

# Simplifying the Denture Process with by John Nosti, DMD, FAGD, FACE, FICOI **GOTHIC ARCH TRACERS**

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“These days, many dentists avoid treating edentulous patients, despite the growing need for denture treatments. By following the step-by-step Gothic arch tracer process described, dentists can now adhere to a successful protocol for creating accurate and well-fitting dentures.”

### Abstract

Dentures can present as a frustrating treatment for both patient and dentist. However, with the prevalence of edentulous patients in the United States alone, they remain a necessary part of dentistry. Utilizing the Gothic arch tracer for designing dentures, along with superior materials and a specific smile design protocol, removes the guesswork from fabricating dentures. By addressing the patient's occlusion during initial visits, as well as determining the precise centric relation, dentists can provide the laboratory with specific and detailed information about the patient's most repeatable bite and denture design, improving the accuracy of fit and comfort.

### Educational Objectives

After reading this article, the reader should be able to:

1. Describe complications associated with ill-fitting dentures
2. Identify products that are available to help resolve problems associated with dentures
3. Explain how the Gothic arch tracer works and why it's valuable for removable dentures
4. Describe the process for using a Gothic arch tracer

### Introduction

Although more than 60 million people in the United States alone have dentures,<sup>1</sup> both dentists and patients frequently report complications and frustrations with ill-fitting removable prosthetics. An independent survey of edentulous patients recently determined that of those surveyed, 48 percent were unhappy with their current denture(s) and only five percent claimed to be completely satisfied with their current dentures.<sup>2</sup> Additionally, of the 48 percent of people that were unhappy with their current denture, 77 percent of those surveyed wanted improvements in the comfort of their dentures, and 49 percent indicated that they desired improvements in their denture appearance.<sup>2</sup> With the prevalence of patients requiring denture treatments, dentists and laboratories are now tasked with creating better fitting dentures with a more natural aesthetic appearance.

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Although dentures are an established facet of dentistry, many professionals avoid this treatment given the likelihood for inconsistent denture fit, marginal aesthetics, and amount of post-operative adjustments required.<sup>3</sup> Adjustment appointments require extra chair and clinical time, while also leading to patient dissatisfaction and reduced patient trust. Although dentures can help to improve some of the emotional effects caused by edentulism, they still can result in pain, discomfort and articulation difficulties.<sup>4</sup> While many dentists avoid treating edentulous patients, there are more than 23 million people in the United States who are fully edentulous, and that number continues to grow.<sup>5</sup>

Edentulism and poor fitting dentures can be life altering emotionally and physically, altering self-image, reducing self-esteem and causing embarrassment.<sup>6</sup> Physical changes include decreased oral facial support because of hard and soft tissue loss, as well as chronic pain.<sup>7</sup> Changes in the facial region caused by bone resorption and decreased lip support and facial height can create the look of premature aging.<sup>3</sup> The physical changes contribute to the emotional and psychological impact of edentulism, and poor fitting dentures. This can also lead to emotional insecurity, inhibiting sociability and relationships.<sup>6</sup>

Conversely, well-fitting and functional dentures have been shown to improve appearance, psychological and social behavior of patients.<sup>8</sup> There are procedures and techniques now available to resolve these issues, ranging from denture base materials and processing systems to anatomically diverse and occlusally based tooth choices, the combination of which contributes to a more natural and better functioning denture.

Since its introduction in 1937, polymethyl methacrylate (PMMA) material has been used as the primary denture base material.<sup>9,10</sup> Its ideal aesthetics, low water sorption and solubility, minimal toxicity, repair ability, and simple processing technique contribute to the heat-polymerized PMMA resin's longevity as a primary denture base material.<sup>11</sup> The conventional method for curing resin was the pack and press technique.<sup>11,12</sup> However, this technique is susceptible to dimensional changes and inaccuracies in the fit of the denture base.<sup>13</sup>

Further, despite excellent impression techniques, denture processing can result in an ill-fitting prosthetic, which can be frustrating for patients and dentists alike.<sup>4</sup> Traditional denture processing methods have been time-consuming and labor-intensive, requiring laboratory technicians to master various steps that must be completed consistently and to precise specifications.<sup>14,15</sup> They also require technicians to compensate for shrinkage, avoid mixing or dosage errors, and prevent any increase in vertical dimension.<sup>15</sup>

Processing techniques utilizing injection methods result in less increase in vertical dimension of occlusion compared to traditional techniques.<sup>16</sup> Utilizing an injection processing method minimizes the possibilities for changes and reduces the chances for fabrication error.<sup>17</sup>

Introduced 30 years ago as an alternative to the conventional method, and setting the standard for injection processing systems the continuous injection processing system (Ivoclar Vivadent, Amherst, NY) allows for the fabrication of highly accurate methyl methacrylate-based dentures.<sup>18</sup> Typically mixed in the capsule, the material is injected into the closed flask under pressure.<sup>17</sup> Constant pressure is then applied during polymerization and, because the denture base material flows consistently, the likelihood for material shrinkage is optimally compensated. This leads to no or minimal increase in vertical dimension and a homogeneous denture base.<sup>17</sup>

Research has indicated that this injection system imparts increased flexural strength values compared to other processing techniques.<sup>19</sup> This increase may result from the reduction in the residual monomer level, which may occur because of the higher degree of conversion.<sup>20</sup> Additional research has indicated that this system exhibits the least amount of wear when compared to five other commonly used orthotic appliance materials.<sup>21</sup>

A more recent development in processing includes a fully automated, controlled continuous injection and polymerization procedure of special PMMA resins (IvoBase, Ivoclar Vivadent, Amherst, NY). This system combines the benefits of heat-curing and self-curing polymers.<sup>22</sup> Research has indi-

cated that using the improved injection molding technology, these denture base resins (IvoBase Hybrid, IvoBase High Impact, Ivoclar Vivadent) demonstrate superior dimensional precision,<sup>23</sup> likely because the process avoids any fluctuation during fabrication. This reduces the chances of providing patients with poor-fitting dentures. Research has also found that this system achieves exceptionally low initial contents in residual monomer for auto-curing acrylic system, reducing the potential sensitization risk for patients to a very low level.<sup>24</sup>

However, advances in material and processing techniques are voided if steps aren't taken to achieve a proper fit by first establishing correct centric relation. By determining a precise and reproducible centric relation and occlusal vertical dimension, edentulous patients in need of prosthetic treatments will have a harmonious, functional, and comfortable occlusion.<sup>25</sup> An accurate occlusion is also essential to fabricating comfortable and well-fitting dentures.<sup>25</sup>

Among the previous tools used to create correct centric relation, proper occlusion, and precise-fitting dentures have been wax bite rims. However, recording the vertical dimension and centric relation can be challenging given the influence of the patient's proprioceptive nervous system and its ability to impact mandibular movements and the condylar position, which reduce the recording's accuracy.<sup>26</sup>

In 1910, Alfred Gysi determined that accurate alignment of the maxillary and mandibular anterior dentitions would result in improvement in phonetics, function and aesthetics in the construction of dental prostheses.<sup>27</sup> Introduced to eliminate occlusal discrepancies and determine the optimal centric relation and occlusal vertical dimension of their patients, pioneers in their field, Harper, Schiffman, Ellinger and Gysi utilized Gothic arch tracers to determine proper centric relation and then treated their patients with selective occlusal grinding and rehabilitation to achieve centric relation and vertical dimension of occlusion.<sup>28</sup> This article demonstrates how to achieve an improved fit and reduce postoperative chairside adjustments with dentures by using the Gothic arch tracer when planning dentures.

### The Gothic Arch Tracer

The Gothic arch tracer has been a staple in restorative dentistry for nearly a century.<sup>25</sup> It captures occlusal vertical dimension and centric relation, and has been developed over the last century to minimize technique sensitivity and reduce other complications associated with traditional Gothic arch tracers.<sup>25</sup> Derived from Gothic architecture, the Gothic arch removed the traditional wax-bite rim and restricted masticatory forces to the central bearing point in the mouth, in order to create a fulcrum of support for the mandible. This allows the muscles of mastication freedom to return to their correct physiological position.<sup>26</sup> Additionally, the path of the central bearing was recorded through protrusive and excursive movements, and then the points at which these movements intersected would be recorded as the patient's centric relation position.<sup>26</sup>

Ultimately, Gothic arch tracers remain a largely underutilized tool because the early versions were considered technique sensitive and difficult to assemble, although they have demonstrated a proven advantage for recording the precise relationship of the anterior teeth in centric relation.<sup>25</sup> Gothic arch tracing utilizes tracing plates to capture and record the lateral movements of the mandible and maxilla. It is a preferred method for obtaining consistent and accurate positions of the mandible at a comfortable vertical dimension of occlusion.<sup>29</sup> Although not essential for denture fabrication, Gothic arch tracing and determining ideal centric relation help ensure the ideal fit, aesthetics and functions prior to denture processing.<sup>29</sup> This technique has a short learning curve that, once mastered, enables consistent, repeatable and accurate occlusal vertical dimension and centric relation, ensuring occlusal harmony in any type of prosthesis construction—including dentures.<sup>25</sup>

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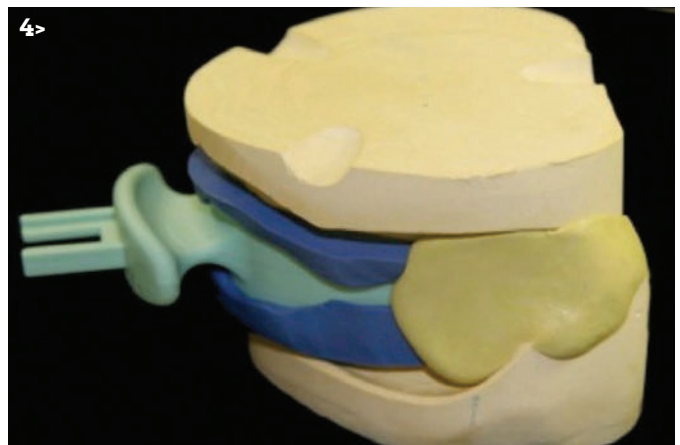
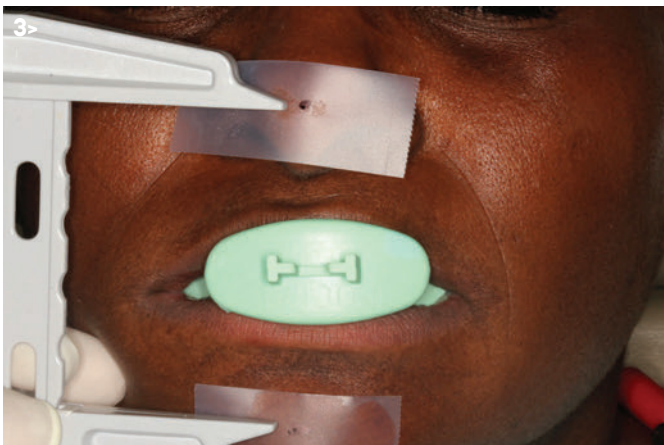
## Setting Up the Gothic Arch Tracer

Utilizing a Gothic arch tracer should only take about 10 minutes, but can save considerable time in postoperative adjustments.

1. The first step in setting up the Gothic arch tracer is recording an arbitrary bite relationship during the first appointment with the centric tray (Fig. 1). This will be sent to the laboratory for mounting the patient's maxillary and mandibular arches parallel to one another so, in return, the laboratory can mount the Gothic arch tracer components perpendicular to one another. The centric tray is lined with gauze to facilitate removal of the putty once the laboratory has mounted the study models (Fig. 2).
2. The putty is then hand-mixed and placed inside the maxillary and mandibular components of the tray.
3. The tray is then placed in the patient's mouth, while the patient is asked to close to a reasonable proximity of the existing denture vertical dimension of occlusion (Fig. 3).
4. The impression is removed once the putty is set and sent to the laboratory, along with the rest of the smile design information. Ask the laboratory to fabricate a second set of base plates with recorder mounted on it without the wax rims (Fig. 4).

## Recording Centric Relation with the Gothic Arch Tracer

After the impression technique, recording the centric relation position is probably the single-most important step in denture construction.<sup>4</sup> The wax rims are uti-



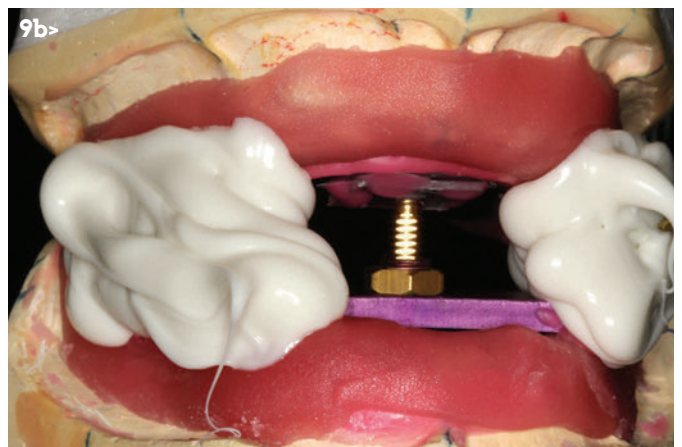
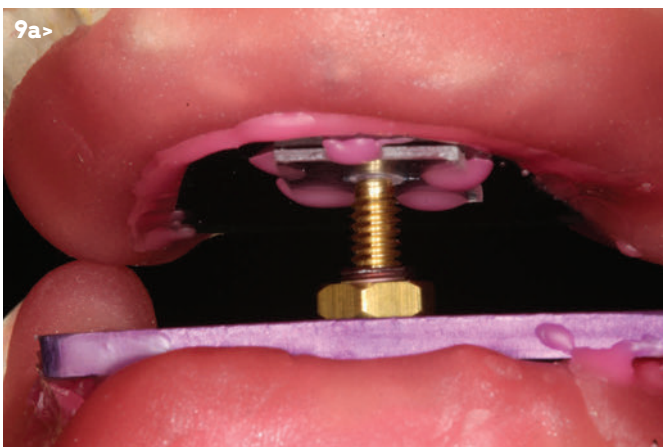
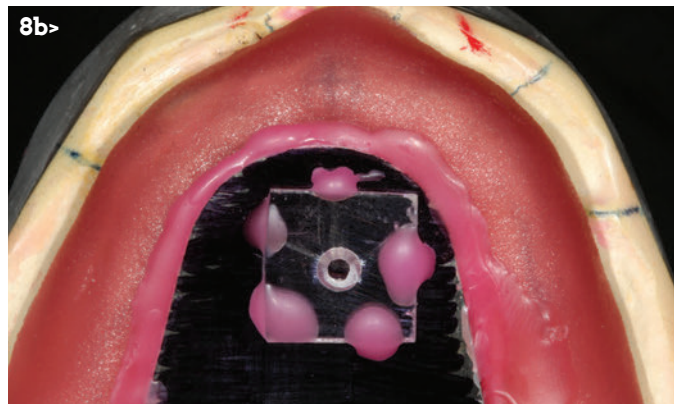
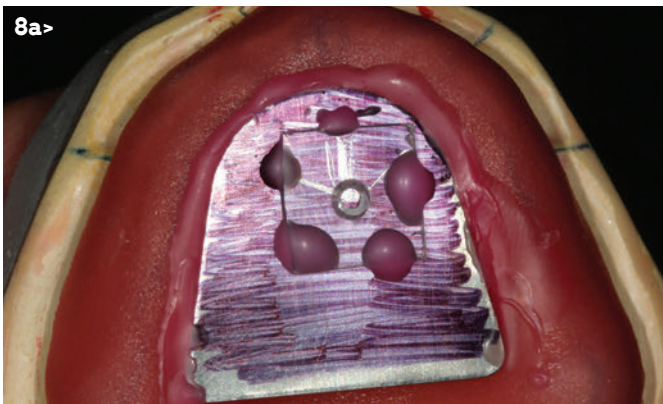
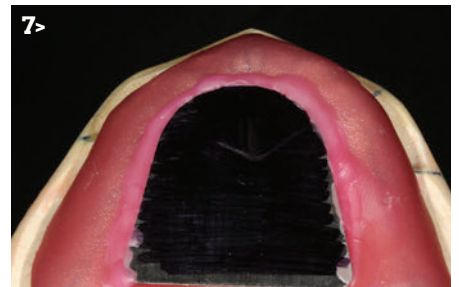
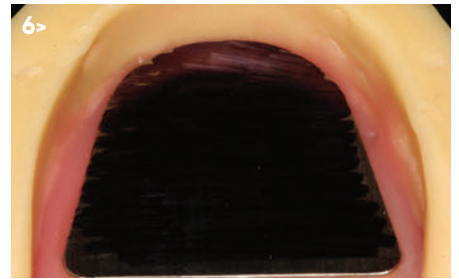
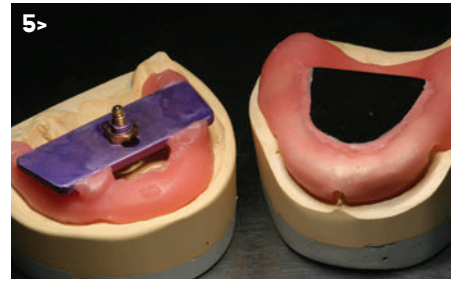
lized to determine the aesthetic and phonetic position of the teeth. The second set of baseplates are returned from the laboratory, with the Gothic arch tracer mounted to record the centric relation position and vertical dimension. Adjustment of the vertical component of the recorder to match the patient's desired vertical dimension of occlusion occurs first.

1. According to the manufacturer's instructions, the strike plate is then painted with magic marker or articulating paper is used to mark the strike plate (Fig. 5. Image courtesy of Brian Carson).
2. After the plate is properly marked, the patient should be instructed to slide the mandible forward, backward, and into left and right lateral excursions. The marks made from these actions should resemble an arrow, and the tip of the arrow is determined as the patient's centric relation position (Fig. 6).
3. Placement of the center of the centric pin receiver over the point of the arrow occurs, and adhesive is used to bind it to the strike plate (Fig. 7).
4. Once the base plate is placed back in the patient's mouth, the patient is guided until the pin goes into the hole in the centric receiver (Figs. 8a-b).
5. The baseplates should then be secured together using a hard bite registration material (Figs. 9a-b).

### Equilibrating Dentures Post-fabrication

In addition to recording centric relation, Gothic arch tracers can also be used after denture fabrication to equilibrate the dentures. With proper mounting on the

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finished upper and lower dentures, the intraoral tracer can be used as a central bearing device for attaining balanced denture occlusion.<sup>25</sup> Once the dentures are fabricated in the laboratory, the technician mounts the maxillary cast and uses a facebow record, while the mandibular cast can be mounted to the maxillary cast using the arch tracings.<sup>26</sup> The centric relation and vertical dimension of occlusion can then be confirmed and any adjustments made prior to the patient's fitting. This ensures that the laboratory-fabricated dentures are precise and accurate replications of the patient's impressions and denture design determined in the office.

## Conclusion

These days, many dentists avoid treating edentulous patients, despite the growing need for denture treatments. By following the step-by-step Gothic arch tracer process described, dentists can now adhere to a successful protocol for creating accurate and well-fitting dentures. Although Gothic arch tracers have been known for their technique sensitivity in the past, it is a valuable tool to avoid chronic adjustments after denture fabrication. Typically completed in less than 15 minutes, Gothic arch tracer processes can save valuable chair and clinician time. Additionally, Gothic arch tracers help avoid patient discomfort and dissatisfaction by outlining the ideal denture occlusion for the laboratory prior to fabrication. These simple steps—combined with updated materials and techniques—enable better laboratory communication, ensure that the impression and design requested is the same delivered to the patient, and instill confidence that aesthetic, precise and comfortable removable prostheses are being delivered. ■

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## Author's Bio



**Dr. John Nosti** practices full-time in Mays Landing/Somers Point, New Jersey, as well as Manhattan, New York, with an emphasis on functional cosmetics, full mouth rehabilitations and TMJ dysfunction. Dr. Nosti is the Clinical Director for The Clinical Mastery Series, a continuum geared towards advancing the cosmetic and functional practices of dentists worldwide. He is a member of the American Dental Association, American Academy of Cosmetic Dentistry, American Academy of Craniofacial Pain, American Academy of Dental Sleep Medicine and the Crown Council. Dr. Nosti also holds fellowships in the Academy of General Dentistry, the Academy of Comprehensive Esthetics, and the International Congress of Oral Implantologists.

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1. **Dentist are apprehensive about dentures because:**
  - a. They don't enjoy the smile design process.
  - b. They don't have a set protocol.
  - c. They have to perform too many adjustments after placement.
  - d. All of the above
  
2. **According to the 2009 National Health Interview Survey, how many edentulous patients are there in the United States?**
  - a. 12 million
  - b. 18 million
  - c. 23 million
  - d. 29 million
  
3. **The traditional processing technique for dentures utilizes:**
  - a. A pack and press technique.
  - b. Auto curing pour processing.
  - c. An injection technique.
  - d. None of the above
  
4. **True or False: Traditional processing has been shown to increase dentures' vertical dimension.**
  - a. True
  - b. False
  
5. **Dentists have avoided using a Gothic arch tracer because it:**
  - a. Determines centric relation.
  - b. Is considered technique sensitive.
  - c. Can be difficult to set up.
  - d. Both b and c
  
6. **The first step in setting up the Gothic arch tracer is:**
  - a. Recording an arbitrary bite relationship.
  - b. Utilizing the wax rims.
  - c. Identifying the centric relation.
  - d. Mounting the casts.
  
7. **True or False: A centric relation recording is necessary for the fabrication of dentures.**
  - a. True
  - b. False
  
8. **The Gothic arch tracer uses the mandible and maxillary positions to create this shape:**
  - a. Circle
  - b. Square
  - c. Arrow
  - d. Triangle
  
9. **Gothic arch tracers can be used to ensure proper:**
  - a. Centric relation.
  - b. Vertical dimension of occlusion.
  - c. Tooth position.
  - d. Both a and b
  
10. **Done properly, a Gothic arch tracer will:**
  - a. Increase time spent during the denture fabrication process with little result.
  - b. Decrease post-op adjustments caused by a poor occlusion, but typically blamed on an ill-fitting prosthesis or the processing technique.
  - c. Help establish the correct incisal plane.
  - d. Help the lab choose the appropriate posterior occlusal anatomy.

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# Simplifying the Denture Process with Gothic Arch Tracers

by John Nosti, DMD, FAGD, FACE, FICOI

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| 9.  | a | b | c | d |
| 10. | a | b | c | d |

Please circle your answers.

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|--|---|---|---|---|---|
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| 2. Course objectives were consistent with the course as advertised                   | 5 | 4 | 3 | 2 | 1 |
| 3. COURSE OBJECTIVE #1 was adequately addressed and achieved                         | 5 | 4 | 3 | 2 | 1 |
| 4. COURSE OBJECTIVE #2 was adequately addressed and achieved                         | 5 | 4 | 3 | 2 | 1 |
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| 7. Course material was up-to-date, well-organized, and presented in sufficient depth | 5 | 4 | 3 | 2 | 1 |
| 8. Instructor demonstrated a comprehensive knowledge of the subject                  | 5 | 4 | 3 | 2 | 1 |
| 9. Instructor appeared to be interested and enthusiastic about the subject           | 5 | 4 | 3 | 2 | 1 |
| 10. Audio-visual materials used were relevant and of high quality                    | 5 | 4 | 3 | 2 | 1 |
| 11. Handout materials enhanced course content  | 5 | 4 | 3 | 2 | 1 |
| 12. Overall, I would rate this course:   | 5 | 4 | 3 | 2 | 1 |
| 13. Overall, I would rate this instructor:   | 5 | 4 | 3 | 2 | 1 |
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