

Study of Complications Associated with Placement of Overdentures on Implants

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Abstract

Purpose

The aim of this study was to compare the complications and the need for maintenance in different kinds of attachment systems for overdentures supported by implants.

Materials and Methods

A questionnaire was administered using yes/no and multiple-choice questions. Two systems were evaluated: splinted or non-splinted attachments of overdentures used for 2 years or more. The sample was collected in 3 clinics in northern Portugal and included 114 overdentures. The results were statistically analysed using SPSS®.

Results

The results revealed that there was no significant difference in the number of consults for maintenance between systems. Both systems need continuous re-valuation consultations. The loss of retention appears to be the most frequent complication regardless of the type of attachment; on the splinted attachments, it is represented by the Teflon retention loss, and on the non-splinted attachments, it is represented by the loss of retention of the clips.

Conclusion

The choice of splinted or non-splinted attachments should be made based on the experience of the clinician, and patients must be aware of the continuity of treatment.

Introduction

Given demographic changes, especially the trend of population ageing, there is a demand for solutions that offer a higher quality of life to the elderly [1]. Edentulism is considered to be a poor health outcome and compromises the quality of life of the individual as it is classified as a chronic, serious and irreversible disease [2,3].

The use of dental implants in oral rehabilitations of partially or fully edentulous patients has become a well-established practice, is accepted clinically as a predictable and successful method in the long run and is described as an asset in terms of patient satisfaction, comfort and quality of life [1-6].

There are several ways to rehabilitate edentulous jaws. These strategies include: muco-supported, implant-muco-supported and implant-supported removable prostheses [7].

Treatment options based on simplicity and lower costs can lead to viable alternatives to bone grafts. Overdentures may thus broaden the indications for oral implantology to include patients who otherwise can only receive removable prostheses [8].

Several studies have reported the benefits of an overdenture versus a conventional removable dental prosthesis: better prosthetic retention, improved masticatory capacity and significant improvement in the individual's quality of life [9-11]. The clinical comfort achieved is dependent on many factors, including the degree of retention provided by the location and orientation of the implants, the use and adjustment of the prosthetic component and correct prosthesis confection.

In recent years, several attachment systems have been used successfully. However, opinions differ as to the need to splint the implants. All the available connection systems are designed to prevent vertical movement of the prosthesis and can be used as an isolated attachment mounted directly to the implant head or attached to a bar system. The choice of connection is dependent on the required retention, maxillary morphology, mucosal anatomy, oral function and patient compliance for maintenance [2,12].

The components of this connection must be resistant to large occlusal forces because they are subjected to great stress and wear and are responsible for the reconstruction of a total arc. Thus, if the retentive forces are

reduced, the replacement of these same components should be simple and easy. This situation leads one to consider the type of maintenance in both jaws, depending on the attachment system used and the number of implants that support the overbite [13].

This maintenance must be calculated in advance by the dentist, and possible complications should be explained to the patient.

Complications associated with the placement of overdentures on implants lead to an increase of the rates of repair and therefore affect patients in terms of time, costs and even in relation to their quality of life [14].

There are several studies in the area; however, this study intends to evaluate the need for maintenance of overdentures in a national population, more specifically, in the northern part of the country (Porto, Gandra, Fafe).

Materials and Methods

In this study, a questionnaire was administered (Figure 1). The sample was collected in 3 clinics in northern Portugal. The questionnaire given to the patients was validated and approved by the University Institute of Health Sciences Bioethics Committee.

The figure displays two pages of a questionnaire. The left page is an informed consent form in Portuguese, signed by Leticia Sousa. The right page is the questionnaire itself, titled 'Study of Complications Associated with Placement of Overdentures on Implants'. It includes several tables for data collection:

- Table 1: Implant**

Implant	Loss	Fracture
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- Table 2: Connection**

Connection	Attachment screw loose	Attachment Fracture	Fracture screw
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- Table 3: Prosthesis**

Prosthesis	Acrylic Fracture	Tooth Fracture	Resin overdenture	Prosthesis slants
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- Table 4: Non Applied**

Non Applied	Screw loose	Shank Failure
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- Table 5: Splinted**

Splinted	Bar Fracture	Distal condenser Fracture	Retention clip loosening	Clip fracture
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Figure 1: Informed consent form and questionnaire given to patients.

A declaration/consent form for the collection of data for research purposes was delivered to each clinic. The clinics were advised that the participants would not be identified at any time and that the collected data would remain confidential. It was also explained that the normal functioning of each institution would not be affected.

The total sample was 114 overdentures comprising both dental arcades.

The following criteria were defined for the selection of participants:

- Inclusion criteria (patients ≥ 18 years; both genders, having one or two overdentures; patients who have a regular maintenance history; patients who were in dental treatment but had at least one complete overdenture for more than 2 years).
- Exclusion criteria (Patients <18 years; patients with removable or fixed dentures in both jaws; patients with overdentures for less than 2 years; patients who did not attend follow-up consultations).
- A questionnaire was applied to the sample by the investigator.
- The data were analysed using IBM® SPSS® statistics software (version 23). Given the nature of the variables under study, the analysis comprised quantitative and qualitative descriptive statistical analysis using chi-square, mean and standard deviation.

Results

Considering gender, we observed that in a sample of 114 overdentures, there is a predominance of 64 female patients compared to 50 male patients (56.1% vs. 43.9%, respectively). (Figure 2)

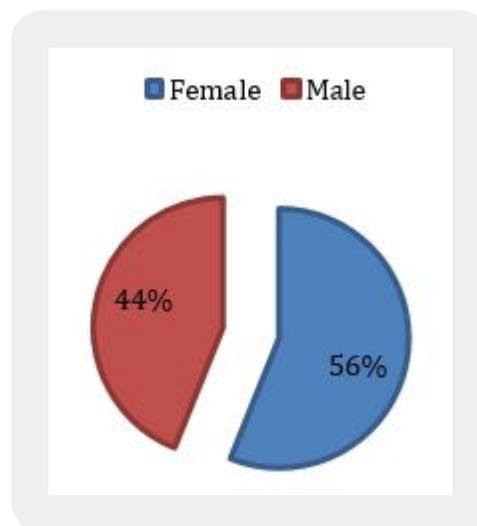


Figure 2: Percent of male and female patients included in the questionnaire.

Regarding age, the group with the highest sampling was predominantly between 50-69 years; the younger age groups (30-49 years) only accounted for 11.4% of the sample, and the older ones 28.1%. (Figure 3)

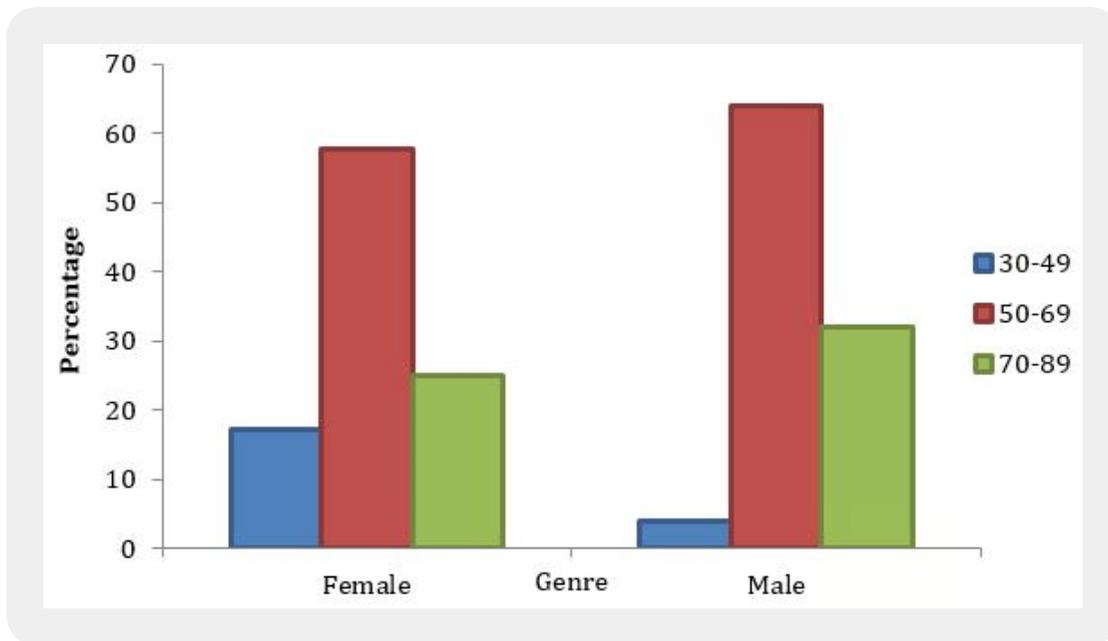


Figure 3: Age groups with corresponding percentages of patients with overdentures

The location of the overdenture was mostly on the lower jaw, (69) corresponding to 60.5% of the sample; overdentures were placed on the upper jaw (45) in 39.5% of the sample. (Figure 4)

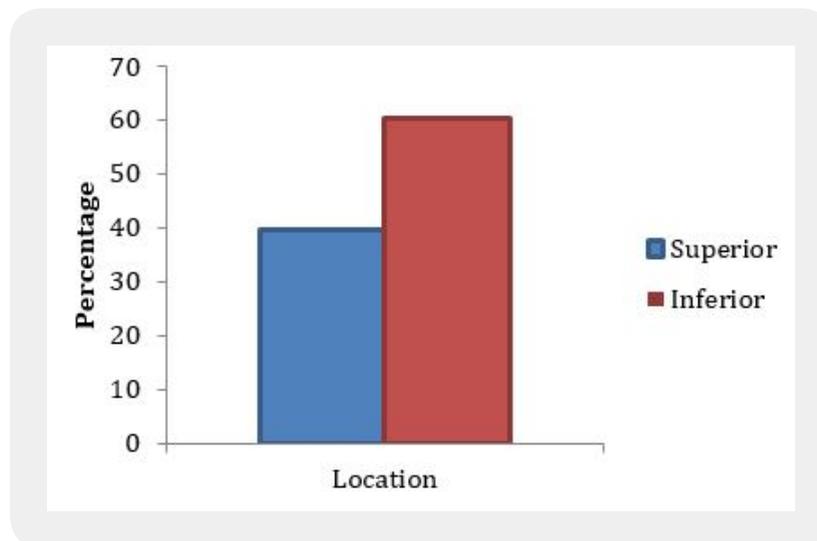


Figure 4: Location of the overdenture on the jaw.

As for the antagonist arch of the overdenture, 45 individuals (39.5%) used a partial removable prosthesis, and 37 (32.5%) used an implant system. The remaining 32 (28%) were distributed among the remaining categories. (Figure 5)

- 10 patients presented a complete antagonist arch with natural teeth (8.8%)
- 6 patients had partial fixed prostheses (5.3%)
- 8 patients did not present any type of prosthesis (7.0%)
- 7 patients presented total removable prosthesis (6.1%)
- 1 patient had a total fixed prosthesis (0.9%)

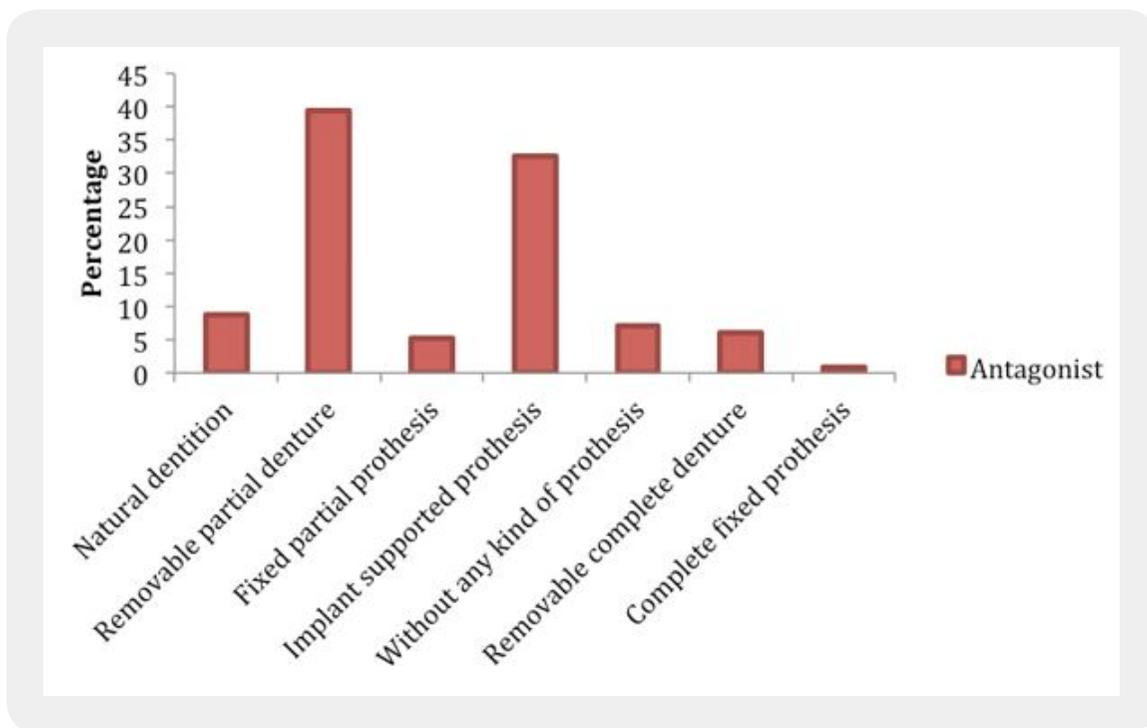


Figure 5: *Antagonists of the overdenture*

Two groups of attachment systems, splinted or non-splinted, were analysed. The results showed a predominance of the splinted systems with 79 overdentures (69.3%), and non-splinted were represented by 35 overdentures (30.7%). (Figure 6)

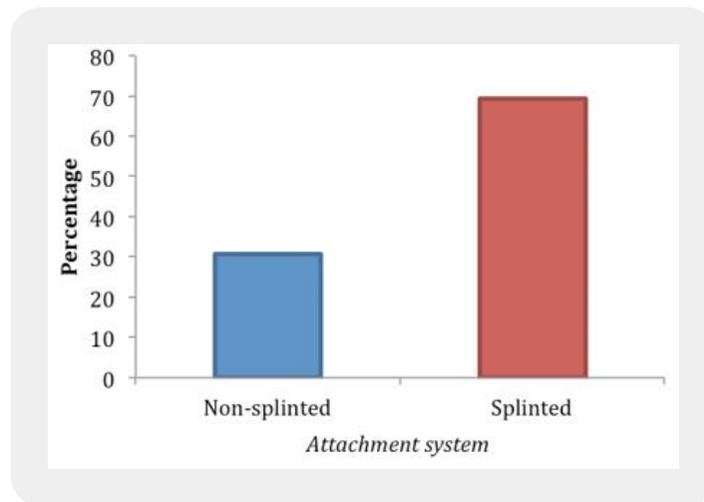


Figure 6: *Percentage of splinted and unsplinted overdentures analysed.*

Data were collected on the number of implants that supported the prostheses in the different overdenture systems. The sample comprised 73 overdentures supported by 2 implants (64.0%), 33 supported by 3 implants (28.9%) and only 8 supported by 4 implants (7.0%). Regarding the location, the predominance was 2 implants in the lower jaw (91.3%) and 3 implants in the maxilla (62.2%). (Figure 7)

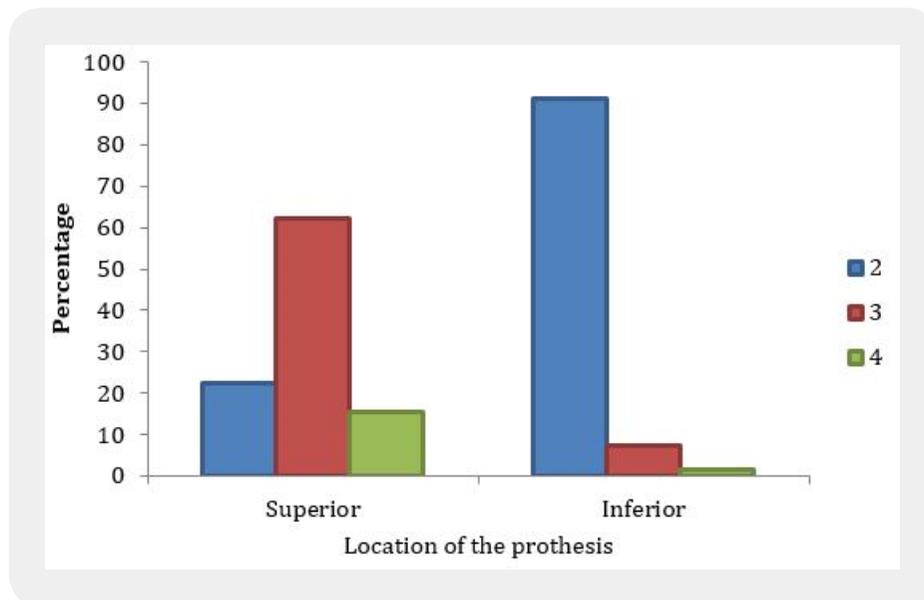


Figure 7: *Number of implants vs. the location of the overdenture.*

The complications occurred mainly in the first period (from 1 to 6 months) in 82 cases (71.9%), and the remaining 32 cases were divided into 6 to 12 months (12.3%), 1 to 2 years (7.0%) and more than 2 years (8.8%). (Figure 8)

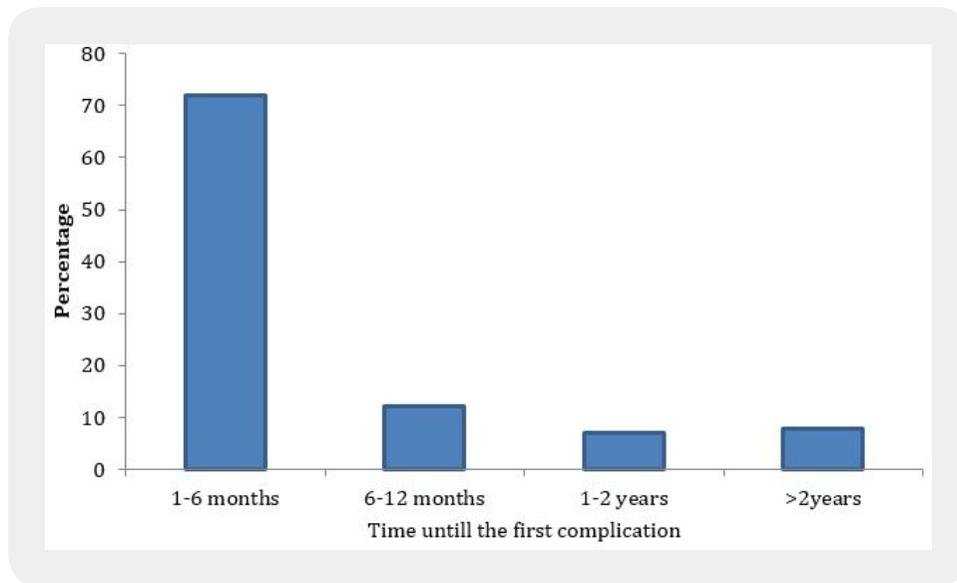


Figure 8: Time until the first complication.

We created categories for time and number of implants to evaluate the variable of time through the chi-square test. The results obtained in this sample seem to indicate a longer time to the first complication when 2 implants are used compared to when 3 or 4 implants are used. (Figure 9)

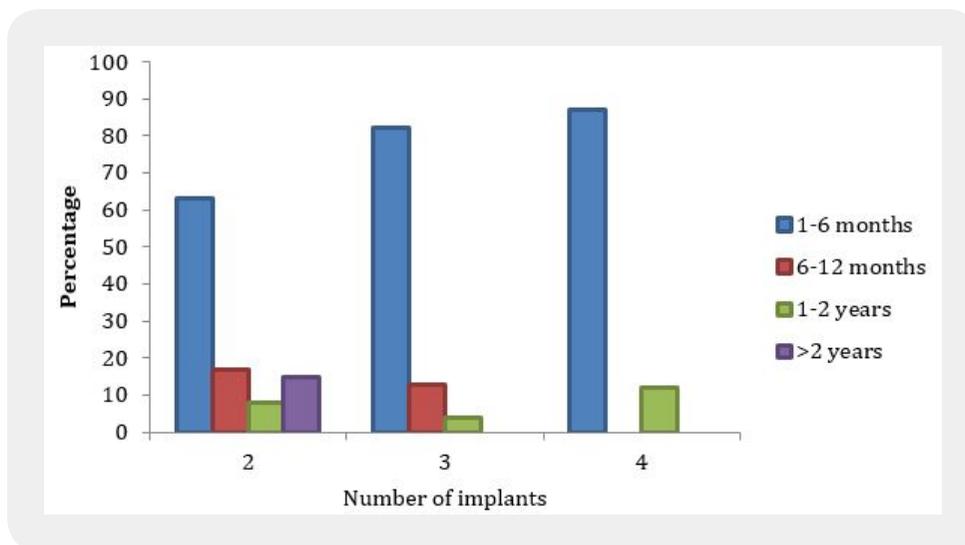


Figure 9: Complications associated with different numbers of implants.

The results obtained in this sample seem to indicate that the first complication occurs later when the implant-supported prosthesis is located in the lower jaw than when it is in the upper jaw. (Figure 10)

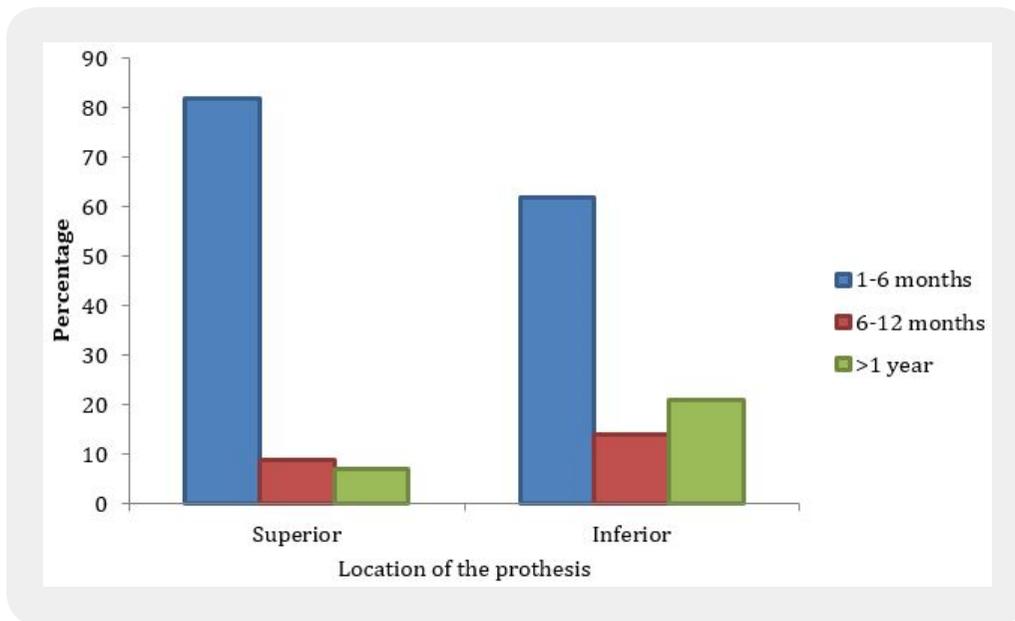


Figure 10: Complications associated with different locations of the prostheses

The results obtained in this sample seem to indicate that the time elapsed until the first complication is greater when a unit type attachment system is used than when a rod is used. (Figure 11)

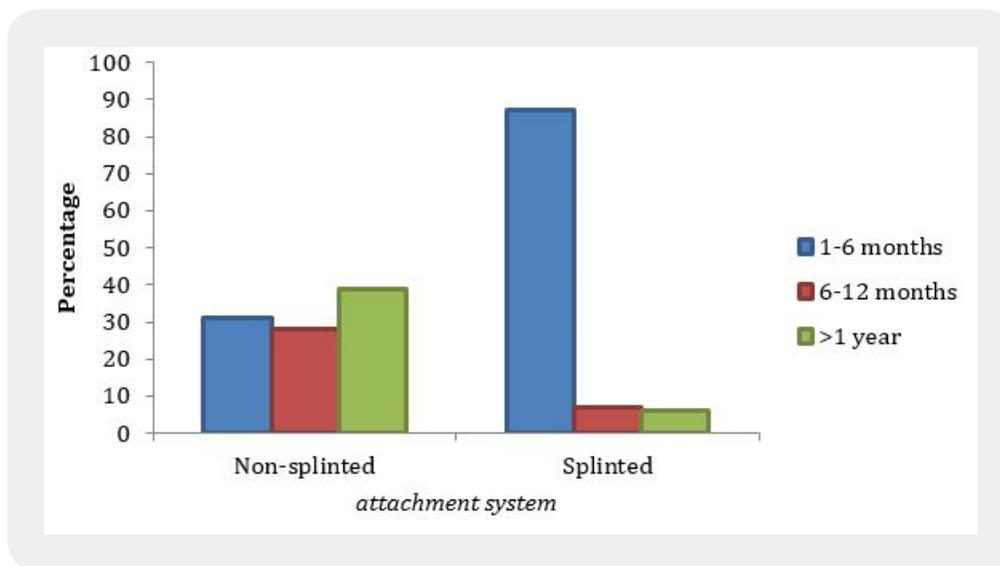


Figure 11: Complications associated with different types of attachment

Regarding the specifications of complications, 78 overdentures (68.4%) of the sample had some complications associated with the prosthetic system, and the remaining 36 overdentures evaluated (33.6%) had complications associated with the implants, type of connection or attachment systems. (Figure 12)

Complications associated with the implant: 7 overdentures (6.1%)

Complications associated with the connection: 1 overdenture (0.9%)

Complications associated with the prosthesis: 78 overdentures (68.4%)

Complications associated with the unitary attachment system: 12 overdentures (10.5%)

Complications associated with the bar attachment system: 16 overdentures (14%)

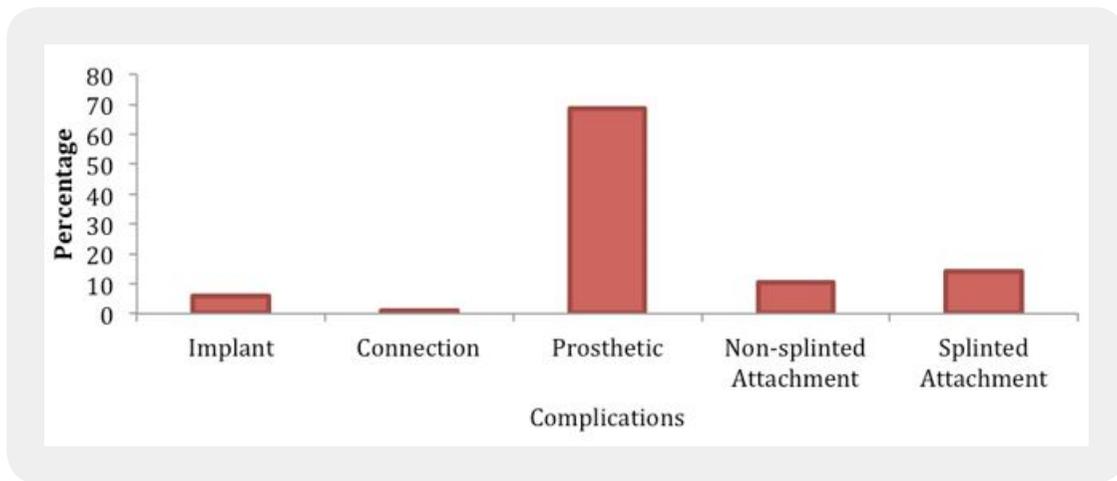


Figure 12: Different kinds of complications.

With regard to overdentures that suffered some type of complication associated with the implants, 7 were considered implant loss (6.1%), and none were derived from implant fracture. (Figure 13)

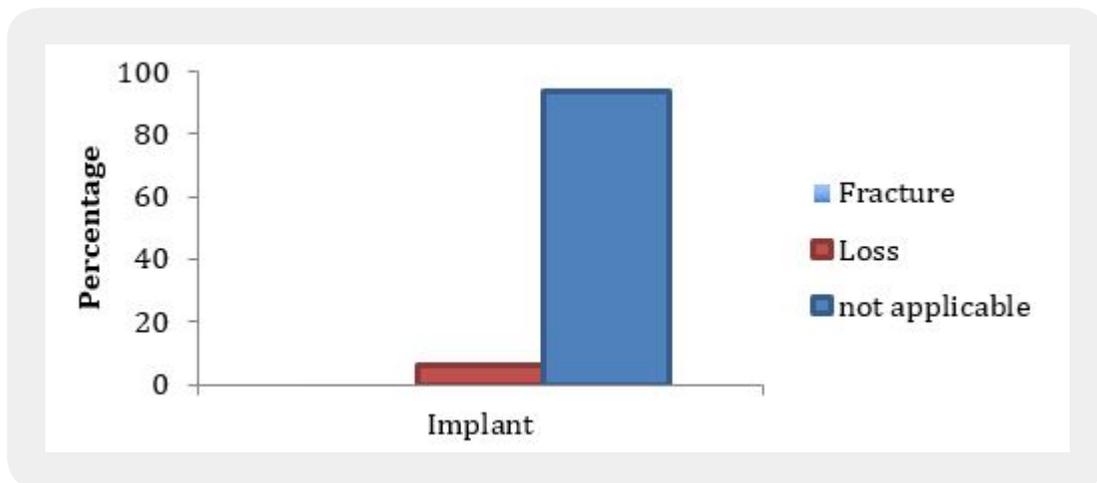


Figure 13: Complications associated with implants

The complications with connections showed only 1 positive result (0.9%) regarding the fracture of the abutment. (Figure 14)

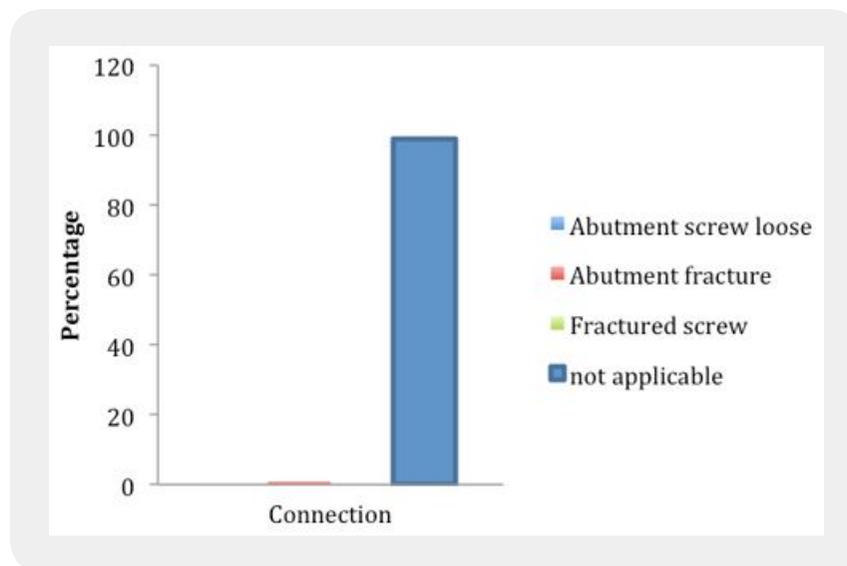


Figure 14: Complications associated with the connective pieces

As for prosthetic complications, the most frequent complications were pressure ulcers in 57 cases (50%), the need for overflow in 16 cases (14%), fracture of the acrylic in 4 cases (3.5%) and fracture of the teeth in one case (0.9%). (Figure 15)

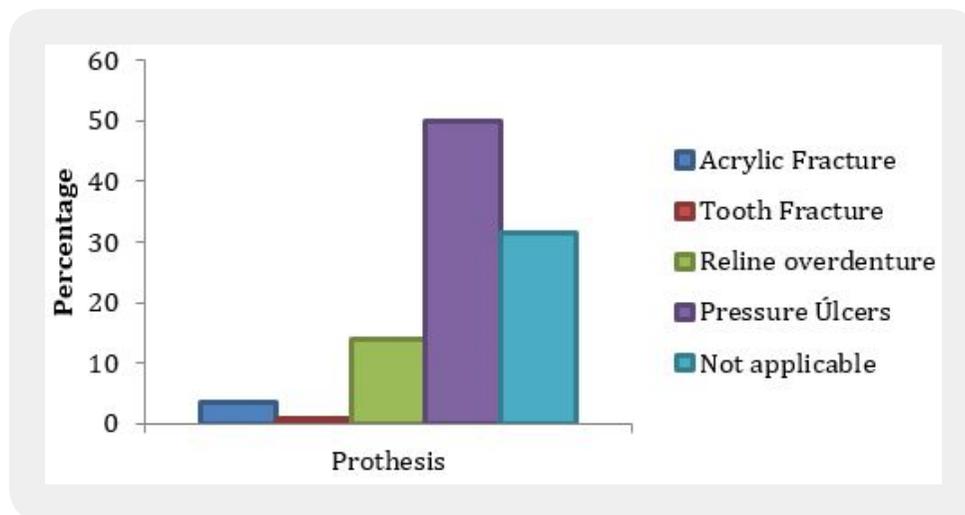


Figure 15: Complications associated with the prosthesis

In the overdentures with non-splinted attachment systems, the most common complication (12 cases) was the loss of Teflon retention, representing 10.5% of these complications. (Figure 16)

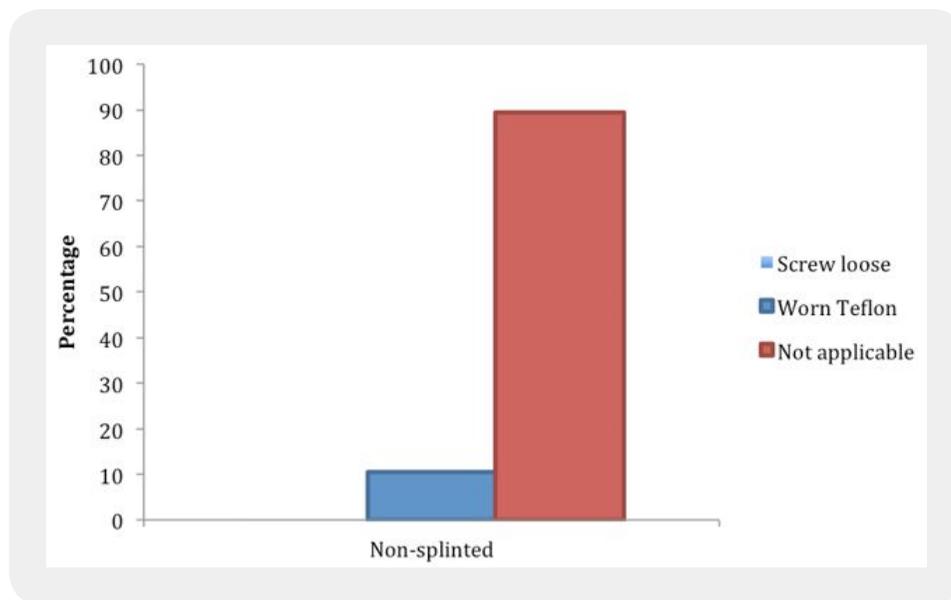


Figure 16: *Complications associated with non-splinted attachment*

The greatest complication associated with bar attachment was loss of retention of the clips in 13 overdentures (11.4%), followed by fracture of the clips in 3 overdentures (2.6%). (Figure 17)

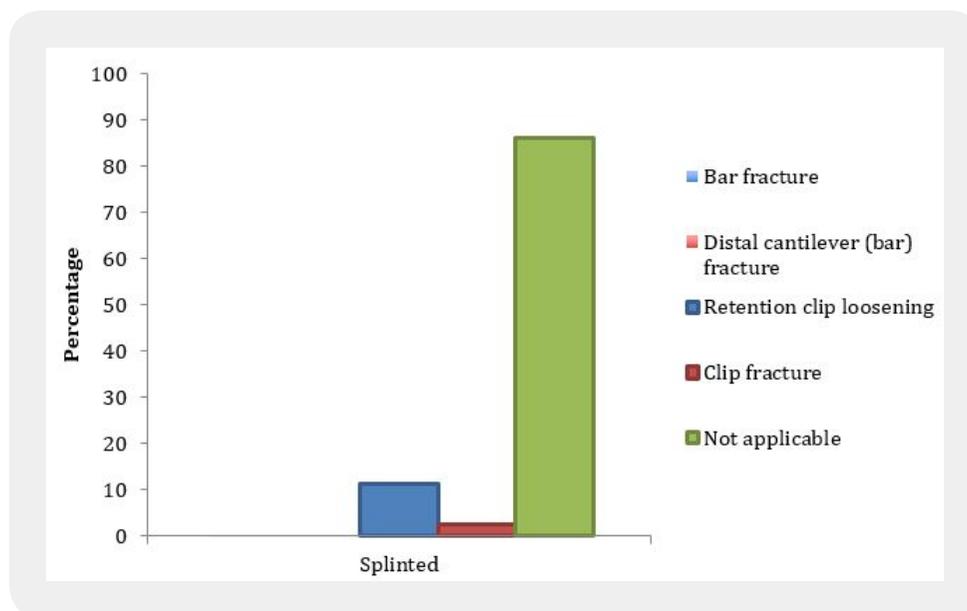


Figure 17: *Complications associated with splinted attachments*

Discussion

The first complication usually appears within the first 6 months and tends to be a minor complication, such as prosthetic trauma, as seen in 71.9% of the sample. In this study, it appears that most subjects with overdentures require prosthetic maintenance within 1 year.

These results are in agreement with those of previous studies, such as that of Bilhan [15] who states that prosthetic maintenance is a requirement during the first year.

There is scientific evidence that the implant survival rate is lower and the frequency of prosthetic complications is higher for maxillary implant-supported overdentures, according to the Andreiotelli study [9].

Regarding the issue of time, Kiener [10] reports that complications tend to decrease with time.

The most frequently described complications have been reported in several studies in the area, such as those of Dudic [16], Kiener [10], Uludag [17] and Chen, [7] who described the complications associated with the prosthesis as being the most common and divided them into mechanical and structural defects of the prosthesis and prosthetic adjustments.

Most studies report no large differences in implant survival rates or the occurrence of peri-implantitis between the two anchoring systems [13]; the most frequent complication in our study was implant loss with no osseointegration (6.1%).

However, a study by Bergendal *et al.* [18] highlights the contrast between the results of the treatment of maxillary overdentures and those of the mandible. The cumulative survival rate of the maxillary implant was 75% after 6 years, with the last implant loss occurring 4 years after placement of the prosthesis. The losses were similar between the two retention systems.

Osman *et al.* [19] suggested the use of zirconia implants to evaluate differences in the maintenance of overdentures supported on these implants and on titanium implants; however, they concluded that among these surface materials, there is no statistically significant difference in the need for maintenance.

In a 2016 retrospective study from University of Illinois at Chicago [20], it was concluded that all 74 implants placed between 2004 and 2012 in this case study maintained osseointegration and continued to successfully support overdentures.

Villa *et al.* [21] conducted a follow-up study with bars after 5 years, with a 96.65% implant survival rate.

Moreover, Karbach *et al.* [22] have reported a success rate of 98.3% in overdentures with unitary systems.

Peri-implantitis is sometimes the cause of implant loss and is mostly associated with hygiene difficulties, but it is also known that the material can be a causal factor. Ayna *et al.* [23] reported that acrylic dentures have a higher surface roughness and a greater affinity for biofilm formation, with a consequent increase in periodontal or peri-implant soft tissue exudation and subsequent bone resorption.

Krishnaraj *et al.* [4], critically, reported that the wrong angulation, improper location of the implant (too close or too distant) and lack of communication are due to poor treatment planning. Problems during the procedure lead to poor stability, mechanical complications, mandibular fractures and ingestion/aspiration.

The complications associated with the type of connection in this study are few in number, showing only the occurrence of pillar fracture.

One study [24] has shown that a loosening fracture of the screw itself or the retentive element or an enlargement of the retentive clips may also occur. As a result, the most frequent change in these cases would be a prosthesis with unitary abutments for splinting and not vice versa.

In an observational study, at 3 months after insertion of the prosthesis, no difference was observed in the retentive forces between all the connection systems [6]. These results are in agreement with the results of the current study, where a pillar fracture of the prosthesis was reported in only one case. These results shows that the need for maintenance is higher when facing biological processes rather than by the physical connection.

Complications associated with the prosthesis in our study were mainly pressure ulcers (50%), overflow (14%) and fracture (3.5% of the pliable area and 0.9% of teeth).

In the study by Ekfeldt *et al.* [8], the most common soft tissue reaction was mucosal hyperplasia adjacent to the bar, which occurred in 25% of the overdentures.

Naert [25] reported that gingival complications occur in different ways in each system; they appear as mucositis in the bars and as decubitus ulcers in the unitary systems.

Merlinse-Stern [26] reported that implants that support overdentures in elderly patients can be maintained with healthy peri-implant tissues for over 5 years, regardless of the presence or absence of keratinized mucosa.

Adreiotelli [9] reported that in addition to implant fracture, fracture of the prosthesis or failure or wear of the acrylic resin may occur. These complications are observed when the applied loads exceed the proportional limit of the material or the resistance to fracture.

Dhillon *et al.* [27] reported that fractures of the prosthesis can be prevented through an inner reinforcement of the metal.

The complications associated with unitary abutments are divided in the literature as the unscrewing of the male element or the loss of retention of the Teflon (female) element [19].

In this study, the most frequent complication associated with the unitary attachment was the loss of Teflon retention (10.5%).

Alvarez-Arenal [28] reported that unitary systems, despite their extended use, are not free from mechanical complications associated with screw loosening and premature switching of the connection systems due to the loss of retention.

The prosthesis survival rate of 100% and a minimum of prosthetic complications were recorded in the present case, with the most frequent incident being the replacement of the males in the Annex ERA (50%), in accordance with the literature. Effective oral hygiene and adequate distance between the bar and the oral mucosa are essential for the prevention of mucosal hyperplasia [29].

Aroso *et al.*, [30] when studying the effect of the angulation of the unit attachments on the retention and durability of different systems, concluded that greater angulation of the abutment influenced the retention capacity of the appendages and that a fatigue test simulating 5 years of insertion and removal of dental prostheses did not produce wear on the metallic abutments (male portion).

The unit ball system in the study by Naert *et al.* [11] showed the best results when compared with magnets and bars because, at the end of 10 years, it had the greatest vertical retention capacity and lower inductive capacity of hyperplasias, and the only maintenance was the replacement of the connective elements.

The bar-type attachment is described as a suitable option for the rehabilitation of edentulous jaws. These restorations, as proven by Rinke *et al.* [31] may show high survival rates of the implant and of the prosthesis itself (>97%) and a limited incidence of technical complications after a mean observation period of > 7 years.

In the present study, only 14% of the sample of 16 overdentures presented complications associated with the bar attachment. The loss of retention of the clips was shown to be the most frequent complication. This loss is a calculable and inevitable consequence.

Several studies in the area corroborate these results, such as that of de Silva *et al.* [32] in which the influence of pH on retention and durability in the bar-type fitting systems was studied. They first concluded that all bar systems of both groups lose retention over time. They also found that a more acidic pH value (pH 4) negatively influences the insertion and removal forces of all the components.

Regarding the distal cantilever fracture, in our study, none were reported. This result was similar to that of Chen *et al.*, [7] who reported few complications associated with the distal cantilever. Moreover, studies such as that of Dunnen *et al.* [33] have reported that if a posterior cantilever is needed, the substructures should be reinforced, although they did not observe positive results regarding complications in their study.

In the study by Hemmings [34], the assertion is made that screw loosening leads to the repair of bars and clips for overdentures. Additionally, this problem seems to be accentuated when overdentures are in the maxilla.

Naert *et al.* [25] reported that the bar system has a higher level of retention; however, the unitary systems have greater long-term stability.

In the study by Van Kampen *et al.* [6], the bar system showed no need for post-insertion maintenance over a period of 3 months.

This study elucidates the clinical continuity of the need for treatment, which is predictable maintenance after the placement of overdentures. It is evident that the clinical use of overdenture is corroborated by clinical

research, where the success rate is quite high; however, post-placement appointments are also important because they influence the expense and the time spent by the dentist and the patient, as well as the degree of satisfaction with the work performed [35-41].

The systems described have different modes of execution and planning, which require the clinician to have an in-depth experience of the systems [35-41].

The study also shows, unequivocally, that despite frequent maintenance, the use of an overdenture greatly improves the quality of life of the patient, influencing masticatory, phonetic and aesthetic capacities.

The present study demonstrates some limitations regarding the method of obtaining data: there was a need to depend on third parties, which relied not only on good data analysis but also on good organizational and patient processes. Maintenance appointments are sometimes quick treatments where registration may be neglected.

The time for data collection was limited and did not allow the collection of a larger sample, which would permit the reporting of statistically significant data.

It would be interesting to use uniform questionnaires to make the study comparable in all parameters to others previously performed.

Dental medicine, as a science that aims to improve the quality of life of patients, edentulous or not, is constantly evolving, creating problems such as the need for evidence-based answers for the clinician to offer the best treatment for the patient in question.

Studies are needed to establish protocols to inform clinicians, identify a range of treatment options, predict expenses, indicate the raw material for each case, and detail the most current guidelines. In this way, the cost analysis, which weighs heavily on the decisions of both the clinician and the patient, will also be facilitated.

Conclusions

Within the limitations of this study, the conclusions based on the results obtained where the maintenance of overdentures with unit attachment systems were evaluated with respect to the type of bar attachment systems are the following:

1. There is a constant need to maintain overdentures once they are loaded.
2. Although overdentures are associated with older patients, there is a significant demand from younger patients (30-49 years).
3. The location of the implant-supported prostheses is mostly in the lower jaw.
4. There is a tendency for placement of a greater number of implants depending on the jaw in question.
5. The success rate of osseointegration was shown to be quite high.
6. The most frequent complication is related to prosthetic trauma and pressure ulcers.

7. The loss of retention appears to be the most frequent complication when the type of attachment is characterized: in the unitary attachment, it is represented by Teflon retention loss; in the bar attachment, it is represented by the loss of retention of the clips.
8. There seems to be a relationship between the need for maintenance and the location of the overdenture: superior overdentures have a need for more frequent maintenance than inferior overdentures, and there is a statistically significant association between these two variables ($p = 0.044 < 0.05$).
9. The time elapsed until the first complication is greater when a unit-type attachment system is used than when a rod is used. Whether the time to the first complication is generally dependent on the type of attachment system used was assessed, and it was concluded that there is a statistically significant association between these two variables ($p = 0.000$).

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