

# Maxillary Implant-Supported Over-Denture, Role of Attachment Selection on Treatment Success Rate: A Literature Review

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**Objectives** Maxillary implant-supported over-denture is a suitable treatment where conventional denture cannot be used. Few studies are available on maxillary over-denture while more are available on mandibular over-denture with no literature referring to attachment selection in maxillary over-dentures.

The objective of this literature review was to see attachment selection strategies in maxillary over-denture and its effect on success rate several successes contributing factors were noted including survival rate, marginal bone loss, soft tissue problems, fracture, and retention of maxillary over-denture.

**Methods** This review study was conducted on available article discussing maxillary implant over-denture. An online comprehensive search was performed on PubMed, Scopus, ScienceDirect, and Google Scholar is using the following key words “implant supported over-denture” and “attachments” from 2000 to 2016, with total 78 articles being obtained.

**Results** Studies including the attachment selection and maxillary implant over-denture were prioritized. Articles that were not peer reviewed were excluded. In total 78 articles were included for initial evaluation among which, with only 35 articles were judged as related to maxillary Over-denture topic and used for evaluation and report.

**Conclusion** Based on the reviewed articles result, the attachments type has a profound effect on the overall success rate. The number and position of implants and corresponding soft tissue are also influenced by attachment selection.

**Keywords** Implant, Over-denture, Attachment

## Introduction

Maxillary implant-supported over-denture is considered as a desired treatment option in certain situations where conventional denture cannot be retentive enough. There are concerns over to use of implant-supported over-denture in Maxilla. These include narrow ridge, low bone density, facial cantilevers, oblique centric contacts, excessive lateral forces during mandibular excursions, absence of a thick cortical plate, and the presence of natural dentition on the opposite arch.<sup>1</sup> Certain clinical situations may need special types of attachment. It is critically essential for the operators to have sufficient knowledge on various attachment systems, their advantages and disadvantages, indications and contraindications along with the mechanical properties of different attachment systems. Wrong attachment choice may cause failure of the treatment and subsequently dissatisfaction of patient.<sup>1-4</sup>

Misch (2015)<sup>5</sup> divided maxillary implant over-denture into two groups based on the implant number and soft tissue support of RP4 and RP5. A maxillary RP-4 implant over-denture (IOD) usually has more than 6 implants with four to six attachments located around the arch. Multiple header clips could be used when the inter-occlusal space is limited. O-rings should be inserted anterior to the clip. Maxillary IOD must be designed with full palatal coverage and labial flange, similar to the complete denture. RP5 implant comes with tissue supported over-denture with at least 4 implants. Based on the need for resilient prosthesis, Dolder bar without cantilever are advised along with O-rings that are distal to the clips.<sup>5</sup> Few studies have evaluated the maxillary

over-denture compared to higher number of studies on mandibular over-denture.

Based on the current findings and search, there were no indications of the specified role attachment on maxillary over-denture success. The focused of this investigation was on the articles that reported the relationship between attachments and treatment success criteria based on the following known contributing points: the implant survival rate, marginal bone loss, soft tissue problems, fracture and retention of maxillary over-denture.

The objective of this review was to see the role of attachment selection on maxillary over-denture success rate.

## Materials and Methods:

This review study was conducted on available articles discussing maxillary implant over-denture and attachments. An online comprehensive search was performed on the content of PubMed, Scopus, ScienceDirect, and Google Scholar web systems using the following key words: implant, over-denture and attachments, from 2000 to 2016 on the total of 78 accessible articles. Initial screening of titles and abstracts were conducted. Studies were included if they assessed the relation between attachment and treatment success contributing factors such as the implant survival rate, marginal bone loss, soft tissue problems, fracture and retention of maxillary over-denture. The inclusion criteria included peer-reviewed articles published from January 2000 December 2016 in English. Studies including the attachment selection and

maxillary implant over-denture were prioritized. Articles that were not peer reviewed were therefore excluded.

## Results

From the total 78 articles selected only 35 articles were included since those were judged as related to maxillary Over-denture and attachment topic.

The combination results of these studies are listed as follow:

### 1) Attachment system and Implant/prosthetic survival/success rate of maxillary over-denture

Maxillary over-denture is a promising treatment plan in which achieving satisfactory survival rate is considered possible.<sup>4</sup>

Relationship between the implant survival rate and attachment is a concerning point for operators. Misch reported that for 6 and 4 implants with bar attachment, and 4 implants with ball attachment having their success rates between 95-98%.<sup>5</sup> In the other hand, Slot et al concluded that implant survival and over-denture survival rates were between 98%-95% for 6 and 4 implants with bar attachment, and 4 implants with ball attachment.<sup>6</sup>

Raghoobar et al. stated that implant-supported maxillary over-denture of  $\geq 4$  implants with a splinted anchorage had a high implant and over-denture survival rate ( $>95\%$ ), while there could be an increase in risks of implant loss when less than 4 implants are used with a non-splinted anchorage.<sup>7</sup>

Survival rate of implants supporting maxillary over-dentures are less than implants supporting mandibular over-dentures.<sup>8-11</sup>

### 2) Attachment system and marginal bone loss related to maxillary over-denture

Trakas et al found no significant differences between "Ceka and Bar" or "Ball and Bar" attachment in marginal bone loss. It was reported that the direction of load has a more important role on survival than the implant connection with attachments. However, rapid bone loss has been documented in maxillary over-denture with O-ring attachment.<sup>12</sup>

According to Steven et al., for both ball and magnetic attachments, as the diameter of the attachment increases, stress also increases in the cortical bone around the implant. If larger diameter attachments are used, implants with a greater width could help to reduce the stress on the cortical bone. It was also concluded that, the Locator provided the best results in marginal bone loss followed by bar and ball attachments without any failure.<sup>13</sup>

### 3) Attachment system and soft tissue problems related to maxillary over-denture:

Regardless of the type of the attachment system, the most common mucosal complications reported with maxillary implant over-dentures are hyperplasia, irritations, and

denture stomatitis.<sup>14</sup>

Trakas et al reported more plaque accumulation in magnet than ball attachments and less bone loss in ball than bar attachment. However, they found no difference in denture stomatitis and hyperplasia between ball and bar or ball and magnet. Gingival cuff at distal abutment is more prone to mucosa complications in ovoid shape resilient bar as compared with parallel shape bar.<sup>12</sup>

Despite a high incidence of hyperplasia with bar attachment in previous studies, Steven compared cleansing ability and patient satisfaction with bars and solitary anchors and showed no significant difference between the two.<sup>13</sup>

### 4) Abutment screw loosening in maxillary over-denture:

Kiener et al reported abutment screw loosening as being the most frequent mechanical complication related to maxillary implant over-dentures supported by bars. For splinted implant over-denture designs, the failure rate of distal cantilever extension is higher compared to inter-abutment connecting bars.<sup>15, 16</sup>

### 5) Attachment loosening and fracture in maxillary over-denture:

Fracture and loosening of attachment system is the most common prosthetic complication in an over-denture with mandibular and maxillary over-denture. Slot showed that the use of small retentive anchors for the attachment system is often the reason for fracture and loosening in the acrylic resin. Large retentive anchors seem to be less subject to complications with more contact in the acrylic resin. However, it is not always practical due to small inter-implant and restricted inter-occlusal spaces. Reinforcement of implant over-denture bases with chromium alloys will make the denture base more fracture resistant. Attachment of the clips is recommended to the metal reinforcement structure rather than to the acrylic resin. Improved anchorage results in lower fracture and loosening rates of the clips.<sup>17</sup>

Tanoue concluded that the material and number of the clips can directly influence on the stress distribution to maxillary IODs with bar attachment. The greatest stress amount was observed on the resin surface around the end of the clip. The plastic clip may absorb the loading force on the surrounding resin because of its elasticity. Plastic structures would prevent denture base from fractures much better than the metal clips. The use of a maxillary bar-retained 4-IOD without palatal coverage required denture base reinforcements at and around the ends of the clips not the midline.<sup>18</sup>

Widbom et al found that complete palatal coverage reduces the wear of attachments and minimizes the risks of base fracture.<sup>19</sup>

### 6) Retention of maxillary over-denture

Although bar attachment has more reliable results<sup>6, 13</sup>, insufficient inter-implant and inter-arch space is considered

as a problem with bar and clip attachments.<sup>20, 21</sup>

Ball attachment might not have adequate retention in divergent implant axes; however, with a parallel orientation of the implants, the Locator may exceed bar and metal clip retention.<sup>22</sup>

In a laboratory study on an edentulous maxilla with 4 implants, Steven demonstrated that retention of bar overdentures with distal ERA attachments was improved in comparison to cantilevered bars with Hader clips. They also showed magnet as being the least retentive of all attachment systems, but could be appropriate for patients with bruxism or dexterity problems.<sup>13</sup>

John et al found that bars provide more retention than solitary anchors when they are subjected to both vertical and oblique forces. Implant angulation may compromise the retention of solitary anchors.<sup>23</sup>

Chung et al, indicated that parallel orientation of the implants in solitary attachment systems such as the grey ERA and white Locator may match or exceed Hader bar and metal clip retention, which is in the range of 20N of force.<sup>22</sup>

According to Steven there is no differences in patients satisfaction with bars or solitary anchors in maxillary implant overdenture.<sup>15</sup> Al-Zubeidi also confirmed these findings for maxillary 3-implant over-dentures.<sup>24</sup>

## Discussion

Treatment success rate depends on several factors, some of which are objective and some are subjective. There is not enough evidence on exact distinction between repair and re-treatment requirements in literature. The wide range of terminology and category for prosthetic maintenance makes it difficult to define success of maxillary implant overdentures.<sup>25-28</sup>

In this study only articles were selected that included the relationship between attachments and treatment success's contributing factors such as the implant survival rate, marginal bone loss, soft tissue problems, fracture and retention of maxillary over-denture. Because of several factors including: the differences in implant systems, number of implants placed in maxilla, different surgical procedures applied, different attachment systems used, different status of opposing dentition and the amount of supporting soft tissue, it is hard to propose a reliable protocol for maxillary implant over-denture.<sup>29</sup>

Many of the maxillary implant over-denture articles had insufficient data making them unable to be used.<sup>30</sup>

The survival rate of implants supporting maxillary overdentures was less than implants supporting mandibular overdentures that could be related to higher bone quality in mandible. However achieving a satisfactory survival rate of the implants is not impossible in properly designed maxillary over-denture treatment.<sup>8, 9</sup>

There is not much difference in the implant survival rate between ball or bar attachment and there is no significant difference between 4 and 6 implants in the maxillary over-

denture either; however, less than 4 implants is not enough according to the literature.<sup>6, 7</sup>

A splinted design with bar attachment has been considered as more reliable.<sup>6, 14</sup> However, it is not critical to maintain a large space between the implants with less gingivo-occlusal height as an advantage of the non-splinted design.

The use of un splinted attachment has better esthetic and phonetic results for patient in textured surface implant in addition to ease in impression, attachment insertion, enhanced prosthetic durability and repair.<sup>22</sup>

Solitary attachment systems such as Locator white may match or exceed the bar and metal clip retention with a parallel orientation of the implants. Moreover, the Locator offers superior clinical results with respect to oral hygiene parameters and the frequency of prosthodontic maintenance.<sup>23</sup> It also requires less space, enabling the resin base to be thicker in areas of stress.<sup>31</sup>

Other studies confirmed that use of Locator in a maxillary un splinted over-denture has successful treatment outcome.<sup>13, 32, 33</sup>

Locator provided the best results without any failure followed by bar and ball attachments on the subject of marginal bone loss.<sup>13</sup>

Concerning complications associated with denture bearing mucosa, splinted design has more complication than solitary attachments. Ovoid shape bar with resilient joint has also more complications as compared to the rigid parallel shaped bar, because the later causes less movements.<sup>12</sup>

In terms of the fracture, large retentive anchors seem to be less subject to complications when have more contact in acrylic resin.

It is recommended to attach the clips to the metal reinforcement structure and not to the acrylic resin however, plastic clips can better prevent denture base fractures compare to metal clips.<sup>17</sup>

In the other hand, Implant angulations may not compromise the retention of solitary anchors and patients appear to be equally satisfied with bars or solitary anchors retaining a maxillary implant over-denture.<sup>15, 23</sup>

Prosthodontic maintenance requirements of maxillary overdentures are directly influenced by attachment system.<sup>30</sup> Although both splinted and solitary anchorage systems are advocated, maintenance is higher for solitary attachments while inflammation is increased beneath the bars. It looks like attachment system has no effect on general patient satisfaction for mandibular implant overdentures.<sup>34</sup> However well-designed RCTs with larger sample cohorts and longer follow-up periods seems required to amplify patient- and clinician-based outcomes in maxillary over-denture.<sup>35</sup>

## Conclusion

Based on the articles reviewed outcome, attachment type has a profound effect on treatment success contributing factors. Solitary low profile attachments like the Locator is

the best choice in most situations of maxillary implant overdentures especially when angle of the implants is correct.

### Conflict of Interests

None Declared ■

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