The casting ability of Non precious alloy used for ceramic restoration After remelting and treatment with new alloy

قابلية الصب لسبيكة من المعدن الغير ثمين والمستعمل لتعويضات السيراميك بعد إعادة تذويبها ومعاملتها مع معدن جديد

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Abstract:

The high cost of gold and other noble metals over the past 25 years have necessitated the use of non precious alloy for the fabrication of fixed dental prosthesis . Castability is of great clinical signification since it is closely related to marginal fit, that in turn may effect the periodontal health because short margin may be more plaque retentive .This investigation for evaluating the castability of one type of non precious alloy after several remelting procedure with the addition of 50% and 35% by weight of new alloy .

Three generation of remelting were performed , one without the addition of any new alloy , the second with the addition of 50% by weight of new alloy, and third with the addition of 35% by weight of new alloy.

A test pattern composed of wax mesh section approximately 40 mm **x** 40 mm , attached to V-shaped sprue rods 5mm long . A castability value was obtained by counting complete segments of cast alloy grid to identify the quantitative and qualitative constituents of the alloy after several treatment procedure .

Test results indicated that whenever remelting required for any type of dental alloy , it should be accomplished with the addition of 50% or at least 35% b**y** weight of new alloy for remelting procedure to obtain a better castability performance .

الخلاصة

إن ارتفاع أسعار الذهب والمعادن النبيلة خلال الخمسة والعشرون سنة الاخيرة أوجد ضرورة استعمال سبائك بديلة ذات نسبة قليلة من الذهب لتصنيع التعويضات السنية الثابتة (Fixed dental prosthesis). ان قابلية الصب للمعدن ذات أهمية كبيرة في العيادة لأنها تعود بشدة إلى انطباق حافة التعويضات الثابتة على الأسنان الساندة لتلك التعويضات والتي بدورها تؤثر على صحة اللثة , لان الحافات القصيرة هي الأكثر تجميعاً لمادة البلاك .

أجريت هذه الدراسة لتقييم قابلية الصب لسبيكة من معدن غير ثمين بعد إعادة تذويبها لعدة مرات مع إضافة كمية من المعدن الجديد بنسبة 35% و 50% . ووفقاً لذلك تم تذويب المعدن على شكل ثلاث حالات، الأول إذابة المعدن بدون إضافة أي نسبة من المعدن الجديد , الثاني إضافة نسبة 50% من المعدن الجديد , والثالث اضافة 35% من المعدن الجديد

لقد تم اختيار نموذج الاختبار وفقاً لدراسات سابقة ويتكون من مقطع من شبكة شمعية حوالي 40 ملم × 40 ملم تتصل بمصب (sprue rod) على شكل حرف Vبطول 5 ملم . وتم تقييم قابلية الصب لكل نموذج بعد إضافة نسب مختلفة من المعدن الجديد (الذي لم يسبق إذابته) باحتساب عدد المقاطع الكاملة في المصبوبة .

أظهرت النتائج بأنه عندما تكون هناك حاجة لإعادة صب أي معدن من المعادن يجب أن يكون مقروناً بإضافة 50% وعلى الأقل 35% من المعدن الجديد للحصول على أفضل مصبوبة ذات قابلية صب عالية (84.38 , 96.48) لكلا النسبتين .

Introduction

The using of high-gold casting alloys in dental practice is based upon mechanical properties,biocompatibility,and corrosion resistance (1). In an attempt to reduce the expense of these restorations, gold alloys could be recast. Recasting of gold alloys vary from adding no new metal, to some new metal, to 50% new metal with previously melted sprues removed from castings (2-4).

For economic reasons, non precious alloys have become widely used to substitutes for the higher cost precious metal alloys (5).To further decrease costs, previously used non precious alloys may be combined with new metal to produce clinically acceptable castings (6) According to American dental association classification 1984 , any alloy that contain less than 25% of noble metal (gold , platinum and palladium) is consider as base metal alloys (non-precious alloy) (7,8) . The improvement in composition of base metal alloys and its low cost than gold lead to widely used for some laboratories. Many studies have been evaluated the physical properties of non precious alloy after repeated use like hardness, tensile strength and percentage of elongation .These physical properties were compared after first, second, third and fourth remelting of alloys without the addition of new alloy, they concluded that there were no significant differences observed among any of the four generation of castings(9).Other evaluation were conducted on mechanical properties of these alloy and compare it with gold (10,11). More recently evaluation of some properties of prepared dental base-metal alloys were conducted by AL-Khafagy 2003 (12).

The purpose of this study is to evaluate the casting ability of one type of non-precious alloy after remelting with the addition of 50% and 35% of new alloy to provide good castability with fine details . The casting process was introduced in dentistry by phil & brook 1897 . Casting can be defined as an object formed by the solidification of fluid that has been poured or injected into a mold(13) . While castability is the ability of molten metal to occupy completely the mold created by the elimination of wax pattern(14) . There are variable method to determine the castability of dental alloy, but castability test based on pattern utilizing a size & configuration that resemble dental casting which would facilitate the evaluation of factors that are critical(15).Pattern used in these studies is removed from the pattern made by Sorensen and Ingeroll in 1966(16).The castability of base metal alloys also was assessed by Govington 1985(17). Recently Bezzon et al.(2001), used the mesh of a nylon net as the casting standard to determine the castability value(18).Nickel - Chromium alloy have become widely used to substitutes for the higher - cost precious metal alloy , and have coefficient of thermal expansion values in the same ranges of the gold alloy replaced(19). However the selection of non- precious alloy should be based on a balanced between the cost factor, physical properties,chemical properties, and ease of manipulation(20). Base metal alloys(non precious alloy) melts at elevated temperature, so the use of phosphate or silica- bonded investments is indicated (21). However other manufacturers of base metal alloys advocated the use of phosphate bonded investment with these alloy specially with Nickel chromium alloys(22) .

Materials and Methods

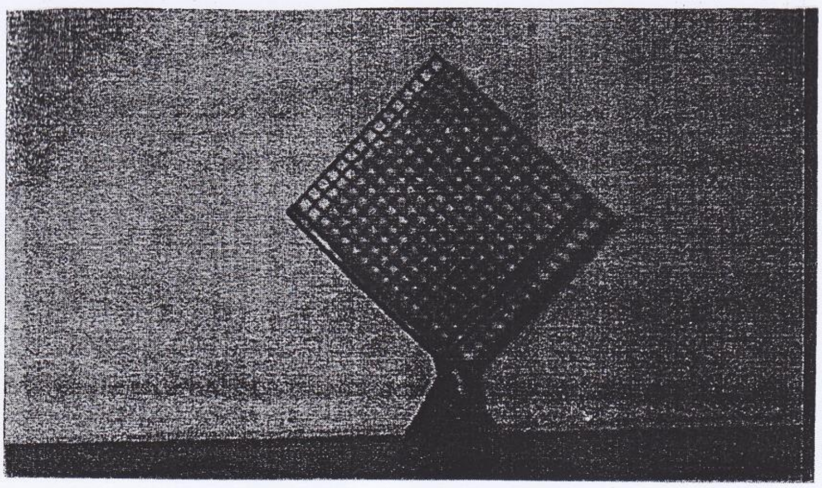
The test pattern used in this study was composed of square section of wax mesh retention grids approximately 40mm x 40mm . It consist of small square opining 2.5mm. x 2.5mm. forming a total number of (256) segments . The two adjacent end of the wax screen was attached to V-shape wax sprue rod gauge (8), at the Junction of the V-shaped a wax sprue gauge (10), 5mm long and 2.5mm in diameter was used, (Fig 1) .

One type of investment (Deguvest soft –Degussa AG-GB Dental und Goldhalbzeug, D-6000 Frankfurt 1.) was used to invest the wax pattern . The casting ring was constructed with special dimension to fit the size of the test pattern . Investment was hand spatulated for 15 second , then vaccum mixed at low speed (425 r.p.m*) for 45 second and kept under vaccum without mixing for 15 second to eliminate any trapped air . The liquid/powder ratio was 1/3 according to the manufacturer instruction , then bench set for 60 minutes and casting .

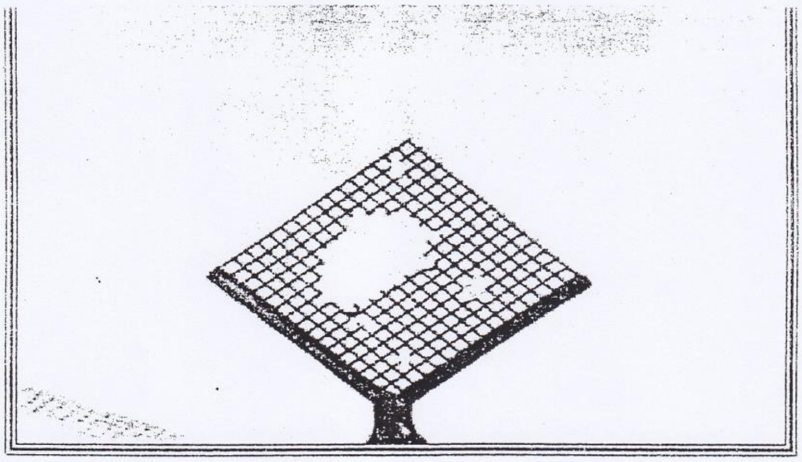
Non-precious alloy (Verarbeitungsanleitung Fur Kera NH- GERMANY) was used to produce 24 specimens with a manual centrifugal casting machine. All the specimens were sandblasted to remove any excess of investment material.The system of casting these specimens are shown in
(table1). X4 magnifying hand lens was used to determine the number of complete segments .

Segments were considered incomplete if they do not completely extend from the far edge of one crossing segments to the far edge of the next one , (Fig 2 and 3). The percentage of castability values for each group of specimens was determine as the number of complete segments multiplied by 100 and divided by total number of segments (256) . The data of castability values were collected and subjected to statistical analysis using multi-variant (multi-range) test in order to compare the alloy at different treatment procedure .

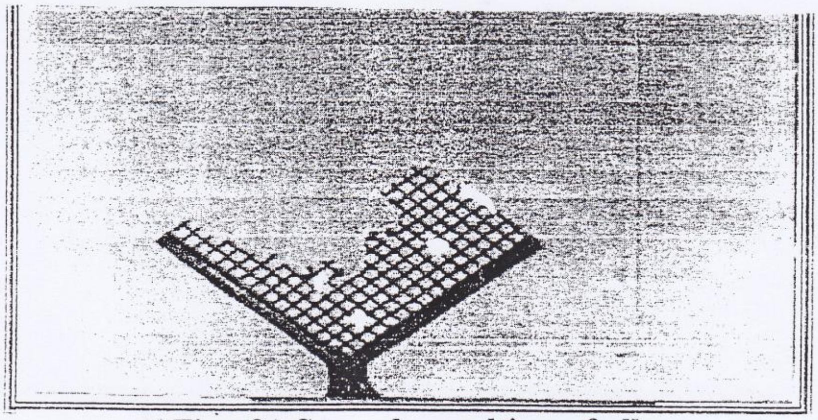
* r.p.m =Revolution per minute



(Fig . 1) Test pattern



(Fig .2) First remelting of alloy



(Fig . 3) Second remelting of alloy

(Table 1) The System Of Casting Alloy

No. of treatment	No of sample of alloy	Type of treatment
1	8 casts	Complete melting of new ingot of the alloy
2	4 casts	1st remelting of material from treatment No. 1
3	4 cast	2nd remelting of material from treatment No.2
4	2 casts	remelting of material from treatment No.l + 50% addition of new metal by weight
5	2 casts	remelting of material from treatment No.l + 35% addition of new metal by weight
6	2 casts	Remelting of material from treatment No.4 +50% addition of new metal by weight
7	2 Casts	Remelting of material from treatment No.5 + 35% addition of new metal by weight
Total	24	

Results

(Table2) represent the percentage of castability and the number of complete segment for each specimen of the test alloy at different treatment procedure with and without the addition of new alloy.

(Table3) represent the minimum , maximum , mean and standard deviation for the percentage of the castability value for each specimen at different treatment procedure . The results obtained from this table were shown that treatment 1 to 3 represent the effect of remelting temperature only on the castability of the alloy, while treatment from 4 to 7 represent the effect of the addition of 50% and 35% by weight of new alloy on castability behavior of the alloy.

The result revealed that before the addition of new alloy a continuous reduction on the castability were shown at treatment 2 and 3 (80.47,51.17). While the situation were improved when 50% and also slightly improved when 35% of new alloy was added where treatment 4 and 5 present (96.48 and 84.38) respectively.

(Table2) percentage of castability , number of complete segment, and new alloy ratio.

No. of treatment	Percentage of castability	No. of complete segments	New Alloy ratio
1	98.83	253	Non
2	80.47	206	Non
3	51.17	131	Non
4	96.48	247	50% New alloy
5	84.38	216	35% New alloy
6	80.08	205	50% New alloy
7	67.19	172	35% New alloy

(Table 3) The minimum , maximum and mean ± standard deviation of treatment of alloy

Alloy	Treatment	Minimum	Maximum	Mean ± S.D
Non precious alloy Kera NH Germany	1	97.65	100.01	98.83 ±1.33
	2	79.18	81.76	80.47 ± 0.77
	3	49.89	52.45	51.17 ± 1.44
	4	95.75	97.21	96.48 ± 0.73
	5	83.64	85.12	84.38 ± 0.74
	6	79.03	81.13	80.08 ± 1.05
	7	65.89	68.49	67.19 ± 1.3

Discussion

The addition of new alloy were significantly improved the casting ability percentage which is possibly as a result of the improvement in the physical and mechanical properties of the alloy, because during remelting procedure the metal loss many properties which lead to reduction in the castability value especially in the second remelting (51.17%- table 2 treatment No.3) .The addition of 50% of new alloy for Non-precious alloy improved the castability behavior of this alloy for the first time(96.48% treatment No 4).This result agrees with Rosenstiel et al 2006 who recommended that at least 50% new metal be included in copings for metal-ceramic restorations.Although most manufacturers concur, there is little experimental justification for the 50% rule. However the improvement with the 35% was less pronounced than with the 50% (84.38% treatment No 5) due to multiple area of incomplete segments that found in the specimens. This could be due to some effect on the chemical composition of the alloy. Other possible causes,probably the impurities. Further,for economic reasons, recycling of an alloy cast sprue is also a procedure in dental laboratories,and the composition change caused by multiple castings is a matter of interest. This result indicated the necessity of adding new alloy whenever remelting is required , this is more evident in the third generation of remelting this alloy.

Conclusion

The improvement of the castability behavior of the Non-precious alloy can be obtained by addition of 50% and at least with 35% by weight of new alloy to the previously melted alloy. This mean that the first remelting of this alloy should be accomplished with the addition of new alloy to improve the castability and any alloy to be reused should be mixed with new alloy in propotion of at least an equal weight.

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