

# Eight-Year Follow-Up of a Fixed-Detachable Maxillary Prosthesis Utilizing an Attachment System: Clinical Protocol for Individuals With Skeletal Class III Malocclusions

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The aim of this article is to describe a successful clinical protocol for prosthodontic rehabilitation of a patient with a skeletal Class III malocclusion using a fixed-detachable maxillary prosthesis supported by 6 implants and the MK1 attachment system. The patient was followed up for 8 years. A 46-year-old edentulous woman with a skeletal Class III malocclusion expressed dissatisfaction with her old existing maxillary denture from an esthetic point of view and frustration regarding its function. A fixed-detachable maxillary prosthesis using the MK1 attachment system was made. The patient was followed up clinically and radiographically for 8 years. No bone loss, fracture of prosthetic components, or fracture of the prosthesis was detected in that period. A fixed detachable maxillary prosthesis using the MK1 attachment system is a treatment option for patients with Class III malocclusions who opt not to undergo orthognathic surgery.

**Key Words:** attachment systems, dental implants, overdentures

## INTRODUCTION

Dental implantology has opened up great possibilities in oral rehabilitation. Similarly to other specialties, the philosophy of implant dentistry has changed.<sup>1</sup> The percentage of mandibular implant success ranges between 90% and 99%, depending on the time of observation and

regardless of the system used and the degree of resorption.<sup>2-5</sup> Nevertheless, in the maxilla, survival currently ranges from 85% to 95%<sup>6,7</sup> depending on the type of bone and degree of resorption. Supported prostheses have been indicated for the rehabilitation of fully edentulous patients since the 1960s, mainly for restoring the edentulous mandible. This preference is related to the instability of conventional prostheses, which results from the physiologic process of alveolar ridge resorption after the teeth have been lost.<sup>8</sup>

Implant-supported overdentures are also a viable treatment option for the fully edentulous maxilla.<sup>9</sup> Among the indications for an overdenture are deficient retention, unstable prosthesis, poor bone quality, and low economic status of the patient. Overdentures offer many advantages com-

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DOI: 10.1563/AAID-JOI-D-11-00195

pared with fixed prosthesis and implants, such as easy oral hygiene, the possibility of modifying the prosthetic base if necessary, and improved lip support, which enhances esthetics when the maxillary ratio is unfavorable.<sup>10,11</sup> However, it is essential to consider the relationship between the jaw bones before any prosthetic treatment. In cases of severe skeletal Class III discrepancy, an overdenture may not be able to provide the desired esthetics and mechanical resistance to the patient. Currently, many practitioners believe the only treatment option for rehabilitation of skeletal Class III edentulous patients involves orthognathic surgery, but in most cases, this is not an acceptable alternative for older patients. In this context, the MK1 system should be considered.

The MK1 system consists of a metal infrastructure with a milled bar that fits over the implants and contains 2 attachment orifices at the extremities. The superstructure placed in the internal portion of the overdenture has 2 pins that lock the prosthesis when they are introduced in the orifices of the bar. The assembly can be unlocked by inserting a small key into an orifice strategically located on the buccal surface of the prosthesis, in a region that has no influence on esthetics and is easily accessible to the patient. The fit is secure but still allows the overdenture and the bar to be separated without great effort. Therefore, this means that placement and removal of the overdenture do not require potentially harmful forces and are easily handled by the patient.<sup>12</sup> Thus, the objective of this clinical report is to describe the use of the MK1 attachment system for manufacturing a fixed-detachable maxillary prosthesis over 6 implants, detailing the clinical steps involved in this modality of treatment.

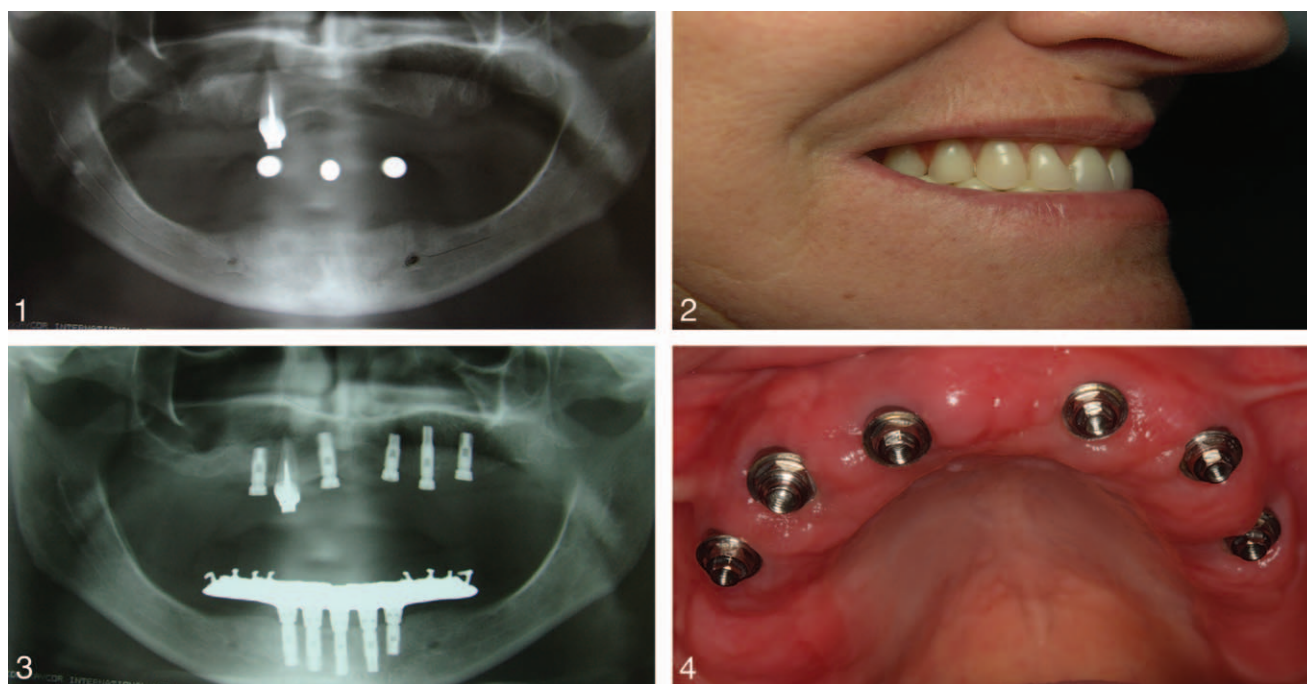
#### CLINICAL REPORT

A 46-year-old woman presented at the Araraquara Dental School (UNESP), reporting dissatisfaction with her denture from an esthetic point of view and expressing frustration regarding its function. The patient was not a smoker and had no systemic disease. Clinical and radiographic examination showed the presence of the right maxillary canine (Figure 1) and an ERA implant (extra coronal attachment; APM, Sterngold Dental, Attleboro, Mass), which, together with the alveolar ridge, supported an overdenture. Posterior-anterior cep-

halometric radiographs and clinical examination showed skeletal Class III malocclusion (Figure 2). At first, it was explained to the patient that these situations normally require orthognathic surgery to reposition the jaws to an ideal relationship. However, the patient refused to undergo surgery. In this case, an implant-supported fixed-detachable prosthesis with MK1 attachments was proposed and accepted by the patient.

Therefore, the placement of 5 maxillary implants (Standard Fixtures 3.75 × 15 mm RP, Conexão Sistemas de Prótese, São Paulo, Brazil) was proposed and carried out. During the 6-month osseointegration period, the canine continued to support the overdenture (Figure 3). Also at this stage, the maxillary prosthesis was rebased with resilient material (Coe-Soft, GC America Inc, Alsip, Ill) in order to prevent overload on the recently placed implants. After the osseointegration period, in the second treatment stage, the canine was extracted for the immediate placement of a tapered implant (Connect AR 3.75 × 15 mm; Conexão Sistemas de Prótese). During the 2-week period of initial healing, healing caps (Perfil 4.5 × 4 mm; Conexão Sistemas de Prótese) were placed and the removable denture was again relined with resilient material to avoid overloading the implants. After 2 weeks, abutments were selected (Micro-Unit abutment, Conexão Sistemas de Prótese), screwed over the implants (Figure 4), and manually torqued to 20 N/cm<sup>2</sup> using a torque wrench (Conexão Sistemas de Prótese). An impression was taken using polyether impression material (Impregum Soft Medium Viscosity, 3M ESPE, Germany) and square transfers (Impression Transfers, Profile 4.5 mm, Conexão Sistemas de Prótese) joined with self-cure acrylic resin (Pattern resin LC, GC America Inc).

The impression was poured with type IV dental stone (Herostone, Vigodent S/A Indústria e Comércio, Rio de Janeiro, Brazil). Intermaxillary records were made, obtaining the vertical dimension of occlusion and centric relation. The casts were mounted on a semiadjustable articulator (Model Mondial 4000; Bio-Art Equipamentos Odontológicos Ltd, São Carlos, Brazil), and artificial teeth were selected and arranged on the record bases. The trial arrangement was checked in the patient's mouth to evaluate the prosthesis for esthetics, phonetics, vertical dimension, and centric relation. The patient also approved the trial arrangement of the teeth.



**FIGURES 1–4.** **FIGURE 1.** The radiographic examination showed presence of the right maxillary canine. **FIGURE 2.** The clinical examination showed that the patient's maxillomandibular relationship displays a Class III tendency. **FIGURE 3.** After a 6-month osseointegration period, the canine continued to support the overdenture. **FIGURE 4.** Abutments screwed over the implants.

The definitive maxillary fixed-detachable overdenture included bilateral attachments from the MK1 system associated with a bar screwed to the osseointegrated implants. The bar was made of titanium alloy (Rematitan Ti 1, Pforzheim, Dentauro, Sande, Germany). Three laser weldings were performed on the infrastructure to minimize potential loss of passivity in relation to the abutments and implants. A perfectly adapted superstructure of titanium was made and fixed to the infrastructure with MK1-type attachments (Figure 5) After that, the acrylic resin teeth were arranged onto the superstructure (Figure 6) and the prosthesis was processed by standard compression molding of heat-cured acrylic.

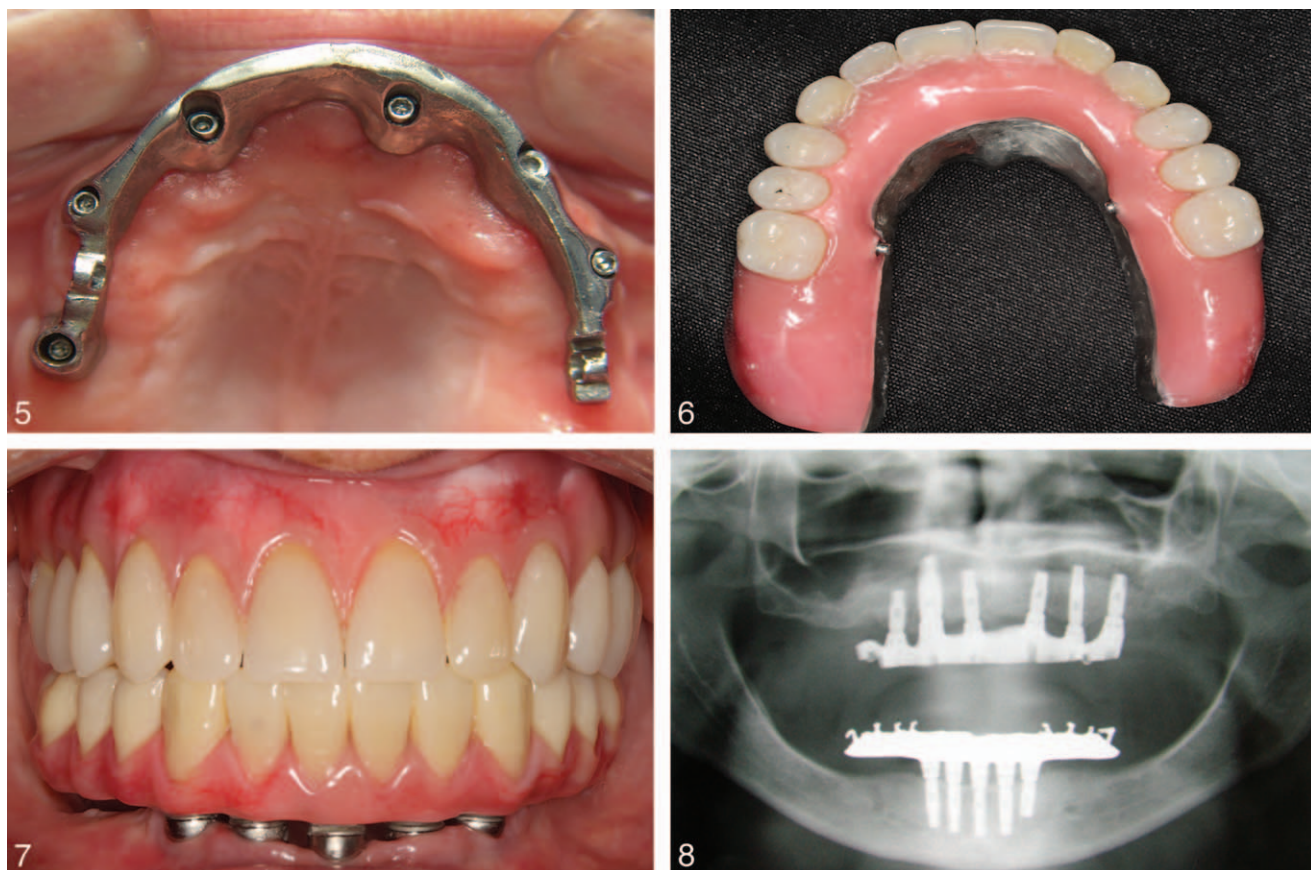
At the time of delivery, the occlusion was refined, and the patient was given the appropriate oral hygiene instructions and informed of the recall and maintenance schedule. At the 1-year recall, the patient reported that the prosthesis was comfortable and easy to maintain. After the 8-year follow-up of the fixed-detachable maxillary prosthesis, clinical and radiographic examination showed that the treatment was successful (Figures 7 and 8).

## DISCUSSION

Prosthetic rehabilitation of patients with skeletal Class III malocclusions poses a challenge in maxillofacial prosthodontics.<sup>13,14</sup> Bone discrepancy may have an unfavorable impact on esthetics, which is frequently aggravated by the presence of accentuated facial asymmetries. This type of malocclusion is usually treated with orthognathic surgery to correct the occlusion and facial esthetics.<sup>15</sup> However, when the patient does not consent to surgery other treatment options should be considered.

Bone characteristics should be evaluated during the diagnostic phase of dental implant therapy. The skeletal Class III malocclusion presented suggests a range of restorative dimensions with associated treatment and prosthesis design considerations. According to Ahuja and Cagna,<sup>16</sup> when the vertical space from the soft tissue crest of the residual ridge to the occlusal plane is between 9 mm and 11 mm, the arch is designated Class III. In these situations, selection of an appropriate overdenture attachment system becomes more critical, particularly at the low end of this dimensional range. The overall height and width of the selected attachment system will affect denture tooth position and the bulk of





**FIGURES 5–8.** **FIGURE 5.** Superstructure of titanium was made and fixed to the infrastructure with MK1-type attachments. **FIGURE 6.** Acrylic resin teeth arranged onto the superstructure. **FIGURE 7.** Front view of the definitive prosthesis installed. **FIGURE 8.** Radiographic examination shows successful treatment after 8-year follow-up of a fixed-detachable maxillary prosthesis.

denture base resin. Most patients with Class III malocclusion may not be candidates for conventional overdenture therapy, but some studies suggest incorporating a metal framework to reinforce or strengthen the overdenture. In the present clinical case, an implant-supported prosthesis (Branemark protocol) should not be recommended, because it would compromise the esthetics due to absence of lip support.

Extreme bone resorption may lead to biomechanical difficulties in distributing the masticatory forces along the long axis of implants, esthetic and phonetic problems, as well as difficulties for the patient in keeping the prosthesis clean.<sup>17</sup> The need to gain biomechanical resistance and support the prosthetic compensation reduces the alternatives and emphasizes the need for an alternative technique to correct the interalveolar incongruences in the edentulous maxilla, by means of a fixed-detachable prosthesis using an attachment system.

Implant-supported overdentures significantly improve the comfort level and masticatory function efficacy in comparison with conventional full prostheses.<sup>18–21</sup> The improvement in masticatory function is a consequence of increased mechanical stability and prosthesis retention.<sup>21</sup> The better performance can also be attributed to greater masticatory forces being exercised after rehabilitation by implant-supported dentures compared with conventional full dentures.<sup>18</sup> Jemt and Stalblad<sup>22</sup> observed that the retention and stability achieved by a muco-supported and implant-retained overdenture provided the patient with a more stable condylar and occlusal position, thereby enhancing masticatory function. Von Wowern et al<sup>23</sup> noted that stimulating and maintaining the process of bone formation prevents maxillary and mandibular osteoporosis and that the continuous resorption occurring after dental extractions can jeopardize the use of broad tissue support for conventional

protheses. This lack of support leads to reduced stability and retention of conventional full dentures.

Bone resorption tends to affect the mandible more than the maxilla, with a lower distribution of forces, as mentioned by Tallgren.<sup>14</sup> Retention and stability are determined by the characteristics and behavior of the prosthesis and its fitting system.<sup>4,17,24,25</sup> The MK1 system (MK1 Dental-Attachment GmbH, Zetel, Germany), developed by Dr Manfred Kipp, includes attachments placed transversally to the alveolar crest and is indicated for uni- or bilateral distal extension protheses, protheses over implants interspersed with natural teeth, and overdentures. Full-arch implant-supported acrylic-based protheses have been used to treat patients who have discrepancies between the jaws and need prosthetic compensation. This compensation is achieved through a superstructure of titanium adapted and fixed on an infrastructure placed over implants. Fixed-detachable protheses offer the dentist and the patient a safe and feasible option for overcoming these challenges.<sup>17</sup> In this clinical report, the decision was made to fabricate a fixed-detachable denture using the MK1 attachment system, which provides all the comfort and assurance of a fixed implant-supported prosthesis, while at the same time allowing the patient to easily handle and clean the prosthesis.

There are few publications about the MK1 attachment system in the scientific literature. In 2001, Zheng et al<sup>26</sup> evaluated the clinical effects of 3 precision attachment systems, including the MK1 system. MK1 attachments were used to restore 22 patients consisting of 17 with Kennedy Class I defects, 3 with Kennedy Class II defects, and 2 with Kennedy Class III defects. The results showed that after 1 year more than 86% of 22 patients were satisfied with the comfort, esthetics, and retention of the prosthesis. The authors found that all 91 abutments were healthy and exhibited no mobility, no periapical pathology, no pain to percussion, and no resorption of alveolar bone.<sup>26</sup>

These satisfactory effects may be explicated because this type of attachment system provides enhanced labial support and minimizes the occurrence of phonetic problems commonly observed with fixed conventional maxillary protheses.<sup>27</sup> Determining the correct implant position and restorative design requires knowledge of prosthetic limitations and patient expectations. For the case in

question, the discrepancies between the jaws were compensated through a superstructure of titanium adapted and fixed on an infrastructure placed over implants. It is important to remember that the dimensions of the superstructure of titanium, the positions of the implants, and the thickness of the acrylic resin are planned before surgery for implant placement. During the demonstration to the patient, a preview of the dental, facial esthetics, and phonetic are analyzed.

The prosthesis described in the present article provided lip support and incising capability. Another advantage of this type of prosthesis is the absence of occlusal access orifices for the retention screws, which in some situations can compromise the occlusion and esthetics.

## CONCLUSION

A fixed-detachable maxillary prosthesis using the MK1 attachment system is a suitable restorative alternative for patients with Class III malocclusions who opt not to undergo orthognathic surgery. The present results show that the major goals set at the beginning of treatment were successfully achieved, providing the patient with adequate masticatory function and pleasant facial esthetics.

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