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Review Article

Capturing precision: The unsung role of impression trays in prosthodontics

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Abstract

Prosthodontists always strive to make accurate impressions to ensure the success of a prosthesis. To achieve this, it is essential for the dental surgeon to properly access the tissues to be recorded, select an appropriate stock tray, fabricate a well-adapted custom impression tray using the correct technique, and choose ideal impression materials and methods. Dental surgeons commonly use both stock and custom trays for impression making. This article focuses on the different types of impression trays available for various clinical situations.

Keywords: Complete dentures, Custom trays, Fixed partial denture (FPD), Implants, Impression trays.

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1. Introduction

Impression tray is a receptacle into which suitable impression material is placed to make a negative likeness. It is a device used to carry, confine, and control impression material while making an impression.[1]

Given that impression materials and the features they reproduce vary greatly, it is logical that the devices used to carry, contain, and control those materials during impression making will also vary. Impression trays come in standard forms and as custom impression trays. Custom impression trays are individually made, i.e., produced specifically for an individual patient. Impression trays can be produced using conventional stone model-based techniques or digital techniques. Impression trays fabricated using conventional stone model-based techniques are custom-made to fit an individual patient's oral anatomy. These trays are essential in achieving accurate final impressions, especially in complete denture, removable partial denture, or fixed prosthodontic procedures.

The step-by-step fabrication process begins with the primary impression and stone model preparation. A preliminary impression is first made using an alginate or irreversible hydrocolloid material in a stock tray, after which the impression is poured with dental stone (commonly Type III gypsum) to obtain a primary cast or diagnostic model. Evidence suggests that the accuracy of the final custom tray depends significantly on the precision of the primary impression and subsequent stone model. Once the primary cast is ready, the borders for the custom tray are marked, typically 2–3 mm short of the depth of the vestibule to allow space for border molding material. A wax spacer, often 1–2 mm thick baseplate wax, is then placed on the cast within the tray outline to provide uniform space for the final impression material. Tissue stops may be created by cutting small holes in the wax to maintain consistent tray seating. The importance of wax spacers and tissue stops in controlling impression material thickness and tray stability has been emphasized in Boucher's Prosthodontic Treatment for Edentulous Patients.

Once the spacer is in place, the tray material is adapted. Autopolymerizing acrylic resin (cold-cure) or light-cured resin such as visible light-cured tray material (e.g., Triad®) is shaped over the wax and cast and allowed to cure. After polymerization, the tray is removed from the cast, trimmed to the desired shape, and smoothed, and a handle is attached in a standard position to aid in tray placement during the

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impression procedure. The completed tray is then disinfected and stored for the final impression appointment.

The stone model-based technique has several advantages. It provides high adaptability to the patient's anatomy, is cost-effective and relatively easy to fabricate, and is ideal for cases with tissue undercuts or unusual ridge morphology. Supporting evidence includes a study, which compared conventional and digital tray fabrication and found that custom trays made from stone models allowed for better adaptation to soft tissues in complex prosthodontic cases. Similarly, a clinical guideline from the American College of Prosthodontists (ACP, 2005) underscores the importance of custom trays made from preliminary casts to improve the accuracy and quality of final impressions.

Standard impression trays, on the other hand, are ready-made and based on standard arch measurements and shapes. They are available in a variety of types, but all share common features such as a handle, a floor, and flanges.[2] Standard trays may be fabricated from either metal or plastic. Metal trays are more rigid and therefore provide greater accuracy and precision compared with flexible plastic alternatives[3]. They may be perforated or non-perforated and may include rim locks. Trays without mechanical retention features such as holes or rim locks require a special adhesive to retain the impression material[4]. Another special type of plastic impression tray is the dual-arch tray.[2] These consist of a handle and a rigid external structure in the shape of a "U," combined with a floor made of flexible plastic mesh. Impression material is applied to both sides of the flexible mesh, and the impression is made by closing the patient's mouth to maximum intercuspation. This technique records the arch of interest, the antagonist arch, and the intermaxillary occlusion simultaneously.

Impression trays may be classified as either stock or custom trays[6]. Stock trays include metal rim-lock trays for both dentulous and edentulous patients, perforated trays for dentulous and edentulous patients, water-cooled trays for reversible hydrocolloid use, and disposable plastic stock trays. Custom trays may be fabricated from acrylic resin, thermoplastic vacuum-adapted materials, or visible light-cured plastics.

The requirements of an impression tray are numerous.[6] The tray should be rigid but not overly thick, and it must retain its shape throughout both impression making and pouring. Its construction method should be simple enough to permit fabrication quickly and affordably, and it should be easily trimmable with instruments such as a bur, mounted stone, scissors, or arbor band. The tray should be smooth to avoid injuring oral tissues and must confine the impression material to ensure close adaptation to both teeth and soft tissues. It should also permit control of impression material space, maintain rigidity to avoid distortion during removal, and allow for mechanical locking of the material via rim-lock undercuts or perforations. Finally, the tray must be capable of being cleansed and sterilized if it is not disposable.

Stock trays are mainly used for preliminary and diagnostic impressions and are manufactured in various sizes and shapes. They are available in reusable metal or disposable plastic forms (nylon or polystyrene, both sterilizable), and in small, medium, and large sizes suitable for dentulous and edentulous patients[7] (**Figure 1**). Dentulous trays have a square cross-section for patients with teeth (**Figure 2**a), whereas edentulous trays have a rounded cross-section for patients without teeth (**Figure 2**b). The selection of a stock tray depends on several factors,[8] including the type of impression material (e.g., non-perforated trays for impression compound and perforated trays for alginate), the size and form of the arch (round, square, or tapered), the need to cover all anatomical landmarks, and ensuring 4–5 mm of space for the impression material.

According to GPT 10, a custom tray is defined as an individualized impression tray made from a cast recovered from a preliminary impression; it is used for making a final impression.[5] Such trays are most commonly fabricated from acrylic resin tray material or thermoset plastic vinyl sheets. The cast is blocked out with spacing material such as wax or an asbestos substitute,[6] and the trays are typically fabricated using polymethyl methacrylate or visible light-cured dimethacrylate resin (**Figure 3**). Spacer designs and tissue stops are incorporated depending on the impression material and technique. However, distortion of final impressions may occur due to polymerization shrinkage and residual stress relaxation in autopolymerized acrylic trays.[9] Phillips[10] advised that such trays be used 20 to 24 hours after fabrication, while Pagniano et al.[11] suggested a curing period of 9 hours. If urgent use is required, the tray may be boiled for 5 minutes and cooled to room temperature. In cases with limited mouth opening (microstomia), sectional trays are recommended.[12] Custom trays are especially desirable for accurate impressions with multiple abutments,[13] and in implant cases with parallel implants, modified tray designs offer increased support.

Spacer designs for impression trays can be classified into several types. [14] Full spacers cover the entire ridge except for the posterior palatal seal in the maxilla and the buccal shelf and retromylohyoid areas in the mandible. Partial spacers include variations such as the I-spacer and T-spacer. Spacers with tissue stops include 2 mm wide windows placed at the canine and molar regions bilaterally. Over the years, a variety of materials have been used as spacers,[14] including tin foil (Roy Mac Gregory), 0.9 mm casting wax (Neil), non-asbestos ring liner, baseplate wax, and resilient polyvinyl sheet.(**Figure 4-6**)

Tissue stops serve several essential functions. They orient the tray, ensure uniform thickness of the impression material, allow equal pressure distribution, and aid in tactile perception for both the patient and operator. Spacer thickness

must be adjusted according to the impression material.[15] For example, 1.3 mm is used for light-body elastomer, 3 mm for medium-body elastomer, 0.5 mm for metal oxide paste, and 3 mm for irreversible hydrocolloid.

2. Methodology

A comprehensive literature search was conducted using PubMed, Scopus, Google Scholar, and ResearchGate. Articles published from 1950 to August 2025 were included. Keywords used were "impression trays," "custom trays," "stock trays," "complete denture impressions," and "microstomia impression techniques." Only peer-reviewed articles, clinical trials, systematic reviews, and authoritative textbooks were considered. References were cross-verified to ensure accuracy, and duplicate reports were excluded.

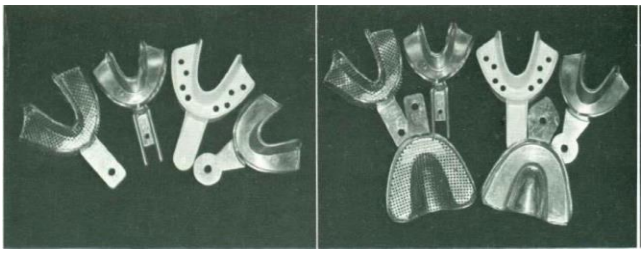

Figure 1: Variety of mandibular and maxillary stock trays are available.

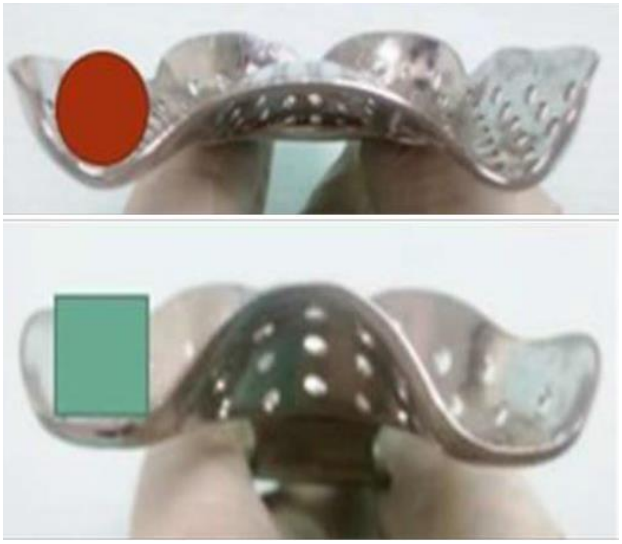

Figure 2: a & **b**: Dentulous and edentulous tray

Figure 3: Custom trays – maxillary and mandibular

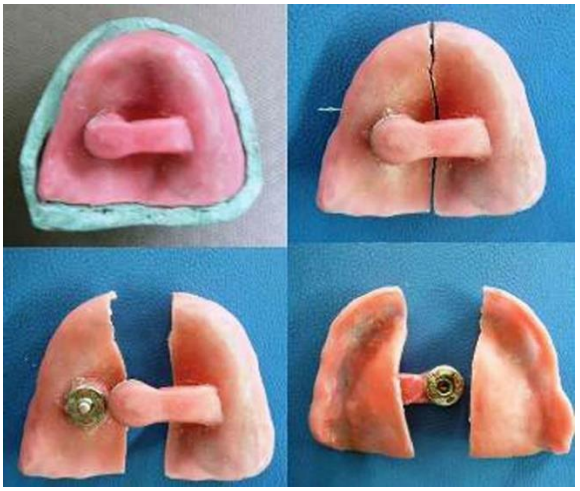

Figure 4: Sectional tray

Figure 5: Custom Tray (FPD)

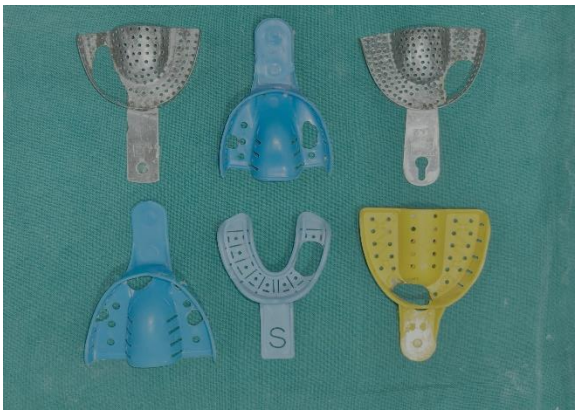

Figure 6: Open Trays for Implant Impression

3. Discussion

Despite significant advancements in impression materials—ranging from polyethers and addition silicones to newer hydrophilic formulations—the innovation in impression tray design has lagged behind, with the notable exception of increased utilization of disposable plastic trays driven largely by infection control mandates. This disproportionate focus on material selection often overshadows the critical role of the impression tray, which serves as the structural foundation upon which accurate and distortion-free impressions are built.

A multitude of studies emphasize that the mechanical properties and geometry of the tray directly influence the accuracy, dimensional stability, and repeatability of dental impressions. The importance of tray rigidity, for instance, has been well-documented. Custom trays fabricated with auto-polymerizing or light-cure resins exhibit significantly less distortion compared to stock plastic trays due to their improved rigidity and uniform spacing of the impression material. These trays also allow clinicians to achieve a uniform thickness of 2-3 mm of impression material, which has been shown to optimize material polymerization and reduce distortion.

Using suboptimal trays can lead to several clinical consequences. Ill-fitting restorations are a major concern, as inadequate tray support can cause non-uniform material thickness and deformation during removal, thereby compromising marginal fit, occlusal integrity, and overall patient comfort. Reported that marginal discrepancies exceeding 100 µm are often clinically unacceptable and can be directly attributed to errors in the impression phase, including tray inadequacies. Furthermore, impression inaccuracies frequently necessitate remakes, which are both economically and emotionally taxing for clinicians and patients. Christensen (2005) highlighted that up to 20–25% of laboratory returns in fixed prosthodontics are due to impression-related errors. When impressions are distorted or incomplete, dental technicians are often compelled to make arbitrary corrections, leading to further deviations from the intended prosthetic outcome. Such a lack of fidelity undermines the technician's ability to deliver a precise prosthesis (Brennan & Spencer, 2004). These challenges become even more critical in complex clinical situations, such as full-arch implant rehabilitations, precision attachments, or cases of microstomia, where uncompromising accuracy is essential. As noted even minor distortions in such settings can result in cumulative misfits, ultimately jeopardizing prosthesis longevity, peri-implant health, and patient satisfaction.

Moreover, studies comparing custom and stock trays have consistently favored the former. For instance demonstrated superior accuracy and detail reproduction with custom trays in implant impressions. Similarly, a randomized trial showed that customized dual-arch trays provided better occlusal accuracy than prefabricated variants.

Given these findings, it is imperative that clinicians adopt a holistic approach to impression-making—one that equally values tray design and material selection. Tailored tray design, particularly custom trays with features like occlusal stops, perforations, and controlled spacing, can significantly improve outcome predictability, especially in edentulous ridges, resorbed arches, or esthetically demanding zones.

The impression tray is not merely a passive container but an active determinant of impression quality. Its design, rigidity, fit, and compatibility with the selected material must be meticulously considered. As the prosthetic success hinges on precision at every step, only a synergistic relationship between the tray and impression material will ensure high-fidelity transfer of intraoral conditions to the working cast. Future innovations should not only focus on material science but also on ergonomic and application-specific tray designs that cater to diverse clinical situations.

4. Conclusion

As impression materials advance, they must be paired with compatible trays. Growing infection control concerns favor increased use of disposable trays. Only practical, cost-effective products that meet modern standards should be used, ensuring no compromise in treatment quality or collaboration with dental technicians.

5. Source of Funding

None.

6. Conflict of Interest

None.

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