



Covid-19: the impact of an amended bonding protocol on bracket failure rate in the Orthodontic Department at Dumfries and Galloway Royal Infirmary, UK

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ABSTRACT

INTRODUCTION: This project looks at the impact of the new non-AGP protocol on the bracket failure rate. Literature search and previous audit looking at bracket failure was considered to agree on standard.

Gold standard was set at no more than 6%.

This project consists of retrospective data collection and the first cycle of prospective data collection. In the retrospective cycle bracket bonding failure rate was analysed, while using protocol that strictly follows manufacturer instructions, thus generating aerosols. Prospective cycle analyses bracket bonding failure with amended bond-up protocol which avoids creating aerosols.

METHODS: All patients with full or sectional bond-ups in the analysed period of time were included in the project.

22 patients who had full or sectional bond-ups provided between 01/09/2019 to 31/12/2019 were included in the retrospective cycle.

24 patients with full or sectional bond-ups provided between 01/09/2020 and 31/12/2020 were included in the first prospective cycle.

Patients in both cycles were followed up for 3 months.

RESULTS:

Retrospective cycle

The Gold Standard was met in the retrospective cycle. 290 brackets were bonded in the retrospective cycle. 15 brackets debonded within the first 3 months following bond-up. This gives bracket failure rate at 5.2% in 3 months following bond-up when using AGP protocol.

1st prospective cycle

The Gold Standard wasn't met in the first prospective cycle.

231 brackets were bonded using amended bond-up protocol between September and December 2020. 17 brackets debonded within the first 3 months following bond-up. This gives bracket failure rate at 7.4%, which exceeds Gold Standard figure.

CONCLUSION: Although we cannot be certain that patients' compliance hasn't contributed to the results due to the incomplete data, an increase in bracket failure was observed when Covid-19 pandemic led bond-up protocol, avoiding aerosol generating procedures, was introduced.

I. BACKGROUND/RATIONALE

Premature debonding of brackets during fixed appliance treatment can be an inconvenience to the patient, the parent and the clinician and can result from poor patient compliance, poor clinical bonding technique or use of unsatisfactory bonding materials¹.

Dealing with such breakages has cost implications to the department as they are a poor use of the clinician's time, whilst rebonding brackets increases material costs¹. Breakages can also prolong treatment time and thus reduce the efficiency of treatment provision¹. It is not cost effective for the department or the patient and parent who must take time out from their normal schedule to attend additional appointments¹.

Prior to the Covid-19 pandemic the orthodontic department followed the self-etching primer protocol for fixed orthodontic appliances bonding, as per manufacturer instructions².

During Covid-19 pandemic The BOS recommended that its members should mitigate the potential risk of AGPs or consider providing treatment without creating AGPs where possible³.

An aerosol-generating procedure (AGP) has been defined as a medical or dental procedure that



results in the production of respirable airborne particles⁴. AGPs have been considered a significant risk for the transmission of COVID-19⁵.

Following resumption of dental services in June 2020, a risk assessment was performed based on AGP Question³ and AGP and NON-AGP in Orthodontic Procedures⁶.

New non AGP bond-up protocol was introduced to allow bond-up procedures to be carried out without producing aerosols.

Aims and Objectives

The aim of this project was to assess the rate of bracket failure prior to the Covid-19 pandemic and following the introduction of a non-AGP protocol.

Pre-Covid Self etching primer protocol² (AGP procedure):

1. Isolate teeth using NOLA Dry field system or cheek and tongue retractors, dri-angles and cotton rolls.
2. Prophyl teeth with oil free pumice or prophyl paste, remove excess water but do not dry tooth surface. Do not allow teeth to become recontaminated with saliva before applying the Transbond Plus self-etching primer.
3. Once primer activated as per manufacturer instructions rub saturated tip of applicator onto tooth surface. Continue rubbing liquid onto enamel while applying some pressure for a minimum of 3-5 seconds per tooth. If bonding to aprismatic enamel e.g.: molar deciduous teeth, lingual surfaces, increase the rubbing time per tooth to achieve desirable etch pattern.
4. Redip applicator into reservoir to saturate tip before rubbing it onto next tooth.
5. Repeat steps 3-4 for each tooth.
6. When all teeth on one arch are primed, use an oil and moisture free air source to deliver a gentle air burst for 1-2 seconds to each tooth to dry primer into thin film.
7. Proceed immediately with bonding. If bonding is delayed, apply another coat; deliver gentle air burst to dry primer into thin film and bond.
8. Light cure.

One Transbond Plus Self Etching Primer unit will etch and prime all teeth in one arch only.

Changes to bonding protocol due to Covid-19 pandemic based on: Table of AGP and Non-AGP Procedures. Version 1.0 published 15 May 2020⁶.

1. The prophyl paste or pumice not to be used at all.
2. 3-in-1 not to be used to dry teeth or primer into thin film. Teeth dried using cotton rolls instead.

These changes in protocol were made to eliminate the risk of producing aerosols, therefore minimising the risk of transmission during Covid-19 pandemic.

Standards/guidelines/evidence base At the time of the project being carried out, there were no known guidelines related to an acceptable failure rate of brackets using Self Etching Primer.

The gold standard was based on systematic review⁷ which concluded that both conventional adhesive systems and the self-etch adhesives provide a satisfactory clinical performance for bonding preadjusted edgewise brackets. The bond failure rate irrespective of the system used varied from 1.57% to 11.2%⁽⁷⁾ Gold standard in previous audit⁽¹⁾ was set as 6%.

Based on both these sources, the gold standard for bracket failure rate in Orthodontic Department at DGRI was set at no more than 6%.

Sample and data source

Cycle 1 (Retrospective data collection): 22 consecutive upper and lower straight wire cases were selected between September 2019 and December 2019 when bond-up procedure using Transbond Plus Self Etching Primer was performed according to manufacturers' instructions⁶, thus generating aerosols.

Cycle 2 (Prospective data collection): 24 consecutive upper and lower straight wire cases were selected between September 2020 and December 2020 where bond-up procedure was modified to avoid Aerosol Generating Procedures.

Methodology

Computer appointment records were used to identify and follow up patients.

All patients with full or sectional bond-ups in the analysed period were included in the project. 22 patients who had full or sectional bond-ups provided between 01/09/2019 to 31/12/2019 were included in the retrospective cycle (n=290 brackets).

24 patients with full or sectional bond-ups provided between 01/09/2020 and 31/12/2020 were included in the first prospective cycle (n=231 brackets).

Patients in both cycles were followed up for 3 months to check for bonding failure.

Data was collected using specially designed Data collection table (**Appendix 1**). Collected data included patient's initials, bond-up date, number of teeth bonded, date, number and distribution of failed brackets, presence of residual composite on the tooth.



II. FINDINGS

1st Cycle (Retrospective)

Out of 290 brackets, 15 debonded in the first 3 months in the retrospective cycle (**Figure 1**). Most of the brackets' failures happened in the first month following bond-up and then gradually decreased by the third month (**Figure2**). Out of all failed brackets 100% (n=15) in the retrospective cycle, 47% (n=7) debonded in the first month, followed by 33% (n=5) in the second month and then by 20% (n=3) in the third month(**Figure2**).

Teeth mostly affected by bracket failure in the retrospective cycle were upper incisors at 40%(n=6), followed by lower incisors at 27%(n=4) and upper and lower molars equally at 13% (n=2 of each) followed by lower premolar at 7%(n=1)(**Figure3**).

2nd Cycle (Prospective)

Out of 231 brackets, 17 debonded in the first 3 months in the prospective cycle (**Figure 1**). Most bracket failures happened in the first month following bond up, the rate decreased in the second month and then increased again in the third month (**Figure2**). Out of all failed brackets 100%(n=17) in the prospective cycle, 58.8% (n=10) debonded in the first month. We observed drop of failure to 11.8% (n=2) in the second month, followed by surge to 29.4% (n=5) in the third month (**Figure2**).

In the prospective cycle bracket failure affected 7 groups of teeth. The most affected teeth were equally: upper incisors 29.4% (n=5) and upper molars 29.4%(n=5) followed by lower incisors 17.6%(n=3) and then by upper premolars, lower premolars, upper canines and lower canines equally at 5.9% each(n=1 of each)(**Figure3**).

Observations

The Gold Standard was met in the retrospective project cycle. 290 brackets were bonded out of which 15 debonded within the first 3 months following bond-up. This gives bracket failure rate at 5.2% in 3 months following bond-up when using AGP protocol.

The Gold Standard wasn't met in the first cycle of project. 231 brackets were bonded using amended bond-up protocol between September and December 2020. 17 brackets debonded within the first 3 months following bond-up. This gives bracket failure rate at 7.4%, which is higher than the Gold Standard set.

Higher number of brackets were bonded using AGP (n=290) as compare to non-AGP protocol (n=231), however lower number of brackets failed with the former (n=15) as compare to the latter (n=17) respectively (**Figure 1**).

Percentage of bracket failure in the 3 months following bond-up varied between AGP and non-AGP protocols (**Figure2**). While the highest number of brackets debonded in the first month in both cycles, the number of failed brackets steadily decreased in month 2 and 3 of first cycle. In contrast to that with the non-AGP protocol brackets failure steadily decreased in the first two months, but raised again in the third month (**Figure2**).

Distribution of failed brackets varied between the two protocols (**Figure3**). While upper incisors were the most affected teeth with AGP protocol, upper molars with the non-AGP respectively. While 5 groups of teeth were affected with the former, 7 with the latter protocol. Interestingly lower molars were only affected by AGP protocol, while upper premolars and upper and lower canines by non-AGP protocol(**Figure 3**). Although the pattern of bracket failure varied between the two cycles, and we cannot be certain that patient behaviour hasn't contributed to the results due to the incomplete data (presence of residual composite on the tooth which would suggest mechanical failure caused by patients poor compliance, wasn't always recorded by clinician), it is clear that modification of the bond-up protocol to minimise the risk of transmission during Covid-19 pandemic, led to increase in the bracket bonding failure in the first 3 months following bond-up.

III. RECOMMENDATIONS

This project was presented at a local level in the orthodontic department at DGRI.

Several recommendations were identified and are outlined below:

- 1) Amend non-AGP bonding protocol based on updated BOS AGP table⁸ as follow:
 - a) Remove plaque with prophylaxis paste to ensure the clean tooth surface
 - b) Wash teeth with water only
 - c) Thoroughly dry tooth surface by using air only
 - d) Use One Transbond Plus Self Etching Primer per arch as per manufacturer recommendations.
- 2) Educate all patients who have bond-ups on brace care and reasons behind bracket failure and provide BOS information leaflet to reinforce the advice
- 3) Re-audit in 3 months following introduction of changes
- 4) Collection of data for the second cycle of prospective audit should include information about the presence of residual composite on the tooth for each case of bracket failure. This would help to establish if the failure results from poor patient compliance (residual composite present on the



teeth) or poor clinical bonding technique (residual composite non present on teeth).

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[8]. British Orthodontic Society. AGP Risk During Orthodontics Procedures - 25th September 2020

Figures (Graphs and tables)

Appendix 1. Data Collection table

Case no	Patient initials	Bond-up date	Number of teeth bonded	CAS date if needed	Number of debonded brackets	Was there any residual composite on the tooth?
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						



Figure 1. Comparison of number of bonded and failed brackets using AGP and non-AGP protocols

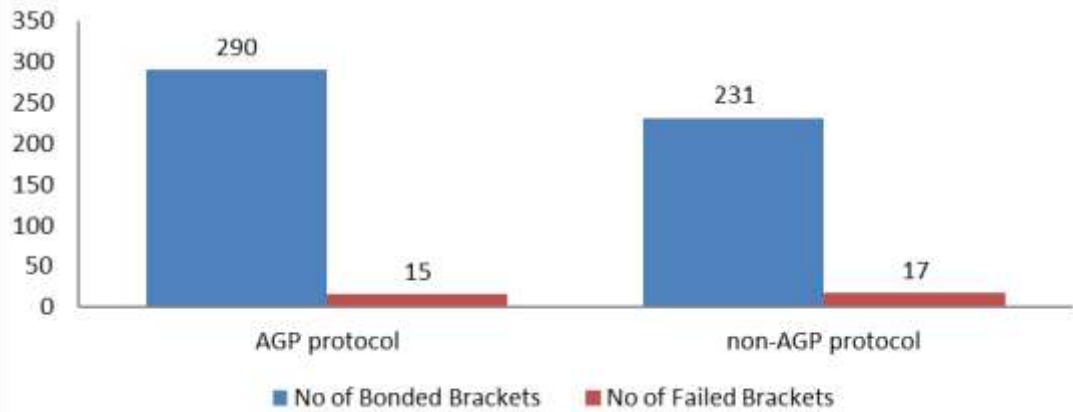


Figure 2. Percentage of bracket failure in 3 months with AGP and non-AGP protocols

