

# Innovative Attachment to Secure Implant-Supported Fixed Full-Arch Restorations

N A D I M Z . B A B A , D M D , M S D

## ABSTRACT

A novel attachment system for implant-supported fixed full-arch restorations eliminates the need for cement, screw access channels, retention screws, and composite filling materials, as well as the clinical complications and challenges such options present. Indicated for the rigid connection of full-arch restorations onto endosseous dental implants, the Locator F-Tx fixed attachment system involves a protocol that is simpler to place, easier to maintain, and more cost-effective and convenient for both dentists and patients. Time-consuming and costly procedures associated with cement- and screw-retained abutment connections can be eliminated with the use of efficient, esthetically pleasing, and less technique-sensitive Locator F-Tx fixed attachments.

**B**roadly defined as a condition characterized by some degree of tooth loss, edentulism continues to be on the rise, whether it involves some teeth (ie, partial edentulism) or all teeth (ie, complete edentulism). In fact, the number of people with one or more edentulous arches is expected to continue to increase over the next 25 to 45 years.<sup>1,2</sup>

Edentulous individuals may endure multiple psychological, emotional, physical, and functional effects resulting directly from their tooth loss. These individuals are often embarrassed by their tooth loss, demonstrate low self-esteem, and have limited social interaction.<sup>3</sup> Physically, they experience oral bone and soft-tissue resorption; decreased oral/facial support that subsequently contributes to a prematurely aged appearance; and decreased lip support and facial height.<sup>4,6</sup> Functionally, edentulism impairs an individual's ability to eat properly and makes speaking and enunciating sounds difficult.<sup>7</sup>

For generations, the conventional remedy for fully edentulous arches has been a full-arch removable denture. Although tooth

designs, base materials, and processing techniques have evolved, conventional removable full-arch dentures still represent the same basic design of a century ago. The denture base fits over the bone and soft-tissue ridge, which deteriorates over time.<sup>2</sup> Ridge resorption and consequential poor denture fit lead to denture movement and instability that ultimately force wearers to use their lips, tongue, and cheek muscles to hold the denture in place; they also often experience chronic sore spots, discomfort, and an inability to eat properly, as well as insecurity when speaking and laughing.<sup>2,5</sup>

## MORE SECURE OPTIONS

Today, however, osseointegrated implants that are placed to retain or support full-arch dentures or full-arch fixed restorations eliminate many of the disadvantages associated with conventional dentures. When endosseous osseointegrated implants are placed to retain or support full-arch dentures or fixed full-arch restorations, enhanced stability, retention, and occlusal function can be achieved, ultimately contributing to greater

comfort, improved self-confidence, better nutritional intake, and enhanced facial esthetics for the edentulous individual.<sup>2,6,7</sup>

*Implant-Retained Dentures:* When referring to cases in which implants are placed to retain an otherwise removable complete or partial denture prosthesis, the implants provide stability to the denture—referred to as an overdenture—while occlusal forces are supported by the individual's remaining hard and soft tissues.<sup>2,7</sup>

*Implant-Supported Prosthesis:* Cases in which implants support the prosthesis—such as a full-arch bridge—involve a prosthesis that incorporates the implants and abutments/attachments to support occlusal forces and function, rather than the individual's hard and soft tissues.<sup>2,7</sup>

*Hybrid Prosthesis:* Implants can also be placed to support a prosthesis in a fixed but detachable manner; only dentists can remove the appliance, by unscrewing it.<sup>2,7</sup>

Selecting the type of full-arch prosthesis that will best restore an edentulous patient to normal function and quality of life requires thoughtful consideration of many factors. These include the individual's ability to maintain proper oral hygiene, any potential periodontal disease risk factors, and functional habits that could affect prosthesis longevity (e.g., clenching, grinding), among other factors. Other considerations include the patient's hard- and soft-tissue volume and quality to accommodate the size, location, angulation, and quantity of implants required for support and/or retention, as well as the location of significant anatomical landmarks (e.g., alveolar nerve, sinus).

## PLANNING THE APPROPRIATE PROSTHESIS

Treatment planning multiple aspects of im-

plant placement, in addition to the different components of the full-arch overdenture or fixed full-arch restoration, minimizes complications during surgery and prosthesis delivery, contributes to precise implant placement and angulation, facilitates proper fit of the prosthesis, and decreases the likelihood of peri-implant disease risks. Predictable diagnosis and treatment planning for implant-supported or implant-retained full-arch prostheses to restore edentulous arches has been enhanced through various technologies, which have included 3-dimensional (3D) implant treatment planning software, 3D imaging such as cone-beam computed tomography (CBCT), and precision surgical guides, among others.<sup>8</sup>

For example, CBCT imaging enables examination of detailed 3D views of oral anatomy for thorough assessment of bone density, height/width, alveolar nerve location, lingual concavity, and other landmarks when planning aspects of implant treatments, most importantly implant size, length, placement location, and angulation.<sup>9-13</sup> Based on 3D diagnostic and treatment planning information, in addition to unique patient characteristics and prosthetic requirements, the most appropriate abutment, connection, and/or fixture type can also be determined.<sup>14,15</sup>

## MAKING THE RIGHT CONNECTION

The type of abutments and attachments/connections to be used in full-arch restorations is dependent on whether the prosthesis will be fixed, removable, or hybrid (ie, fixed detachable). Similar to natural tooth preparations for crown-and-bridge restorations, implant abutments must follow basic design principles that contribute to ideal emergence and angulation, height, and occlusion.<sup>16,17</sup> Considerations influencing abutment selection include such factors as soft-tissue height and contours, interocclusal space, level of support required, ability to facilitate oral hygiene, periodontal stability, and implant position and angulation.<sup>16,17</sup> Based on these factors, abutments and connections for fixed or hybrid full-arch restorations have typically included screw-retained or cement-retained options. A retrievable full-arch restorative solution will be the focal point of the balance of this discussion.

Although few significant differences have been found between cement- and screw-retained restorations in major and minor outcomes, such as implant loss, crown loss, screw loosening, de-cementation, or porcelain fracture,<sup>18,19</sup> each type presents unique advantages and disadvantages.<sup>20</sup> The type

of abutment/connection selected for fixed or hybrid full-arch restorations affects passivity and fit, stability, occlusion, retention, and overall success.<sup>20,21</sup>

*Cement-Retained:* Cement-retained prostheses incorporate an abutment that is first screwed and torqued into place, after which the prosthesis or restoration is cemented onto it. Cement-retained prostheses have gained popularity as a means to overcome the difficulties associated with implant angulation problems and nonparallel implants.<sup>22</sup> However, although full-arch prostheses are frequently cement-retained, residual cement at or below implant margins has been positively associated with peri-implant diseases that subsequently lead to implant failure.<sup>23</sup> The potential for residual cement contamination of peri-implant tissues and the amount of cement required to retain restorations have been minimized through the use of custom abutments, which allow abutment/restoration margins to be positioned at the ideal tissue-level location, as opposed to deep within the sulcus, which helps to avoid undetectable retained cement remnants.<sup>24</sup>

*Screw-Retained:* Screw-retained prostheses are secured via retention screws that require a screw access hole typically positioned on the occlusal aspect, which is sealed with composite after placement. Popular based on their retrievability,<sup>25</sup> screw-retained prostheses require consideration, planning, and management of the screw access hole exit point and closure to ensure proper occlusal anatomy, avoid the facial aspect, prevent microleakage and bacterial infiltration, and establish ideal function and esthetics.<sup>22</sup> Despite helping to prevent the negative sequelae associated with intraorally cemented restorations, screw-retained prostheses are often challenging and demanding. Attempting to provide a patient with an immediate hybrid prosthesis solution via the conversion of an existing denture is time consuming, includes a degree of complexity that may be challenging to some restorative clinicians, and typically results in a provisional prosthesis with a loss of structural integrity given the degree of denture manipulation required to pick-up the temporary cylinders.

## A CHALLENGING PROPOSITION

Despite the sophisticated nature and tremendous amounts of information provided by CBCT scans, they present limitations that can complicate implant support and/or retention of full-arch prostheses. Underestimated jaw sizes (e.g., ~0.5 mm) and bone height, as well as unidentified areas of thin bone,

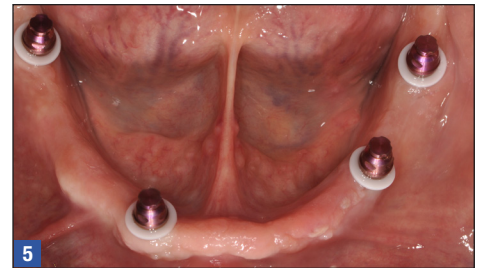
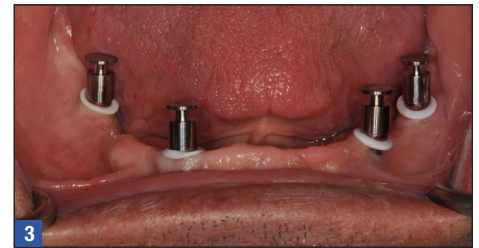
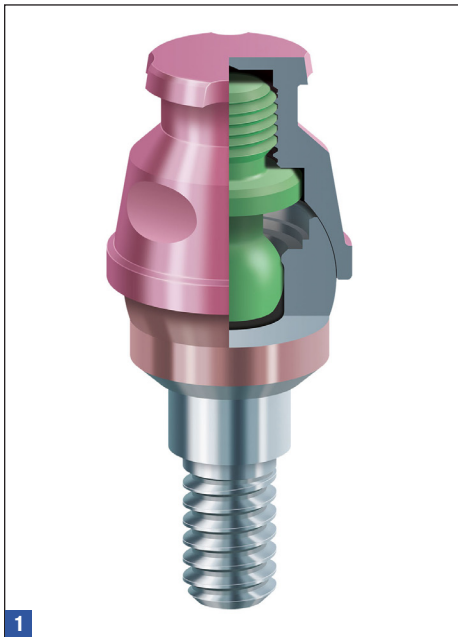
have been reported with CBCT scans used for planning the placement and position of implants to secure full-arch restorations.<sup>14,26</sup> Such deviations of as much as 0.3 mm to 2.3 mm between the surgical plan and the actual plan of the hex, and from 0.3 mm to 2.4 mm in the apex, help to explain why well-planned treatments still result in prostheses that do not fit passively.<sup>26</sup>

Unfortunately, poor prosthetic fit is a known risk factor for peri-implant diseases that directly affects peri-implant bone and soft-tissue integrity.<sup>27,28</sup> Additionally, despite meticulous planning, placing implants at the ideal location and position for full-arch prostheses is not always possible; consequently, it may be necessary to place implants at a less-than-ideal angulation or orientation in order to circumvent issues related to inadequate bone quality or quantity.<sup>29,30</sup> As a result, abutment/connection options may then be limited to cement-retainable components that increase the potential for subgingival cement, peri-implant diseases, and subsequent implant failure.<sup>23,30</sup>

It is also not uncommon for prostheses originally intended for fixed support or retention to be converted to overdentures requiring attachments.<sup>29</sup> However, the originally placed implants may not have been positioned in parallel, which could result in premature attachment component wear, retention loss, nonpassive prosthesis seating, and the need to replace insert housing.<sup>31</sup>

Finally, despite meticulous treatment planning, selection and placement of the most appropriate and patient-specific implants and abutment/connection components, and stringent patient selection and implant maintenance follow-up, late implant failures can occur after complete or partial implant osseointegration.<sup>32</sup> This often necessitates explantation of the implant(s), placement of a new implant, and fabrication of a new full-arch prosthesis to accommodate the new implant positioning, with the latter two usually requiring significant time, laboratory expense, and further financial investment by the patient.<sup>33</sup>

All of these potential challenges combined underscore dentistry's need for an attachment system that can mitigate the complications inherent with cementable and screw-retained full-arch restorations. Such an attachment system would eliminate the need for placing angled abutments in the presence of nonparallel implants, correct convergence or divergence between implants, contribute to passive insertion and removal, resist component wear, and



**FIG 1.** LOCATOR F-Tx. **FIG 2.** The abutments torqued onto the implants of the mandibular arch. **FIG 3.** Impression copings seated on abutments to take abutment level impressions for lab fabrication of final prosthesis. **FIG 4.** Milled titanium framework for mandibular IFCD (Framework was milled by Cagenix, cagenix.com). **FIG 5.** Seated denture attachment housings with new black processing balls on each of the mandibular abutments. **FIG 6.** Definitive prosthesis picked up chairside by cementing the framework to the denture attachment housings.

enhance overall full-arch restoration treatment survival. To be most beneficial to both clinicians and patients, requisite characteristics of such an attachment system should also include simplified chairside clinical procedures and cost effectiveness.

### THE LOCATOR F-TX SOLUTION

An alternative to cement- or screw-retained implant attachments is the Locator F-Tx fixed attachment system for rigid connection of full-arch restorations onto endosseous dental implants (LOCATOR F-Tx®, Zest Dental Solutions, zestdent.com). The use of the Locator F-Tx fixed attachment system can eliminate the challenges associated with implant-supported full-arch prostheses, including angled abutments, using cement- or screw-retained options, and/or placing implants at different insertion axes.<sup>34-37</sup>

According to prosthodontists in the American College of Prosthodontists and the American Academy of Maxillofacial Prosthetics surveyed about common restorative preferences for removable attachments, 86% of prosthodontists have used Locators,<sup>38</sup> most likely due to their 90% prosthodontic success rate over 3 years, which is higher than for other attachment systems observed during the same time frame.<sup>39</sup> In a 3-year study, Locators demonstrated better clinical results than other attachments when peri-implant hygiene, cost, prosthodontic maintenance frequency, and ease of overdenture

preparation were evaluated.<sup>40</sup>

Building on the success of the removable Locator, the Locator F-Tx fixed attachment system achieves fixation through a snap-on attachment that eliminates the need for subgingival cement, prosthetic screws, and screw access channels. The attachment housing is internally threaded to accept a polyether ether ketone (PEEK) retention ball or Radel processing ball, which then snaps into the abutment (Figure 1). These components eliminate the need for abutment temporary cylinder preparation, screw access channels and filling composite, and intensive chairside procedures to ensure retention of the full-arch prosthesis. As a result, the Locator F-Tx fixed attachment system removes significant known risk factors for peri-implant diseases and subsequent implant failure.<sup>23,30</sup> The provisional or final prosthesis restored with the Locator F-Tx fixed attachment system, in comparison to a traditional screw-retained equivalent, yields greater structural integrity to the prosthesis and enhanced esthetics given the absence of screw access channels.

A spherical coronal abutment geometry enables the denture attachment housings to rotate in any direction and correct up to 20° in any direction from a common vertical reference between implants. Therefore, the Locator F-Tx fixed attachment can be positioned ideally for the prosthesis, reducing the need for angled abutments while ensuring a stress-free, passive fit. Considering that discrepancies and devia-

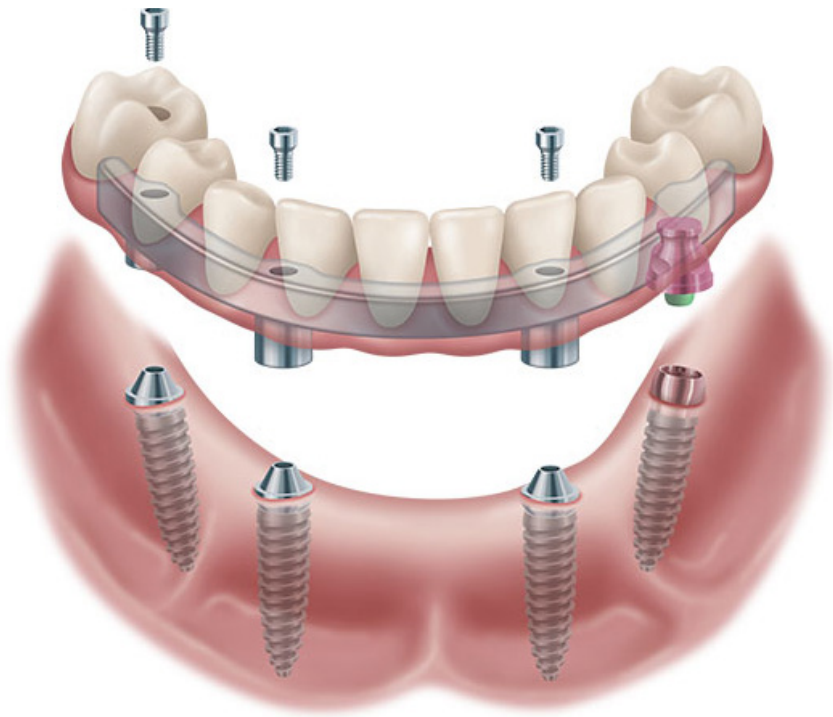
tions in implant/abutment position contribute to a non-passive fit of prostheses, the Locator F-Tx fixed attachment system's spherical abutment geometry and ability to pivot in any direction is significant to creating a more parallel, stress-free draw for a prosthesis.

Capable of being removed and reattached only by a dentist as needed, Locator F-Tx fixed attachment systems are indicated for rigid connection of partial and full-arch restorations with cross-arch stabilization on endosseous dental implants in the maxilla or mandible (Figure 2 through Figure 6). They can be used to stabilize newly fabricated full-arch restorations (eg, all-ceramic, PFM, or acrylic wrapped bars) or a conversion of the patient's existing full denture. They can also be used to salvage a screw-retained full-arch restoration after late implant failure and retreatment (Figure 7).

Contributing to its stability are aggressive grooves and flats on the denture attachment housing, which is easily and passively picked up in the prosthesis during a simple chairside procedure. These characteristics limit vertical and rotational movement, contribute to prosthetic stability, and essentially lock the prosthesis into place.

Further, compared with the complex protocol required to maintain, repair, and/or salvage screw-retained or cement-retained full-arch prostheses, Locator F-Tx fixed attachment systems have demonstrated favorable results regarding prosthodon-





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**FIG 7.** The LOCATOR F-Tx can also be used to salvage a screw-retained full-arch restoration after late implant failure and retreatment.

tic maintenance, cost, and ease of preparation. With Locator F-Tx fixed attachments, full-arch restorations can be quickly and easily removed during recall appointments and/or yearly maintenance appointments using simple hydraulic displacement or specialized instruments provided by the manufacturer, and only the retentive balls require replacement. Such procedures are far less intensive than drilling out composite material, unscrewing components, cleaning access channels and components, and then refilling them. With Locator F-Tx, there is also no risk that tiny retention screws are swallowed or aspirated by the patient, as all retention ball replacement is performed extraorally. Additionally, when salvaging a prosthesis in the case of a late implant failure, any retrofitting techniques can easily be performed chairside.

## CONCLUSION

Using a novel F-Tx fixed attachment system for implant-supported full-arch restorations eliminates the need for cement, screw access channels, retention screws, and composite filling materials, as well as the clinical complications and challenges such options present. Indicated for the rigid connection of full-arch restorations onto endosseous dental implants, a Locator F-Tx fixed attachment system involves a protocol that is simpler to place, easier to maintain, and more cost-effective and convenient for

both dentists and patients alike. At a time when many patients could benefit from the life-altering benefits of implant-supported prostheses, a Locator F-Tx fixed attachment system can help make such solutions a reality, particularly in cases where the adverse effects of edentulism and wearing conventional removable dentures (eg, limited or thin bone and soft tissue) may present anatomical challenges that could otherwise compromise prosthetic integrity. Unlike the time-consuming and costly procedures associated with cement- and screw-retained abutment connections, Locator F-Tx fixed attachments are efficient, esthetically pleasing, and less technique-sensitive.

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## DISCLOSURE

Dr. Baba is a paid consultant for Zest Dental Solutions.

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