restorations following the use of a chemical caries removal agent, Carisolv.⁵⁵ The success rate for both groups was similar and statistically insignificant.

The studies identified have short follow-up periods from six months to two years, small sample size and high dropout rates. Additionally, some of the

studies used different restorative materials for each group;^{52,53} GI was used for the ART group and resin-modified glass ionomer (RMGI) was used for the conventional group. This may introduce bias, as despite the fact that high-viscosity GI was recommended initially, ART restorations are now understood to perform better when RMGI is used rather than GI.⁵⁶

Resin infiltration, selective/stepwise caries removal techniques and repair rather than replacement of restorations

No studies were identified looking at the success of these procedures among older adults.

Phases of minimum intervention dentistry

The diagnostic phase of MID aims to estimate the risk of caries for the individual patient through caries risk assessment (CRA) and caries diagnosis at an early stage.

The prophylactic phase aims to establish a balance between protective and pathological factors. It focuses on prevention of caries and remineralisation of tooth structure by influencing oral health behaviour and by using topical preventive agents such as fluoride and chlorhexidine. MID suggests that oral hygiene and diet advice should follow individual risk assessment.¹⁴ Topical fluoride is a central aspect of the prophylactic phase. It acts by promoting remineralisation, increasing enamel resistance to acid attacks and inhibiting bacterial activity.¹⁵ Various forms of topical fluoride are available, including water and milk fluoridation, and fluoridated toothpastes, mouthwashes, gels, varnishes and solutions. Non-fluoride topical agents have also been suggested for prevention of caries in older adults and include chlorhexidine, casein phosphopeptides-amorphous calcium phosphate (CPP-ACP) and xylitol products.^{14,16-18}

The restorative phase involves minimally invasive operative interventions, applied if caries has led to significant loss of dental tissue necessitating intervention to restore aesthetics and function. Minimally invasive operative interventions for elderly patients include procedures such as: the resin infiltration technique; the atraumatic restorative technique (ART); and, stepwise and selective caries removal and repair rather than replacement of defective restorations.¹⁹

Resin infiltration technique

The resin infiltration technique involves arresting the progression of a carious lesion by perfusion of porous enamel with resin via capillary action.²⁰ It is indicated for early, non-cavitated carious lesions radiographically limited to enamel or the outer third of dentine.

Atraumatic restorative technique

The ART was first introduced in the 1980s and has been defined as "a minimally invasive care approach in preventing dental caries and stopping its further progression".²¹ It consists of a preventive (ART sealant) and a restorative (ART restoration) component. The ART sealant involves placing

Table 3: Success of ART restorations in older adult patients.

Author	Study design (n)	Intervention	Duration	Outcome	Comments
Honkala, 2002 ⁵¹	Case series (33)	ART restorations	One year	Retention, presence of marginal defect	Success of ART restorations is high (79%)
Lo <i>et al.</i> , 2006 ⁵²	Double-blinded RCT (162)	Conventional restorations vs ART restorations	One year	Retention, marginal integrity, marginal discolouration, recurrent caries, anatomic form, surface texture	No statistical difference found between restoration methods
Gil-Montoya <i>et al.</i> , 2014 ⁵⁵	Double-blinded RCT (81)	ART vs ART + Carisolv	Two years	ART evaluation criteria published by Frencken <i>et al.</i> , 1996	Carisolv does not statistically improve success rates of ART restorations
da Mata <i>et al.</i> , 2015 ⁵³	Double-blinded RCT (300)	ART vs conventional restorations	Two years	Assessment of restoration (scale 0-8)	The type of treatment (ART or CT) had no effect on restoration survival
Cruz Gonzalez and Marin Zuluaga, 2016 ⁵⁴	Double-blinded RCT (174)	ART vs conventional restorations	Six months	Retention, adaptation, discolouration, anatomical shape, surface, secondary caries	Success of conventional restorations statistically significantly higher than ART restorations
ABBREVIATIONS ART = atraumatic restorative technique GI = glass ionomer N = sample size RCT = randomised controlled trial RMGI = resin modified glass ionomer					

Discussion

This study aimed to review the literature regarding the use of MID for older adults. The MID philosophy supports a preventive approach whereby every effort should be made to remineralise non-cavitated lesions. This review found evidence to support the use of topical fluorides like varnish, rinses and high-fluoride toothpaste to prevent dental caries in older adults. Evidence for the use of SDF for root caries was also noted. While chlorhexidine varnish has shown promising results in reducing caries in older adult patients, fluoride remains the gold standard agent in the prevention and arrest of early carious lesions. This means that topical fluorides can be recommended for this population as part of the MID philosophy promoting prevention in order to

avoid or minimise operative intervention.⁵⁷ At its core, the practice of MID begins with caries risk assessment (CRA). There are a number of tools and resources to help dental care professionals in this task.⁵⁸⁻⁶² In the absence of national guidelines in Ireland specifically for adults,⁶³ readers are directed towards the essential UK guidelines 'Delivering Better Oral Health' regarding the use of topical fluorides for individuals at high and low risk of dental caries.⁶⁴ Insufficient evidence was found for other preventive components of MID that have been recommended in the management of caries for older adults, such as oral health education, CPP-ACP and xylitol.

This review also sought evidence for operative MID in older age. No studies could be identified to test the use of resin infiltration for older adults, despite

glass ionomer (GI) in the pits and fissures using finger pressure, while the ART restoration involves removal of caries-infected dentine with hand instruments and the use of GI to fill the cavity.²¹

Stepwise and selective caries removal

In 1979, Fusayama categorised carious dentine histopathologically into two categories: the caries-infected dentine; and, the caries-affected dentine.²² The soft, caries-infected dentine is often found at the periphery (close to the enamel-dentine junction [EDJ]) and is irreversibly damaged due to the denaturing of collagen. On the other hand, the caries-affected dentine is hard and is found deeper. It is reversibly damaged since the collagen is not denatured and has the potential to repair.²³ In an attempt to preserve tooth structure and pulp vitality, MID does not advocate complete caries removal to hard dentine. Instead, a carious lesion should be approached with either stepwise removal or selective removal of caries. Stepwise removal involves cleaning the EDJ until it has no discolouration and removing carious tissue from the floor of the cavity until soft dentine is reached. A temporary restoration is placed, and six to twelve months are given for tertiary dentine to form, before selective removal to firm dentine and placement of a long-term

restoration. However, there are recent trends to suggest that stepwise removal of carious tissues is being superseded by selective caries removal. Selective caries removal is a one-step procedure that involves cleaning the EDJ until it has no discolouration and then removing only soft infected dentine from the floor of the cavity, leaving behind hard affected dentine, which has the potential to heal and re-mineralise.²⁴

Repair rather than replacement of defective restorations

The principles of MID suggest that repair rather than replacement of defective restorations is preferred when possible. The rationale is that replacing an extensive restoration can have detrimental effects, and potentially render the tooth unrestorable. This is particularly true for older patients, who are likely to have large restorations as a consequence of the restorative cycle.²⁵ While the restorative phase is needed in some cases, it is not an essential component of MID as it does not address the aetiological factors and therefore does not provide the primary solution to caries.¹³ Recall is integral to the MID concept, allowing evaluation and reinforcement, with the interval depending on each patient's risk for caries.

superior results to topical agents when studied in younger groups.^{20,65} Similarly, while minimal caries removal techniques such as stepwise and selective caries removal have shown decreased incidence of pulp exposure in primary and permanent teeth of younger patients,⁶⁶ evidence for their use with older adults is lacking.

Most evidence in this review regarding operative MID in older age focused on the ART. The evidence presented suggests similar effectiveness to conventional restorative approaches for older adults. ART restorations can be particularly useful in the management of older adults and evidence is indeed available to support their success. Despite this, many dentists find it hard to accept this concept and adopt it in routine practice.⁶⁷

MID suggests that repair rather than replacement of defective restorations is preferred.⁶⁸ While relevant studies were not identified for the older population, two recent Cochrane reviews have looked at the evidence for the effectiveness of replacement versus repair of defective amalgam and composite restorations in adults.^{69,70} Both reviews were inconclusive, emphasising the need for further research in this field.

The limitations of this literature review need to be considered by readers. Firstly, this study adopted a narrative rather than a systematic design. A standardised quality assessment tool was not used; rather, the quality of the studies was assessed narratively. Another point worth considering is that MID is a huge field of dentistry and this study did not expand on all the elements of this approach. Some approaches that fit into a broader definition of MID were omitted when applied, such as CRA, the use of salivary substitutes, and slot and tunnel preparations.^{17,71} One last factor to consider is that the authors have an interest in improving the oral health of older adults in Ireland and therefore promote MID as a favoured approach from their previous understanding of the literature and their own practice. Readers should consider our own biases when considering this review.

While there is promising evidence to support elements of MID for older adults in Ireland, barriers exist that impede the widespread adoption of MID in routine dental practice. These include a lack of training and awareness regarding its effectiveness by dentists and policymakers.¹³ If MID is truly to be established as a preferred approach, the structure of the healthcare system must support minimal intervention and prevention rather than treatment of disease. However, the current Dental Treatment Services Scheme for adult medical cardholders in Ireland, which many older adults are entitled to, encourages operative rather than preventive interventions. The Irish Department of Health, which prioritises the oral health of older adults,^{72,73} has committed to introducing a preventive dental health package for medical cardholders, recognising that “early intervention saves the taxpayer later”.⁷⁴ MID seems a suitable vector for such ambitions. Such measures will hopefully promote MID and the prevention of oral disease, decrease destructive operative interventions, and improve the oral and general health of Irish older adults. Examples exist where this has been achieved. In Sweden, fixed annual subsidies for preventive dental care⁷⁵ have coincided with the improvement of dental health among the older Swedish population.⁷⁶

Conclusion

This literature review appraised the evidence available for the use of MID in older patients. Among older adults, fluoride, especially in toothpastes and varnishes/gels/solutions, is the most extensively studied component of MID, with a high level of evidence supporting its use. Research into the ART is also promising. Further RCTs with longer duration, larger sample size and low

dropout rates are required to strengthen available evidence. Studies on the effectiveness of oral health education, selective caries removal, the use of the resin infiltration technique, and the repair rather than replacement of restorations for older patients, are needed.

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CPD questions

To claim CPD points, go to the MEMBERS' SECTION of www.dentist.ie and answer the following questions:

1. The resin infiltration technique can be used to arrest a carious lesion that is:

- ☐ A: cavitated but limited to enamel
- ☐ B: cavitated but limited to enamel or outer third of dentine
- ☐ C: uncavitated but limited to enamel or outer third of dentine
- ☐ D: uncavitated or cavitated but limited to enamel or outer third of dentine

2. Based on minimum intervention dentistry (MID) principles, which of the following apply when preparing a cavity for a restoration?

- ☐ A: Only soft caries-infected dentine should be removed from the dento-enamel junction (DEJ) and the floor of the cavity, leaving behind caries-affected dentine
- ☐ B: All discolouration should be removed from the DEJ but only soft caries-infected dentine should be removed from the floor of the cavity, leaving behind caries-affected dentine
- ☐ C: All discoloured carious dentine should be removed from the DEJ and the floor of the cavity, leaving behind only healthy dentine of a normal colour
- ☐ D: All discoloured carious dentine should be removed from the DEJ and the floor of the cavity, in addition to some healthy dentine if required to improve the retention and resistance form of the preparation

3. Which sentence(s) best describe silver diamine fluoride?

- ☐ A: It is effective in preventing caries
- ☐ B: It is effective in arresting caries
- ☐ C: It is associated with black staining
- ☐ D: All of the above

