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A STANDARDIZED TECHNIC FOR GOLD PARTIALS

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PARTIAL denture prosthesis has not developed as it should have during the past twenty-five or thirty years and surely no other part of our practice deserves more attention just at this time when extracting is so popular. And to my mind the thing most needed is standardization of technic. My attention in the use of the term "standardization" is to convey the idea that a definite procedure should be followed for each step in the production of any given class of partial denture. While each case will vary in detailed requirements the essentials of construction are fundamentally the same. Standardization is the "watch word" of all industrial and manufacturing enterprise. Why not ours? No line of human endeavor is more important. By standardization only can we hope to reach the highest degree of production in both quantity and quality.

Standardization is absolutely necessary to the further development of this part of our practice.

The technic I am offering is the result of many years of concentrated effort and so far as possible has been standardized. The procedure is so simple, the time so short, and the results so uniformly satisfactory that the employment of all gold and porcelain is made possible in a very much larger percentage of cases than ever before. The advantages of the gold base over vulcanite or other materials employed for bases is so well known that discussion is unnecessary, and particularly is that true of the cast gold base.

We believe the cast gold base with loose pin porcelain crown to be the best form of construction and should be employed wherever possible. This type of appliance is almost ideal in every respect. The principal advantages are

that it permits of sectional construction, is stronger, less bulky, more easily and accurately fitted, more sanitary, more natural in appearance, with better lingual contour of teeth and easier of repair.

Sectional construction is especially advantageous in extension saddle and long-span cases where it is so essential to have the saddle in compressed relation to the alveolar ridge.

There is but little need today for the swaged saddle having the teeth attached with rubber. The cast saddle is more easily made and surely more

floors and pins for dummies, cast in one piece; (7) one quality of gold for the entire structure; (8) very little solder; (9) a new porcelain crown tooth for this purpose; (10) low heat in dissipating wax; (11) horizontal, visible investment; (12) vertical, centrifugal casting.

1. *Preparation of teeth.*—Some preparation of teeth to be clasped is necessary. We must keep in mind that all alloys suitable for clasps are rather low in elastic limit and will not spring over extreme contours and return to a firm grasp on the tooth when in place, hence

Fig. 1.—Buccal view of molar showing the difference in mesio-distal diameter at contact point and gingival surface emphasizing the necessity for some reduction of contour.

accurately fitted, and while the casting as a general proposition is not so strong as the wrought metals, the fact that the pattern is fashioned in wax permits of reinforcement wherever necessary. This feature in addition to the employment of more rigid alloys makes possible adequate strength with no greater bulk.

Where gum restoration is necessary, protesyn is employed with most gratifying results. The essential features are: (1) sectional impressions; (2) sectional bites; (3) smooth hard casts; (4) waxing and casting direct to cast; (5) sectional or unit construction for the larger or multiple space cases; (6) for the smaller cases the clasps, saddles,

Fig. 2.—Mesial view of molar showing the greater diameter near the gingival surface, emphasizing the importance of carrying clasps well around the mesial and distal angles, thus securing reciprocal bearing, greater elasticity, and firmer grip.

the necessity for the removal of excess contours. And by this do not understand that any considerable amount of enamel is removed at any one point. Never under any circumstances should the dentin be exposed (Figs. 1, 2).

2. *Impressions.*—Impressions are taken in sections for the sectional impression yields the most accurate results. Complaster is used for posterior and modeling compound for anterior impressions. By sectional impressions is meant the placing of material into the mouth in sections—not carrying the material into the mouth en masse and

breaking out in sections. By the former method we predetermine the line of separation so that impression is taken in two clean sharp well defined parts.

In view of the fact that practically all castings are made directly to the cast it is very essential that accurate impressions of the teeth be obtained at the time the impression is taken of the saddle areas. And this can be done by

materials is the lessened danger of mutilating the cast when separating. Modeling compound is also a desirable material to use where compression of soft tissue is necessary (Figs. 3, 4, 5).

3. *Taking bite.*—In taking the bite more accurate results are obtained when small pieces of wax are fitted and the bite taken of each space as a separate unit.

Fig. 3

Fig. 4

Fig. 5

Figs. 3-5—Fig. 3 *a*, sectional impression for lingual bar case using combination of plaster of Paris and compound to secure compression of tissue over which saddle is to rest. A good impression of saddle areas and lingual surfaces of teeth is taken in plaster, after which the saddle areas are relieved to the extent of about one-sixteenth of an inch and modeling compound traced on the surface with dry heat. The impression is replaced in the mouth and pressed down firmly until plaster part of impression shows accurate apposition to the teeth. Having completed this part of the impression a small bit of compound is used to get an impression of the buccal surfaces of teeth to be clasped. *b* shows a similar method for bridge case. Figs. 4 and 5 are sectional compoaster impressions for short-span double clasp one-piece cast bridge. Fig. 4 *a*, buccal view of teeth and space, and sectional tray; *b*, tray in position with buccal excess of compoaster trimmed away; *c*, lingual view of same. Fig. 5 *a*, mesial view of same showing predetermined line of separation as indicated by dotted line; *b*, completed impression with the two sections united.

the sectional plan only. Modeling compound or compoaster are the materials preferred. These materials may be used in combination for some cases. The principal object in using these

4. *Casts.*—Casts are made of a hard smooth investment compound so that they will withstand mutilation and yield a smooth surface to the casting. Weinstein's Cast Clasp Investment was

designed especially for this purpose. Great care is required in making the cast to avoid air bubbles and other imperfections. Since we are casting directly upon the cast it is essential that it be hard enough to withstand mutilation during construction, and re-

Fig. 6.—*a*, Cast; *b* and *c* buccal and occlusal views of case waxed up ready for investing.

sistant enough to heat to stand the casting process. Great care should be taken to secure smooth-surfaced models. The smoothness of the casting is almost wholly dependent upon the smoothness of the cast; hence the importance of this feature. A very considerable experience and observation has convinced me that the Franzwa Investment Spatu-

lator is the most efficient device yet produced for this purpose.

5. *Waxing*.—Wax is melted to place on the cast and carved to the exact form of desired casting. Melting the wax in a ladle and carrying it to place with a suitable spatula has the advantages of being quick, free from danger of mutilation of cast and permits the essential variation in thickness. Preference is given to some translucent inlay wax. Cast should be comparatively dry so that the wax will adhere closely to surface; otherwise subsequent investment will run in between and

Fig. 7.—Side of flask cut out, showing case in position ready for pouring investment.

cause a rough imperfect-fitting casting (Figs. 6, 7).

6. *Investing*.—The same careful procedure outlined for making casts will result in smooth surfaces of casting that is made against the flasking investment. The cast with wax pattern and wax sprue and air vent attached is placed in an open-side horizontal flask and the investment poured in around it.

7. *Dissipating wax*.—A high percentage of plaster content in the investment necessitates a slow low heat in dissipating the wax. The temperature should be kept between 350° and 400° F. for from one hour and a half to two hours. The size and number of cases placed in the oven will be cause for

variation in time. Maves's oven or some similar controllable heat oven is desirable for this purpose.

Fig. 8.—Chart showing seven variations in oxy-acetylene torch; No. 6 is the neutral flame which represents complete combustion and is the proper flame to use.

Fig. 9.—Vertical throw machine: *a*, flask; *b*, crucible; *c*, balance ball; *d*, propeller cord.

8. *Casting.*—The fundamental principles of casting inlays and prosthetic pieces are very much the same. There are nevertheless many points of difference and the routine procedure followed

in most cases for inlays will not result in good prosthetic castings (Figs. 8, 9, 10). The principal points for consideration are the handling of the special alloys for clasps and saddles and the difficulties of casting these larger pieces.

Fig. 10.—Diagrammatic drawings showing comparative effect of force on gold exerted in both vertical and horizontal throw casting machine: *a* shows crucible and flask of vertical throw machine (arrows in floor of crucible indicate uninterrupted path of gold into mold; dotted line in floor shows improper opening in flask); *b*, zigzag line of arrows shows course of gold in horizontal casting machine, flask and crucible on a straight line from center of rotation; *c* shows course the gold takes when flask and crucible are set at an angle of 45° from this line. Dotted line shows incorrect position of blow-pipe and form of crucible where vertical flask is used in connection with other forms of casting machines.

In casting inlays where pure gold is used, there is not the danger of overheating, oxidizing, or carbonizing the metal as in the case of alloys, and when alloys are used for inlays the damage from these influences is not so vital as in prosthetic castings.

The requirements for greater strength and free flow of the metals used in making saddles, bars, and clasps call

Fig. 11.—*a*, *b*, and *c*, three views of the mesio-distal grip clasp; *d*, modified form; *e*, distal view of bucco-lingual contour grip clasp on molar.

for a careful consideration of these features. The four common causes of damage to prosthetic castings are (1) the use of too hot a flame, (2) an oxidizing flame, (3) a carbonizing flame, (4) contamination with some base metal. Too hot a flame dissipates the lower fusing metals in the alloy, the oxidizing flame renders the metal sluggish in casting and brittle in re-

sults. The carbonizing flame while affecting the platinum-palladium alloys particularly on account of the affinity

Fig. 12.—A variety of continuous ring clasps on molar. This is a light narrow clasp yet very strong, indicated in mouths where there is a marked susceptibility to decay.

of these metals for carbon is also a dangerous flame for any alloy on account of the high temperature obtain-

Fig. 13.—Cuspid and molar special crowns showing long labial, buccal, and lingual ridge-lap and beveled base, also wax base ready to assemble with saddle and crown.

able with this source of heat (the oxy-acetylene torch for example). Contamination with base metals, such as

traces of iron that may be contained in the investment compound or the use of scrap gold the contents of which is not known, will also result in castings of an indifferent quality and in a high

ment compound thoroly cleaned off with a stiff brush and either pickled in hydrofluoric acid or subjected to mechanical removal of borax. (The use of the centrifugal casting machine auto-

Fig. 14

Fig. 15

percentage of failures (Figs. 11, 12, 13).

Too much emphasis cannot be given to the importance of keeping up the standard of purity of the alloys that are to be used in this class of work. The excess and trimmings from each casting should have all adhering invest-

ment compound removed and the metal automatically does this refining at each casting.) (Figs. 14, 15, 16.)

In addition to precautions regarding the flame and refining, it is advisable to always add a portion of new alloy; for pieces requiring the full strength of metal, such as lingual and palatal bars and clasps, the use of fresh alloy of

standard known quality is advisable. For many of the saddles the requirements of strength are not so great; so that for these parts one need not be so particular.

Casting gold into any form, size, or thickness for dental purposes is a very simple thing when one has acquired a definite technic with an efficient equipment. If a given piece can be cast once it can be duplicated any number

may be used which permits free passage of gold into mold; (3) there is no danger of the sprue hole being stopped up with a bit of gold that has been dropped in advance of the attempt to cast.

Some very desirable features to be found in a casting machine are as follows: (1) vertical throw; (2) tight joint between crucible and flask as a precaution against spilling gold; (3)

Fig. 16

Figs. 14-16—Casts waxed up ready for investing; lines show where casts are cut in sections preparatory to casting.

of times if each step in producing that one casting is duplicated exactly.

There are a great many sorts of casting devices in use and good castings can be made and with a reasonable degree of certainty with most of them, but careful study and experimentation has proved the vertical throw centrifugal type of machine to be the most dependable.

The essential advantages of centrifugal machines are: (1) gold is melted in a crucible, some distance away from flask; (2) a larger sprue

continuous surface for run of gold; (4) propelled by pulley cord which gives a quick, smooth get away and an accumulating speed with a constant sustained pressure until gold congeals; (5) no noisy gear or spring to get out of order; (6) practically automatic balance; (7) double locking device with automatic release; (8) variety of flasks suited to inlays, clasps, and saddles of any size; (9) automatic refining of gold every time a casting is made; (10) concentration and uninterrupted passage of gold into mold; (11) the employment

of air vents; (12) flask that permits of visible horizontal investment, using wax sprue, stiff mix, double investment and air bubble control.

The following is an explanation of the terms used in making tests:

Cold mold—room temperature.

Warm mold—approximately 350° F.

Annealing—subsequent heating of the casting to dull red, 1300° F.

Slow cooling—either in air or in flask, room temperature.

Quenching—immersed in water either in or out of flask, after sufficient time has elapsed for metal to turn dark. Quenching should never be done while metal is at red heat.

Elastic limit is determined by high point to which metal will stretch and come back to its original condition or shape. Indicates breaking down to some extent of crystalline formation.

Tensile strength represents the ultimate strength under pulling stress.

Ratio of ductility is computed by amount in pounds per square inch of stress the metal will stand after passing the elastic limit, to the ultimate breaking-point.

Reduction of area—reduction in the diameter of the bar tested at the breaking-point.

Elongation—the amount of elongation that takes place under pulling stress up to and including breaking-point.

After making a series of about fifty castings, which were cast into warm and cold molds, cooled slowly and quenched, and another series which were subsequently heat treated, some being cooled slowly and some quenched, the bars were taken to the Armour Institute of Technology where physical tests for elastic limit, tensile strength, ratio of ductility, reduction of area and elongation were made.

After studying the Armour report

showing the physical properties of cast gold bars tested, a chart (Fig. 17) was made for purposes of comparison, which has enabled us to draw the following definite conclusions:

Group 1: Casting into cold mold with slow cooling in or out of flask causes metal to become too hard, to a point that might be termed brittle. Casting into cold mold, then annealed and cooled slowly provides practically the same physical condition as casting and cooling.

Group 2: Casting into cold mold and quenching in flask almost immediately (viz. after thirty seconds has elapsed) increases ductility to a desirable degree for clasps, bars, etc.

Group 3: Casting into warm mold, annealing and cooling slowly provides a more desirable physical condition than casting into a cold mold with slow cooling. Tests show it to be slightly more ductile but not sufficient to be considered the most desirable.

Group 4: Casting into warm mold, then annealed and quenched, softens the metal a little in excess of the amount required. It provides a slightly greater degree of ductility than is indicated for cast clasp work.

Group 5: Casting into warm mold and quenched provides a very desirable physical condition and safeguards the technician against undue brittleness. It produces a tough, strong and elastic casting, with just enough ductility to prevent breakage.

Group 6: Casting into warm mold and cooled slowly provides a slightly harder metal with less ductility than warm mold quenched and while this method produces an ideal physical condition for some cases where the nature of the work reduces the danger of breakage, we believe it is not as desirable for all purposes as the casting made into a warm mold and quenched.

The quality and smoothness of sur-

face of casting are dependent upon the casting temperature. The temperature of the metal at the time of casting must neither be too high nor too low. When the metal is at white heat and sputtering, it is too hot. It is important however, that care be exercised not to attempt casting until the entire mass is in a molten or liquid condition. This determination can be made by watching

the metal at the time the scum breaks, displaying a clear and mirror-like surface. It is easy to determine whether the mass is all molten or not by whipping the blowpipe flame on the mass.

In conclusion I wish to thank Mr. Thomas G. McMahon of the Dee Company, and Mr. Huntly of the Armour Institute for valuable assistance in making the tensile strength tests.

Designated	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
	Cast into cold mold, annealed and cooled slowly	Cast into cold mold, annealed and quenched	Cast into warm mold, annealed and cooled slowly	Cast into warm mold, annealed and quenched	Cast into warm mold and quenched	Cast into warm mold and cooled slowly
	Group Average	Group Average	Group Average	Group Average	Group Average	Group Average
Elastic limit Pounds per square inch	84,750	55,600	84,700	57,750	60,125	75,525
Tensile strength Pounds per square inch	87,600	67,850	90,650	69,200	72,750	86,275
Ratio of difference between elastic limit and tensile strength as it compares to tensile strength						
Difference, Pounds per square inch	2,850	12,250	5,950	11,450	12,625	10,750
Percentage	3.2	18.04	6.6	16.5	17.3	12.4
Percentage of reduction of area.....	5.3	23.4	2.6	22.7	18.4	5.7
Percentage of elongation in two inches...	2.5	15.2	1.5	15.5	11.1	2.0

Fig. 17—Chart of tensile tests made by the Armour Institute.