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Patients' Satisfaction with Mandibular Overdentures Retained Using Mini-Implants: An Up-to-16-Year Cross-Sectional Study

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Abstract: Background: Patients with edentulism often have an impaired functional, phonetic, and esthetic status, resulting in poor quality of life; hence, the mandibular overdenture has been considered the standard implant treatment for such patients. Therefore, this study aimed to assess the effectiveness of mandibular overdentures retained using mini-implants on patient-reported satisfaction and their long-term survival. Methods: We searched patients' medical records for eligible subjects, screening and inviting patients who received a mandibular overdenture anchored on mini-implants over ten years ago. We used a numerical rating scale from 0 (the worst) to 10 (the best) to assess four aspects: comfort, retention, chewing ability, and speaking ability before and after having mini-implants. We carried out Kaplan–Meier analysis to assess their survival. Results: Forty-eight elderly patients who were medically compromised and had a mandibular overdenture anchored on four permucosal mini-implants were included. All patient-reported satisfaction (comfort, retention, chewing ability, and speaking ability) was significantly improved after supporting mandibular overdentures with mini-implants (p-values < 0.05), with retention and chewing ability being the most substantially improved. The 10- and 15-year mini-implant survival rates were both 97.9%. Conclusions: Mandibular overdentures with mini-implants can be considered a valid and practical alternative to conventional implant-supported overdentures in patients with atrophic ridges, medically compromised, and the elderly.

Keywords: dental implant; patient with edentulism; elderly patient; immediate loading; mini-implant; overdenture; patient-reported outcome measures; prosthodontics

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1. Introduction

Oral implant rehabilitations have been recognized as very predictable medium- and long-term treatments for patients with partial and complete edentulism [1,2]. The maxillary and mandibular edentulous ridges could drastically impair aesthetics and oral cavity function, potentially shortening patients' lives [3,4]. Hence, patients with edentulous mandibles often wear a mandibular prosthesis, and the primary source of discomfort is always retention since it is closely related to the vertical and torsion forces experienced [5]. Implant-supported overdentures relieve discomfort and boost patient satisfaction by compensating for a traditional prosthesis's insufficient retention and stability and increasing masticatory function [6]. Also, the quantity of denture retention significantly impacts

patient satisfaction [5]. Implant-supported overdentures may be the treatment of choice in patients with conditions (e.g., unfavorable ridge relationships, inadequate number of implants, and poor distribution or alignment of implants), as well as such an approach facilitates removal to ensure abutment and/or prosthesis hygiene, or financial limitations that may prevent the use of a fixed implant prosthesis [7]. Furthermore, Implant-supported overdentures could be a more practical alternative treatment for 'satisfied' denture wearers who desire their prostheses to be more stable to improve their quality of life [8].

For instance, in cases of severe atrophy (particularly in the early stages), the resorption component is more horizontal, necessitating the use of bone grafts. However, small-diameter implants can be a solution that avoids such grafting procedures [9]. Although the generic indication is for edentulous ridges, such implants offer a feasible therapeutic strategy clinically in patients with inadequate space for the implantation of standard-size implants; hence, the indication of mini-implants (<2.5~3 mm diameter) [10,11] focuses primarily on the maxilla and mandible anterior areas (i.e., the frontal area) [12]. As a result, these mini-implants can be used to support overdentures on compromised edentulous sites to treat bone width or site length deficiencies [13]. Scepanovic et al. reported that no overdenture failed after 1 year, but that there was a failure of two implants with a 98.3% success rate [14]. A similar outcome has been reported by Park et al. at a 4–6-year follow-up with 100% implant survival rate [15]. Bidra et al. reported a mini-implant cumulative survival rate (CSR) over a 9-year period, primarily attributed to data from a single study, of 92.2% [16]. Schiegnitz et al. reported a significant difference of implant survival rate (ISR), comparing narrow and standard diameter implant [10]. A total of three different subgroups were considered—implant diameter of <3.0 mm (Group I), implant diameter of 3–3.25 mm (Group II), and implant diameter of 3.3–3.5 mm (Group III)—that reported, respectively, ISRs of 94.7 $\pm$ 5%, 97.3 $\pm$ 5%, and 97.7 $\pm$ 2.3% [10]. Mini-implants have lower percutaneous exposure and displacement, which can reduce complications [17]. However, controlling the occlusal load is crucial since mini-implants transmit nearly twice as much force to the supporting bone [18]. As such, maxillary lateral and mandibular incisors sites may be the most suitable locations for mini-implant treatment [19]. Despite these premises, mini-implants behave slightly differently under functional loading compared to regular-size implants; the clinician should use them cautiously and prudently [13].

However, assessing oral health and its implications could be assessed by a clinician- or be patient-reported. The clinician-assessed oral health approach needs to be more holistic since it ignores the patient's general condition, falling short of expressing the complete meaning of oral health [20–22]. As a result, a multidimensional approach was adopted to address the shortcomings of past definitions of health by encompassing a wide range of aspects (e.g., mental, physical, psychological, emotional, social, and overall health), which can be evaluated through a patient-reported assessment [20–22]. Patient-reported outcome measures are assessments (objective or subjective) used to evaluate an intervention's effectiveness, often in self-reporting questionnaires [23]. Such assessments are distinguished by simple and reliable measurements, feasible administration techniques, and low resources and costs for health care professionals [24–26]. As such, dental patient-reported outcomes (dPROs) are reports of a patient's oral health condition provided directly by the patient and not interpreted by a clinician or anyone else, aiming to investigate the patient's perceptions of the effectiveness and impact of dental therapies [24,27]. Accordingly, the application of dPROs has steadily grown since they form the foundation for value-based care, evidence-based health care, and effective clinician–patient communication [25,28–30].

In this regard, dental patients seek care to rehabilitate compromised oral functions (e.g., chewing and speaking), relieve orofacial pain, enhance orofacial appearance, or diminish the psychosocial consequences of oral diseases [31].

According to the McGill consensus statement [32], the minimum treatment option for patients with edentulism is a removable prosthesis supported by two mandibular implants; thus, this study targets elders who are edentulous, aiming to restore satisfactory physiological functions, such as mastication, speech, and deglutition. Therefore, we conducted

this study to assess the long-term effectiveness of mandibular overdentures anchored on mini-implants in terms of implant survival, complications, and patient satisfaction.

2. Methods

2.1. Study Design

This study follows the STROBE guidelines for reporting cross-sectional observational studies [33]. The study protocol was a priori approved by the Internal Review Board of the Department of Innovative Technologies in Medicine and Dentistry, University of Chieti–Pescara, Italy (ID: CRRM;2023;09;02;01), and conducted under the local Good Clinical Practice procedures for quality control [34]. All study participants provided written informed consent under the Helsinki Declaration for experimentation on human subjects.

2.2. Setting, Participants, and Study Size

We performed a consecutive sampling to recruit and invite all subjects who received a mandibular overdenture anchored on mini-implants at the University of Chieti–Pescara, School of Medicine and Health Sciences, between July 2007 and October 2011 to participate in this study. Our inclusion criteria were patients with complete mandibular edentulism (either untreated or previously treated), with an unsatisfactory perception of their denture, and accepted treatment with an overdenture anchored on mini-implants. Patients were initially recruited based on their confirmation of the recall appointment to follow up on the denture and its supported mini-implants. On the day of the follow-up appointment, each patient was clinically examined and requested to complete the questionnaire themselves to ensure as little bias as possible.

2.3. Surgical Procedure

Forty-eight elderly patients underwent microsurgery under local anesthesia or intravenous sedation with local anesthesia to place four mini-implants each between the mandible's mental foramen. Under copious irrigation, a hall drill with a 0.8 mm round bur was used to initiate 1mm starting holes, followed by a standard 1.1 mm diameter titanium drill to initiate a hole through the superior cortical plate. Then, in a single-stage procedure, solid one-piece mini-implants (Isomed, DUE CARRARE, Padova, Italy) with a 2.7 mm standard diameter and a length ranging from 10 to 13 mm, as well as collar and O-ring as an anchoring system, were placed. These mini-implants were made of titanium (grade 5) that was sandblasted and acid-etched to have an arithmetical mean height (Sa) of 1–2 µm. Such implants were placed in tooth locations 32, 34, 42, and 44 using a handheld finger driver followed by a ratchet and were considered successful when sufficient resistance was at around 35–45 Ncm (Figures 1 and 2). Finally, the prosthesis was mounted with soft resin to avoid micro-movements during bone healing, and the O-rings were positioned four months later.

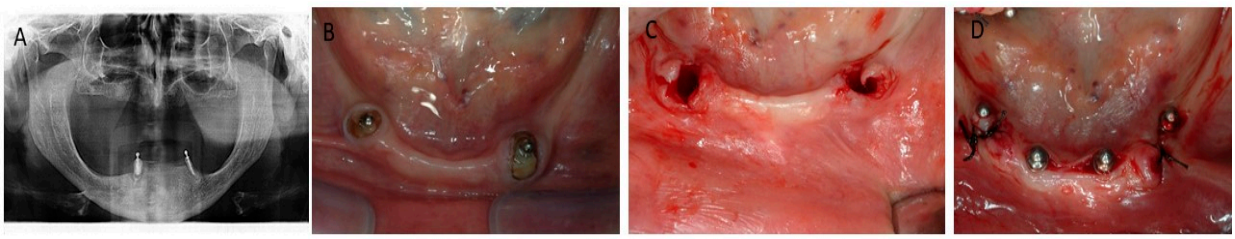

Figure 1. (**A**) Radiograph of elderly patient with teeth to be extracted. (**B**) Clinical appearance of mobile teeth. (**C**) Extracted teeth. (**D**) Four mini-implants placed.

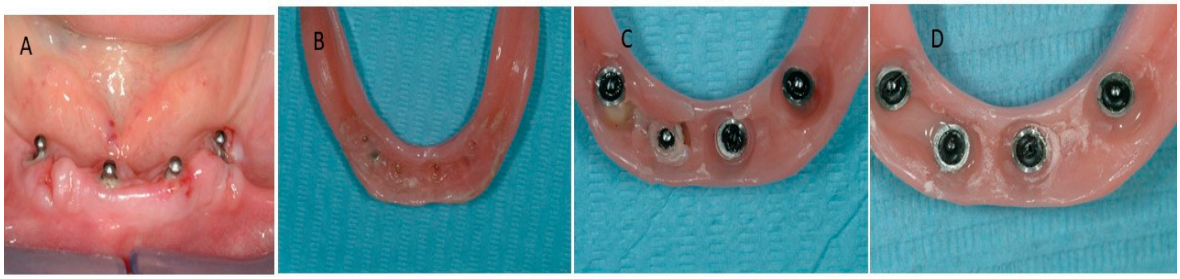

Figure 2. (**A**) One week after placement of mini-implants. (**B**) Removable prosthesis mounted with soft resin. (**C**,**D**) The placement of the attachments after 4 months.

2.4. Variables

The following data were obtained from patients' records:

- Patients' age, gender, and medical histories.
- Mini-implant settings (type, length, diameter, number, location, and attachments type).
- Surgery information (date of implantation, type of anesthesia and drilling, and complications during surgery).
- Post-operative information (data on maintenance sessions, implant loss, and aftercare needs).

2.5. Questionnaire

The questionnaire contained a closed-answer mode with a numerical rating scale from 0 to 10 to assess four aspects—comfort, retention, chewing ability, and speaking ability—before and after having mini-implants, with 0 being the worst and 10 being the best. Given that this study was conducted on an elderly population and frailty is the most problematic expression of an aging population, it was unattainable to administer the questionnaire scale beyond 10 points because the patients had aged, resulting in a cumulative decrease of multiple physiological systems. Before applying the questionnaire, an initial questionnaire was distributed in person to a pilot sample to assess its suitability, and, after reviewing the responses, the questionnaire was considered suitable for use in this survey without change.

2.6. Outcomes

The primary outcome was to assess the impact of a mandibular overdenture anchored on mini-implants, performed more than ten years ago, on patients' satisfaction with complete dentures regarding comfort, retention, chewing ability, and speaking ability. The secondary outcome was to assess the survival curve of mini-implants using Kaplan–Meier analysis. The final follow-up of the denture was the last reported follow-up appointment at the University of Chieti–Pescara, School of Medicine and Health Sciences, whereas the denture was considered a "failure" and an "event" in the Kaplan–Meier analysis due to denture fracture, attachment loss, and implant loss. As such, we first measured the patients' satisfaction post-operatively and after a 12- to 16-year follow-up, as well as recorded any interventions performed to address the reduction in prosthesis retention during the follow-up period (e.g., relining of the denture or repair for fractured, replaced rings, fractured resin teeth).

2.7. Statistical Analysis

Two investigators independently extracted data from questionnaire responses and patients' records, and entered them into two separate datasets, which were then integrated into a single spreadsheet intended for this study. Descriptive statistics were performed and reported as means and standard deviations (SDs) for continuous variables and frequencies and percentages for categorical variables. The paired *t*-test was used to compare patients' satisfaction before and after mini-implants. The Kaplan–Meier approach was conducted to

determine the estimated implant survival curve of implants considering 12 to 16 years of follow-up. The statistically significant difference was considered at $p < 0.05$. All statistical analyses were performed using STATA/BE 18.0 (StataCrop LLC, College Station, TX, USA).

3. Results

3.1. Participants

The review of patients' medical records yielded 65 patients who received mini-implants to support their overdentures from July 2007 to October 2011. Among them, fifteen patients were excluded; twelve patients were deceased; and three detailed records were unavailable. Consequently, the remaining fifty eligible patients were contacted and invited to participate in this study; however, two of them did not respond. As a result, we enrolled 48 patients (17 males and 31 females) aged 60 to 92 years (mean = 69 years) who received 192 mini-implants to support their dentures, with their follow-ups ranging from 12 to 16 years (mean = 15 years) (Figure 3).

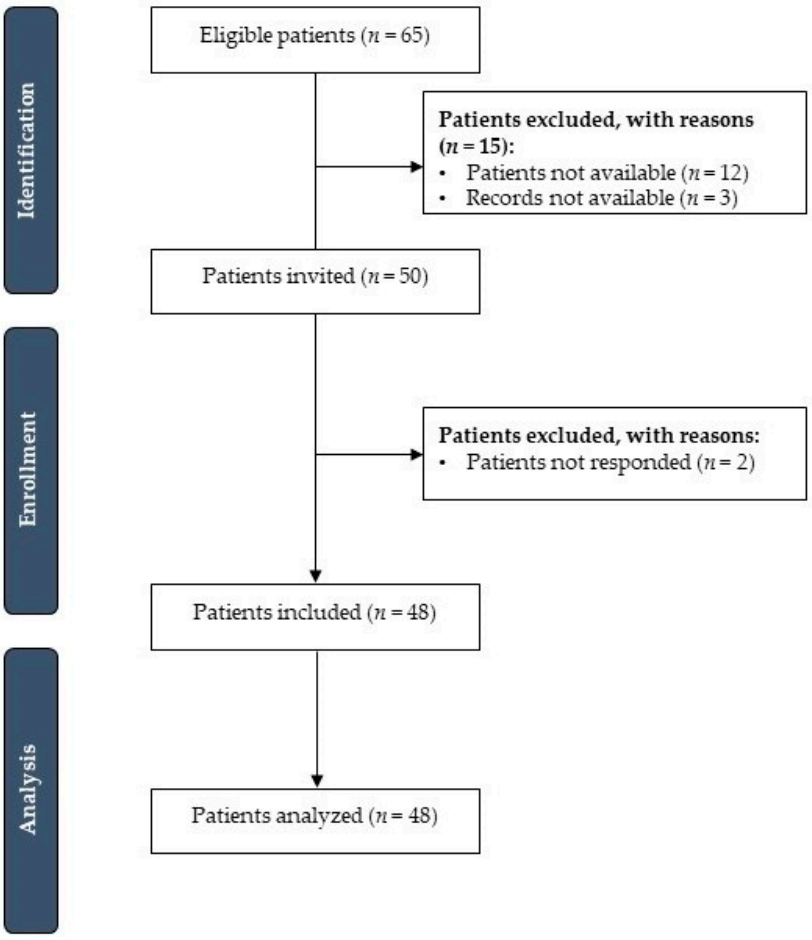

Figure 3. Flowchart illustrates the study design.

The patients' medical histories revealed that 54% had severe hypertension, 43% had atrial fibrillation, 8% had a stroke, 6% respiratory failure, 6% chronic kidney disease, 2% liver failure, 4% hyperthyroidism, and 2% had drug allergies. Given their general health statuses, 90% of the patients did not comply with the scheduled follow-up appointments, and they went to follow-up appointments when noticing a reduction in prosthesis retention; hence, the worn-out ball due to the implant's head was frequently noted.

Table 1 describes the included patients' baseline characteristics and implant settings.

Table 1. Baseline characteristics of the included patients.

Characteristic	Value
Age—(years)	
Range	60–92
Mean (SD)	69
Sex—no. (%)	
Male	17 (35.4%)
Female	31 (64.6%)
Follow-up—(years)	
Range	12–16
Mean (SD)	15 (2.3)
Implant settings	
Diameter (mm)	2.7
Length (mm)	10–13
Systemic diseases—no. (%)	
Severe hypertension	26 (54.75)
Atrial fibrillation	21 (43.75)
Stroke	4 (8.43)
Respiratory failure	3 (6.25)
Chronic kidney disease	3 (6.25)
Hyperthyroidism	1 (2.08)
Liver failure	2 (4.17)
Drug allergies	1 (2.08)

3.2. Study Outcomes

3.2.1. Patient-Reported Satisfaction

There were statistically significant differences in patient-reported satisfaction with their overdentures after being supported with mini-implants regarding their comfort, retention, chewing ability, and speaking ability ($p < 0.05$). The most remarkable improvements in patient-reported satisfaction were seen in retention, which increased from 2.23 ± 0.42 preoperatively to 8.60 ± 0.49 postoperatively, followed by chewing ability, which increased from 2.79 ± 0.54 preoperatively to 9.00 ± 0.58 postoperatively. Also, the comfortability and speaking ability improved from 3.25 ± 0.64 and 3.50 ± 1.01 to 9.29 ± 0.46 and 8.00 ± 0.41, respectively (Table 2 and Figure 4).

Table 2. Comparison of patient-reported satisfaction with their overdentures before and after being supported with mini-implants.

Patient-Reported Satisfaction	Variable	Mean	Std. Err.	Std. Dev.	[95% Con. Interval]	*t*-Statistic (DF)	*p*-Value
Retention	Before	2.23	0.06	0.42	[2.11, 2.35]	−62.7969 (47)	0.0000
	After	8.60	0.07	0.49	[8.46, 8.75]		
	Difference	−6.38	0.10	0.70	[−6.58, −6.17]		
Chewing ability	Before	2.79	0.08	0.54	[2.63, 2.95]	−47.8883 (47)	0.0000
	After	9.00	0.08	0.58	[8.83, 9.17]		
	Difference	−6.21	0.13	0.90	[−6.47, −5.95]		

Table 2. *Cont.*

Patient-Reported Satisfaction	Variable	Mean	Std. Err.	Std. Dev.	[95% Con. Interval]	*t*-Statistic (DF)	*p*-Value
Comfort	Before	3.25	0.09	0.64	[3.07, 3.43]	−61.2970 (47)	0.0000
	After	9.29	0.07	0.46	[9.16, 9.43]		
	Difference	−6.04	0.10	0.68	[−6.24, −5.84]		
Speaking ability	Before	3.50	0.15	1.01	[3.21, 3.79]	−29.6401 (47)	0.0000
	After	8.00	0.06	0.41	[7.88, 8.12]		
	Difference	−4.50	0.15	1.05	[−4.81, −4.19]		

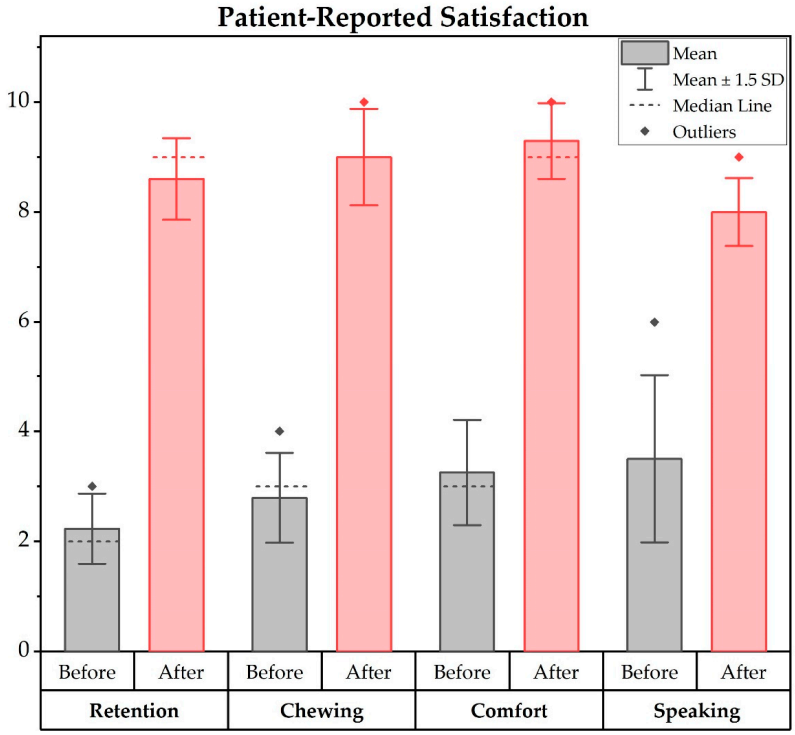

Figure 4. Bar chart describes patient-reported satisfaction before and after mini-implants.

3.2.2. Implant Failure Analysis

After 12 to 16 years of follow-up, the denture base was relined in 27 (56%) and fractured in 12 (25%) patients, while the rings were replaced in 10 (21%) and resin tooth fractured in 9 (18.8%) patients. The Kaplan–Meier survival curves are reported in Figure 5. The analysis was conducted considering the 12 to 16 years of follow-up. However, only 5 implants (2.5%) were fractured, and only 3 were removed for mobility (1.52%), but the remaining 184 mini-implants remained stable, with a 97.9% survival rate after an average 15-year follow-up. One patient lost three implants to mobility, compromising the stability of the prosthesis. At the last follow-up appointment (mean follow-up period 12 to 16 years), no dentures were lost; thus, the 5-, 10-, and 15-year survival rates of overdentures anchored on mini-implants were 100%, 97.9%, and 97.9%, respectively (Figure 6). Therefore, the survival of the prosthesis was inferior to that of the implants.

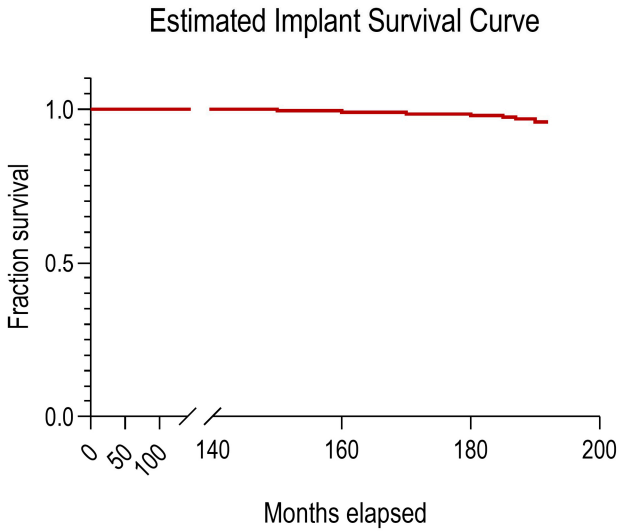

Figure 5. Kaplan–Meier curve. Estimated implant survival curve of implant.

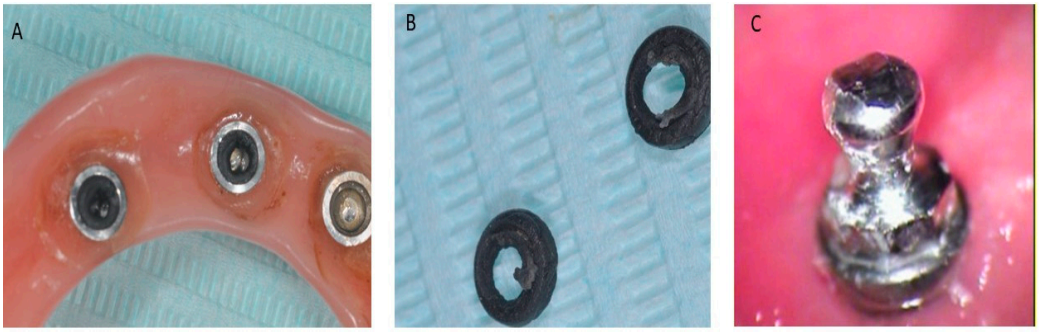

Figure 6. (**A**) Worn O-rings are observed. (**B**) Worn O-rings removed. (**C**) In this case, failure to replace the O-rings resulted in the wear of the implant's head.

4. Discussion

In this study, we assessed the effectiveness of mandibular overdentures retained with mini-implants on patient-reported satisfaction and their long-term survival. As a result, forty-eight elderly patients who were medically compromised with mandibular overdentures anchored on four permucosal mini-implants were included, and their satisfaction (comfort, retention, chewing ability, and speaking ability) was recorded after a follow-up period ranging from 12 to 16 years of loading. As such, we recorded the patients' findings subjectively, with the only objective clinical data evaluated being prosthesis maintenance and implant survival. We found that all patient-reported satisfaction significantly improved after supporting mandibular overdentures with mini-implants, with retention and chewing ability being the most substantially improved, and the 10- and 15-year survival rates were both 97.9%. Our findings revealed mini-implants' longevity in supporting overdentures to treat elderly patients with edentulous mandibles, with a high cumulative survival rate of up to 16 years of loading. The results reported in this study were good, especially for the survival of mini-implants. Clinicians usually encounter problems in their daily practice [35,36] that are correlated to incongruous rehabilitations caused by passive residual bone ridges' resorption and retention failure [5,17]; such difficulties are common and can result in significant limitations regarding speech and eating, leading to psychological-social issues [37]. As a result, several approaches were proposed to overcome these problems, including the use of dental implants to support dental prostheses. Implant-supported prostheses are often used to treat patients who are partially or completely edentulous; however, conventional dental implants may be limited in their application due to limited

bone height and thickness [38]. Hence, mini-implants (i.e., ≤2.7 mm length) could be a valid and feasible solution in these clinical conditions [39,40].

Our findings revealed significant improvements in patient-reported satisfaction (i.e., comfort, retention, chewing ability, and speaking ability) after supporting their mandibular overdentures with mini-implants, whereby retention and comfortability were the most substantially improved. On the other hand, this investigation revealed a 97.9%. survival rate in line with the concerning medium-term literature in this field, considering a follow-up of 16 years [10,14–16].

The use of mini-implants to support dental prostheses has many benefits for a variety of reasons: such implants minimize complicated surgical procedures and bone ridge grafting, minimizing surgical invasiveness and post-operative discomfort, and allowing mandibular atrophies to recover with adequate primary stability for prosthetic loading [36,41]. Still, the primary disadvantage of this approach is the reduced surface contact with the surrounding bone (i.e., lesser mechanical strength to functional loading) [42,43] and the limited surface area of small-diameter implants (i.e., less resistance to occlusal forces) [44,45]. However, Teodarescu et al. demonstrated that a sufficient number of mini-implants and a functional topographical distribution based on biomechanical masticatory forces could prevent these mechanical challenges [46]. Also, Chatrattanarak et al. found that the configuration of two mini-implants supporting mandibular overdentures with an immediate loading approach had a significantly higher success rate, cost effectiveness, and patient satisfaction after eight years of follow-up compared to four mini-dental implant-retained mandibular overdentures [7].

Two-stage loading was described by some authors, e.g., Park et al., 2023, as a soft loading procedure with, first, a soft relining, and the incorporation of housings with O-rings after four months [15]. This technique could be useful in immediate loading with housings for mandibular mini-implants [15].

Additionally, overdentures anchored on mini-implants can be an alternative treatment for patients who are completely edentulous with either conventional or implant-retained prostheses due to their characteristics (small diameter, variable length, O-ring retention system), which allow for a closer adaptation to the morphological conditions that characterize patients with complete edentulism [47,48]. Moreover, the surgical procedure for placing mini-implants is less invasive, with more preference for no soft tissue incisions to attain minimal surgical trauma [39], which make this approach more suitable and practical for medically compromised and older patients [48,49]. Mini-implants with new materials have now been proposed; in fact, a recent study reported a high success rate using mini-titanium–zirconium implants. We used one-piece implants with a diameter of 2.7 mm. Today, 'conventional' two-piece implants with a diameter of 2.9–3.3 mm are also available, which can be used with the advantage that these implants can be loaded after osseointegration. From a financial perspective, overdentures anchored on mini-implants are less expensive than conventional implant-supported overdentures [45]; this lower cost is due to the lower cost of mini-implants, use of panoramic radiographs in planning and assessment (CBCT not essential in most cases), and the elimination of certain surgical procedures [9,42].

5. Conclusions

Patient-reported satisfaction, considering comfort, retention, chewing ability, and speaking ability, has significantly improved after supporting patients' mandibular overdentures with mini-implants. Given the benefits of supporting overdentures with mini-implants and its long-term effectiveness, this approach has superior features to traditional complete dentures.

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Informed Consent Statement: Written informed consent has been obtained from the patient(s) to publish this paper.

Data Availability Statement: All experimental data to support the findings of this study are available upon request from the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Albrektsson, T.; Chrcanovic, B.; Östman, P.-O.; Sennerby, L. Initial and Long-Term Crestal Bone Responses to Modern Dental Implants. *Periodontol. 2000* **2017**, *73*, 41–50. [CrossRef] [PubMed]
2. Adell, R.; Lekholm, U.; Rockler, B.; Brånemark, P.-I. A 15-Year Study of Osseointegrated Implants in the Treatment of the Edentulous Jaw. *Int. J. Oral Surg.* **1981**, *10*, 387–416. [CrossRef]
3. Froum, S.J.; Cho, S.-C.; Florio, S.; Misch, C.M. Use of Narrow-Diameter Implants in Treatment of Severely Atrophic Maxillary Anterior Region With Implant-Supported Fixed Restorations. *Compend. Contin. Educ. Dent.* **2016**, *37*, 334–339.
4. Greco, G.; Borgia, R.; Casto, C. Occlusal-Vertical Rebalancing for Implantprosthetic Planning: Technical Considerations. *Eur. J. Muscoloskel. Dis.* **2023**, *12*, 13–18.
5. LaBarre, E.E.; Ahlstrom, R.H.; Noble, W.H. Narrow Diameter Implants for Mandibular Denture Retention. *J. Calif. Dent. Assoc.* **2008**, *36*, 283–286. [CrossRef]
6. Kapadia, A.; Wankhade, S.; Khalikar, A.; Deogade, S.; Mukhopadhyay, P.; Dutta, V.; Doibale, P. Comparing the Functional Efficiency of Tooth-Supported Overdentures and Implant-Supported Overdentures in Patients Requiring Oral Rehabilitation: A Systematic Review. *Dent. Res. J.* **2022**, *19*, 94. [CrossRef]
7. Chatrattanarak, W.; Aunmeungtong, W.; Khongkhunthian, P. Comparative Clinical Study of Conventional Dental Implant and Mini Dental Implant-Retained Mandibular Overdenture: A 5- to 8-Year Prospective Clinical Outcomes in a Previous Randomized Clinical Trial. *Clin. Implant. Dent. Relat. Res.* **2022**, *24*, 475–487. [CrossRef]
8. Mangano, F.; Shibli, J.A.; Sammons, R.L.; Veronesi, G.; Piattelli, A.; Mangano, C. Clinical Outcome of Narrow-Diameter (3.3-Mm) Locking-Taper Implants: A Prospective Study with 1 to 10 Years of Follow-up. *Int. J. Oral Maxillofac. Implant.* **2014**, *29*, 448–455. [CrossRef]
9. Abenavoli, F.M.; Inchingolo, A.D.; Inchingolo, A.M.; Dipalma, G.; Inchingolo, F. A Technical Note for the Use of Small-Diameter Cannula for Lipoaspiration Technique in Aesthetic Reconstructive Post-Oncological Surgery. *J. Biol. Regul. Homeost. Agents* **2019**, *33*, 1011–1013.
10. Schiegnitz, E.; Al-Nawas, B. Narrow-Diameter Implants: A Systematic Review and Meta-Analysis. *Clin. Oral Implant. Res.* **2018**, *29* (Suppl. 16), 21–40. [CrossRef] [PubMed]
11. Jung, R.E.; Al-Nawas, B.; Araujo, M.; Avila-Ortiz, G.; Barter, S.; Brodala, N.; Chappuis, V.; Chen, B.; De Souza, A.; Almeida, R.F.; et al. Group 1 ITI Consensus Report: The Influence of Implant Length and Design and Medications on Clinical and Patient-Reported Outcomes. *Clin. Oral Implant. Res.* **2018**, *29* (Suppl. 16), 69–77. [CrossRef]
12. Agliardi, E.L.; Romeo, D.; Panigatti, S.; de Araújo Nobre, M.; Maló, P. Immediate Full-Arch Rehabilitation of the Severely Atrophic Maxilla Supported by Zygomatic Implants: A Prospective Clinical Study with Minimum Follow-up of 6 Years. *Int. J. Oral Maxillofac. Surg.* **2017**, *46*, 1592–1599. [CrossRef] [PubMed]
13. Cruz, R.S.; Lemos, C.a.A.; de Batista, V.E.S.; Yogui, F.C.; Oliveira, H.F.F.; Verri, F.R. Narrow-Diameter Implants versus Regular-Diameter Implants for Rehabilitation of the Anterior Region: A Systematic Review and Meta-Analysis. *Int. J. Oral Maxillofac. Surg.* **2021**, *50*, 674–682. [CrossRef] [PubMed]
14. Scepanovic, M.; Calvo-Guirado, J.L.; Markovic, A.; Delgardo-Ruiz, R.; Todorovic, A.; Milicic, B.; Misic, T. A 1-Year Prospective Cohort Study on Mandibular Overdentures Retained by Mini Dental Implants. *Eur. J. Oral Implantol.* **2012**, *5*, 367–379. [PubMed]
15. Park, J.-H.; Shin, S.-W.; Lee, J.-Y. Mini-Implant Mandibular Overdentures under a Two-Step Immediate Loading Protocol: A 4-6-Year Retrospective Study. *Gerodontology* **2023**, *40*, 501–508. [CrossRef] [PubMed]
16. Bidra, A.S.; Almas, K. Mini Implants for Definitive Prosthodontic Treatment: A Systematic Review. *J. Prosthet. Dent.* **2013**, *109*, 156–164. [CrossRef] [PubMed]
17. Degidi, M.; Piattelli, A.; Carinci, F. Clinical Outcome of Narrow Diameter Implants: A Retrospective Study of 510 Implants. *J. Periodontol.* **2008**, *79*, 49–54. [CrossRef] [PubMed]

18. Romanos, G.E.; Bastardi, D.J.; Moore, R.; Kakar, A.; Herin, Y.; Delgado-Ruiz, R.A. In Vitro Effect of Drilling Speed on the Primary Stability of Narrow Diameter Implants with Varying Thread Designs Placed in Different Qualities of Simulated Bone. *Materials* **2019**, *12*, 1350. [CrossRef]
19. Galindo-Moreno, P.; Padial-Molina, M.; Nilsson, P.; King, P.; Worsaae, N.; Schramm, A.; Maiorana, C. The Influence of the Distance between Narrow Implants and the Adjacent Teeth on Marginal Bone Levels. *Clin. Oral Implant. Res.* **2017**, *28*, 704–712. [CrossRef]
20. Dolan, T.A.; Atchison, K.A. Implications of Access, Utilization and Need for Oral Health Care by the Non-Institutionalized and Institutionalized Elderly on the Dental Delivery System. *J. Dent. Educ.* **1993**, *57*, 876–887. [CrossRef]
21. Grad, F.P. The Preamble of the Constitution of the World Health Organization. *Bull. World Health Organ.* **2002**, *80*, 981–984.
22. Reisine, S.T. Theoretical Considerations in Formulating Sociodental Indicators. *Soc. Sci. Med. A* **1981**, *15*, 745–750. [CrossRef]
23. Cochrane Handbook for Systematic Reviews of Interventions. Available online: https://training.cochrane.org/handbook (accessed on 17 September 2023).
24. John, M.T. Health Outcomes Reported by Dental Patients. *J. Evid. Based Dent. Pract.* **2018**, *18*, 332–335. [CrossRef]
25. Reissmann, D.R. Dental Patient-Reported Outcome Measures Are Essential for Evidence-Based Prosthetic Dentistry. *J. Evid. Based Dent. Pract.* **2019**, *19*, 1–6. [CrossRef]
26. Rozier, R.G.; Pahel, B.T. Patient- and Population-Reported Outcomes in Public Health Dentistry: Oral Health-Related Quality of Life. *Dent. Clin. N. Am.* **2008**, *52*, 345–365. [CrossRef]
27. John, M.T. Standardization of Dental Patient-Reported Outcomes Measurement Using Ohip-5—Validation of "Recommendations for Use and Scoring of Oral Health Impact Profile Versions". *J. Evid. Based Dent. Pract.* **2022**, *22*, 101645. [CrossRef]
28. Listl, S. Value-Based Oral Health Care: Moving Forward With Dental Patient-Reported Outcomes. *J. Evid. Based Dent. Pract.* **2019**, *19*, 255–259. [CrossRef]
29. Palaiologou, A.; Kotsakis, G.A. Dentist-Patient Communication of Treatment Outcomes in Periodontal Practice: A Need for Dental Patient-Reported Outcomes. *J. Evid. Based Dent. Pract.* **2020**, *20*, 101443. [CrossRef]
30. Stellrecht, E.; Theis-Mahon, N.R.; Schvaneveldt, N. Role of Librarians and Information Professionals in Identifying Dpros in the Evidence. *J. Evid. Based Dent. Pract.* **2022**, *22*, 101649. [CrossRef]
31. John, M.T.; Sekulić, S.; Bekes, K.; Al-Harthy, M.H.; Michelotti, A.; Reissmann, D.R.; Nikolovska, J.; Sanivarapu, S.; Lawal, F.B.; List, T.; et al. Why Patients Visit Dentists—A Study in All World Health Organization Regions. *J. Evid. Based Dent. Pract.* **2020**, *20*, 101459. [CrossRef]
32. Feine, J.S.; Carlsson, G.E.; Awad, M.A.; Chehade, A.; Duncan, W.J.; Gizani, S.; Head, T.; Heydecke, G.; Lund, J.P.; MacEntee, M.; et al. The McGill Consensus Statement on Overdentures. Mandibular Two-Implant Overdentures as First Choice Standard of Care for Edentulous Patients. *Gerodontology* **2002**, *19*, 3–4.
33. von Elm, E.; Altman, D.G.; Egger, M.; Pocock, S.J.; Gøtzsche, P.C.; Vandenbroucke, J.P.; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: Guidelines for Reporting Observational Studies. *Lancet* **2007**, *370*, 1453–1457. [CrossRef]
34. World Health Organization. *Handbook for Good Clinical Research Practice (GCP): Guidance for Implementation*; World Health Organization: Geneva, Switzerland, 2005; ISBN 978-92-4-159392-2.
35. Scarano, A.; Conte, E.; Mastrangelo, F.; Greco Lucchina, A.; Lorusso, F. Narrow Single Tooth Implants for Congenitally Missing Maxillary Lateral Incisors: A 5-Year Follow-up. *J. Biol. Regul. Homeost. Agents* **2019**, *33*, 69–76.
36. Scarano, A.; Murmura, G.; Carinci, F.; Lauritano, D. Immediately Loaded Small-Diameter Dental Implants: Evaluation of Retention, Stability and Comfort for the Edentulous Patient. *Eur. J. Inflamm.* **2012**, *10*, 19–23.
37. Dilek, O.C.; Tezulas, E. Treatment of a Narrow, Single Tooth Edentulous Area with Mini-Dental Implants: A Clinical Report. *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod.* **2007**, *103*, e22–e25. [CrossRef]
38. Flanagan, D. Fixed Partial Dentures and Crowns Supported by Very Small Diameter Dental Implants in Compromised Sites. *Implant. Dent.* **2008**, *17*, 182–191. [CrossRef]
39. Brandt, R.; Hollis, S.; Ahuja, S.; Adatrow, P.; Balanoff, W. Short-Term Objective and Subjective Evaluation of Small-Diameter Implants Used to Support and Retain Mandibular Prosthesis. *J. Tenn. Dent. Assoc.* **2012**, *92*, 34–38; quiz 38–39.
40. Allum, S.R.; Tomlinson, R.A.; Joshi, R. The Impact of Loads on Standard Diameter, Small Diameter and Mini Implants: A Comparative Laboratory Study. *Clin. Oral Implant. Res.* **2008**, *19*, 553–559. [CrossRef]
41. Davarpanah, M.; Martinez, H.; Tecucianu, J.F.; Celletti, R.; Lazzara, R. Small-Diameter Implants: Indications and Contraindications. *J. Esthet. Dent.* **2000**, *12*, 186–194. [CrossRef]
42. Barber, H.D.; Seckinger, R.J. The Role of the Small-Diameter Dental Implant: A Preliminary Report on the Miniplant System. *Compendium* **1994**, *15*, 1390, 1392.
43. Erwood, I. Denture Stabilization with Small-Diameter Implants. *Dent. Today* **2010**, *29*, 116–118.
44. de Sá, B.C.M.; Andrighetto, A.R.; Bernardes, S.R.; Tiossi, R. Fracture Strength of Standard and Small Diameter Prosthetic Abutments for Full-Arch Implant-Supported Restorations. *J. Oral Implantol.* **2017**, *43*, 175–179. [CrossRef]
45. Christensen, G.J. The Increased Use of Small-Diameter Implants. *J. Am. Dent. Assoc.* **2009**, *140*, 709–712. [CrossRef]
46. Teodorescu, C.; Preoteasa, E.; Preoteasa, C.T.; Murariu-Măgureanu, C.; Teodorescu, I.M. The Biomechanical Impact of Loss of an Implant in the Treatment with Mandibular Overdentures on Four Nonsplinted Mini Dental Implants: A Finite Element Analysis. *Materials* **2022**, *15*, 8662. [CrossRef]

47. Comfort, M.B.; Chu, F.C.S.; Chai, J.; Wat, P.Y.P.; Chow, T.W. A 5-Year Prospective Study on Small Diameter Screw-Shaped Oral Implants. *J. Oral Rehabil.* **2005**, *32*, 341–345. [CrossRef]
48. Moris, I.C.M.; Faria, A.C.L.; de Mattos, M. da G.C.; Ribeiro, R.F.; Rodrigues, R.C.S. Mechanical Analysis of Conventional and Small Diameter Conical Implant Abutments. *J. Adv. Prosthodont.* **2012**, *4*, 158–161. [CrossRef]
49. Erwood, I. Stabilizing Partial Dentures Using Small-Diameter Implants. *Dent. Today* **2010**, *29*, 116, 118–119.