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ADVANTAGES OF THE ARTIFICIAL STONE METHOD FOR MAKING DENTAL RESTORATIONS, WITH METHODS FOR ITS USE.

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Mr. President and Gentlemen: This subject is so much larger than the time which can usually be allowed, that I will give it to you in as condensed a form as possible. Please remember that the technical phase of this question is a subject in itself, and it would be impossible to discuss the laws of contraction of gold and how to measure them and diagram them, but we will hurry immediately to the practical application of this work.

There are three fundamental laws to meet regarding the gold: First, that gold expands when you heat it and contracts when it cools, no matter who does it, and that contraction will be about one one-thousandth of its dimension for every one hundred degrees you raise the temperature. Porcelain contracts less than one-half as much as gold. The gold, when heated from a cool state to the melting point, or when cooling from the melting point down to normal temperature, has its greatest expansion or contraction at the point nearest its melting point. If you heat a piece of gold one hundred degrees it will expand one one-thousandth of its dimension, and so on, up to about 1500 degrees. From that to the melting point it expands more rapidly. When the gold is in those temperatures near the fusing point, it is about like ice cream in consistency when it is not frozen hard, and it is yielding when in those conditions. Under those conditions you must use more or less pressure to move the gold into the cavity which is to be your filling, and should the major part of the contraction take place in the sprue instead of in the gold, don't think the gold can be condensed by atmospheric pressure. You can move it as you would move a pile of mud when it is yieldable, and that is the only time you can make any impression on it with your pressure.

To restore that contraction, note as follows: If you take a crucible of gold and place in a ring and allow to cool, you may

have a column high enough to force it out against the side of the ring by its own weight. We fuse silica with one-one hundred and twentieth as much contraction as gold. If you allow the gold to cool in the ring it will drop out, but if you increase the heat of the column its base will not move at all, and the top will.

I speak of the cause of the relation of pressure to the expansion and contraction of the gold.

Suppose you are casting, we will say, a ferule for a root which is to be the base of a crown. The gold will contract if you have a plaster investment. It will contract and compress the investment and you will have the maximum contraction almost, and the ferule will not go on the root. If you put something inside that is dense, such as carbon, it will retain its position simply by making it stretch, and this will illustrate the application of the pressure. If I cast a ring, as I have for this, which is a duplicate of the piece of wax which will pass over the base of the column, it will only pass down a little less than an inch of the base of the column. If you use the ordinary air pressure machine, with the ordinary investment, you will control the contraction so it will be dropped down to within one-half inch. If we increase the size of the ring three or four times, the strength of the gold will crush even the porcelain tooth. So we are limited in the amount of control we get in holding it. That might apply to a large bridge you were casting and trying to hold from contracting, if it had considerable size and length.

The advantages of the artificial stone. I want you please not to misunderstand me in being over enthusiastic about something I have gotten up myself, as I am always anxious to have something better presented for your and my use. You should use the methods which will do the best for yourselves and your patients. The advantages of this method in my hands are these: In the preparation of your cavity, etc., you avoid a great deal of the cutting in the dentine, because you can re-enforce with gold to give strength in the step, but that is secondary to other advantages. With this method we not only save the malleting of gold in the tooth and the accompanying discomfort, but we save the finishing of the filling in the mouth as well.

There is greater ease in securing the impression of the cavity and greater ease in polishing. The filling is retained in position in the artificial stone until it is all polished. In case you have two or three cavities prepared at the same time, if there be no undercuts, you may take the impression of all at the same time. You have the great advantage of having the piece in your hand, so that you may get the contour exact. You know how difficult it is to get access to the second or third molars, or even to bicuspids, and carve down to the cervical margin and get the angles and all correct. It is difficult to work with exactness in the mouth. You have great advantage in preparing your contours in this way. The contact point, too, may be gotten within one or two-thousandths part of an inch. The occlusion is secured in the mouth. With some of the other methods the patient can bite in the wax; but with this method, on the articulator, you can produce the conditions as they were in the mouth. You can do practically all the finishing on the model as though it were in the mouth.

You save the disadvantage of getting the filling hot in the mouth from polishing. The margins can not be distorted or spun.

You can practically avoid the making of gold crowns, and there is not anything so distasteful and painful to me as to see the average gold crown, with its little contour all around the margin, and I can not understand why so many of them are being put out. Any tooth bad enough to need a gold crown is bad enough to need a porcelain crown. If part of the tooth wall is standing, leave it and make a tight joint at every margin, instead of leaving margins underneath the gum and covering them up.

Another great advantage is this: The man with a busy practice can have a graduate assistant who will be able to make better operations for him on this model than he makes himself in the mouth with other methods. The assistant will make the stone model and fuse the gold in it, and hand it back to the operator with the contact points within two one-thousandths of an inch, and with the occlusion so perfect that the patient will bite through a piece of wax, and requires no trimming after being set in place. It will increase the capacity of the busy

operator for serving patients fully fifty per cent, and sometimes more than that.

I insist on quality first as our ideal, and if we can make better operations by some other method, then mallet your gold, or follow out some other plan that you may be able to use best. I am confident that the operations we can make with this method—and practically all of my professional friends think the same way—will be more perfect so far as the joints, the contact and the occlusion is concerned than with any other method.

I am not interested in this commercially. I am interested for the sake of humanity and the sake of the profession. It makes no difference to me financially whether a pound of this material is ever sold or not.

The simplest proposition to consider is this: You must have your wax supported at every point to get a perfect impression. In an impression for a plate, if the material extends beyond the plate and is not supported, you do not get a perfect impression.

The simple occlusal cavities will not give much trouble, and the simplest tray will ordinarily be your finger. Mold a piece of wax in the form of a cone after dropping it in warm water. Fold it over, and before the edges come together put them in the flame and heat a bit and squeeze the water out. Then perhaps you may chill the base of it and warm the point, and then press on the tooth, covering all the margins of the cavity.

The question is asked, will any of the inlay waxes answer? Use any wax that will burn off the artificial stone completely. The wax I find most suitable contains gum dammar, resin and beeswax, and I have prepared it myself. I think it better to use that wax instead of experimenting, as poor wax will make the stone black if it does not burn off.

Having taken the impression, we put the artificial stone in. Use strong enough metal so the wax will not be distorted by the spring of the metal afterwards. You may create a failure before you ever start your preparation in this way. You will see here trays for the anterior teeth; incisal angles; boxes for back teeth, and the length of septum that passes between the teeth depends on the conditions existing, etc.

After the stone is put in the impression material—and it may

be a simple occlusal cavity—put the wax, stone and all on a piece of asbestos in the edge of a slow heat, and melt the wax out. Never put the artificial stone in water until it has been baked. The wax is quickly burned out, and in two or three minutes you may proceed with the filling. The artificial stone mixes almost like a silicate cement, and you want to add a little more powder to the liquid as you proceed.

For simple cavities, take gold and platinum pellets. Rollins gold and platinum rolls are very nice. Pack in a few pieces, covering the margins. Use a piece of rubber dam and unvulcanized rubber and press down. You may press thin platinum foil, well annealed in the cavity. Proceed with the blow pipe and fuse pieces of pure gold into the platinum foil, and you will have no difficulty in making an operation of that kind in a very few minutes. From the time you take the impression you can go to the laboratory and have the work back to the patient easily in ten minutes for an ordinary occlusal cavity. For a large contour you can not so successfully use the blow pipe method, because of the difficulty of getting contours in this way.

The case I have in my hand shows a tooth made from a simple impression, the filling finished in the stone model and then transferred to this tooth, and you see the margins just as they came from the tooth. Some of the models are white and some black. The white ones have been heated a dull red and the others have not been heated red at all.

Two bicuspids are shown on the card.

What to do in case of an undercut. Here, with the first molar prepared with natural undercut at the contact point with second molar; remove the impression with an ordinary box tray and ou will destroy the impression of the first molar. The tray therefore is properly made with a septum passing down below the cervical margin of the cavity. When that is withdrawn you have your contact point and also the impression of the cavity. Nearly all the trays for the molars are required to have a septum to carry the gum tissue down and expose the cervical margin, as well as support the wax thoroughly so as to prevent distortion in its removal. You want perfect contact against the adjoining tooth, as well as occlusion and cavity margins.

The occlusion you get with the model of the opposing tooth, and for the contact point you may use a piece of base plate wax and allow the patient to bite into it, thus giving an imprint of the opposing teeth. Then lay that on the stone model, putting vaseline on each end, and flow the stone over the wax bite. This gives the simplest possible form of articulator. To get contact point you must have separation by packing some filling material in there. You get about four one-thousandths in the mouth of a patient twenty to thirty years of age by the use of gutta percha. You must allow for the gold you will polish off in the final polishing, too. Polish a little off the contact point to have a little excess of gold there for polishing and for burnishing.

It occurs to me I have failed to mention the method of handling the stone after mixing and waxing. Flow the wax in hot, with a spatula, and after carving to the margins and removing the excess you can get right down there and carve the cervical margin to your liking. Attach the sprue to the wax in the cavity and the whole is invested in your cup. You can not do anything to hurt the cavity surfaces, and you can work then very rapidly. Cast as you would in any ordinary silicate and plaster investment. You will then have the tooth with the filling in it, as illustrated in the specimens. You can polish the inlay as it remains in the cavity.

Just a point relative to cavity preparation. The illustration is not, in my judgment, a proper cavity at the cervical margin. I would insist on having a blunt knife edge of gold for every cavity margin, and it should be trimmed off at that angle to allow for burnishing. You may use the septum tray very nicely for this work.

The question is asked, "Is the septum in the way?" You probably have a different condition in mind from what I have—any cavity so prepared that the filling that would fit the cavity can be withdrawn. If you have not removed the thin marginal walls you have not fulfilled the first principles of extension for prevention. The septum has really nothing to do with that condition. The septum is not in the way; it pushes the gum tissue down, and is a decided advantage there. As to the formation of the contact point for a simple or single cavity, this

would apply; but not to a double one, as you can not take same off the adjoining teeth.

To get a little excess gold for polishing off, etc., we must move these teeth bodily apart, and to overcome the difficulties of doing that I have devised the micrometer articulator, which allows you to move the teeth you are filling with gold apart any definite distance you want and which may be required. The way I used to do that was to make the model thick enough to fracture through between the teeth, then build in the wax fillings and place back together and guess how much thickness of metal I wanted there. This method I have now is very exact. We have here the cavities in a molar and bicuspid, the tray and impression and method of making the filling. These were cast in that position. When the impression was filled with the stone it was in between those jaws to set. After setting enough to chill it was removed and the wax burned off. You will see each one is a unit. You get your occlusion with the occluding model attached to the articulator. You can open up this instrument two one-thousandths of an inch for each surface, or say eight one-thousandths in this case. Put them in the articulator with a little excess of wax, then screw it up until you come within eight one-thousandths of an inch of where it was before, and you have compressed your wax to get correct surplus of metal for polishing off, etc. You will readily see the great advantage in the second or third molar in being able to remove those surfaces and make the separation complete outside the mouth, instead of carving the contours and contact points in such positions.

We have here an impacted third molar, which decayed the second molar. I made the restoration by building this up to reproduce the contour, because the man needed it for occlusion, and I have reproduced it in such manner that it will be substantial and cleanly, without any crowding, I am sure.

Now have in mind a third molar with large cavity in the occlusal and middle surfaces; a second molar with large cavity in the distal and occlusal and mesial surfaces, and the first molar with large cavity in the occlusal and distal surfaces. All the contact points are gone. It would be almost impossible to carve up any wax and get the contact and contour correctly.

With this method it is easy to make all those fillings at once, so that the contact points will be within one or two one-thousandths of an inch. I have the models here for a case of the second and first molar and second and first bicuspid, all done at once. I took the patient over to Ann Arbor, and you may be perfectly free to ask any of the dentists who saw it about the result obtained. I do not think you can find in the man's mouth anywhere a single sign of cement or margin. I doubt if you could catch an instrument to find a ledge there anywhere. The occlusal surfaces were secured outside the mouth. He could bite the wax right through and separate it. The contact points were all made outside the mouth. One or two of them had to have a slight polishing off.

This model shows three and four cavities in a row, and these would be teeth that ordinarily would be crowned, but by this method it is not necessary to remove so much of that enamel.

We now come to the anterior teeth, and you will readily see it is very easy to take an impression of a cavity where the cavity walls are parallel with the external walls of the tooth if the entrance of the cavity is at an angle to the long axis of the tooth. You can take both impressions at the same time and get all the surfaces. That applies to incisors and cuspids. Having the cavity so prepared that the impression will withdraw lingually, insert the tray with some wax on it; pass it between the teeth from the lingual surfaces and chill it. Scrape off the wax that sticks to the septum with a small lancet. You don't want that wax on the septum to be in the way of the new wax you will use for the second part of the impression. Back up the impression, then use a second piece of wax and press right on to the septum and chill with water. Remove and take out the innerpiece, and you have the complete impression in two sections. The gold is cast into that cavity in the ordinary way. Polish a little off the opposing tooth to get our contact, and by a very simple method you get a restoration for the anterior teeth with the aid of a light colored cement under the plate of enamel, and you can burnish down the knife edge of gold and make a nice joint.

There is no operation we dread so much as the restoration of incisal angles. Much disappointment may arise in the use of

porcelain alone in such places because of the chipping away. No operation has been so satisfactory to me as the making of a compound gold and porcelain filling for the restoration of front teeth.

The gold filling, or gold and platinum filling, is made in the ordinary way you will perceive, with a cavity in it. Then you bake the porcelain directly into the gold, or you can cement the piece in the mouth; first the gold inlay with the cavity in it, and then take an impression of the cavity and fill it in the ordinary manner. In making the gold filling and baking the porcelain directly into it, you have the gold line next to the tooth. If the tooth is yellow, or dark, that will not be very serious: if light or blue you can overcome the transparent effect of the gold shining through the porcelain. Trim away the gold next the cavity margin and fit with porcelain inlay.

A solid gold tip is shown here.

Two cavities, with the gold inlay ready to bake porcelain in, shown.

The question is asked, what kind of porcelain do I use? I used to use the high and low-fusing porcelains. The high-fusing porcelains have not so great a contraction on cooling as the low-fusing kinds. Use the porcelain with just as much contraction as possible in order to allow it to get out of the way of the contraction of the gold.

I am sure you have all had some embarrassment in making restorations in porcelain, especially in building up some of the angles. I have not been able to do it and not have the angle deficient at some point, because you have to carry the relations of the other teeth to that tooth in your mind. If you can have all those before you as you are working, you readily see how much more perfectly and accurately you can build on that angle and get the contours normal. By taking platinum foil, say one ten-thousandth inch in thickness, and pressing loosely into the cavity and then taking an impression tray, with the wax in it, and pressing up on the dry platinum surface, it will carry the platinum into every corner. Put the stone in, and you have all the teeth in proper relation, and you have the cavity surface and the margins. You may then bake up just as you wish, and you get the contour and angles just as you wish.

A point which you will watch out for if you bake porcelain on the artificial stone, is the wax left in the stone after heating will have enough carbon in it so that if you put the porcelain directly on the stone it will discolor the porcelain. So be careful to remove all the wax. This work is applicable to orthodontists, bridgework and other uses that I will not take your time to speak of, but have this in mind: In orthodontia, if you want an appliance that will be ideal you may take the impression and by heating some wax can take a brush and paint on your ordinary beeswax, attaching a ring or ferule here and there as you wish. When you have the piece just as you want it, cast the whole thing. You can solder on the lugs, etc., and have it just as though it were built right in the patient's mouth.

In bridgework you can do all the assembling, up to the last connection, on the stone. If you undertake to cast over an impression taken over the teeth it will fit so tight you can not get it on without pressure. Take the impression, after removing and chilling and put a thin piece of rubber dam over it and place back in the mouth and force into place.

There are a number of points I will only have a word about. As to the polishing. The man who is making beautiful operations by malleting fillings is putting hard work on it and taking time to finish; he has a high ideal. If that class of men will undertake to make gold inlays and will use the same amount of skill and determination he will make more beautiful fillings than he can secure with the mallet. If he thinks he can do slipshod work, he will be disappointed. The finishing of these inlays is one of the most important and beautiful things we have in our work. Every cavity margin must be prepared with a knife edge. You cannot have a square piece of gold come up to a square piece of enamel and have a good joint. You will have a microscopic air bubble, or something of that kind. There are so many ways of failure that it is essential to have a margin of gold to burnish up. If every surface of the filling is finely burnished up, you will have as tight a joint as you have with a malleted filling—if you finish with a hydraulic cement while the cement is soft. You want a blunt knife edge of pure gold, and it will burnish up as close as if you were using malleted gold.

You will squeeze out the soft line of cement and close it. You will use a fine grit stone, and cut toward the margin. If you wish to use a gold finishing bur, it also will drag the gold down to the margin and close it perfectly. If correctly finished, I defy any person to say whether it is a malleted filling or an inlay!

I want you in your discussion to be perfectly free to ask questions.

DISCUSSION.

Dr. Ford—Mr. President, Ladies and Gentlemen: I will only take a very few minutes of your time in opening the discussion on Dr. Weston A. Price's paper, for I appreciate the fact that many of you wish to ask the doctor questions in regard to this most valuable addition and process to the gold inlay worker.

A little over two years ago Dr. Taggart announced his process of constructing gold inlays, and this society had the honor of having the first cast gold inlay clinic given on the Pacific Coast—and what an eye-opener it was to us. Since that time many valuable suggestions and additions have been made to assist us not only in the making of the inlay and preparation of activities, but also for the construction of crowns, bridges, etc. I honestly believe that Dr. Price has this morning presented to us one of the most valuable additions to this line of work that the dental profession has ever received. Many of you have used gold inlays as abutments for bridges, and have experienced the difficulty of removing the same from the model for soldering, and, after the piece of work was assembled, to find that the inlay had been shifted just a little, enough, however, to ruin the fit; now Dr. Price has given us a material that we can use for the model, and it will not be necessary for us to remove the inlay at all, and that the parts will remain in their several positions, as this material neither shrinks nor expands. It is also possible for us to take an impression of the cavity and to make our model with this material and flow the gold directly into the mold and to finish our inlay in that position. This is of great value as it saves considerable time finishing the inlay in the patient's mouth, and we are not liable to injure the margins, as some of us have done when