ORIGINAL ARTICLE

# COMPARISON OF ENAMEL SURFACE ROUGHNESS PARAMETERS FOR RESIN REMOVAL FOLLOWING DEBONDING USING TUNGSTEN CARBIDE BUR AND SOFLEX DISCS WITH HIGH SPEED AND LOW SPEED HAND PIECES

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## ABSTRACT

*This study was done to compare the enamel surface roughness parameters and the time taken to remove the resin from tooth surface after de-bonding, using tungsten carbide bur (TCB) and soflex discs with high and low speed hand pieces. It was a Randomized control trial, and was conducted at Children's Hospital / Institute of Child Health and PCSIR, Lahore from 1st January 2016 to 31st December 2016. A total of 60 patients (30 in each group) were enrolled. Group A comprised of patients in which resin remnant was removed by TCB in high speed hand piece (HSHP) whereas in Group B, resin remnant was removed by TCB in low speed hand piece (LSHP) followed by soflex discs in both groups.*

*Root mean square roughness (µm) changes were noted as 1.45±1.79 and 1.56±0.82 (µm) in Group A and B respectively. Maximum roughness depth (µm) changes were 4.36±2.93 in Group A and 4.33±3.92 (µm) in Group B. Time (sec) consumed in group A was 29.47±4.06 and in group B was 29.67±4.18.*

*It was concluded that TCB in LSHP along with soflex disc produces slightly more roughness as compared to TCB in HSHP and soflex disc. However, the difference was not statistically significant. Slightly less time was taken by tungsten carbide bur and soflex disc in HSHP.*

**Keywords:** *Diamond bur, enamel surface roughness, tungsten carbide bur.*

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## INTRODUCTION

Removing adhesive remnants from tooth surface following orthodontic bracket de-bonding is the final step to reinstate the enamel surface close to its pre-treatment condition devoid of inflicting iatrogenic harm.[1] Enamel surface modifications following bracket removal are considered significant in relation to outer layer of enamel that includes high levels of minerals when compared to deep layers. Damage to enamel surface may result in lesser enamel resistance to organic acids, formation of plaque and greater threat of decalcification.[2]

The proficient and secure way of adhesive resin removal following de-bonding comes in the form of variety of instruments and methods like manual removal using debonding pliers, ultrasonic scalar, various shapes of TCBs, soflex discs, composite finishing burs and intra oral sand blasting.[3,4]

Studies have revealed that some of the suggested options may harm enamel surface. Campbell PM[4] preferred the usage of carbide burs in HSHP followed by rubber points and cups. Zachrisson BU et al[5] recommended that enamel loss may be lessened employing

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TCB in LSHP. A study by Ozer et al shows that mean change in enamel surface roughness parameters following debonding after use of carbide bur and soflex discs with high speed hand piece is as, root mean square roughness $R_q$ (0.34±0.23), maximum roughness depth $R_t$ (-2.52±0.97) and mean time required for cleanup is (25.76±4.03). Mean change in enamel surface roughness parameters after use of carbide bur and soflex discs with low speed hand piece is as, root mean square roughness $R_q$ (0.72±0.4), maximum roughness depth $R_t$ (4.89±2.6) and mean time required for cleanup is (30.82±5.68).[6]

Evaluation of efficiency of rotating instruments was restricted to examine the morphological details of enamel surface under scanning electron microscopy. However, it gives more subjective information and cannot be used individually to judge reliability of clean up protocol.[4] Various protocols are exercised to find enamel damage following de-bonding like enamel detachment index, composite remnant index and surface roughness index.[5] Standard microscopic methods lack quantitative scale, so these may not be employed to target comparative evaluation of roughness of treated surfaces.[7] Profilometry provide more quantitative results. Scanning electron microscope (SEM) analysis can be used to support quantitative evaluation method.

Not much is local data is available regarding enamel surface roughness measurement by using TCB and soflex disc with HSHP and LSHP. We compared the enamel surface roughness parameters by using TCBs and soflex discs with HSHP and LSHP, and to measure the time taken to remove the resin from tooth surface after de-bonding by using TCBs and soflex discs with HSHP and LSHP. This study is thought to be helpful in reducing post treatment complications in Pakistani population such as excessive plaque accumulation, gingival irritation, increase surface staining and teeth sensitivity.

## MATERIALS AND METHODS

This study was a randomized control trial, conducted at The Children's Hospital / Institute of Child Health and PCSIR, Lahore from 1-01-2016 to 31-12-2016. The minimum calculated sample size was 30 cases (15 in each group) with 80% power of test, 95% confidence level and taking mean±S.D of mean change in root mean square roughness (Rq) in both groups i.e. 25.76±4.03 in carbide bur and soflex discs with high speed hand piece group versus 30.82±5.68 in carbide bur and soflex discs with low speed hand piece group.[6] We enrolled 60 cases (30 in each group). These included patients having teeth with intact buccal surface not subjected to any bracket bonding procedure, premolars from both arches and all needing extractions for orthodontic treatment. All those who had carious teeth, already bonded or banded premolars or tooth damaged by extraction forceps or trauma were excluded from this study.

Extracted teeth were stored in distilled water that was replaced every week to avoid bacterial growth. Embedding of teeth was done horizontally in dental white stone blocks, keeping the buccal surface exposed. Teeth were coded for identification purpose. Then, surface profilometry of each tooth was performed at PCSIR, Lahore and readings of roughness parameters i.e. $R_q$ (root mean square roughness) and $R_t$ (maximum roughness depth) were recorded. After that, enamel was etched with 37% phosphoric acid gel for a period of 15 seconds, rinsed using water and air spray for a duration of 15 seconds. A thin, uniform coating of bonding agent to etched surfaces was applied. After that, premolar brackets (MBT, 3M UNITEK) coated with adhesive resin (Transbond XT, 3M UNITEK, Monrovia, Calif) were placed on tooth surfaces, adjusted to its ultimate position and pushed smoothly in place. Excess adhesive from peripheral area of bracket base was removed to have each bond area consistent. Then each side of tooth (mesial, distal, occlusal and gingival) was light cured for 10 seconds i.e. for total of 40 seconds. Afterwards teeth were stored in distilled water for 24 hours at room temperature. Brackets were de-bonded with bracket removing plier. Teeth were divided randomly into 2 groups of 30 each using random numbers table. In group-A, resin remnant was removed by using TCB (Mani, Inc., Tochigi-Ken, Japan) with HSHP followed by soflex discs (3M UNITEK). In group-B, resin remnant was removed by using TCB (Mani, Inc., Tochigi-Ken, Japan) with LSHP and soflex discs (3M UNITEK). Water coolant was used with both techniques. Time taken by both techniques was recorded to remove composite completely. Profilometry of each tooth was performed again to record roughness parameters. All the readings were recorded in pre-designed proforma. Mean change in enamel surface roughness parameters were calculated by subtracting pre-treatment enamel surface roughness parameter measurements from post-treatment measurements.

All statistical analysis was done using SPSS 20. Enamel surface roughness parameters i.e. $R_q$ and $R_t$ and time were presented as means and standard deviation (quantitative variables). Mean change was calculated by subtracting pre-treatment enamel surface roughness parameter measurements from post-treatment measurements. T-test was employed to compare mean roughness parameters and time between both study groups. P value < 0.05 was considered significant.

## RESULTS

Baseline $R_q$ (µm) in Group A was 2.89±1.75 and in Group B was 3.13±0.91. $R_q$ (µm) after using discs in Group A was 1.44±0.55 (µm) while in Group B was 1.58±0.56 (µm). $R_q$ (µm) change was 1.45±1.79 and 1.56±0.82 (µm) in group A and B, respectively. As table number 1 shows, no statistical significance (p value > 0.05) was found in between the two groups for $R_q$ (µm).

Baseline $R_t$ (µm) in Group A was 8.34±2.86 and in Group B was 8.28±4.02. $R_t$ (µm) after using discs in Group A was 3.97±2.08 (µm) while in Group B it was 3.95±1.61 (µm). $R_t$ (µm) changes were 4.36±2.93 and 4.33±3.92 (µm) in Group A and B, respectively. As table number 2 shows, no statistical significance (p value > 0.05) was found in between the two groups for $R_t$ (µm).

TABLE 1: COMPARISON OF ROOT MEAN SQUARE ROUGHNESS RQ (µM)

| Root Mean Square Roughness (µm) | | Groups | | p Value |
|---|---|---|---|---|
| | | Group A (n=30) | Group B (n=30) | |
| Before | Mean + SD | 2.89+1.75 | 3.13+0.91 | 0.653 |
| After | Mean + SD | 1.44+0.55 | 1.58+0.56 | 0.570 |
| Change | Mean + SD | 1.45+1.79 | 1.56+0.82 | 0.823 |

TABLE 2: COMPARISON OF MAXIMUM ROUGHNESS DEPTH (µM)

| Maximum Roughness Depth (µm) | | Groups | | p Value |
|---|---|---|---|---|
| | | Group A (n=30) | Group B (n=30) | |
| Before | Mean + SD | 8.34+2.86 | 8.28+4.02 | 0.967 |
| After | Mean + SD | 3.97+2.08 | 3.95+1.61 | 0.971 |
| Change | Mean + SD | 4.36+2.93 | 4.33+3.92 | 0.983 |

TABLE 3: TIME CONSUMED (SECONDS) TO REMOVE THE RESIN FROM THE TOOTH SURFACE

| | | Groups | | P Value |
|---|---|---|---|---|
| | | Group A (n=30) | Group B (n=30) | |
| Time Consumed (seconds) | Mean + SD | 29.47+4.06 | 29.67+4.18 | 0.895 |

Fig 1: Teeth embedded in dental white stone blocks

Fig 2: Profilometer used to assess enamel surface roughness parameters

In terms of comparison of time consumed to remove the resin from the tooth surface in between both the study groups, Group A noted mean time was 29.47 seconds with standard deviation of 4.06 seconds in comparison to a mean of 29.67 seconds with standard deviation of 4.18 seconds in Group B. As table number 3 shows, no statistical significance (p value > 0.05) was found in between the two groups for time consumed (sec).

## DISCUSSION

Adhesive resin removal after debonding is essential to eradicate plaque accumulation and to reinstate aesthetic appearance of enamel surface. Several factors e.g. type of adhesive resins, incorrect debonding instruments and techniques may be responsible for enamel damage and may consume more time.

The apprehension over debonding-induced enamel surface alterations is due to the significance of the outermost layer of enamel, which has higher mineral content and more fluoride relative to deeper zones.[8] The loss of surface enamel and exposure of enamel prism endings to the oral environment may decrease the resistance of enamel to organic acids formed in plaque and make it more exposed to decalcification.[8]

Care is advised in adopting band removers and scalars, as unnecessary force with these sort of instruments may visually gouge the enamel. Green rubber wheel with subsequent use of pumice has long been advocated.[9] On the other hand, TCBs at low speed with subequent pumice and / or polishing cups have also been recommended. These are known to mark finest scratch patterns, cause low degree of loss to the surface enamel, provide good access to developmental

irregularities and to the areas which are difficult to reach.[10]TCB at high speed, followed by graded medium, fine as well as superfine Sof-Lex discs at low speed, and a final finishing with rubber cup and Zircate paste has also been advocated.[11]

Low speed TCB has been known to be the best method for this purpose.[12] Variety also exists in terms of materials related to polishers (silicon carbide, silicon dioxide and diamond particles), but their efficiency regarding removal and protective properties related to enamel surface are scarcely evaluated.[13,14]

Different methods exist regarding removal of adhesive remnants following de-bonding but TCBs used as low or high speed are commonly noted to have the most satisfactory results.[8] However, regarding tooth enamel, it has been demonstrated that TCBs when used alone, cause more damage in comparison to green rubber wheel, innovative finishing carbide bur or a fiber reinforced composite bur.[4,9]

In present study, the surface roughness parameters of teeth cleaned with the high speed TCBs along with soflex disc were comparable to low speed TCBs and soflex disc. According to Zarrinia et al,[11] TCBs with high speed handpiece showed efficiency in terms of residual resin removal but yielded not much satisfaction when used alone. Retief and Denys have also advocated the use of TCBs at high speed with adequate air-cooling.[15] In a study carried out in Brazil, author recommended TCBs in high speed handpiece followed by polishing for better enamel surface after debonding.[16]

Adhesive resin removal with TCBs in slow speed handpiece seems to be a popular approach. This method has been shown to result in minimum damage to enamel surface in comparison to other methods as demonstrated by Janiszewska-Olszowska, J and colleagues.[17]

Reverting enamel surface back to its pretreatment status with no iatrogenic harm following de-bonding is one of the primary goal of orthodontic treatment. If good approach is chosen regarding residual resin removal, smooth surface and less enamel damage is achievable providing plaque free environment.[18]

## CONCLUSION

No statistical significance in terms of difference between enamel surface roughness produced by both methods was found. However, slightly less time was consumed by TCB and soflex disc in high speed hand piece.

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| **5 Muhamamd Anwaar Alam:** | Drafting And Revising. |
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