

## ORIGINAL RESEARCH

### Assessment of marginal gap of complete crowns made by using wet and dry ceramic ring liners – a comparative study

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#### ABSTRACT:

**Backgrounds:** Indirect restorations constitute a major part of dental restoration. The accuracy of casting is subject to material volumetric changes occurring due to shrinkage of wax and alloys. Hence; the present study was conducted for assessing marginal gap of complete crowns made by using wet and dry ceramic ring liners – a comparative study. **Materials & methods:** A total of 30 stone dies duplicated from a brass master die mimicking a prepared premolar tooth were included. A counter die with dimensions 1mm larger than the master die was made for making wax patterns of uniform dimensions. A custom tray of autopolymerising acrylic resin and polyvinyl siloxane impression material was used for duplicating brass master die. Thirty stone dies were prepared in this manner and were divided into groups of fifteen each as follows: Group A – Castings made by using dry ceramic ring liner and Group B – Castings made by using wet ceramic ring liner. Wax patterns were made on stone dies. The casting procedure was performed by using an induction casting machine. Nickel chromium alloy was used to fabricate the castings. The castings were seated on the stone die with finger pressure. Assessment of marginal gap was done using scanning electron microscope. **Results:** Mean marginal gap among the specimens of Group A and Group B was found to be 59.3µm and 152.3µm respectively. Significant results were obtained while comparing the mean marginal gap among the specimens of both the study groups. **Conclusion:** Crowns made by using dry ceramic ring liners show significantly less marginal gap in comparison to wet ceramic ring liners.

**Key words:** Marginal Gap, Complete crown

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#### INTRODUCTION

Indirect restorations constitute a major part of dental restoration. This includes the inlay, onlay, crown, bridges, ceramic restorations, and implant prosthesis. Accurate contour, proximal contact, compatible occlusion, and good marginal adaptation are critical for the long-term durability of indirect restorations. Poor marginal adaptation of crown and bridge leads to multiple deleterious consequences such as secondary caries, discoloration, and periodontal breakdown.<sup>1-3</sup> The accuracy of fit of casting is essential for longevity and clinical success of the cast restoration in the oral cavity. The accuracy of casting is subject to material volumetric changes occurring due to shrinkage of wax and alloys. This shrinkage can be compensated by setting expansion, hygroscopic expansion or thermal expansion of the investment. As this expansion is restricted because of rigid metallic ring, hence the need for a ring liner which

acts as a buffer. For many years asbestos was being used as the ring liner of choice. Reports of asbestos fibres being carcinogenic have led to alternative ring liners like cellulose and ceramics being introduced.<sup>4-6</sup> Hence; the present study was conducted for assessing marginal gap of complete crowns made by using wet and dry ceramic ring liners – a comparative study.

#### MATERIALS & METHODS

The present study was conducted in the department of prosthodontics of the medical institute and it included assessment of marginal gap of complete crowns made by using wet and dry ceramic ring liners. A total of 30 stone dies duplicated from a brass master die mimicking a prepared premolar tooth were included. A counter die with dimensions 1mm larger than the master die was made for making wax patterns of uniform dimensions. A custom tray of autopolymerising acrylic resin and

polyvinyl siloxane impression material was used for duplicating brass master die. Thirty stone dies were prepared in this manner and were divided into groups of fifteen each as follows:

Group A – Castings made by using dry ceramic ring liner

Group B – Castings made by using wet ceramic ring liner

Wax patterns were made on stone dies. The casting procedure was performed by using an induction casting machine. Nickel chromium alloy was used to fabricate the castings. The castings were seated on the stone die with finger pressure. Assessment of marginal gap was done using scanning electron microscope. All the results were recorded in Microsoft excel sheet and were analysed by SPSS software. Chi-square test was used for assessment of level of significance.

## RESULTS

In the present study, a total of 30 casting were made and were broadly divided into two study groups with 15 castings in each group. Group A included castings made by using dry ceramic ring liner, and group B included castings made by using wet ceramic ring liner. Mean marginal gap among the specimens of Group A and Group B was found to be 59.3 $\mu$ m and 152.3 $\mu$ m respectively. Significant results were obtained while comparing the mean marginal gap among the specimens of both the study groups.

**Table 1:** Marginal gap assessment

Parameter	Group A	Group B	p- value
Number of castings	15	15	-
Mean Marginal gap ( $\mu$ m)	59.3	152.3	0.00 (Significant)
SD	23.13	41.82	

## DISCUSSION

In most dental casting techniques, the investment sets, and is then heated, in a heat-resisting alloy casting ring. The need for a soft ring liner, to reduce the restriction to investment expansion, was first suggested by Souder, who recommended asbestos paper for the purpose. Since dry asbestos readily absorbs water, the ring liner was pre-wetted to prevent its absorbing water from the unset investment mix.<sup>7-9</sup> Hence; the present study was conducted for assessing marginal gap of complete crowns made by using wet and dry ceramic ring liners – a comparative study.

In the present study, a total of 30 casting were made and were broadly divided into two study groups with 15 castings in each group. Group A included castings made by using dry ceramic ring liner, and group B included castings made by using wet ceramic ring liner. Mean marginal gap among the specimens of Group A and Group B was found to be 59.3 $\mu$ m and 152.3 $\mu$ m respectively. Earnshaw R et al assessed the effect of casting ring liners on the potential expansion of a gypsum-bonded investment. A study was made of the effects of all three of these materials on the setting and subsequent thermal expansion of a gypsum-bonded

crystalite casting investment (W/P = 0.40). Thermal expansion measurements were made on the same specimens that were produced during the setting expansion tests. Control specimens setting against a smooth dry surface showed a total expansion of 1.7%. Specimens setting against dry ceramic liners had similar total expansions, in the range 1.6 to 1.7%. Specimens setting against either of the wet lining materials showed an increased total expansion (in the range 2.2 to 2.3%), by virtue mainly of a large increase in setting expansion. In order for reproducible setting expansion results to be obtained with wet liners, it was necessary to control the amount of absorbed water carefully. Dry asbestos and dry cellulose liners gave higher expansions than pre-wetted ones, since they abstracted water from the mix, reducing its effective W/P ratio (giving a thicker mix), and then functioned as wet liners. These results suggested that, at least as far as potential investment expansion are concerned, wet cellulose liners having an effect similar to that of the traditional wet asbestos liners. Dry ceramic liners give a much lower investment expansion, and when these liners are used, an investment with an increased measured expansion could be an advantage.<sup>10</sup>

In the present study, significant results were obtained while comparing the mean marginal gap among the specimens of both the study groups. Shah R et al compared the vertical marginal accuracy of single full coverage metal restorations, between ring-less and metal ring investment techniques, using two different investment materials, for implant supported fixed dental prosthesis. Three groups were made of ten samples each. Group I consisted of metal ring with PCT® FlexVest (phosphate bonded investment material). Group II consisted of metal ring with Bellasun® investment material. Group III and the final group consisted of ring-less investment system and Bellasun® investment material. The wax patterns were prepared on a metal die, cast and finished. The cast restorations (samples) were again seated on the metal die and the accuracy of fit was evaluated by measuring the gap between the finish line on the die and the margins of the sample at four specific sites using a profile projector (Helios-350H, Microtecnica, LTF, Italy) having accuracy of 1 $\mu$ m. Mean marginal accuracy for Group-III was found to be the least (58.87 + 17.87  $\mu$ m) followed by Group-II (97.23 + 16.37  $\mu$ m), and Group-I (109 + 7.55  $\mu$ m). However, Group I showed the least variability among the readings (SD=7.55). Ring-less system of casting can be recommended for use in fabricating implant supported fixed dental restorations.<sup>11</sup> Haralur SB et al evaluated the effect of varying cellulose casting ring liner length and its prewetting on the marginal adaptation and dimensional accuracy of full veneer metal castings. The master die was milled in stainless steel to fabricate the wax pattern. Sixty wax patterns were fabricated with a uniform thickness of 1.5 mm at an occlusal surface and 1 mm axial surface, cervical width at 13.5 mm, and 10 mm cuspal height. The samples were divided into six groups (n = 10). Groups I and II samples had the full-length cellulose prewet and dry ring liner, respectively. The

groups III and IV had 2 mm short prewet and dry cellulose ring liner, respectively, whereas groups V and VI were invested in 6 mm short ring liner. The wax patterns were immediately invested in phosphate bonded investment, and casting procedure was completed with nickel-chrome alloy. The castings were cleaned and mean score of measurements at four reference points for marginal adaption, casting height, and cervical width was calculated. The marginal adaption was calculated with Image J software, whereas the casting height and cervical width was determined using a digital scale. The group II had the best marginal adaption with a gap of 63.786  $\mu\text{m}$  followed by group I (65.185  $\mu\text{m}$ ), group IV (87.740  $\mu\text{m}$ ), and group III (101.455  $\mu\text{m}$ ). A large marginal gap was observed in group V at 188.871  $\mu\text{m}$ . Cuspal height was more accurate with group V (10.428 mm), group VI (10.421 mm), and group II (10.488 mm). The cervical width was approximately similar in group I, group III, and group V. Statistically significant difference was observed in Tukey post hoc analysis between group V and group VI with all the other groups with regards to marginal adaptation. The dry cellulose ring liners provided better marginal adaptation in comparison to prewet cellulose ring liners.<sup>12</sup>

## CONCLUSION

From the above results, the authors concluded that crowns made by using dry ceramic ring liners show significantly less marginal gap in comparison to wet ceramic ring liners.

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