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Review Article

Dental impression materials: A mini-review

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ABSTRACT:
Dental impression making is the process of creating a negative form of the teeth and oral tissues, into which gypsum or other die materials can be processed to create working analogues. Contemporary dentistry generates new information every year and digital dentistry is becoming established and influential. Although dentists should stay abreast of new technologies, some of the conventional materials and time-tested techniques remain widely used.
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INTRODUCTION

Impression materials are used to copy the teeth and surrounding oral structures by creating a dental impression poured with dental plaster to fabricate a dental cast. This procedure provides a tridimensional and accurate mouth replica, allowing dental work even in the absence of the patient. Dental models enable dentists to perform a better diagnosis and treatment planning since the teeth can be meticulously visualized and studied from angles that are difficult to see in the patient's mouth. Particular treatment, such as removable and fixed prostheses, can be executed thanks to dental casts. The final restoration or prosthesis fit depends on how accurately the impression material has recorded the tissue details.[1]

HISTORY OF IMPRESSION MATERIALS

Wax was the only impression material used in dentistry until the mid-19th century when gutta-percha first appeared. Then in 1857, Charles Stent created a thermoplastic modeling compound similar to today's impression compound. Still, the problem with this material was that it was rigid and could not reproduce undercut areas. All the impression materials used until that date became rigid after setting and could not copy the oral tissues accurately. Thus, there was always a need for an impression material that could remain elastic even after setting. That is when agar, a reversible hydrocolloid manufactured from algae, was introduced in dentistry. Although this jelly-like material was elastic, it required a complicated procedure to be used as an impression material. When the algae used to manufacture agar was unavailable during the second world war, Americans used local algae to manufacture another elastic impression material known as alginate, which has gained popularity since then. Alginate and agar have disadvantages, like dimensional instability and low tear strength, which led to the manufacture of elastomeric (also known as rubber-based) impression materials. First came polysulfide, then condensation silicone followed by polyether, and then addition silicones.[2- 3]

Dentists realized that the construction of a prosthetic restoration required both a detailed capture of the oral tissues along with stone cast fabrications. To accomplish these goals, impression materials were essential. Beeswax represents the first impression material, while important bechmarks during the historical evolution of dental impression materials are considered to be the introduction of dental trays in the early 1800s and the invention of the gutta-percha, thermoplastic resins and plaster of Paris. The double (corrective) impression technique, along

with the functional impression concept that was established after mid 1800s, are also identified as pivotal innovations. During the 20th century, the advances in material development slowed significantly since the majority of the current impression materials had already been invented. However, the introduction of elastomeric impression materials in the field of prosthodontics that offered the advantages of accuracy and dimensional stability substantially upgraded both the impression accuracy and the quality of the final restoration. Presently, the dental practitioner has access to a variety of impression materials and should be aware of their properties, indications and limitations as well. Futhermore; while continuous attempts are being made to enhance these materials, the ideal impression material has yet to be developed.[4- 6]

STERILIZATION AND DISINFECTION

Sterilization and disinfection are two words which are quite inseparable from the practice of dentistry in today's world. However, with regard to dental impression materials and dental gypsum products, sterilization procedures are literally ruled out as the commonly used sterilization methods in a clinical setup may alter the properties of these materials to an extent that they may no longer be fit for dental professional use. Hence, disinfection is what we were left with. Over the past two decades and more, several studies have been conducted to find effective means of disinfection of both dental impressions and dental gypsum casts, with a single objective of reducing the risk of transmission of various pathogens. Disinfection of impressions has been recommended as a mandatory procedure for a long time now. This has been accomplished by thorough rinsing of the impressions, followed by exposure of such impressions to one of a variety of recommended disinfecting chemicals, either as a spray or by immersion in the same. This is performed to eliminate most of the microorganisms picked up from the patient's mouth. If contaminated items were to enter the dental laboratory environment, there is a high chance that unsuspecting laboratory personnel would be placed at increased risk for cross infection.[4- 6]

Such procedures of disinfection should ideally be taken care of at the dental clinic level soon after the dental impression is made. Some dental laboratories also have protocol to disinfect all dental impressions received at their laboratory. However, such highly recommended protocols for safeguarding the health of all dental professionals involved are not complied with universally. These procedures are seen as additional time-consuming procedures. And this is where the idea of incorporating certain drugs into the dental impression materials fits in. This would certainly not consume any additional time on the part of the dental clinic/laboratory personnel and also results in universal compliance.[7]

Hydrocolloid materials for dental impressions are available in the form of viscous liquids in the “sol” state or in the form of semi-solid substances of a gelatinous consistency. Without a filler, the gel would lack stability and would have a slimy surface covered with synerate exudate. Alginates are salts of alginic acid, a polysaccharide extracted from the cell walls of brown algae (washed, ground and chemically treated, especially the pulp) belonging to the Phaeophyceae family, widespread especially in America.[8, 9]

The extracted alginic acid is then converted into a salt (alginate) of sodium, calcium, potassium or magnesium. Although alginate is insoluble in water, its alkaline salts are water-soluble and therefore sodium or potassium alginate is used in the dental field. The production process of sodium alginate from brown algae can be done in two ways; using the calcium alginate method or the alginic acid method. To extract alginic acid, the algae are placed in a sodium carbonate bath, exploiting the solubility of alkaline alginates in water. The alginic acid is recovered from the obtained solution by precipitation with hydrochloric acid or sulfuric acid. The difficulty of the processes lies in the required physical separations, such as in the filtration of muddy residues from viscous solutions or in the separation of gelatinous precipitates that retain a large amount of liquid in their structure, resisting filtration and centrifugation. Alginates are used as thickeners and stabilizers in the food, pharmaceutical and cosmetic industries, are easy to use, low cost, well tolerated by patients, excellent for primary prosthetic, orthodontic and design imprints. They come in the form of a powder to be mixed with water in appropriate doses. Once mixed, the alginate turns into a soft paste that is placed on the tray and introduced into the oral cavity for the detection of the impression. They are irreversible hydrocolloids because the picking reaction is a chemical reaction of irreversible precipitation, therefore they cannot return in sol form using physical means, such as temperature, as with reversible hydrocolloids. The chemical reaction occurs two times: a first phase called ‘slowing’ and a second phase called ‘setting’. Initially the powder is mixed with water and the sodium phosphate reacts with the calcium sulfate to allow an adequate processing time. After the sodium phosphate has reacted, the remaining calcium sulfate reacts with sodium alginate to form an insoluble calcium alginate that forms a gel with water which acts as a catalyst. The alginates available on the market can be of two types: fast setting (hardening time of 1–2 min) or normal setting (setting time between 2–5 min). The setting time depends on the composition (water/powder ratio, where increasing the powder accelerates the hardening reaction) and the temperature at which mixing takes place (the setting time is inversely proportional to the temperature, where the higher the temperature, the lower the setting time and therefore the reaction is faster).[10, 11]

Impression materials will contact saliva and blood during impression taking. Oral microorganisms and other infectious pathogens can be transmitted from impressions to dental laboratories. Dentists and dental nurses are responsible for disinfecting the impression before pouring it with gypsum or sending it to the dental technician.

The first step in disinfecting impressions is to rinse them well with tap water, which removes a significant number of microorganisms from the impression. The most effective method for disinfecting an impression is by immersing it in a disinfectant liquid for 30 minutes. This is more advantageous for hydrophobic materials because they only experience a slight distortion when disinfected this way. By contrast, irreversible hydrocolloids are hydrophilic materials and undergo distortion when immersed in a solution. Alginates are usually disinfected during the preparation step by spraying or mixing the alginate powder with a disinfectant solution instead of water, allowing the impression to be poured immediately. However, mixing alginate with disinfectant solutions may affect its properties, depending on the type and concentration of the disinfectant agent. Studies indicate that chlorhexidine is the most suitable disinfection agent to mix with alginate as it did not significantly alter the properties of the material. Disinfected gypsum die stones may also be used, avoiding the distortion experienced by the impression material during other disinfection maneuvers.[12, 13]

Clinical Significance

Alginate impressions play a key role in daily dental practice due to their easy manipulation, fast set times, and affordable price. Understanding the properties, mode of setting, and manipulation of dental alginates is essential to achieve correct and predictable impressions, translating into good dental casts and avoiding the need to repeat the impression. Furthermore, decontaminating and disinfecting dental impressions to decrease the risk of cross-contamination must be emphasized. The selection of the appropriate disinfection method is dictated by the properties of the material, namely imbibition, syneresis, and evaporation. Thorough knowledge of the mechanical properties of alginates enables clinicians to selectively utilize these materials to optimize outcomes.[14, 15]

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