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The Effect of Recast Base Metal Alloys on Crown's Marginal Accuracy

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The purpose of this study was evaluation of the influence of recasting base metal alloys on internal and vertical marginal adaptation of the casting crowns. Sixty crowns with identical thickness have been made out of wax over 60 metallic models. Wax copings were randomly divided into 3 groups of 20. Group A contained 100% new alloys, group B included 50 new-alloys and 50% once recast alloys and group C comprised 100% once recast alloys. Each group of 20 objects was randomly separated into 2 groups of 10 specimens. One of the groups was casted with Supercast base metal alloys and the other was casted with Verabond base metal alloy. Having placed and cemented the caps, the vertical distance of restoration margins to die's finishing line was measured and recorded in four points of buccal, lingual, mesial and distal using a stereo-microscope with detection of one micron. Then the dies were cut buccolingually and the internal distance between the margin and die was measured in buccal and lingual. The data were statically analyzed using one-way ANOVA and t-test with the confidence internal of 95%. Meaningful differences were not detected among the three groups in terms of average internal and vertical gaps in Supercast and Verabond alloys. There was no discrepancy in internal and vertical gap between Supercast and Verabond using various percentages of alloys. According to the result of this study on using the three various Supercast and Verabond alloys (100 new alloys, 50 new-alloys and 50% once recast alloys and 100% once recast alloys), regarding the internal and vertical gap indicators no difference was noticed.

Key words: Recasting, internal gap, vertical gap

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INTRODUCTION

Marginal accuracy is one of the most significant factors in success as and longevity of a porclain-metal reatoration, whereas, inadequate adaptation of a cast reatoration leads to teeth and periodontium destruction (Walton *et al*., 1986; Karlsson, 1986; Tjan *et al*., 1992; Jacobs and Windeler, 1991; Ericson *et al*., 1990). Various researches have been conducted regarding the influence of recasting on marginal accuracy of noble alloys and their physical and mechanical characteristics and instructions on how to reuse them have been published in books and articles (Craig and Powers, 2002; Ayad, 2002).

For instance, in order to achieve a clinically acceptable casting, manufacturing companies producing gold alloys recommend that recast metal should be combined, at least, with a 50% new metals (Reisbick and Brantley, 1995). In textbook, a mixture of 50% new alloys and 25 to 50% recast alloys is suggested for the purpose of reapplication of noble alloys (Craig and Powers, 2002). An investigation has shown that recasting type III gold alloys may adversely affect the marginal accuracy of complete cast crowns, however, the marginal discrepancy was less than 25 microns and there wasn't any significant effect on marginal accuracy clinically (Ayad, 2002).

Repeated casting show more stability in noble and nickel-based alloys in comparison with high noble alloys and Titanium (Peraine *et al*., 2007). But a study reveals that new palladium-silver alloys show better marginal and internal adaptation than recast alloys (Lopes *et al*., 2005). Nowadays, in respect to the high price of noble metals, base-metal alloys are broadly used for casting restorations. The problem associated with base-metal alloys is that it is hard to cast them and after casting, their margins are shorter than the required amount (Mclean, 1979).

Hesby italic compared some physical properties of cobalt-chromium alloy after repeated casting. There were no meaningful difference in tensile strength, percentage of elongation and hardness properties among any of the four generations of casting (Hesby *et al*., 1980). Recasting of nickel-chromium alloys reveals no meaningful effect on their castability in comparison with Titanium which elicited a significant decrease in castability (Mosleh *et al*., 1995). But some studies have demonstrated that recasting base metal alloys has negative effects on the alloys properties (Issac and Bhat, 1998; Mirkoviæ, 2004) and the cytotoxicity of base-metal alloys increases after recasting (Al-Hiyasat and Darmani, 2005).

The studies as to recast base-metal alloys are restricted to examine the physical characteristics of these alloys. However, no study has been done concerning the effect of base-metal recasting on margin adaptation so far. The purpose of this study is to determine the influence of base-metal alloys recasting on internal and vertical marginal adaptation of cast crowns.

MATERIALS AND METHODS

This study was conducted at the center of Mashhad Dental Research of Mashhad University of Medical Science in 2006. Sixty metal models made of brass along with metal caps from the same material were made. Each metal model was designed to simulate the morphology of a prepared premolar with sloping shoulder finish line and 6 degrees of occlusal convergence. A notch was prepared on the surface of occlusal model to stop copings' turning over the metal model. The occlusal model's surface and axial walls were covered by a die spacer close to one millimeter of internal angle of finish line. Having lubricated the die and internal surface of the coping, Inlay wax (HARVARD, Richer and Hoffman Harvard Dental-Gmbh, Germany) was melted with steady and gentle heat and poured into the coping with a special castanet. The models were placed inside the copings. Copings were removed from the model after the wax became cool. Sixty wax copings were made in this method, were randomly divided into 3 groups of 20 specimens The contents of each group was as follow: In group A, 100% new alloy was used, group B contained 50% new alloy and 50% once cast alloy and in group C, 100% once cast alloy was used. afterwards, 20 specimens were randomly divided into 2 groups of 10, one of the groups was casted by Supercast base metal alloys (THERMABOND ALLOY Mfg, USA) and the other one by Verabond base metal alloys (Alba Dent, USA) (Table 1).

After casting the copings were seated on their respective dies. The copings were cemented by Zinc Phosphate cement (Richer and Hoffman Harvard Dental GmbH, Germany). A 1000 g weight was used over all the copings while cementing to make the excess cement leave out. Having removed excess cement, vertical distance of each coping margin up to finish line was measured and recorded by an Olympus-B 60 reflective microscope with detection rate of 1 μ in four points (buccal, lingual, mesial and distal).

Afterwards, the dies were embedded in silicon resin and sectioned buccolingually. Vertical distance of the meeting point of axial wall and sloping shoulder in respect to internal surface of each restoration was measured and recorded in two buccal and lingual points. This measured distance is called internal gap. The data were statistically analyzed using one-way analysis of variance (ANOVA) and t-tests ($\alpha = 0.05$).

Table 1: Composition of used base metal alloy (in present)

Brand	Ni	Cr	Mo	Be	Co	Al	Ti
Super cast	74.00	14.00	5	1.60	-	-	-
Verabond	77.95	12.60	5	1.95	0.45	2.9	0.35

RESULTS AND DISCUSSION

The average gap for the whole 60 specimens was calculated.

On the basis of one way analysis of variance test there exists no significant difference between various percentages of Supercast and Verabond alloys considering vertical gap as shown in Table 2. The ANOVA test indicates no important difference between various percentages of Supercast and Verabond alloys in respect to internal gap average (Table 3).

t-test was used to compare Supercast and Verabond with different percentages of the alloys (100 new alloys, 50 new and 50 recast alloys and 100% recast alloys). The results indicated no important difference in vertical and internal gap average between two Supercast and Verabond alloys with different percentages of new and once-cast alloys.

Many investigations have evaluated the effect of repeated use of alloys on their characteristics, however, the studies showed different results. For instance, the comparison of Hesby (Hesby *et al*., 1980) and Mosleh's (Mosleh *et al*., 1995) studies, with Issac and Bhat (1998) and Mickovic's (2004) studies reveals contradictory results about the effect of recasting on physical characteristics of base-metal alloys. This study shows that there is no meaningful statistic distinction in average internal and vertical gap among different percentages (100 new alloys, 50 new and 50 recast alloys and 100% once-cast alloys) of Supercast and Verabond alloys (Table 2, 3). This result supported the conclusion of a study done by Mosleh *et al.* (1995), who stated high capability of casting for recast Nickel-Chrome alloys (Mosleh *et al*., 1995).

Marginal accuracy is considered as an essential factor in success of a restoration, however, varying figures have been presented as clinical authorized extent of vertical margin gap. Two hundred microns of this extent is considered acceptable by Gulker. Mclean and Von Fraundhofer have agreed on 120 μ as vertical margin gap (Gulker, 1985). On the other hand, considered a gap of over 50 microns as an open margin (Shillingburg *et al*., 1997). In the light of this study's results and its comparison with aforementioned figures, it is understood that the vertical gap in the margins of recast crowns is within the permissible range and the application of three varying percentages of alloys (100 new alloys, 50 new and 50 recast alloys and 100% recast alloys) are satisfactory.

Table 2: Mean and SD for vertical gap (μm) among costing group (S: Supercast, V: verabond)

Casing group	Alloy brand	Mean±SD
Group A: 100% new ally	S	34.9±2.7
	V	36.9±5.2
Group B: 50 new and 50% recast alloy	S	37.4±6.8
	V	38.4±3.9
Group C: 100% recast alloy	S	39.5±3.7
	V	36.6±4.3

Table 3: Means and standard deviations for internal gap (μm) among casting goap (S: Supeacat, V: Verabond)

Casting group	Alloy Brand	Mean±SD
Group A: New alloy	S	43.0±11.6
	V	42.5±9.5
Group B: 50% new alloy, 50% recast	S	44.0±17.1
	V	41.0±9.7
Group C: 100% recast alloy	S	42.0±16.4
	V	40.0±15.4

According to Ayad (2002) study, recasting type III gold alloys doesn't effect the crowns margin vertical adaptation, however, all the gaps were less than 25 μ. Although, the recent study indicated that recasting of basemetal alloys has no significant effect on margins vertical adaptation, but all the vertical gaps were more than 25 μ (It is noticeable since the applied alloys are base metal alloys). In Supercast alloys, vertical gap averages of the three kinds of different percentages of alloys showed no special distinction, but the minimum gap related to 100% new alloys was 34.9, thus, it is suggested to use new alloys as far as possible while utilizing Supercast alloys.

There is a trace of distinction in vertical gap average of various percentages of Verabond alloys (Table 2). The examination of internal gap average in both Supercast and Verabond alloys in the three studied groups depicted no particular distinction. However, when 100% recast alloys were used the internal gap average was a bit less (Table 3). Although, alloys recasting has decreased the internal gap, but this decrease is minute (about 1-2 μ) and clinically it might not be substantial. It seems that other factors including accuracy during investing and casting stages, wax pattern expansion, investment expansion, wax pattern stress release are involved in these changes.

Comparing the two Supercast and Verabond alloys when various percentages of new alloys and recast alloys were used, no meaningful distinction was disclosed in vertical and internal gap. Beryllium is far effective in improving the capability of base metal alloys casting (Shillingburg *et al*., 1997). Comparing the amount of Beryllium in Verabond alloys (1/9%) and in Supercast alloys (1/6%) does not indicate a huge amount of Beryllium in the two groups. Therefore, this non existence distinction of internal and vertical gap can be related to closeness amount of Beryllium in the two Supercast and Verabond alloys.

CONCLUSION

Within the limitations of this study, there is no significant distinction between varying percentages of Supercast and Verabond alloys (100 new alloys, 50 new and 50 recast alloys and 100% recast alloys) in internal and vertical gap average. Hence, the application of the three different alloys categories is acceptable in this respect.

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