ATTACHMENT SYSTEMS FOR IMPLANT OVERDENTURES. LITERATURE REVIEW

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ABSTRACT

Introduction Implant overdentures, as a treatment alternative for complete edentulism, are well known for their many benefits, directly related to attachment systems, the connection elements between overdentures and implants. **Material and methods** A narrative review was conducted on studies reporting data on the attachment systems for implant overdentures, considering aspects as design and biomechanical consequences (e.g., the impact on the balance of the overdenture, the relationship with the implants, technical characteristics for usage, efficiency and complications of different types of anchoring systems). There were included studies reported in the past 10 years. **Results** The choice of attachment systems in implant overdentures must take into consideration results on the long term, related to the retention and the stability of the overdenture, mechanical complications and also selecting criteria concerning the implant number and inclination, prosthetic conditions, the dexterity of the patient in manipulating the overdenture, biological conditions and therapeutic expectations, financial and time resources, and usage technique Most frequent complications of implant overdentures are related to biomechanical aspects of the attachment systems. **Conclusions** Treatment planning for implant overdentures must include selecting criteria for the attachment systems that should be based upon analysing the prosthetic space, implant particularities, advantages, disadvantages and possible complications of each type of attachment system.

Keywords: overdenture, attachment, ball, locator, bar, denture, edentulous

INTRODUCTION

Complete edentulism is a clinical situation typical for the elderly people, defined by the total absence of one's own natural teeth, in one or both arches. While the loss of teeth there are a series of negative effects on the general social, and psychological oral general, social and psychological status, frequently leading to a decrease in the quality of the individual's life, damage of the oral structure and disturbance of oral functioning, decreased ability to chew, compromising facial aesthetic, a negative influence on self perception and diminishing of social interactions (Lee et al. 2004; Emmami et al. 2013).

Till not long ago, the only treatment alternative for complete edentulism was complete denture, which most of the times was unable to meet the expectations of the patients, usually having a poor stability and associating difficulties during mastication.

Once the dental implants have been introduced, new alternatives also appeared for completely edentulous patient i.e, fixed and removable implant prosthesis. Implant based

removable prosthesis for treatment of complete edentulism ensures a much better balance for the denture, and has many advantages such as increased efficiency in chewing and reduction of bone resorption at the level of the residual ridge. Implants overdentures are today prosthetic alternatives considered the first option for treatment of mandibular complete edentulism, as recognized by the McGill and York Consensus (Melescanu Imre M, 2011, British Society, 2009).

Concerning implant overdentures, there are different concepts related to the type of implant used (conventional, narrow, miniimplant), their number, placement or loading, but also as the attachment system used and their impact on the balance of the overdenture (Preoteasa E., 2014). The usual connection systems between implants and overdenture are: bars, metal clips, locator, magnets, and telescopes. The retention force is ensured by a retention system that must be sufficiently as its magnitude, in order to prevent overdenture from moving. Prosthodontist often rely on selecting retention systems empirically, by assuming their retention characteristics, and considering the level of satisfaction of the patients using that system (Kune et al., 2005). The outcome of implant overdentures and complications associated with different attachment systems may provide useful guidelines for the clinician (Daou E. 2013).

Defining an "acceptable" level of retention for a retention system stays elusive (Alsabeeha, 2010), and producers supply limited information concerning retention system power and wearing in time (Pigozzo et al., 2009). For example the minimal retention force expected from one single individual attachment could be of 4N (Chung et al., 2004).

MATERIAL AND METHODS

A narrative review was conducted on studies reporting data on the attachment systems for implant overdentures, considering aspects as design and biomechanical consequences (e.g., the impact on the balance of the overdenture, the relationship with the implants, technical characteristics for usage, efficiency and complications of different types of anchoring systems). There were included studies reported in the past 10 years. The articles have been selected after a critical assessment of the research reported, aspect directly correlated to the validity of the information presented. The impact of the attachment systems on the balance of implant overdenture has been analysed, considering their role in retention, support and stability of the prosthesis, usage method, efficiency and complications for different types of systems.

RESULTS

Retention and stability of implant overdenture

The attachment systems of implant overdenture offer increased retention and stability compared to the conventional complete denture (Klemetti, 2008, Preoteasa, 2012). The degree of retention and stability is directly linked to the type of system used and their number. Also there are systems that can and systems that cannot be activated.

Overdenture support

Overdentures have either only a mucosal support, a mixed support (on both oral structures and dental implants) or an implant support (e.g., some variants of implants overdentures with bars as attachment system, Simon, 2003).

Relationship with implants

The connection between implant and overdenture ensured through the attachment system should decrease the movement of the overdenture, without increasing the tension in the implant. (Tokuhisa, 2003, Chung et al.,

2004). Gulizio et al. noticed a reduction of the retention force of the attachments when the angulation of the implants has been increased from 0 to 30 degrees (Gulizio et al., 2005). The increase of the angle between implants reduces therefore the longevity of retention (Al-Ghafli et al., 2009), by a premature wearing off of the components, leading to the need for further maintenance procedures (Ortegon et al., 2009).

Technical usage characteristics

Attachment systems for implant overdenture are relatively easy to use, by a direct technique (realized entirely by the dentist in his office) or indirect technique (when they imply more steps in the dental laboratory). Currently numerous direct and indirect systems are available (Alsabeeha, 2009, Paulo Maló, 2009). Direct fixation of the prosthetic part of the attachment system, in the dental office, varies according to implant design, i.e. one- or two-piece implant. The most frequently used attachment systems are O-ring type, but also other alternatives are encountered, such as Locator, magnets, telescopes (especially double conical crowns, which are less rigid). O-ring attachment system is used for both one- and two-piece narrow and mini dental implants.

Efficiency of different anchoring systems

The efficiency of metal caps, spheroflex ball and hader bar are well documented and largely utilized, having both advantages and disadvantages. (Büttel and Marinello, 2009). Some types of attachments are produced without demonstrating the capacity for long term maintenance or repairing, and they are described as in vivo failures (Bayer et al., 2007).

In 2001, Zest Ancore (Escondido, CA, SUA) introduced the Locator attachment, offering a better design and combining the strengths of spheroflex balls, ERA (Sterngold), with matrices attachments. The Locator device uses a dual approach for retention and different retention values (Evtimovska et al., 2009). It is considered like a universal elastic articulation, recommended in cases with decreased vertical prosthetic space, and helps correct angles between implants up to 40 degrees (Nguyen et al., 2010).

The retention value of the locator attachment is available in many forms, using a colour code of the Locator abutment (the replaceable nylon insertion) (Evtimovska et al., 2009). Despite using them on a large scale internationally, there is limited data about the in vitro retention force of this type of attachment system. The resistance of the transversal section of the Locator attachment is derived from its double retention (inner and outer) (Rutkunas et al., 2007).

The attachment uses retention caused both mechanically and by friction because the nylon insertion is slightly oversized in relation to the outer ring of the Locator (Alsabeeha et al., 2010).

However, after 5,000 insertion-separation cycles, locator attachments showed better retentive properties than ball attachments (Türk PE, 2014).

Complications

Biomechanical or technical complications of the overdentures or attachment system used can be encountered, such as overdenture fracture, retention loss, aging of the material, teeth wear and attachment system loosening, loss or damage. Technical complications include the mechanical deterioration of the implant (fracturing) or of the prosthetic components (or the anchoring system, Andreiotelli, 2010). The loss of overdenture retention and overdenture adjustments have been the most frequent type of reported complications (30%) (Goodacre et al., 2013).

DISCUSSIONS

Regardless the attachment system is used, selecting and adjusting them through

placement in the overdenture base, is the most frequently encountered mechanical issue in implant overdentures that are linked to the encountered complications (Watson and al., 1997) have studied the tendencies in the incidence rates of complications from the raw data coming from original studies in the scientific literature. Although these types of attachments seem to function pretty well, there are extremely few long term clinical evaluations of their performance (Kune et al., 2005, Visser et al., 2006, Kleis et al., 2010).

In regard to implant overdenture, initially the clinical studies have focused on the survival of the implants, but recent studies have also taken into consideration the maintenance of the overdenture (for example its capacity to adapt and be repaired) and compared several retention systems using this criteria (Meijer et al., 2004). Alongside the aspects concerning durability of the retention of attachments (Sadowsky, 2001), technical aspects are presently also taken into consideration as criteria for choosing an appropriate attachment system (Büttel and Marinello, 2009).

When selecting an attachment system the dentist must take into consideration the long term results (Daou E., 2013, Andreiotelli, 2010).

The **selection criteria for the attachment system** are the following:

1. **The number, the position and the angulation of the implants**. There can be used a minimum of two implants, unsplinted or splinted by bar. Thus, their number depends on the prosthetic factors, but also on the number of implants that must be inserted (Marzola R, 2007). The choice of the attachment systems must take into consideration also the inclination of implants, ball attachments imposing a divergence of maximum 30 degree, and locator allowing up to 20 degree divergence on each implant, meaning a divergence of the long axis of implants of up to 40 degree.

2. **The prosthetic features**: the vertical prosthetic space, the resilience of the oral mucosa, occlusal loading, the overdenture retention and stability requirements analysed in conjunction with patient's anatomical and functional particularities.

3. **The manual dexterity** of the patient influences his ability to properly manipulate the overdenture, as its insertion and removal. In patients with decreased manual dexterity, relatively frequently encountered in elderly, it is more appropriate to chose a less retentive attachment system.

4. **Biological conditions and therapeutic expectations**. Splinting the dental implants by choosing bar as attachment system provides a more uniform distribution of occlusal forces, but has the disadvantage of higher costs for addressing the complications – loss of one implant may be accompanied by the need of replacement of the entire bar system and also the prosthesis.

5. **Financial and time resources of the patient**. The cost of fabrication of the bar attachments in contrast to stud abutments will be much higher in most instances. Treatment options should never solely be based on finances. (Gotfredsen K, 2000).

Choosing the attachment systems for the implant overdentures must take into consideration long term results concerning retention, stability, mechanical complications, and selection criteria related to the number, inclination of implants, prosthodontic conditions, the dexterity of the patient, biological conditions, and therapeutic expectations, financial and time resources of the patients, overall costs and usage technique.

CONCLUSIONS

More clinical studies, preferably randomized control trials, are needed in order establish clinical outcome of implant

overdenture, comparatively through usage of different attachment systems. Considering the appropriateness of this treatment solution for the complete edentulism, a medical condition with relative increased prevalence in the elderly, a growing segment in the population, it should be well known, as predicted to have an increased use in the future.

Knowledge of the long term treatment outcome of implant overdentures, including its complications, comparatively in regard to the type of the attachment system, used can offer useful information for the dental practitioner. Treatment planning for implant overdentures must include selecting criteria for the attachment systems that should be based upon analysing the prosthetic space, implant particularities, advantages, disadvantages and possible complications of each type of attachment system.

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