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An in Vitro Pilot Study to Evaluate the Effect of Surface Treatment with "Mcinnes" Solution on Metal Surface-Sem Analysis

JOPD

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ABSTRACT

Aim: The aim of this pilot study was to evaluate the effect of surface treatment on metal substrate using"McInnes solution

Materials &Methods: A total number of 75 nickel –chromium (Max Bond Ruby) metal samples each of 1x1x0.3mm (height x width x thickness) were fabricated and grouped into three groups of 25 each. The samples present in the first group were performed with Sand blasting using 50 μm Al_2O_3 particles under a pressure of 50 psi at a distance of 10 mm. Similarly the samples of second group were surface treated with freshly prepared McInnes solution consisting of a mixture of 1ml of 36% HCL, 1ml of 30% Hydrogen peroxide and 0.2ml anaesthetic ether (5:5:1) using a cotton applicator.In the third group, both the surface treatments were performed on the metal samples. After completing the surface treatments of all the samples were evaluated for sem analysis.

Results: SEM evaluation of the samples of combined groups treated by both acid etching and sand blasting showed micro Roughness of metal surface comparatively greater than surface treated with sand blasting or acid etching alone.

Conclusion: Within the limitations of the study, McInnes solution can be recommended as a surface treatment agent along with sand blasting Ni Cr base metal alloy for better bonding.

Key Words: Sandblasting, Surface treatment, Bond strength, Acid etching.

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INTRODUCTION:

The clinical success and durability of any bonded fixed prosthesis depends on the proper mechanical retention between metal surface of the prosthesis and the adhesive cement used. As a result, most of the clinical failures with regards to these restorations have been observed in between the interface of metal substrate and the luting cement there by compromising the micro mechanical retention[1-2]. This provoked a lot of researches to focus on the conditioning of metal surface by different methods both mechanically and chemically. In adhesive dentistry, these failures has been minimized by performing various surface treatments like rotary, sand blasting, chemical etching ,surface conditioning and others to alter the surface texture area there by increasing the chemico - mechanical bond[3,4]. In context to indirect bonded restorations, Sandblasting is a routine procedure done in labs before delivery of crown or bridge to the clinician for increasing the effective surface are inorder to enhance the mechanical retention strengths of luting cements to substrates. Apart from air abrasion, researchers have also recommended use of different acid treatments for etching of base metal alloys such as the use of chemical gel etchants, liquid etchants, alloy primers, Hydrofluoric acid, Phosphoric acid etc[5,6].

Considering chemical composition of McInnes solution, even though it is generally used in dentistry to bleach the teeth with mild to moderate flourosis, an attempt was given to etch the Ni-Cr metal surface with McInnes solution to enhance its surface texture. This study was designed to evaluate the possibility of etching and surface alterations of Ni-Cr metal specimens by using ***McInnes solution***[7,8].

Materials and methodology:

A total number of 30 wax (GC Inlay wax) patterns, each of 1x1x0.3cm (height x width x thickness) were fabricated and grouped into three groups of 10 each.[Group1-sand blasted surface treated group alone;Group2-McInnes solution surface treated group ; Group 3 combination of both surface treatments]. Wax patterns were invested and cast in nickel –chromium (Max Bond Ruby) metal alloy. After casting, all the samples were retrieved, cleaned of the investment material and finished. The samples present in the first group were performed with Sand blasting using 50 μm Al_2O_3 particles under a pressure of 50 psi at a distance of 10 mm. Similarly the samples of second group were surface treated with freshly prepared McInnes solution consisting of a mixture of 1ml of 36% HCL, 1ml of 30% Hydrogen peroxide and 0.2ml anaesthetic ether (5:5:1) using a cotton applicator. In the components of the McInnes solution; Hydrogen peroxide acts as oxidising agent; Hydrochloric acid – etching agent; Anesthetic ether- cleansing agent. In the third group, both the surface treatments were performed on the metal samples. After completing the surface treatments of all the samples, then the surface topographic structure of the metal samples were seen under the Scanning Electron Microscope (JOEL Scanning Electron Microscope)with magnification 500X.

Results: SEM evaluation of sand blasted group (Fig.1) showed uniform rough surface with uniform presence of irregularities and shallow pits. Similary samples of McInnes solution treated group (Fig 2) showed less areas of corrosion with narrowed grooves. But the samples of combined groups treated

by both sand blasting followed by acid etching (Fig-3) showed **micro** roughness of metal surface comparatively greater than surface treated with sand blasting or acid etching alone.

DISCUSSION:

The most common clinical scenario in most of the failures of bonded indirect restoration has been observed at metal and cement interface due to poor mechanical interlocking between them. This quality of bonding depends mainly on the presence of surface roughness on the metal surface prior to luting of adhesive cement. Although there are many surface treatment applications for metal substrate, based on the chemical composition of the McInnes solution which is generally used as a bleaching agent in dentistry, an attempt has been made in this study to evaluate the micro-roughness of the metal surface induced by bleaching agent **McInnes** solution[8] and compare with sand blasted metal surface using scanning electron microscopy (SEM).

Sandblasting is a common method for surface conditioning of the metal substrates that uses aluminium oxide abrasive powder to produce scratch like micro irregularities which can be clearly noticed in electron microscope images. This method of surface treatment of metals has been approved by several studies demonstrating the efficacy of sandblasting in achieving proper bond strength to the surface of base metal alloys such as ni-cr .Similarly there were some studies reported on the surface treatments of metal substrates done by using acid etching. The efficacy of proper bonding to the metal substrates is due to acidic nature of acid (HCL) which is adequate for etching the metal surface. However, there were less to nil studies reported on the combination of both surface treatments of sandblasting followed by acid etching on the metal substrates[5,6,9,10].

In the present study, SEM analysis of the group 3 samples demonstrated more micro-irregularities as pitted areas when compared to group 1 and group 2. This might be due to the both presence of micro irregularities and preservation of the oxide layer on the metal surface which were caused due to sand blasting followed by the acid etching. It was expected that the surface topography after sandblasting following acid etching would provide suitable conditions for micromechanical retention of the luting cements. As a result, one can expect higher bond strength values compared with samples which were only sand blasted and acid etched. By the visual perception of the SEM images, we can conclude that there were no significant differences in surface irregularities between the sandblast and acid etching despite there was slight increase in the surface texture with the sandblasting following acid etching technique.

LIMITATIONS:

1. Bond strength between luting agent and metal was not evaluated.
2. The effect of McInnes solution was not tested clinically.
3. Surface roughness was evaluated only by visual perception.

CONCLUSION:

Within the limitations of the present pilot study, McInnes solution can be recommended as a surface treatment agent for acid etching along with sand blasting for Ni Cr base metal alloy for enhancement of better bonding between metal substrate and adhesive cement. The combined surface treatments of metal substrates showed more surface irregularities compared to the individual sand blasted and acid etching groups. Despite of the above results, this in vitro study has to be done on larger sample size and randomized controlled trials need to be evaluated before authentication of these results into the clinical scenario.

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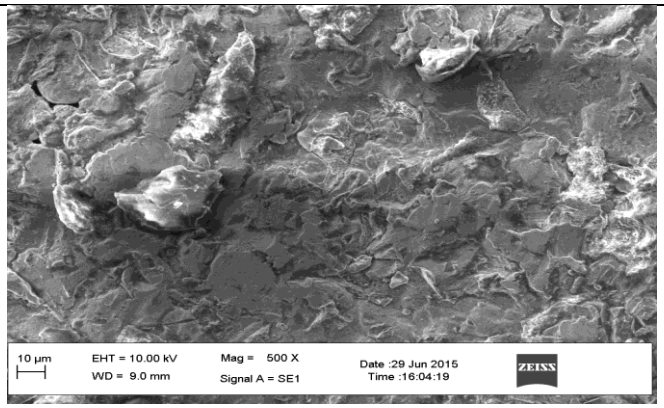
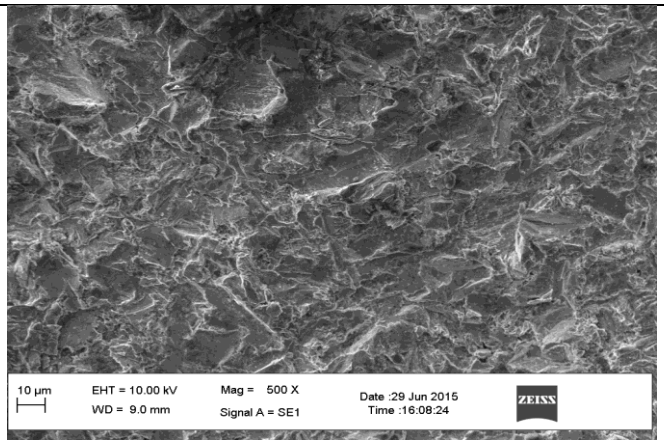
Figure legends

FIGURE1. SEM OF SAND BLASTED SURFACE	
FIGURE 2. SEM OF MCINNES SOLUTION SURFACE TREATED	
FIGURE 3.SEM OF COMBINATION OF BOTH SURFACE TREATMENTS