Minimal Intervention Dentistry: Part 2. Strategies for Addressing Restorative Challenges in Older Patients

Jane M. Chalmers, *BDSc, MS, PhD, DABSCD*

Contact Author

Dr. Chalmers
Email:
jane-chalmers@uiowa.edu

ABSTRACT

Minimal intervention dentistry (MID), a modern, evidence-based approach to caries management in dentate patients, uses a medical model whereby disease is controlled by the "oral physician" and an affiliated dental team. Geriatric MID helps clinicians to address the ever-increasing restorative challenges presented by older patients, including erosion, abrasion, demineralization, rampant coronal and root caries, retained roots, recurrent caries (necessitating crowns and other repairs), subgingival caries, "wet" oral environments, salivary dysfunction, disruptive behaviours, poor compliance with preventive care, high plaque levels, and financial and other restrictions on care options. The main components of a geriatric approach to MID are assessment of the risk of disease, with a focus on early detection and prevention; external and internal remineralization; use of a range of restorations, dental materials, and equipment; and surgical intervention only when required and only after disease has been controlled. This second in a series of 2 articles describes direct restorative strategies to address the challenges of geriatric caries management, including choice of material, placement of glass ionomers, sandwich technique, techniques for the management of erosion and abrasion, tunnel and slot preparations, techniques for "wet" subgingival environments, vital pulp therapy and geriatric atraumatic restorative technique.

MeSH Key Words: dental bonding; dental caries/prevention & control; dentistry, operative/methods; glass ionomer cements/therapeutic use

The "extension for prevention" surgical approach to oral disease management, with G.V. Black cavity designs specified for each lesion type, has been the cornerstone of 20th century dentistry.[1] Of great importance has been the design of the cavity preparation to include a self-cleansing outline form, resistance form, retention form, convenience form, removal of caries, and finish of the enamel walls, margins, and toilet of the cavity.[1] The resulting "lifetime cycle of restoration" involved a substantial loss of tooth structure, weakening of cusps and undermining of crowns. In particular, use of the mesio-occlusodistal amalgam has resulted in a large number of cusp fractures.[1] Unfortunately, this traditional restorative approach does not help to address the ever-increasing number of complex restorative challenges in older patients, which include erosion, abrasion, demineralization, rampant coronal and root caries, sound and decayed retained roots, recurrent caries (necessitating crowns and other repairs), subgingival caries, "wet" oral environments,

Table 1 Caries classification and treatment options for geriatric minimal intervention dentistry (based on Mount and Hume,[4] modified by Chalmers)

	Size				
Site	0 (no cavity)	1 (minimal)	2 (moderate)	3 (enlarged)	4 (extensive)
1 (pit and fissure)	1.0 External remin, sealant	1.1 Caries removal, sealant or GI	1.2 Caries removal, internal remin with GI, GI or composite or amalgam (lamination)	1.3 Caries removal, internal remin with GI, GI or composite or amalgam (lamination)	1.4 Vital pulp therapy, internal remin with GI, review for GI or composite or amalgam (lamination)
2 (contact area)	2.0 External remin	2.1 Caries removal, open access (GI or composite), tunnel (GI), box or slot (GI or composite or amalgam)	2.2 Caries removal, internal remin with GI, GI or composite or amalgam (lamination)	2.3 Caries removal, internal remin with GI, GI or composite or amalgam (lamination)	2.4 Vital pulp therapy, internal remin with GI, review for GI or composite or amalgam (lamination)
3 (cervical)	3.0 External remin	3.1 External and internal remin and/or caries removal, GI or composite	3.2 Caries removal, internal remin with GI, GI or composite or amalgam (lamination)	3.3 Caries removal, internal remin with GI, GI or composite or amalgam (lamination)	3.4 Vital pulp therapy, internal remin with GI, review for GI or composite or amalgam (lamination)

GI = glass ionomer, remin = remineralization

salivary gland hypofunction, disruptive behaviours, poor compliance with preventive care, high plaque levels, bleeding and swollen gingival tissues, and financial and other restrictions on care options.

Minimal intervention dentistry (MID) is a philosophy that offers useful strategies for managing these restorative challenges. Geriatric MID uses a broad range of dental materials and instruments as appropriate for tooth preparation and restoration. The materials used are classified by their method of clinical placement: direct or indirect.[2] In-depth discussion of MID restorative techniques is presented in several texts and articles.[2–9] A new caries classification by Mount and Hume[4] describes dental caries by site (1 = pit and fissure, 2 = contact area, 3 = cervical) and size (from 0 to 4) (**Table 1**).[4] This classification has been modified in Table 1 for older patients, with various MID strategies recommended for each type of caries; for example, a carious lesion in a contact area without cavitation can be externally remineralized, whereas a cavitated deep carious lesion in a contact area might need internal remineralization with a glass ionomer and composite sandwich (lamination) restorative technique. This article focuses on the use of direct restorative materials in older patients and on several aspects of MID that can be routinely used in geriatric dentistry: choice of material, placement of glass ionomers, sandwich technique, techniques for the management of erosion and abrasion, tunnel and slot preparations, techniques for dealing with "wet" subgingival environments, vital pulp therapy and geriatric atraumatic restorative technique.

Choice of Material

In geriatric MID, the choice of the direct restorative material to be used cannot be made until caries removal is complete and field control has been evaluated. Conventional hand instruments, rotary handpieces and, if available, air abrasion or lasers are used for removing caries.[10–12] Other factors affecting choice of restorative

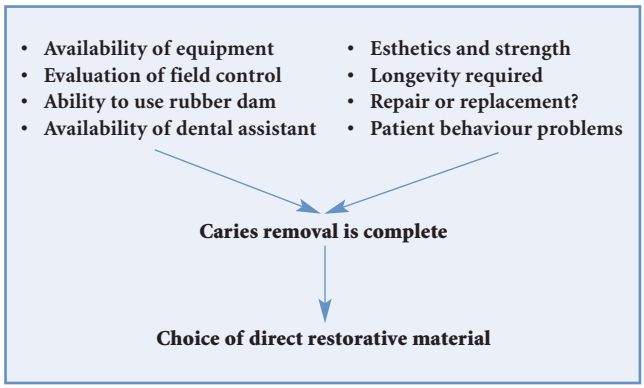

Figure 1: Factors influencing choice of direct restorative material in geriatric minimal intervention dentistry.

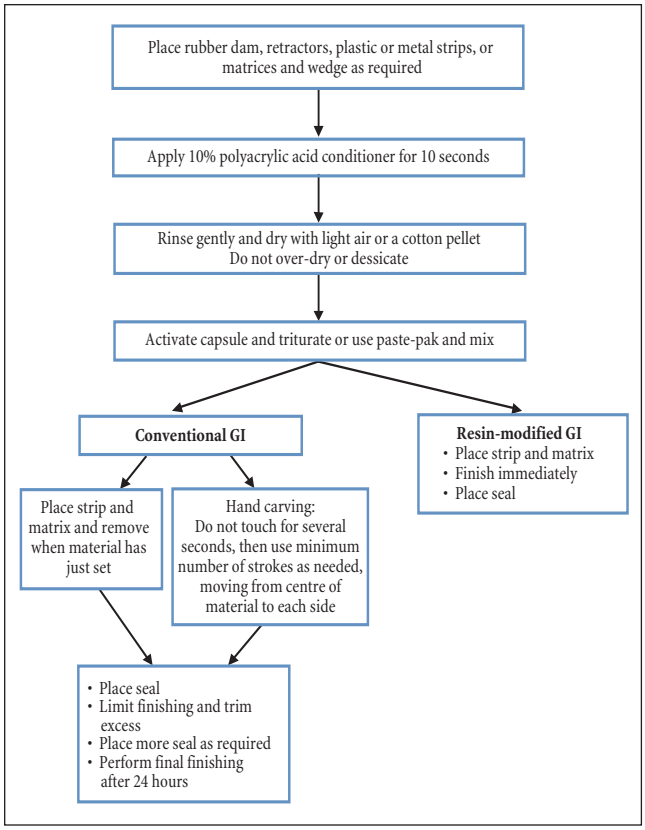

Figure 2: Placement of glass ionomers (GI).

material are esthetic requirements, required longevity and whether the restoration is being repaired or replaced (**Fig. 1**). Caution is needed when probing root surfaces, as probing has been shown to increase the progression of caries.[13] The use of a blunt or periodontal probe is advocated for exploring root-surface caries in older adults.[13]

In clinical situations where field control is excellent, traditional MID techniques involve using the most appropriate amalgam, composite resin or glass ionomer direct restorative material.[10–12] For example, in carious lesions that are not deep, but where esthetics and strength are important, composite resins may be the material of choice. In a similar situation but where esthetics are of less concern, or where cusp protection is indicated, then amalgam may be the material of choice.[11,12] If an erosion or abrasion lesion is being restored, then a conventional or resin-modified glass ionomer may be selected, as is described below.[14] In clinical situations where field control is less than optimal (even with the use of gingival retraction techniques), the restorative material of choice will be an amalgam or a conventional glass ionomer,[11,12] especially for subgingival areas and areas that are difficult to access, such as molar bifurcations and root areas around crowns. For deep carious lesions, the use of glass ionomer will aid internal remineralization, which is especially important if subgingival visibility is poor.[8,15] Where strength is also needed posteriorly, the stronger glass ionomers, with a higher liquid-to-powder ratio, can be used (e.g., Fuji IX, GC America, Alsip, Ill.; Ketac Molar, 3M ESPE, St. Paul, Minn.). Where the highest fluoride release and recharge is needed, Fuji Triage (GC America) will be the material of choice.

Placement of Glass Ionomers

As with composite resins, use of a rubber dam, retractors and/or plastic or metal matrices and strips is recommended to ensure optimal placement of glass ionomers.[14,16] Following the basic principles of glass ionomer placement, use cavity conditioner (10% polyacrylic acid) for 10 seconds to remove the smear layer, and do not over-dry or desiccate (a clean cotton pellet, rather than water and air, is optional for removing the conditioner) (**Figs. 2** and **3**). Note that different companies use different capsule activation systems. After triturating for the required time, squeeze the glass ionomer into the deepest part of the preparation and slowly back-fill, and then place a matrix or hand-carve the material. When hand-carving conventional glass ionomers, do not touch the material for several seconds, then use the minimum number of strokes needed, moving from the centre of the material to each side (for a total of at most 3 to 5 strokes). As a helpful guide to the setting time, place a small amount of glass ionomer from the applicator onto your glove, or try to squeeze the remaining glass ionomer out of the applicator. Both conventional and resin-modified glass ionomers require a seal; either a varnish or a light-activated resin enamel bond can be applied. Conventional glass ionomers need to be sealed as soon as the material is set, to limit immediate water exchange. A small amount of finishing to trim excess can be completed, with another layer of sealant added if required. Final polishing should not be performed for at least 24 hours. Resin-modified glass ionomers can be finished immediately, and a seal

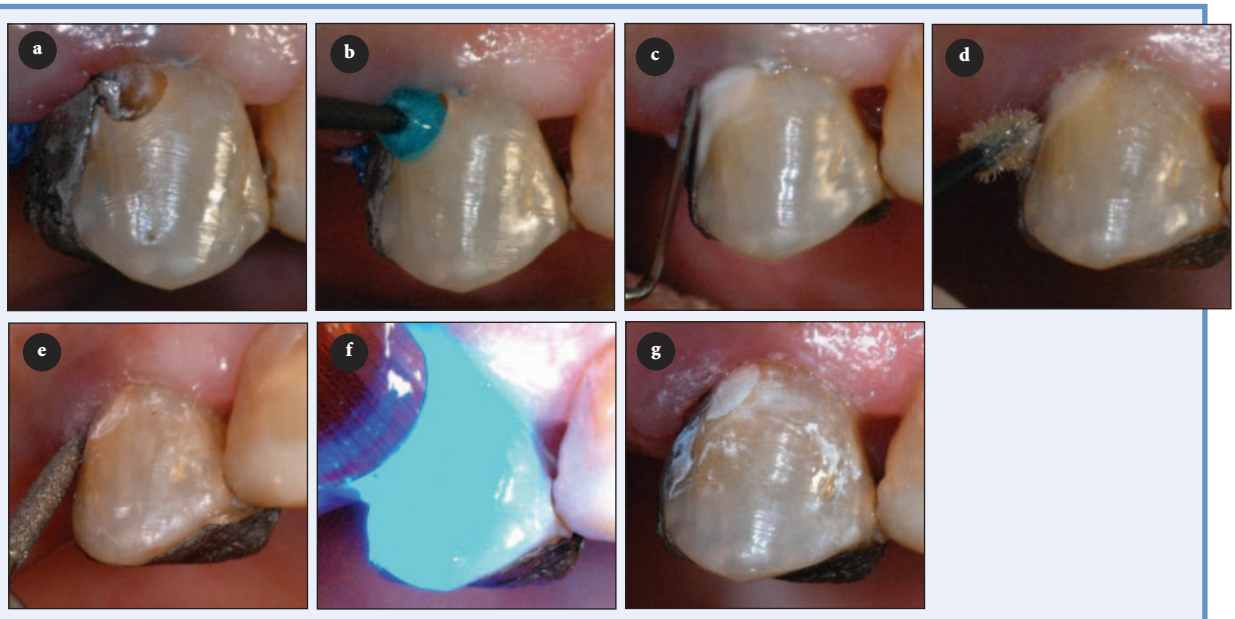

Figure 3: Placement of a Fuji Triage glass ionomer restoration in a "wet" subgingival location in a patient with dementia, whose behaviour made treatment difficult: **(a)** placement of retraction cord and removal of recurrent caries using high- and low-speed handpieces and hand instrumentation; **(b)** application of cavity conditioner; **(c)** hand carving; **(d)** placement of light-cured seal; **(e)** completion of limited finishing; **(f)** placement of another light-cured seal; and **(g)** completed restoration.

is recommended to prevent water uptake over the next 7 days.[14,16]

Sandwich Technique

As described by Mount[14] a lamination or "sandwich" technique with 2 direct restorative materials can be used to "make the most of the biological, physical and/or aesthetic properties of each material, and in the presence of adhesion, to achieve as close as possible to a single monolithic reconstruction of a tooth." This technique is especially useful in situations when strength and pleasing esthetics are essential. The strongest glass ionomer material (i.e., that which releases the most fluoride) is placed and allowed to fully set and is then covered with the final restorative material (amalgam or composite resin).[14] Composite resin bonds micromechanically to set glass ionomers and chemically to hydroxyethylmethacrylate (HEMA) in resin-modified glass ionomers.[14] Thus, if a composite resin is being placed over a conventional glass ionomer, then both glass ionomer and enamel are etched with 37% orthophosphoric acid before placement of the bond and composite resin. If a composite resin is being placed over a resin-modified glass ionomer, then it is not necessary to etch the resin-modified glass ionomer, because of the chemical HEMA bond. However, if the etching material does contact the resin-modified glass ionomer, "it will do it no harm."[14] Contact areas should be built in composite resin but not glass ionomer, and sufficient space should be allowed for an adequate thickness of composite resin.[14] With the full sandwich technique, the internal glass ionomer is completely covered by the overlaying restorative material, whereas with the partial sandwich technique, the internal glass ionomer is only partly covered.[14]

Remineralization and Restoration to Counteract Erosion and Abrasion

Erosion is defined as the loss of dental hard tissues by chemical action from intrinsic and extrinsic sources not involving bacteria; abrasion is the loss of tooth substance because of factors other than tooth contact.[17] Erosion and abrasion lesions vary in shape and size but are most often located on the buccal tooth surface. It appears that erosion and abrasion contribute in combination to cervical tooth wear.[17] Patients with these lesions often complain of hypersensitivity. Cervical tooth wear can occur around any type of dental restorative material. In many cases, caries are not present initially, but many cervical carious lesions develop over time on eroded and abraded root surfaces. In addition to treating the cause of the erosion or abrasion, it is essential to monitor the progression of cervical lesions over time.[18] There are 2 main treatment choices for cervical lesions: remineralization and restoration. Remineralization involves the use of products such as topical fluorides and amorphous calcium phosphates. Topical fluorides must be used at home and must be supplemented with regular professional application of fluoride varnish. Adjunctive use of amorphous calcium phosphates

will increase remineralization; MI Paste (GC America) in particular has shown impressive clinical results in reducing hypersensitivity[19–21] (please see Part 1 of this series on p. 427). Restoration of cervical lesions may be undertaken when esthetics is an issue or when soft caries and cavitation have occurred. The use of glass ionomers and composite resins either alone or in combination (with a sandwich technique) is generally recommended.[20] Glass ionomers will adhere to the dentin and assist in reducing hypersensitivity and enhancing internal remineralization.[14] The resin-modified glass ionomers were designed for use in these situations and have a wider colour range than traditional glass ionomers.[14]

Tunnel and Slot Preparations

Access to and conservative restoration of interproximal carious lesions can be challenging. Tunnel and slot preparations are conservative preparations that can be used effectively in older patients. Slot preparations are indicated for lesions that are less than 2.5 mm from the marginal ridge.[11,12] Glass ionomer, composite or amalgam can be used, and indeed slot amalgams have proven as successful as traditional Class II amalgams.[22] If needed, a preventive resin or glass ionomer restoration can be placed over the occlusal surface.[23] In certain carefully chosen cases where the lesion is more than 2.5 mm from the marginal ridge, a tunnel preparation can be used. In-depth description of this technique is provided elsewhere.[11,12,24] In general, initial access is gained through the fossa immediately medial to the marginal ridge.[14] This entry area should not be under occlusal load. A small tapered cylinder bur is aimed at the lesion, after which a long-shanked bur, held in a more upright position, is used to increase visibility. Small round burs and hand instruments are used to complete the preparation. Glass ionomer is the material of choice, as some of the demineralized interproximal areas will not be removed, and the interproximal enamel cannot be bevelled.[14]

Techniques for "Wet" Subgingival Environments

In many older patients, especially those with poor oral hygiene, it can be extremely challenging to control bleeding and saliva during restoration of subgingival carious lesions, which tend to recur around large restorations and crowns. The use of a rubber dam, electrosurgery, periodontal surgery and retraction techniques may not be feasible for some older patients and in some geriatric dental settings. Behaviour and communication problems can further increase the need for a quick and efficient method for restoring such lesions.[25] Because it may be difficult to penetrate these deep subgingival areas with a curing light, the materials of choice are amalgam or conventional glass ionomer. A glass ionomer such as Fuji Triage works well in these "wet" environments because it has low viscosity and does not "run" (**Fig. 3**). As with all conventional glass ionomers, the clinician must wait several seconds before carving, and the gingiva should be used to guide subgingival carving.

Vital Pulp Therapy

For deep carious lesions in older patients, vital pulp therapy, a conservative MID technique involving stepwise remineralization and biocompatible dental materials, can be used.[11,12] Vital pulp therapy provides an optimal clinical result, especially when finances, time and behaviour problems limit the clinical treatment options. Whenever possible, it is advisable to have a periapical radiograph of the tooth being treated to ensure the absence of periapical abnormalities; however, obtaining such radiographs may be a challenge in some geriatric dental treatment settings. If radiographs are not available, the clinician must determine the extent of bacterial infection in the pulp and the feasibility of vital pulp therapy. The lower layers of dentin may not be infected and can often be retained during caries removal.[11,12,16] The following stepwise excavation technique is used: remove only as much marginal enamel as necessary to gain access to the carious lesion and remove the infected dentin (additional dentin should only be removed around the complete circumference of the lesion to enable bonding of restorative material and minimization of microleakage.[11,12,16] In the traditional stepwise technique, a "temporary" restoration is placed at this stage, with a note in the patient's record that the tooth is not caries-free; the material of choice is glass ionomer to encourage internal remineralization. The temporary restoration is left in place for 3 to 6 weeks, but no longer than 6 months.[11,12,16] Pulp vitality is reassessed, and the clinician has the option of removing all or some of the temporary restoration to place a permanent restoration. It is advised to leave some glass ionomer material in the deepest part of the lesion as a base for the final restoration.[11,12,16] It has been shown that the number of bacteria decreases during stepwise excavation procedures and that deep lesions become clinically arrested after restoration.[14,16,26] The stepwise excavation of caries will change the cariogenic environment and will also limit the removal of carious dentin close to the pulp to reduce the risk of an iatrogenic pulp exposure.[14,16,26]

In rational treatment planning for older patients, a modification of this vital pulp therapy technique is often required, whereby stepwise excavation may be limited to the initial stage and the restoration that is placed is not temporary but permanent. This method is required in cases of ringbarking of root caries (circumferential caries), palliative care, behaviourally difficult patients, patients seeking emergency care and patients who can visit a dentist only intermittently. It is also an option when patients and their caregivers refuse to have "unsavable" teeth extracted, when a "repair" is the only reasonable option

and when extensive subgingival restorations are needed around complex restorations such as crowns and bridges.

Geriatric Atraumatic Restorative Technique

In some clinical settings where access to rotary handpieces is limited, such as in nursing homes or patients' homes, only hand instruments may be available for removing caries. In these settings, an atraumatic restorative technique using glass ionomer may be appropriate.[14] The choice of glass ionomer material will be limited only by the clinician's access to a triturator and a curing light. The diversity of conventional glass ionomer materials is increasing and provides choice among hand-mixed materials, paste-pak and triturated capsules. At present, resin-modified glass ionomers are available in the latter 2 forms, which require use of a curing light. As discussed previously, both conventional and resin-modified glass ionomers require a seal, and in these settings a varnish or a light-activated resin enamel bond can be applied.

Conclusions

Geriatric MID offers the dental professional working with older patients realistic, rational, evidence-based options for treating oral disease. Geriatric MID restorative techniques will continue to evolve with the development of more biocompatible restorative materials to help address the ever-increasing challenges encountered with dentate older patients.

THE AUTHOR

Acknowledgement: *The author would like to thank Drs. Hien Ngo and Graham Mount for their advice concerning the MID concepts used in this article.*

Dr. Chalmers *is associate professor and director of geriatric and special needs program, preventive and community dentistry, College of Dentistry, The University of Iowa, Iowa City, Iowa.*

Correspondence to: *Dr. Jane Chalmers, Preventive and Community Dentistry, College of Dentistry, University of Iowa, Iowa City, Iowa USA 52242. Email: jane-chalmers@uiowa.edu.*

Dr. Chalmers is a member of the Speakers' Bureau for GC America.

References

1. Osborne JW, Summitt JB. Extension for prevention: is it relevant today? *Am J Dent* 1998; 11(4):189–96.

2. Mount GJ, Ngo H. Minimal intervention: a new concept for operative dentistry. *Quintessence Int* 2000; 31(8):527–33.

3. Hewlett ER, Mount GJ. Glass ionomers in contemporary restorative dentistry — a clinical update. *J Calif Dent Assoc* 2003; 31(6):483–92.

4. Mount GJ, Hume WR. A new cavity classification. *Aust Dent J* 1998; 43(3):153–9.

5. Pitts NB. Are we ready to move from operative to non-operative/preventive treatment of dental caries in clinical practice? *Caries Res* 2004; 38(3):294–304.

6. Tyas MJ, Anusavice KJ, Frencken JE, Mount GJ. Minimal intervention dentistry — a review. FDI Commission Project 1-97. *Int Dent J* 2000; 50(1):1–12.

7. Featherstone JD. The caries balance: the basis for caries management by risk assessment. *Oral Health Prev Dent* 2004; 2 Suppl 1:259–64.

8. Hicks J, Garcia-Godoy F, Donly K, Flaitz C. Fluoride-releasing restorative materials and secondary caries. *J Calif Dent Assoc* 2003; 31(3):229–45.

9. Mount GJ, Hume WR, editors. Preservation and restoration of tooth structure. Sandgate (Qld): Knowledge Books and Software; 2005.

10. Mount GJ, Walsh LJ, Brostek A. Instruments used in cavity preparation. In: Mount GJ, Hume WR, editors. Preservation and restoration of tooth structure. Sandgate (Qld): Knowledge Books and Software; 2005. p. 119–44.

11. Mount GJ, Hume WR. Basic principles for cavity design. In: Mount GJ, Hume WR, editors. Preservation and restoration of tooth structure. Sandgate (Qld): Knowledge Books and Software; 2005. p. 145–62.

12. Mount GJ, Hume WR. Vital pulp therapy. In: Mount GJ, Hume WR, editors. Preservation and restoration of tooth structure. Sandgate (Qld): Knowledge Books and Software; 2005. p. 299–308.

13. Warren JJ, Levy SM, Wefel JS. Explorer probing of root caries lesions: an in vitro study. *Spec Care Dentist* 2003; 23(1):18–21.

14. Mount GJ. Glass-ionomer materials. In: Mount GJ, Hume WR, editors. Preservation and restoration of tooth structure. Sandgate (Qld): Knowledge Books and Software; 2005. p. 163–98.

15. Ngo HC, Mount G, Mc Intyre J, Tuisuva J, Von Doussa RJ. Chemical exchange between glass-ionomer restorations and residual carious dentine in permanent molars: an in vivo study. *J Dent* 2006; 13. In press.

16. Mount GJ, Ngo H. Minimal intervention: advanced lesions. *Quintessence Int* 2000; 31(9):621–9.

17. Bartlett DW, Shah P. A critical review of non-carious cervical (wear) lesions and the role of abfraction, erosion, and abrasion. *J Dent Res* 2006; 85(4):306–12.

18. Walsh LJ. Lifestyle impacts on oral health. In: Mount GJ, Hume WR., editors. Preservation and restoration of tooth structure. Sandgate (Qld): Knowledge Books and Software; 2005. p. 83–110.

19. Hay KD, Morton RP. The efficacy of casein phosphoprotein-calicum triphosphate complex (DC-CP) [Dentacal] as a mouth moisturizer in patients with severe xerostomia. *N Z Dent J* 2003; 99(2):46–8.

20. Reynolds EC, Walsh LJ. Additional aids to the remineralisation of tooth structure. In: Mount GJ, Hume WR, editors. Sandgate (Qld): Preservation and restoration of tooth structure. Knowledge Books and Software; 2005. p. 111–8.

21. Reynolds EC. Anticariogenic complexes of amorphous calcium phosphate stabilized by casein phosphopeptides: a review. *Spec Care Dentist* 1998; 18(1):8–16.

22. Burke FJ. From extension for prevention to prevention of extension: (minimal intervention dentistry). *Dent Update* 2003; 30(9):492–8, 500, 502.

23. Nicholson JW. Evidence-based approach to minimal restorative intervention for early carious lesions. *Tex Dent J* 2003; 120(10):960–9.

24. Mount GJ, Hume WR, Monteith B. Minimal intervention dentistry. Available from: URL: www.midentistry.org (accessed May 7, 2006).

25. Chalmers JM. Behavior management and communication strategies for dental professionals when caring for patients with dementia. *Spec Care Dentist* 2000; 20(4):147–54.

26. Bjornal L, Kidd EA. The treatment of deep dentine caries lesions. *Dent Update* 2005; 32(7):402–4, 407–10, 413.