THE ALVEOLAR MODEL

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Fig 1 The versatile dentogingival alveolar cast.

When fabricating indirect dental restorations, it is necessary to create a working cast with dies that accurately record the position, surface area, and margins of the prepared teeth, surrounding soft tissues, and adjacent teeth. Gingival contours and occlusal vector force distribution of full- and partial-coverage restorations are the two most important factors that influence and maintain periodontal health.[1,2]

In many laboratory practices, dies are trimmed to expose the margins of preparations; however, the soft tissue emergence profile that surrounds the prepared tooth is lost in the process. Failing to preserve these gingival elements may result in an inappropriate contour and emergence profile of the final restoration.

Overcontoured restorations result in food and plaque retention in the interproximal, facial, and lingual cervical areas.[3–5] This may lead to caries, gingival inflammation, and/or gingival hyperplasia.[5–8] On the other hand, undercontoured restorations result in excessive interproximal spaces and problems with phonetics and esthetics.

A variety of procedures for the fabrication of soft tissue casts have been reported in the literature.[9–16] Some reports suggest using provi-

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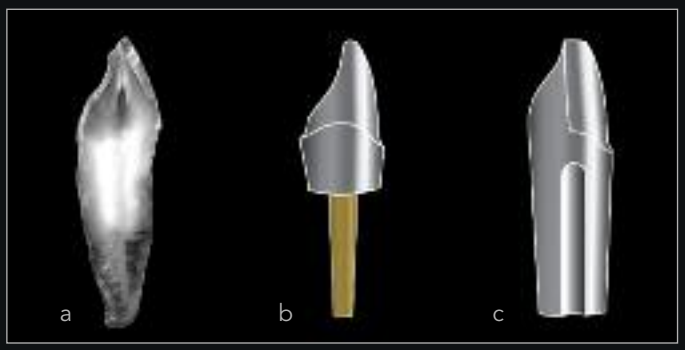


Fig 2 The alveolar cast uses nature as a model *(a)*. Compare a Geller die *(b)* with an alveolar die *(c)*.

sional restorations as an aid in the fabrication procedure.[9–10] Special care must be exercised when selecting the materials for soft tissue casts. Impression materials that contain sulfur inhibit the surface polymerization of polyvinyl siloxane materials and should be avoided.[17]

Use of a removable silicone gingival mask limits the realization of precise cervical morphology at the contours of the restorations due to the inherent elastomeric flexibility of the material. Therefore, a rigid material such as type IV gypsum is preferred.[18]

The alveolar model is an innovative technique inspired by nature (see Fig 2) that can be used during the laboratory fabrication of all traditional and contemporary fixed restorations. This includes but is not limited to tooth- and implant-supported prostheses.

The interchangeability of the multiple removable dies[19] and custom implant analogs[20] on a common type IV gypsum dentogingival alveolar cast (see Fig 1) provides freedom to the restorative team during material selection when restoring adjacent teeth. Additionally, the instrumentation (Fig 3a) used to fabricate the dentogingival alveolar cast and alveolar dies has been simplified, reducing both the time needed for the procedure and the laboratory costs.

ALVEOLAR MODEL PROCEDURE

1. The polyvinyl siloxane dental impression is examined for any voids or irregularities. Accurate marginal reproduction with a minimum extension of 0.5 mm into the gingival sulcus is required to relay adequate information regarding the emergence profile of the prepared tooth.
2. A segmental cast of the prepared teeth is poured with a minimum height of 30 mm in type IV gypsum (Fuji Rock, GC America, Alsip, IL, USA). This ensures efficiency and ease of removability of the stone segment from the impression.
3. The dies are sectioned radially (Figs 3b and 3c) and then proximally using a large diamond disk (Visionflex 6924.104.400, Brasseler, Savannah, GA, USA) (Fig 3d) operating at 10,000 rpm. The dies are further refined to achieve a 6-degree

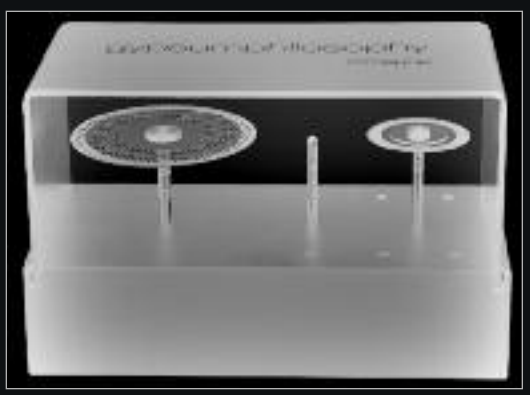
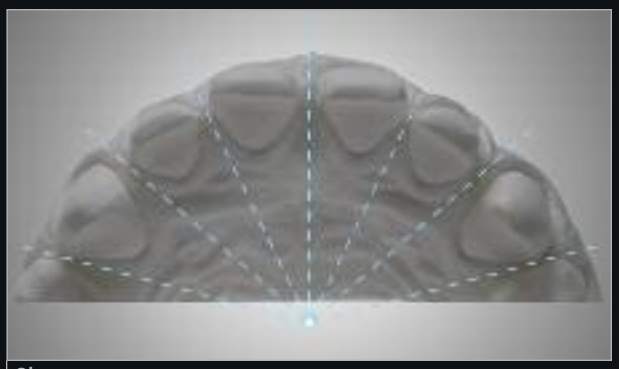
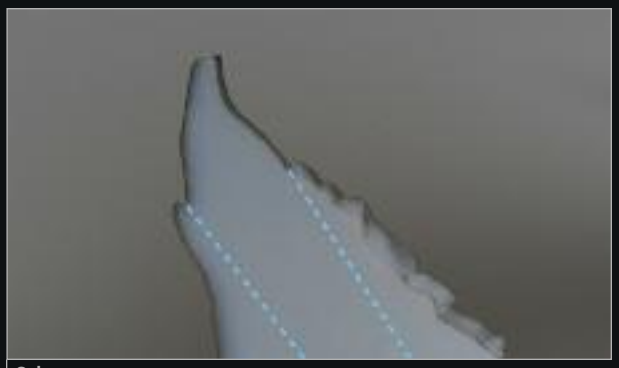


Fig 3a Simplification of the required instrumentation provides consistent results and expedites the protocol during sectioning and trimming of the dies.



3b

3c



3d

3e

Fig 3b Radial orientation lines are conceptualized on the segmental cast.

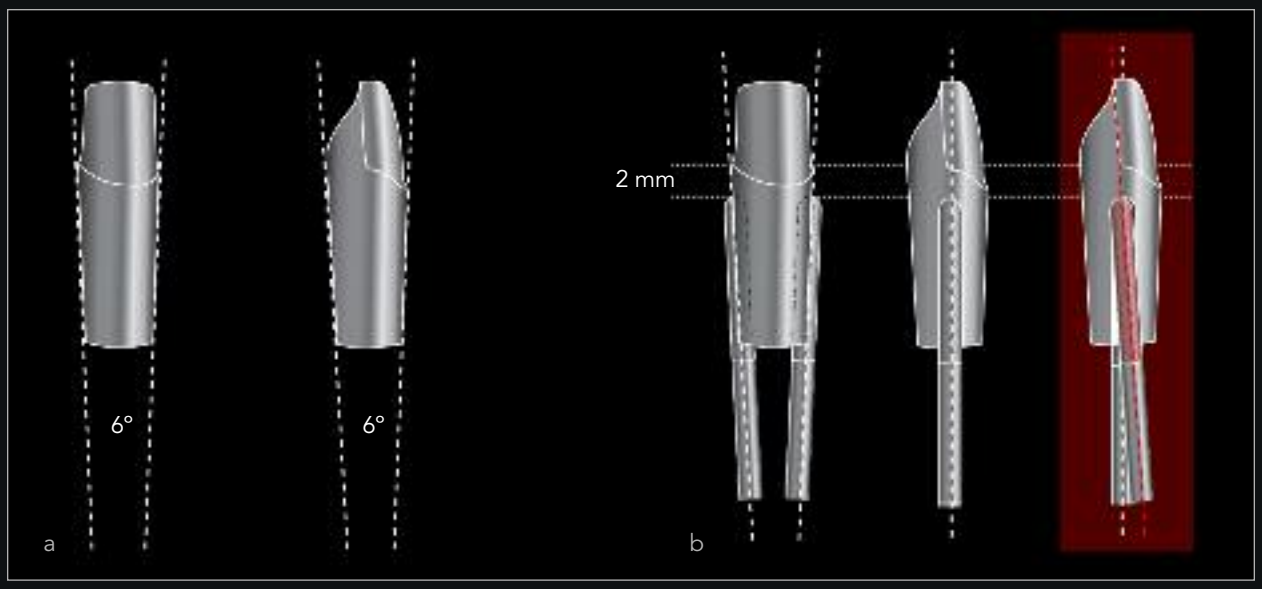
Fig 3c Sectional cuts are made using a large diamond disk.

Fig 3d Visualization of the anticipated proximal tapering of the artificial root portion.

Fig 3e A gradual taper and smooth surface are attained using a parallel-sided round-tipped carbide bur at low speed. Mesial and distal grooves are placed.

conical taper with a parallel-sided round-tipped carbide bur (H364RE.104.023, Brasseler) (Fig 3e and Fig 4a). These are designated as the alpha dies because they are the first generation in the series and thus are the most accurate representation of the actual tooth preparation. On the mesial and distal surfaces of the artificial root, guidance grooves are created 2 mm apical of the margin to provide vertical penetration stops and antirotational support. Care must be taken to keep the grooves axisymmetric (in plane) to ensure a path of withdrawal. Nonaxisymmetric (out of plane) errors (Fig 4b) will deleteriously interlock the die in the dentogingival alveolar base.

4. The alpha die serves as the control for the subsequent generations of dies. It will be duplicated in a small cylinder using addition-reaction silicone, ideally with a 1:1 ratio and a shore-A hardness of approximately 22 (Elite Double 22 Fast, Zhermack, Badia Polesine, Italy). Once the silicone is set, it is removed from the cylinder and the alpha die is disengaged using compressed air.



Figs 4a and 4b Refining the alpha die: *(a)* Creating the conical taper; *(b)* placing the proximal guidance grooves. Nonaxisymmetric errors are shown in red.

5. The dies that will be duplicated from the alpha die are designated as the beta dies. The comprehensive alveolar die mapping sequence is shown in Fig 5. The beta-1 die is formed by the first cast of the alpha duplication silicone, which is treated with a coating of die spacer 0.5 mm coronal from the margin (Die Spacer, Benzer Dental, Zürich, Switzerland) (Fig 6a). When dealing with a refractory technique, silicone duplication of the beta-1 die is required to provide the third generation gamma dies, which will be cast in refractory material. When using a conventional coping technique (eg, metal, alumina, zirconia), the margins are marked with a red pencil and then sealed on the die.
6. The second cast of the alpha duplication silicone generates the beta-2 die, which will be used to form the alveolar socket in the dentogingival alveolar base. A stone surface sealer (Margidur, Benzer Dental) is placed over the entire surface of the artificial root up to the margin (Fig 6b). The beta-2 dies are gently positioned in the polyvinyl siloxane impression and peripherally sealed with

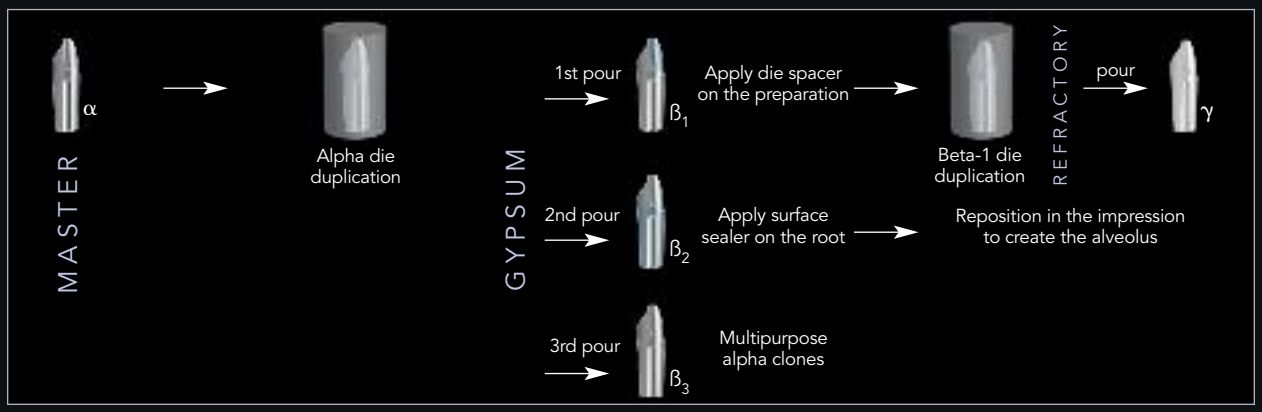
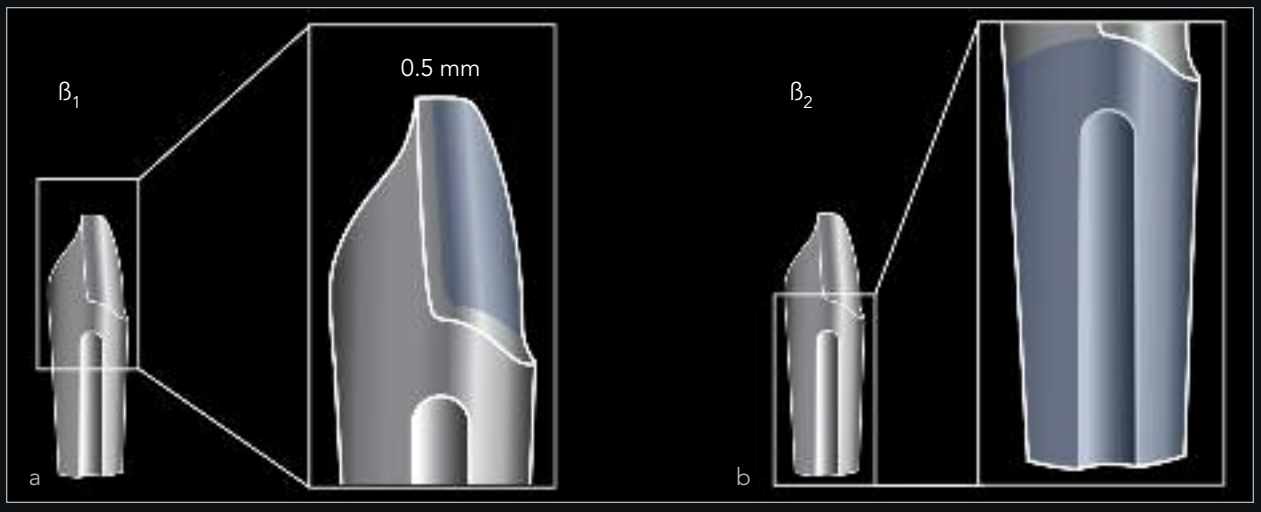


Fig 5 Mapping sequence of the alveolar dies.



Figs 6a and 6b *(a)* Beta-1 die with die spacer 0.5 mm from the margin. *(b)* Beta-2 die with stone surface sealer on the root.

uncolored utility wax under microscopic magnification (Fig 7). An alcohol-based stone-separating liquid (SuperSep, Kerr, Orange, CA, USA) is sprayed to facilitate die removal (Fig 8).

7. The dentogingival alveolar cast is fabricated by pouring type IV gypsum into the impression. It is important to have minimal vibration during pouring to maintain the position of the beta-2 dies. Once the gypsum is set, the alveolar model is separated from the polyvinyl siloxane impression and the beta-2 dies are removed and disregarded, since they have served their sole purpose of forming the alveolar sockets.
8. The third pour of the alpha duplication silicone provides the beta-3 die. This is a multipurpose die that does not receive further modification and is used for a variety of applications, eg, waxing, refinishing, polishing, and marginal adaptation. Beta-3 dies also expedite the transfer of the diagnostic waxup volumetric contours to the alveolar model (Fig 9).[21]

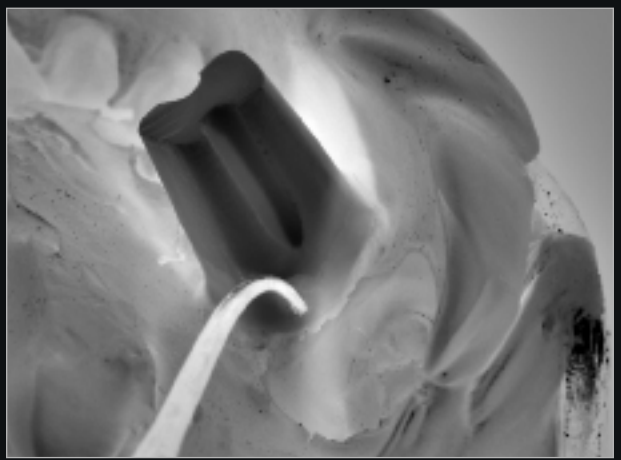


Fig 7 Peripheral wax seal of the beta-2 die completed under microscopic magnification.

Fig 8 Original impression and repositioned beta-2 dies with the isolated root portion just before pouring the dentogingival alveolar cast.

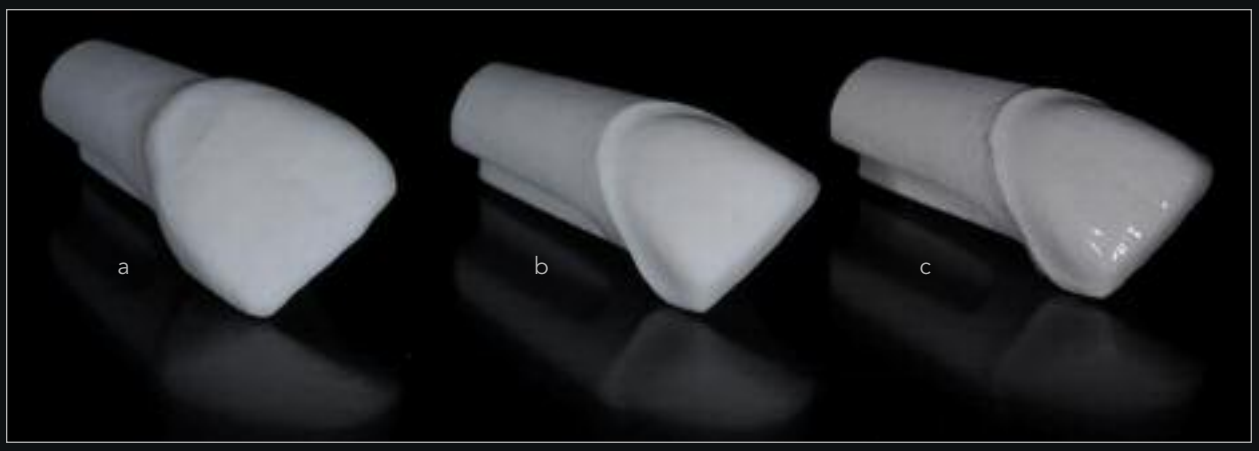


Fig 9 *(a)* Beta-3 diagnostic waxup transfer die. *(b)* Alpha die. *(c)* Gamma refractory die.

DISCUSSION

The alveolar model consists of a modular dentogingival alveolar cast, which uses removable and interchangeable dies to provide flexibility in the simultaneous fabrication of multiple fixed restorations that may differ in material origin (Figs 10a to 10c). The conical nature of the alveolar dies also facilitates the scanning procedures for computer-aided design/computer-assisted manufacture (CAD/CAM) coping materials. The major advantage of the alveolar model is that it maintains an unaltered dentogingival perspective during the fabrication of the restoration.


10a


10b

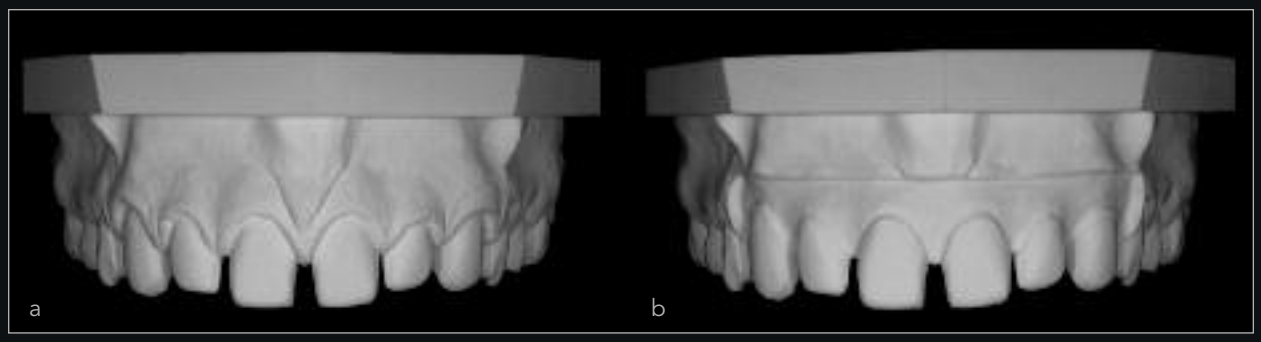

10c

Figs 10a to 10c Dentogingival alveolar cast with the interchangeable dies.


11a


11b

Figs 11a and 11b Evaluating marginal adaptation with the alpha dies.



Figs 12a and 12b Solid casts ultimately regulate and control the interdental relationships, contact areas, and occlusal verification. *(a)* Solid cast with gingival elements used to verify the insertion sequence of the restorations. *(b)* Solid cast without gingival elements used to verify proximal contacts and occlusion.

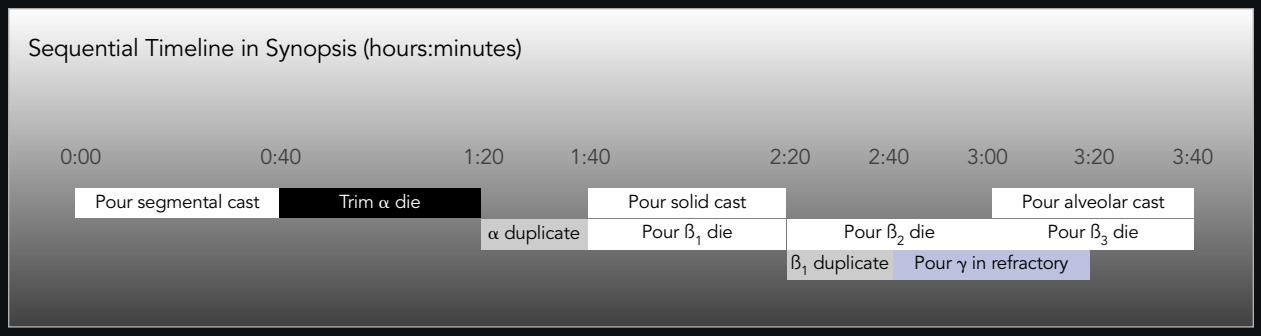


Fig 13 Efficient multitasking reduces the time needed to complete the process.

The alpha dies provide a definitive seating platform to evaluate marginal fidelity (Figs 11a and 11b). As in every system that employs removable dies, the introduction of errors is a significant concern that should be closely monitored using solid casts to verify the final interdental relationships of the restorations. Emphasis is therefore placed on the solid casts to control contact areas and validate occlusal relationships (Fig 12).

Duplication silicones are offered with a variety of shore-A hardness values (8/22/32) and setting times. This enables the operator to select the ap-


14a


14b

Figs 14a and 14b Clinical case based on the casts shown in Fig 12: *(a)* preoperative condition; *(b)* final postoperative view with porcelain veneers. (Clinical case by Pascal and Michel Magne.)

propriate material characteristics based on the task at hand. Accordingly, duplication silicones have proven to be accurate and dimensionally stable after multiple pours. Other advantages of these materials include resilience, tear resistance, and rebound ability when duplicating structures with undercuts.

Upon initial examination, this technique may appear to be a daunting task; however, in reality it is highly efficient, and well-planned multitasking can expedite the various phases of the process (Fig 13). Additionally, it is likely that future developments in CAD/CAM technology will further accelerate and simplify the fabrication process.

Ultimately, the use of an alveolar model ensures physiologic, functional, and esthetic integration of the final restorations (Fig 14).

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