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Ten-year clinical outcome of single implant-retained mandibular overdentures—A prospective pilot study

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ABSTRACT

Objectives: The aim of this prospective pilot study was to evaluate the concept of one single implant placed in the edentulous mandible to retain a complete denture with regard to implant survival and prosthodontic maintenance over an observation period of 10 years.

Materials and methods: Eleven edentulous patients were included and received one implant in the midline of the mandible. Five implants healed submerge and were uncovered 2 months later. The other six healed un-submerged and were provided with a healing abutment 4 mm in height thus moderately loaded. All denture bases were temporarily relined during the healing period and two months later provided with a ball attachment for implant retention. Implant related parameters and prosthodontic maintenance interventions were assessed four weeks after implant loading and then annually.

Results: Over a mean observation period of 108.9 months (35–136 months), no implant was lost. The most frequent prosthetic maintenance intervention was activation of the matrix due to loss of retention, followed by exchange of the female part. Fracture of the denture base in the attachment area was a frequent complication and occurred in 8 cases. Two denture bases fractured twice.

Conclusion: Within the limitations of this prospective pilot study, the concept of a single midline implant to retain a mandibular complete denture is promising over ten years for edentulous patients. Regular recall visits should be scheduled due to frequent maintenance interventions. Further research on this topic with a larger study cohort is needed.

1. Introduction

Edentulism is a chronic condition and affects mostly the elderly population. According to a systematic review on the global burden of severe tooth loss, the global age-standardized prevalence and incidence rate of total tooth loss in the entire population decreased by 45% between 1990 and 2010 [1]. The same review stated that in 2010, 2.3% of the world population, representing 158 million people worldwide, were edentate. However, prevalence and incidence of tooth loss are age dependent with incidence peaking around 60 years of age. According to the fifth German Oral Health Study, which was conducted between October 2013 and July 2014, 12.4% of the younger seniors (65–74 years) and 32.8% of the older seniors (75–100 years) are edentulous in Germany [2]. Edentulism among seniors is still common in other industrial countries, as well [3–5]. The prevalence of edentulism is declining, but with an increased life expectancy and ongoing demographic chance, the dental care of edentulous patients will remain an important part of dentistry.

Some edentulous patients can adapt to their complete dentures but many patients are dissatisfied with the retention and fit of their mandibular denture [6,7]. According to an investigation by de Baat et al., 71% of the 397 complete denture wearers rated the retention of their mandibular denture unsatisfactory [6]. They complain about a reduced masticatory function [8–10] often resulting in a mal- or undernutrition [11]. Implants are known to well stabilize overdentures and implant therapies with two or more implants are well documented and show excellent results [12–14]. However, many patients cannot afford an implant therapy with two or more implants or do not want to undergo an extensive surgery [15,16]. In order to reduce treatment time and treatment costs, the concept of a single mandibular implant in the edentulous mandible was introduced in the 1990s [17]. So far, this concept shows promising results over a short to medium period of time [18,19] but long-term data are still missing.

Therefore, the present prospective pilot study was conducted to

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evaluate the prosthetic maintenance as well as the implant outcome of single implant retained mandibular overdentures over an observation period of 10 years.

2. Materials and methods

The present investigation was approved by the institutional review board of the medical faculty of the Christian-Albrechts University, Kiel, Germany (IRB number: D 411/03). All patients participating in this clinical trial were informed in detail before giving their informed written consent. All interventions as well as all follow-up investigations were performed in the Prosthodontic Department of the University of Kiel. Edentulous patients were screened according to predefined in- and exclusion criteria [20]. Eleven patients, six men and five women, with a mean age of 66.7 years were included and received one median implant (Root Line, Promote, Camlog Biotechnologies, Switzerland, lengths 11–13 mm, diameter 3.8 mm) in the mandible. In six cases, implants were provided with a healing abutment 4 mm in height and healed unsubmerged and moderately loaded. The other five implants followed a conventional submerged healing protocol and second stage surgery was performed 2 months later. All denture bases were relined with a soft acrylic temporary relining material (GC soft-liner, GC-Europe, Leuven, Belgium) during implant healing. After two months, all implants were provided with ball attachments and the corresponding matrixes (Dalbo-Plus Elliptic, Cendres Métaux, Biel, Switzerland) were integrated intraorally into the existing denture bases, using a self-curing bis-acrylate resin (Luxatemp, DMG, Hamburg, Germany).

The detailed surgical and prosthetic procedures have been described already by Harder et al. in 2011 [20]. All patients received detailed instructions regarding implant and denture hygiene. Follow-up examinations were performed four weeks after implant loading and then once a year. During follow-up visits, all complications of the implants and/or the denture bases as well as all prosthodontic maintenance interventions, divided up into adjustments and repairs [21], were recorded. Additionally, probing pocket depth, bleeding on probing, and Periotest values were recorded [20]. Seven patients were available for the 10-year follow-up examination.

3. Results

Between September 2006 and May 2007 eleven patients received one median implant in the mandible. Four participants had died within the 10 years of observation. One of them had died 35 months after implant placement, one had attended the 7 year and one the 8 year recall visit, one died shortly after the 9 year follow-up examination. No implant complication had occurred during their follow-up period. The other seven patients attended the 10-year recall visit. The mean observation period for all patients was 108.9 months (minimum: 35 months, maximum: 136 months) with no implant loss during the observation period. Probing pocket depth was performed at four sites per implant and was on average 2 mm with a maximum of 4 mm. From the 28 probing sites, two showed bleeding on probing. The Periotest values ranged from -2 and -6. The most common prosthetic maintenance intervention was readjustment of the matrix due to loss of retention, which had to be performed up to 7 times in one patient. All patients were affected by this event. A loosening of the ball attachment occurred in 3 patients, one ball attachment had to be retightened three times. Replacement of the matrix was a common maintenance intervention, as well and was performed 23 times in 6 patients. Fracture of the denture base in the area of the ball attachment was a frequent complication. Six prostheses (55%) fractured during observation period and two prostheses (18%) fractured twice. One of the fractured denture bases was reinforced with a metal framework during repair. The other fractured denture bases were repaired with no metal framework. Table 1 shows the required adjustments and repairs during the follow-up period. Complications and maintenance interventions from patients, who had died during the follow-up period, are listed until their last recall visit, as well.

Table 1
Required adjustments and repairs during the follow-up period. Adjustments and repairs from all patients, that died before the 10-year follow-up examination, are listed until their last recall visit.

Adjustments			
Location	Event	No. of events (N)	No. of patients that were affected by the event (%)
Attachment (matrix)	Loss of retention	29 [a]	100
Attachment (ball)	Loosening	5 [b]	45
	Pressure sore	14 [c]	64
Denture base	(reshaping)	**47**	
Total			
Repairs			
Location	Intervention	No. of interventions	
Attachment (matrix)	Replacement	23 [d]	55
Attachment (ball)	Replacement	4	36
	Repair (fracture)	8 [e]	55
Denture		**34**	
Total			

[a] up to 7 events in one attachment.
[b] up to 3 events in one attachment.
[c] up to 3 events in one patient.
[d] up to 5 events in one denture.
[e] two fractures in two prostheses.

4. Discussion

In the present investigation on the clinical outcome and prosthodontic maintenance interventions of single implants retaining mandibular complete dentures all 7 implants, that were available for the 10-year follow-up examination, survived, representing 100% implant survival. Four of the initial 11 patients had died during the follow-up period but these four implants were in function until death of the patients. The concept of one single implant to retain complete mandibular dentures shows promising results in the literature as long as implants with rough surfaces are used and immediate loading is avoided [18,22,23]. However, so far, results are available over a short to medium follow-up period. According to a recently published systematic literature review, the cumulative implant survival of single implants retaining complete mandibular dentures was 96.6% over a mean follow-up period of 37.3 months [24]. This was irrespective of the loading protocol, as immediately loaded and conventionally loaded implants were included in this meta-analysis. All implants with rough surfaces, which healed submerged and were loaded between 6 weeks and 3 months after implant placement, revealed a 100% survival rate after 12–80 months of observation. The results of the present investigation that firstly reports an observation of 10 years with this treatment modality fit well into these results although six implants were provided with a healing abutment after implant placement healing unsubmerged and being moderately loaded with the relined dentures.

All implants showed negative Periotest values, representing sufficient osseointegration [25]. Similar PTV´s for single implants retaining complete mandibular dentures were reported in the literature [17,26]. PTV´s for overdentures supported by two implants were slightly higher, but still in a similar range [27].

Activation or exchange of the matrix, were the most frequent prosthodontic maintenance interventions in the present investigation. These maintenance interventions are reported frequently by other investigations on single mandibular implants, as well [28–30]. They are known to be the most common intervention for implant supported overdentures, in general [31].

Fracture of the denture base in the area of the ball attachment occurred frequently often. It is a complication that was also reported by other investigations on single mandibular implants [17,21,26,29,32,33]. According to a systematic review, single implant retained overdentures do not fracture significantly more often than dentures which are retained by two implants [24]. None of the existing mandibular dentures that were provided with the ball attachment after implant healing had a metal framework and none of them received a metal framework at the day of implant loading. The dentures were fabricated as complete dentures being rather thin in the anterior mandible. The ball attachment system has a construction height of 6 mm resulting in thin and weak denture bases in the area of the ball attachment after integration of the attachment into the denture bases.

When discussing the results of the present investigation, it has to be considered, that the number of patients is limited, and only 7 out of 11 patients were available for the 10-year follow-up investigation. However, this study was designed as a prospective pilot study to investigate the concept of one single implant in the edentulous mandible as a treatment option for elder edentulous seniors. Recruiting younger patient would not have been representative for the age group, this concept was initially meant for.

5. Conclusions

Within the limitations of this prospective pilot study, the concept of one median implant to retain a complete mandibular denture is a promising treatment option for elderly edentulous patients, especially if a therapy with two or more implants is not affordable. Frequent maintenance interventions have to be considered. Further research on this topic with a larger study cohort is needed.

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