The AGP Question; Implications for Orthodontics

Current guidance on treatment of patients in the Covid-19 era advises limitation of Aerosol Generating Procedures (AGP) where possible, and cessation of routine dental care including orthodontics. Current guidance therefore focuses on the generation of aerosol in dentistry, the limiting of AGP procedures as well as cross infection issues.

The British Orthodontic Society (BOS) have reviewed the evidence available and produced this guidance and these recommendations. BOS is not a legislative body and does not produce regulations that require to be adhered to. These can only come from the regulatory bodies in England, Northern Ireland, Scotland and Wales. However, BOS do have a duty to inform, educate and protect members of the public, clinicians and staff during the delivery of orthodontic care. This guidance constitutes best practice and the standard BOS would expect of its members.

An aerosol is a suspension of fine solid particles or liquid droplets in air or another gas.\(^1\)

An aerosol can comprise solid particles or liquid droplets of varying size within the air and in addition these may or may not include bacteria, fungi and viruses. How these particles (solid or liquid) will behave in air is dependent very much on their size, shape and mass. Very large particles may have a ballistic trajectory and land on surfaces close to where they are generated. In dentistry this may be nearby work tops, the dental chair or the operator/ assistant. This is why, in the current COVID-19 pandemic in particular, in order to prevent indirect spread, eye and face protection is recommended.

Some of these large particles may also be inhaled and enter the nose or mouth. However, smaller particles with a mass median aerodynamic diameter of around 10\(\mu\)m or less can enter the upper respiratory tract, and those particles that are even smaller, less than 4.25\(\mu\)m in diameter, can reach the deeper parts of the lungs.

Aerosol Generating Procedures (AGPs) are defined as any medical and patient care procedure that results in the production of airborne particles (aerosols). These are relevant to COVID-19 transmission, since this may occur via both direct air-borne infection and indirect spread via contact with contaminated surfaces. Restriction of AGPs is, therefore, an important control measure.\(^2\)

Each Nation’s guidance\(^2,3,4,5\) suggests parameters of dental AGPs, but with some disparity between them. They acknowledge the list is not exhaustive and state ‘Not all dental procedures have been covered’.\(^2\)

Based on the most up to date information available\(^6-17\) dental AGP are produced when using any of the following:

- High speed air rotor drills including surgical drills\(^6,7,8,10,11,14,16\)
- Slow speed drills, run wet and dry, including surgical drills \(^9,10,12,13,14,17\)
- 3 in 1 spray or air/water syringes\(^7,8,14\)
- Ultrasonic and sonic handpieces\(^7,8,14\)
- Air abrasion or intra oral sandblasting \(^14,15\)
For orthodontics this extrapolates for our procedures to include use of high speed air turbine or slow speed rotary drill, 3 in 1 air/water syringe, and enamel preparation using ultrasonic or air abrasion devices.

This will have a direct impact on adhesive removal from enamel, and the use of air/water sprays and rotary handpieces for moisture control and cleaning.

**Table of Aerosol Generating Procedures in Orthodontic Practice**

<table>
<thead>
<tr>
<th>Orthodontic Procedure</th>
<th>AGP</th>
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<tr>
<td><strong>Debond</strong></td>
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<tr>
<td>With handpiece driven adhesive removal (high speed or slow speed)</td>
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<tr>
<td><strong>Repair bracket failure</strong></td>
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<tr>
<td>With handpiece driven adhesive removal (high speed or slow speed)</td>
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<td><strong>Repair Fixed retainer</strong></td>
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<tr>
<td><strong>Placement of new Fixed retainer</strong></td>
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<tr>
<td>With enamel preparation using either air abrasion/ ultrasonic/ high speed or slow speed handpiece and a 3 in 1 for washing and drying</td>
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<tr>
<td><strong>Bond up</strong></td>
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<tr>
<td>Etch, bond with use of 3 in 1 for wash and dry</td>
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<tr>
<td><strong>Bond up</strong></td>
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<tr>
<td>With handpiece (high speed or slow speed) tooth polish, dry or with pumice</td>
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<tr>
<td>Prior to the use of Self-Etch Primer or etch, bond</td>
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<tr>
<td><strong>Trimming acrylic (worn or tried in) removable appliance/functional/retainer etc</strong></td>
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<td><strong>Scale and Polish</strong></td>
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<tr>
<td>Use of ultrasonic scaler/air abrasion or high speed or slow speed hand piece</td>
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Even with the use of High Volume Suction (HVE) and/or rubber dam to limit aerosol and the bio impact, these procedures are still considered AGP and appropriate PPE should be worn, along with appropriate decontamination protocols in the surgery.

High and low volume suction themselves are NOT considered AGP.
Alternatives to AGP in the orthodontic setting.

Debond
Removal of brackets and wires alone is not considered the AGP part of a debond. Use of a handpiece, (high speed or slow speed, with or without water coolant) ultrasonic scaler or 3 in 1 air/water spray should be avoided.

For patients with poor oral hygiene where the risk of continuing treatment is high, consideration could be given to removing the brackets alone and hand trimming the adhesive carefully using:
- band removing pliers,
- Mitchell’s trimmers or hand scalers,
- adhesive removing pliers.

Any small remnants of composite left on the enamel surface are likely to be lost over time with toothbrushing.

There is no more enamel loss when using debanding pliers than with slow speed Tungsten Carbide bur run dry, but take care not to gouge the enamel surface. Pliers should only be used to remove the adhesive on posterior teeth, not the incisors where a Mitchell’s trimmer of hand scaler should be used instead. If there are large restorations on the posterior teeth consider placing a cotton wool roll on the occlusal surface before applying any force with the plier.

Repair of brackets mid treatment
As above, if residual composite can be removed by hand, this may enable a new bracket to be placed (using Non AGP bonding technique - see below). Alternative options would be to place a premolar or molar band using GIC, or to bypass the debonded tooth, using dead coil or sleeve on the wire, or using sectional wires mesial to the debonded tooth.

Removal of fixed devices mid treatment
Removal of fixed devices such as Bands, TPA Nance arches, Quad helix and RME devices only becomes AGP if a handpiece is used to remove the residual cement. As above, consider adhesive removal using hand instruments.

Bonding
Conventional acid etch bond up protocols are AGP when using polishing/pumice prior to etching and the 3 in 1 air syringe to rinse the enamel after etching. Alternative non AGP options are listed, but it should be recognised that bond strength may be compromised:

Light cured resin modified GIC, can be used without the need for any pre procedural tooth preparation (i.e. pumicing/etching washing/ drying). With these materials there is NO need for a dry field and indeed for successful bonding the enamel surface should remain moist during bonding.

Self etch primers (SEP) can also be used without the need for etching washing and drying the enamel, but they require the pellicle to be removed prior to use, usually with a pre procedural enamel preparation such as pumice/polishing of teeth, which would be an unwanted AGP. Without this stage the bond strength is likely to be reduced. To avoid the use of a pumice/polishing of teeth using a handpiece and 3 in 1 syringe with SEP:
- Wipe the bonding surface of the tooth with a cotton roll prior to applying SEP.
- Suction may be used as this is non AGP.
- The Technique for using SEP is also important, with 3-5 seconds rubbing of the SEP to enamel, with re-dip into the SEP reservoir before repeating on each subsequent tooth. Following application of the SEP some manufacturers recommend gentle air drying. This latter stage is potentially an AGP and should be avoided.
Bands
Avoid the use of 3 in 1 due to the AGP hazard, but suction may be used. The use of GIC or resin modified GIC doesn’t not require a completely dry field on either the tooth or band prior to placement.

Fitting and trimming the acrylic on removable appliances
It should be borne in mind that removable appliances may act as a conduit for cross infection, and laboratory protocols should be adhered to in order to minimise this risk. Although new appliances cannot be assumed to be infection free, strict adherence to laboratory infection control procedures including processing of impressions, equipment and appliances is crucial in minimising the risk of any cross infection. Simple fitting and adjustment of a removable appliance is not likely to be an AGP provided no acrylic trimming is required during fitting i.e. after try-in.

In the case of appliances already being worn by the patient that require repair and refitting, they should be decontaminated according to HTM01-05 protocol and current PHE cross infection guidance, using an appropriate disinfectant before ideally being transferred to the laboratory for repair, where superior high volume suction can be used to minimise the impact of any aerosol generated.

Often removable appliance acrylic trimming would be undertaken at the chairside in the clinical setting, either as part of the fitting procedure for a new appliance, or following the repair of a worn appliance. There is currently a paucity of evidence in the literature on the microbial load on a worn or tried in orthodontic appliance made from acrylic following disinfection, and no evidence that any aerosol generated during trimming is therefore not a biohazard risk. Acrylic trimming of a new but tried in appliance or currently worn appliance in the surgery should therefore be **considered an AGP**.

Repair of Fixed retainers
Removal of adhesive from the retainer wire can be achieved using Weingart or Birdbeak pliers, and HVE (High Volume Evacuation/Suction).

Adhesive removal from the lingual surface of the incisors may be achieved using hand scalers or Mitchell’s trimmers, or the use of adhesive removal pliers.

Aligner Attachments
Placement of aligner attachments can be considered non-AGP if placed using bonding technique as suggested above.

Removal of attachments will be non-AGP if using adhesive removal tool as suggested and will only be considered AGP if a handpiece is used to remove the residual composite.

Taking impressions
An impression in itself is not an AGP, but carries a risk of gag or cough reflex which is a known aerosol risk. Where accessible, an intra oral scan may be preferable (although this does not eliminate the gag/cough risk).

Any impressions should be sterilised in accordance with HTM01-05 protocol to ensure safe transfer to the laboratory for casting and appliance production.

Retention
Consideration should be given to changing to using a removable retainer regime. This could be made over the remnants of a broken fixed retainer.
Minimising the impact of Aerosol Generation when performed within the clinical environment.

Where AGP has to be undertaken, this should be in accordance with current National Guidance, with appropriate PPE and management of the clinical environment.

High volume suction (HVE)
The use of high volume suction (HVE) is established as significantly reducing the amount of aerosol in the environment and should be employed if AGP is used, including when trimming appliances outside of the mouth.\(^5,12,14,26-31\)

Rubber dam
The use of rubber dam to reduce the biodiversity of aerosol has been suggested.\(^5,14,29,31\) Studies are very varied in confirming the impact of rubber dam in reducing the biodiversity of aerosol produced.\(^32-34\) It is certainly a technique sensitive procedure and this may account for the variability of results in studies. The practical implications in orthodontics are limited, where multiple teeth are being treated and it is unlikely to be a technique operators are skilled in at present.

Pre-procedural mouth-rinse
Although both Chlorhexidiene and H\(_2\)O\(_2\) mouthwash have been shown to reduce the bacterial load of aerosols Chlorhexidine is not known to be effective against coronavirus.\(^\text{16}\) It has been suggested\(^14,16,29,35\) that since the virus may be vulnerable to oxidation, a pre-procedural mouth-rinse with an oxidising mouthwash such as H\(_2\)O\(_2\), povidone iodine, or Hypochlorus acid may be worthwhile.\(^31,36\)

However, high viral loads have been found in the oropharynx of infected patients, as well as in the asymptomatic subjects.\(^37\) Since Coronavirus is expelled from the lungs at each exhalation there is some limitation to the impact of such pre-procedural mouthwash even if it was effective in reducing the viral load.\(^38\) A previous clinical study examining the bacterial loading of aerosols generated at orthodontic debond found that the use of preprocedural mouthwash (either sterile water or Chlorhexidine) actually increased the biodiversity within the aerosol generated at debond rather than reducing it. This was the case even when using a slow speed handpiece without water coolant to remove the residual adhesive.\(^17\)

A pre-procedural mouth-rinse is therefore not currently seen as a significant step in reducing the risk of aerosol generating procedures.

Face masks
There are 2 main types of face mask; Fluid resistant surgical masks (type IIR) and respirator masks; FFP2 and FFP3 according to filtration rates. Masks have been shown to be effective against nosocomial transmissions of SARS.\(^\text{39}\)

Studies have shown\(^\text{12,13}\) up to 95% filtration rate with surgical masks, but many studies looking at types of mask and the effect of filtration tend to be laboratory based, and do not correlate with the real world issues of namely exhalation as well as inhalation, the impact of moisture on the efficiency of masks, and the fit of the mask to the user.

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of the mask, the fit of the mask to the individual face and the impact of facial movement on the fit during episodes of wear. The filtering efficiency of a mask is only as good as its fit or the moisture content. Therefore, masks and respirators should be fit tested, checked and always discarded if moist/wet.\textsuperscript{30}

**Current Guidance for PPE during AGP** in the dental setting is for an FFP3 mask to be worn along with other PPE components.\textsuperscript{40}

WHO continues to recommend airborne precautions for circumstances and settings in which aerosol generating procedures and support treatment are performed\textsuperscript{42}, according to risk assessment. Current WHO recommendations emphasise the importance of rational and appropriate use of all PPE, not only masks, which requires correct and rigorous behaviour from health care workers, particularly in doffing procedures and hand hygiene practices.
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