Dimensional Changes Approach Alginate Impressions

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Alginate impression is an elastic material included in the category of irreversible hydrocolloids. Obtaining indirect restorations cannot be separated from this material that has withstood the test of time (even if other elastic materials appeared more accurate). It is one of the most commonly used material impression and the price / quality ratio is favourable. Their chemical composition, setting time, dimensional stability and change have been the subject of exhaustive studies since their patenting in 1940. The aim of the study was to measure the dimensional change and mass loss of alginate impression. The material used was commercially XantALGIN Select Fast Set from Heraeus Kulzer’s company. It was mixed according to the manufacturer. There were made 20 impressions on mandibular study models made of epoxy resin. After the preparation, these impressions were weighed and measured for 6 hours. For measuring dimensional changes there were used Stainless Hardened calliper and height measurements consisted of measuring the lateral incisor, the first premolar and the second molar, mesial - distal width and sagittal plane of the teeth (vestibular - oral). The dimensional variation used a CAD Scanner DD Argus M1 and a 3D Designer program by Exocad to process the information. For the mass of the impression, there was a slight initial decrease at first, followed by a bigger decrease of its mass at the end of the time for evaluation. The trend observed was the change in size – it was an initial expansion, followed by a regress, then another expansion (in the first hour), finally observing a decrease in the net, in the last 5 hours of the measuring. This study revealed that the mass and dimensional variations were not stable. Therefore, the best period of time to make the impression is the first half hour.

Keywords: alginate, impression, dimensional variation, variation in weight

During the last years, dental impressions became one of the most effective, commonly used diagnostic and restorative tools in a dentist’s arsenal. They are made by using a container which is designed to roughly fit over the dental arches. Impression materials are designed to be liquid or semi-solid when first mixed and placed in the tray, and then quickly set to a solid (usually a few minutes depending upon the material), leaving an imprint of the structures in the mouth. Impressions and the study models which are cast from them are used in several areas of dentistry including prosthodontics (such as making dentures, inlays and plastic casts), orthodontics, restorative dentistry (e.g. to make impressions of teeth which have been prepared to receive indirect extra coronal restorations such as crowns or bridges), maxillofacial prosthodontics (prosthetic rehabilitation of intra-oral and extra-oral defects due to trauma, congenital defects, and surgical resection of tumours) restorative, diagnosis, oral and maxillofacial surgery for both intra-oral and extra-oral aims (e.g. dental implants).

The required type of material for taking an impression and the area that it covers depends on the clinical indication.

A correctly made dental impression will capture a part or all of a person’s dentition and surrounding structures of the oral cavity. The dental impression conveys (i.e. a ‘negative’ mould) teeth and soft tissues, which can be used to make a cast of the dentition. Casts are used for diagnostics, patient records, treatment planning, fabrication of custom trays, fabrication of dentures, crowns or other prostheses and orthodontics.

An impression is made by placing a viscous, thixotropic impression material into the mouth via a custom or stock dental impression tray. The material, then sets to become an elastic solid, and, when removed from the mouth, provides a detailed and stable negative of teeth [1]. Common materials used for dental impressions are sodium alginate, polyether and silicones – both condensation-cured silicones and addition-cured silicones, such as polyvinyl silxane (fig.1).

![Fig.1. Material impressions – classification.](image-url)
This second reaction occurs in preference to the first disodium phosphate from reacting with sodium alginate to form diodium phosphate to produce calcium phosphate, preventing calcium phosphate from the powder. Trisodium phosphate reacts with diatomaceous earth, zinc oxide, and potassium titanium fluoride. When mixing the powder with water, a sol is formed. Furthermore, the chemical reaction takes place, the result of this procedure being a gel. Here, sodium alginate reacts with calcium sulfate, resulting in a two viscosities, tray and syringe viscosities. The paste-type material has a shorter gelation time than the powder-type material. The best surface quality can be obtained with the paste-type material [2].

The powder contains: sodium alginate, calcium sulfate, trisodium phosphate, diatomaceous earth, zinc oxide, and potassium titanate fluoride. When mixing the powder with water, a sol is formed. Furthermore, the chemical reaction takes place, the result of this procedure being a gel. Here, sodium alginate reacts with calcium sulfate, resulting in a two viscosities, tray and syringe viscosities. The paste-type material has a shorter gelation time than the powder-type material. The best surface quality can be obtained with the paste-type material [2].

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An alginate impression was taken and sprayed all the surfaces with Okkleen Occlusion spray to prevent the light reflection during the process of scanning. The spray used was not toxic and was easy to remove with water.

Once the impression was positioned in the scanner, regular steps were followed in order to realise the processing of information by selecting the scanned portion and the made impression. The teeth must be visualised in 3D.

The two cameras inside the scanner captured the impression from many angles; the images obtained were processed by the 3D Designer program by Exocad. Exocad is one of the most advanced CAD/CAM software used for applications in the dental field, providing a complete software solution for the digital dentistry, furthermore minimizing training costs. It is also known to be easy to use and fast for operating. It can be indicated for: simple copings, bridge frameworks, inlays, onlays, veneers, wax-ups, extra-coronal attachments and other more.

The next step was to convert the denture impression from a negative form into a positive one, a digital study model. On this model all the requested measures were made (fig.5).

Results and discussions

The results obtained after 6 h of evaluation revealed a permanent state of change in all the parameters assessed. The first method of study was the one using the electronic calliper. The measurements showed an initial expansion, being followed by a notable regress. Even if it was expected that all those values continue to decrease, after the first hour there were noticed dimensional climbs and declines (fig.6). Also, the variations of the 3 analysed parameters were not the same, the measured areas were differently modified. It was very important that all the impressions to be made by the same person, preventing the errors occurred during processing the impressions, and

Experimental part

The decision was to research the behaviour of the alginate impression.

Alginate is an elastic, irreversible impression material derived from the hydrocolloids class.

The most popular form of alginate is supplied as a powder, which is mixed with water. Many alginate are supplied with a reaction indicator that changes colour of the impression when the material is set. Presently, dustless alginate are preferred. Powder may be available in bulk form in containers or in individual sealed pouches. Paste types of alginate is also available. Paste form is available in two viscosities, tray and syringe viscosities. The paste-type material has a shorter gelation time than the powder-type material. The best surface quality can be obtained with the paste-type material [2].

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also the alteration of the resulted values. These errors were easily revealed in the frontal vestibular area. An insufficient amount of material applied can change the results, so all 20 impressions were made from the same quantity of material.

After ensuring that the impressions were done correctly, the analysis of the frontal and parallel area was followed. It has been observed that the lateral area was more stable over time.

The variation of the cervico-occlusal height and the mesial-distal width were two times lower than the bucco-lingual thickness. The difference between the mesial-distal width and the cervico-occlusal height being of more than 0.5 mm, the bucco-lingual thickness decreasing by about 1 mm.

To ensure that the errors during assessments were minimal, there were checked the values obtained with the electronic calliper with the ones made by scanning using the CAD technology. The results confirmed the first measurements as being correctly performed.

Using the Exocad software, there were obtained the same results as those achieved previously (fig.7). Also, the study has demonstrated that CAD technology can be used in the future as a method of making impressions, facilitating the work of the dentist and dental technician.

Regarding the weight variation of the impressions, it was noticed a continuous decrease during the 6 h of evaluation, in the first half hour about 0.02 g per minute, later the reduction being smaller (fig 8). The difference between the first weighing and the last one, was of approximately 4.25g.

The fact that the alginate impressions were kept in the normal environment but not in a 100% humidity space, as is indicated by the producer, changed a lot the dimensional variations, and also our measurements, the decrease being more pronounced.

Therefore, the study revealed a better stability of all the parameters in the first 20 min. After making the impression, the results were close to those of the prosthetic field.

Conclusions

Concluding, the study revealed that the mass and dimensional variation are not stable, so the time to realize the positive copy of the impression is very important in order to obtain a prosthetic that adapts to the needs of the prosthetic field. In the case of alginate, the first 20 min after making the impression are the most important, because in that period of time the variations are minimal. The optimum time the impression can be used for casting a model coincides with that indicated by the manufacturer. Also, the linear decrease in the ambient environment corresponds to 1/3 of the impression decreased mass, owing to the water.

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