Appendix II

Clarifications on Atraumatic Restorative Treatment

Atraumatic restorative treatment (also called alternative restorative treatment or ART) is one of many mercury-free restorative techniques that is increasingly used worldwide as more dentists embrace minimally-invasive restorative treatments that preserve patients' own healthy tooth structure. The technique relies on glass ionomer for the filling material and uses only hand instruments to place the filling.[1] "The WHO Oral Health Programme (ORH) believes ART is one of the most suitable caries controlling approaches for use in primary oral health care programmes and therefore the continuation of the global promotion of ART is one of its major objectives."[2]

As noted in a 2005 study of ART use in the UK,[3] some dentists have not received much training in this technique, and so there are still misconceptions about its use in Europe. The following information addresses the major points of confusion that arose at the stakeholder meeting.

Survival of ART restorations

Research on the longevity of ART restorations has been done. For example:

- A 2010 study concluded that ART can be "effective after ten years of clinical service"[4]: "The survival rates observed, especially for single-surface restorations, confirm the potential of the ART approach for restoring and saving posterior permanent teeth. The technique was effective after 10 years of clinical service."[5] By comparison, amalgam can last for about 10-15 years according to some,[6] although major U.S. dental insurer Delta Dental says "the average life span of amalgams is 8 to 10 years."[7]

- A 2009 study explained that "The aim was to report on the longevity of restorations placed using the atraumatic restorative treatment (ART) approach compared with that of equivalent placed amalgam restorations. Five databases were systematically searched for articles up to 16 March 2009…From the 27 separate computable dichotomous datasets, four yielded a statistically significant improvement of longevity of ART versus amalgam restorations: posterior class V, 28% over 6.3 years; posterior class I, 6% after 2.3 years and 9% after 4.3 years; posterior class II, 61% after 2.3 years. Studies investigating restorations placed in the primary dentition showed no significant differences between the groups after 12 and 24 months. In the permanent dentition, the longevity of ART restorations is equal to or greater than that of equivalent amalgam restorations for up to 6.3 years and is site-dependent."[8]

- A 2006 study compared ART restorations and amalgam in permanent teeth after 6.3 years, and concluded "that the restorations produced with the ART approach, with high-viscosity glass ionomer, survived longer than those produced with the traditional approach, with amalgam, in the permanent teeth of young children."[9]

While longer-term studies on ART, such as the above, are more recent, there are earlier shorter-term studies too. For example:

- A 2004 meta-analysis found no difference between survival rates for single-surface amalgam restorations and ART restorations in permanent teeth after three years: "Based on the available data, it appears that there is no difference in survival results between single-

surface ART restorations and amalgam restorations in permanent teeth over the first 3 yrs."[10]

- An earlier 2002 study said "It can be concluded that the ART approach using glass-ionomer yielded better results in treating dentinal lesions in deciduous teeth than did the traditional approach using amalgam after 3 years. It is recommended to select the ART approach to complement the other activities of the school oral health programme."

Definitiveness of ART restorations

ART restorations are sometimes confused with temporary interim therapeutic restorations, but these are not the same. The American Academy of Pediatric Dentistry says "[t]hese procedures have similar techniques but different therapeutic goals." [11] As AAPD explains, unlike temporary interim therapeutic restorations, "ART, endorsed by the World Health Organization and the International Association for Dental Research, is a means of restoring and preventing caries in populations that have little access to traditional dental care and necessarily functions as *definitive* treatment."[12]

The fact that the most recent long-term study of ART shows that "[t]he technique was effective after 10 years of clinical service"[13] clearly demonstrates that ART restorations are no more temporary than amalgam, which can last about the same length of time. [14] The fact is, no filling material is permanent; whether amalgam, composite, or the glass ionomer used in an ART restoration, no restoration will last forever. [15]

Use of ART restorations in adult teeth

According to studies, "The survival of one-surface ART restorations in primary and permanent teeth does not vary much."[16] There are many studies showing that ART restorations are used in permanent dentition, adult teeth. For example:

- A 2010 study found that the "technique was effective after 10 years of clinical service" [17] in the permanent dentition. In this study, that permanent dentition belonged to adult women who were pregnant at the time of placement, not children.[18]

- A 2009 study found that "In the *permanent* dentition, the longevity of ART restorations is equal to or greater than that of equivalent amalgam restorations for up to 6.3 years and is site-dependent."[19]

In fact, the widely-used ART training text *Manual for the Atraumatic Restorative Treatment Approach to Control Dental Caries* says "Based on studies already conducted, ART can certainly be used with confidence in one-surface cavities particularly in *permanent* teeth."[20]

Preventive properties of ART restorations

ART restorations offer an important improvement over amalgam because unlike amalgam, ART is both restorative *and* preventive. [21] As the training text *Manual for the Atraumatic Restorative Treatment Approach to Control Dental Caries* explains "ART provides preventive and curative treatment in one procedure." [22] This is because "fluoride is released from the restoration to prevent and arrest caries." [23]

Studies have consistently demonstrated that ART restorations do prevent secondary caries:

- A 2007 study reported in the *Journal of the American Dental Association* concluded "The antimicrobial properties of freshly prepared restorative materials and aged restorative materials used in ART have a potent effect against cariogenic bacteria. These properties have crucial importance in preventing secondary caries."[24]

- A 2003 study found that "Secondary caries was observed for 2% of glass-ionomer and for 10% of amalgam restorations. This difference was statistically significant ($p = 0.001$). The ART approach using glass-ionomer performed equally well as conventional restorative approaches using electrically driven equipment and amalgam for treating dentinal lesions in occlusal surfaces after 6 years."[25]

Use of ART in modern dental clinics

While ART was *originally* developed for use in rural areas without electricity and without dentists, now a wide range of stakeholders – from dental researchers to dentists to dental non-profits to the dental industry – acknowledge the use of ART in developed countries as well:

- According to a 2007 article from the *Journal of the American Dental Association*, "Atraumatic restorative treatment (ART) is recommended for use worldwide, not only in developing countries where resources are not readily available, but also in more industrialized countries."[26]

- A 2009 study concluded "ART is also a cost-effective means of oral health care within a modern dental clinic."[27]

- ART pioneer Jo Frencken says "ART has its place not only in poor and underserved communities but also in the most exclusive dental practices, as has been reported from countries like the USA, UK and the Netherlands."[28]

- T
he organization Developing International Networks for Oral Health explains, "The Atraumatic Restorative Treatment was developed following the mentioned principles and it is on line with the philosophy of MID [minimally-invasive dentistry]. What started as an alternative resource for out-reach situations, it became one of the most flexible methods for caries removal and restoration of the cavity in many private dental offices worldwide…Supported by a considerable advantages such as painless procedure, nonsensitive technique, reasonable relationship cost-benefits, feasible and sustainable in out-reach situations, flexible and combinable, etc., the Atraumatic Restorative Treatment approach stands as a excellent alternative method for treating caries lesions in a diverse variety of situations, ranging from rural settings to a modern pediatric clinic."[29]

- According to Alliance for a Cavity-Free Future, "Originally, ART was developed for use in developing rural countries because it does not require local anesthesia or electricity. More recently, ART has become increasingly accepted in developed countries because of its "atraumatic" approach in relation to the stress and pain experienced by patients. ART conserves tooth structure, minimizing trauma, and has been found to reduce pain perhaps due to the creation of smaller cavities."[30]

- GC Europe, the company that manufacturers the Fuji IX glass ionomers that are commonly used in ART, says "Fuji IX was introduced by the WHO on World Health Day in 1994 as an innovative restorative method …The technology has been applied in numerous countries

since then. Fuji IX is also widely used in industrialized nations as a restorative method in keeping with today's emphasis on retaining the tooth structure."[31]

Preserving tooth structure with ART

The American Academy of Pediatric Dentistry explains "Amalgam restorations often require removal of healthy tooth structure to achieve adequate resistance and retention. Glass ionomer or resin restorative materials might be a better choice for conservative restorations, thereby retaining healthier tooth structure."[32]

ART, which uses glass ionomers and only had instruments[33], has been shown to preserve healthy tooth structure. For example:

- A 2009 study of ART observed that "Undoubtedly, using only hand instruments to open and clean the cavity preserves more sound dental structure than does the traditional approach that recommends the use of the drill."[34]

- An earlier study examining specifically whether ART was really atraumatic concluded that indeed "preparations with hand instruments were smaller than those produced with rotary instruments."[35]

Leading dental expert Dr. Gordon Christensen expressed concern that "there has been an obvious trend in dentistry toward complex techniques and accomplishing more treatment than required. The trend has been mentioned to me many times by colleagues as I have traveled the world." [36] "[W]ith the hope that readers will consider performing more minimally invasive procedures," [37] he goes on to explain that with minimally-invasive procedures "Practitioners know that they are preserving dentitions and supporting structures, instead of merely selecting the easiest or most expensive alternative, and patients appreciate this… If more dentists would practice it, the dental profession could enhance the public's perception of its honesty and increase its professionalism as well."[38]

But Dr. Christensen did note one particular barrier to minimally-invasive dentistry that could explain why some dental trade groups are reluctant to embrace ART: "Is the dentist's income influenced detrimentally by the practice of minimally invasive dentistry? It is apparent that some of the minimally invasive procedures have the potential to reduce a dentist's income…"[39] But he was quick to explain that this barrier is not insurmountable: "that effect may be avoided by having dental staff members perform many of the conservative procedures (where such activity is legal). Increasing office efficiency and organization also allows more procedures to be accomplished in a given period."[40]

Cost-Effectiveness of ART

According to the Pan American Health Organization in 2006, "The findings from the PRAT [procedures for atraumatic restorative treatment] study clearly demonstrate the cost-effectiveness of the ART technique in a variety of settings in the Region in comparison with the cost-effectiveness of the Amalgam technique in the same settings…the cost savings that can be achieved are substantial…The costs of employing the PRAT approach for dental caries treatment, including retreatment, are roughly half the cost of amalgam without retreatment."[41]

A more recent 2009 study confirmed that "ART is also a cost-effective means of oral health care within a modern dental clinic. The ART approach can be undertaken at approximately 50% of the capital costs of conventional restorative dentistry."[42]

Studies have identified several factors that make ART less expensive, including:

- According to the South African study, "Duration of procedure for one amalgam and one composite restoration is estimated as an average of 22 minutes; ART restorations are estimated to take 19.8 minutes."[43] Therefore, the labor costs would be lower.

- A 2005 study noted that "there is often no need for the administration of LA, and, accordingly, time could be saved." [44]

- According to the 2009 study: "ART can be practiced as a viable economic alternative to conventional treatment procedures within the clinical setting. This is not only from a direct cost point of view but also with the added spin-off of reduced maintenance cost of dental equipment, which are not used in the ART approach."[45]

Appropriateness of ART

ART is sometimes used – even when amalgam, composite, and other materials and techniques are available. For example:

- According to University Nijmegen (the Netherlands)'s website: "ART is used to various degrees in various high income countries…In the USA, ART appeared to be (very) often applied by 44 % of dental practitioners, mainly to treat children restoratively. The percentage of dentists using ART in the Netherlands was somewhat lower (26%). They used it to treat children and anxious and handicapped adults. In the United Kingdom, ART was reported to have been used mainly for children by appr. 10 % of respondents by the year 2002."[46]

- A survey of general practitioners in the United States reported in the *Journal of the American Dental Association* found that 44% of respondents used ART "very often/often" and 23% used it sometimes.[47]

- In a 2007 study, dental practitioners had a choice of amalgam, composite, or ART restorations. [48] "The proportion of traditional, more invasive types of restorative care, was reduced from 100% in period A [before ART was introduced] to 1.8% in period C [after ART was introduced]…In period C, ART was the predominant rendered type of treatment (45.4%) and the proportion of ART to the total number of restorations was 98.2%."[49] "[A]ll respondents indicated ART restoration as their present choice of treatment for carious single- and multiple-surface lesions of pre-molar and molar teeth without infected or exposed pulp. The reasons given for this choice included: the lower overall cost of ART restoration; the improved properties of glass-ionomer cements; the absence of the need to use local anaesthetics, noisy drills and suction in the ART approach; the potential toxicity of amalgam."[50]

[1] *Manual for the Atraumatic Restorative Treatment Approach to Control Dental Caries,* http://www.dentaid.org/data/dentaid/downloads/ART_Manual_English.pdf

[2] WHO, *Atraumatic Restorative Treatment (ART) for Tooth Decay: A Global Initiative 1998-2000* (1998), http://whqlibdoc.who.int/hq/1998/WHO_NCD_ORH_ART_98.1.pdf.

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[4] Regia Luzia Zanata, Ticiane Cestari Fagundes, Maria Cristina Carvalho de Almendra Freitas, José Roberto Pereira Lauris and Maria Fidela de Lima Navarro, *Ten-year survival of ART restorations in permanent posterior teeth*, CLINICAL ORAL INVESTIGATIONS, Volume 15, Number 2, 265-271 (2010), http://www.springerlink.com/content/w208655418q560g0/

[5] Regia Luzia Zanata, Ticiane Cestari Fagundes, Maria Cristina Carvalho de Almendra Freitas, José Roberto Pereira Lauris and Maria Fidela de Lima Navarro, *Ten-year survival of ART restorations in permanent posterior teeth*, CLINICAL ORAL INVESTIGATIONS, Volume 15, Number 2, 265-271 (2010), http://www.springerlink.com/content/w208655418q560g0/

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[7] Delta Dental, Dental Amalgam or Resin Composite Fillings? (July 2008), http://www.deltadentalins.com/oral_health/amalgam.html

[8] Steffen Mickenautsch, Veerasamy Yengopal and Avijit Banerjee, *Atraumatic restorative treatment versus amalgam restoration longevity: a systematic review*, CLINICAL ORAL INVESTIGATIONS, Volume 14, Number 3, 233-240 (2009), http://www.springerlink.com/content/ng3g624824682h53/

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[11] http://www.aapd.org/media/Policies_Guidelines/G_Restorative.pdf (emphasis added)

[12] http://www.aapd.org/media/Policies_Guidelines/G_Restorative.pdf (emphasis added)

[13] Regia Luzia Zanata, Ticiane Cestari Fagundes, Maria Cristina Carvalho de Almendra Freitas, José Roberto Pereira Lauris and Maria Fidela de Lima Navarro, *Ten-year survival of ART restorations in permanent posterior teeth*, CLINICAL ORAL INVESTIGATIONS, Volume 15, Number 2, 265-271 (2010), http://www.springerlink.com/content/w208655418q560g0/

[14] See Delta Dental, Dental Amalgam or Resin Composite Fillings? (July 2008), http://www.deltadentalins.com/oral_health/amalgam.html (giving average life span of amalgam as 8-10 years); WHO, *Future Use of Materials for Dental Restoration* (2011), http://www.who.int/oral_health/publications/dental_material_2011.pdf, p.11 (giving life span of amalgam as about 10-15 years).

[15] See Delta Dental, Dental Amalgam or Resin Composite Fillings? (July 2008), http://www.deltadentalins.com/oral_health/amalgam.html (giving average life span of amalgam as 8-10 years); WHO, *Future Use of Materials for Dental Restoration* (2011), http://www.who.int/oral_health/publications/dental_material_2011.pdf, p.11(giving life span of amalgam as about 10-15 years).

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permanent posterior teeth, CLINICAL ORAL INVESTIGATIONS, Volume 15, Number 2, 265-271 (2010), http://www.springerlink.com/content/w208655418q560g0/

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[23] *Manual for the Atraumatic Restorative Treatment Approach to Control Dental Caries,* http://www.dentaid.org/data/dentaid/downloads/ART_Manual_English.pdf

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[31] http://www.gceurope.com/company/gcc_rws.php

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