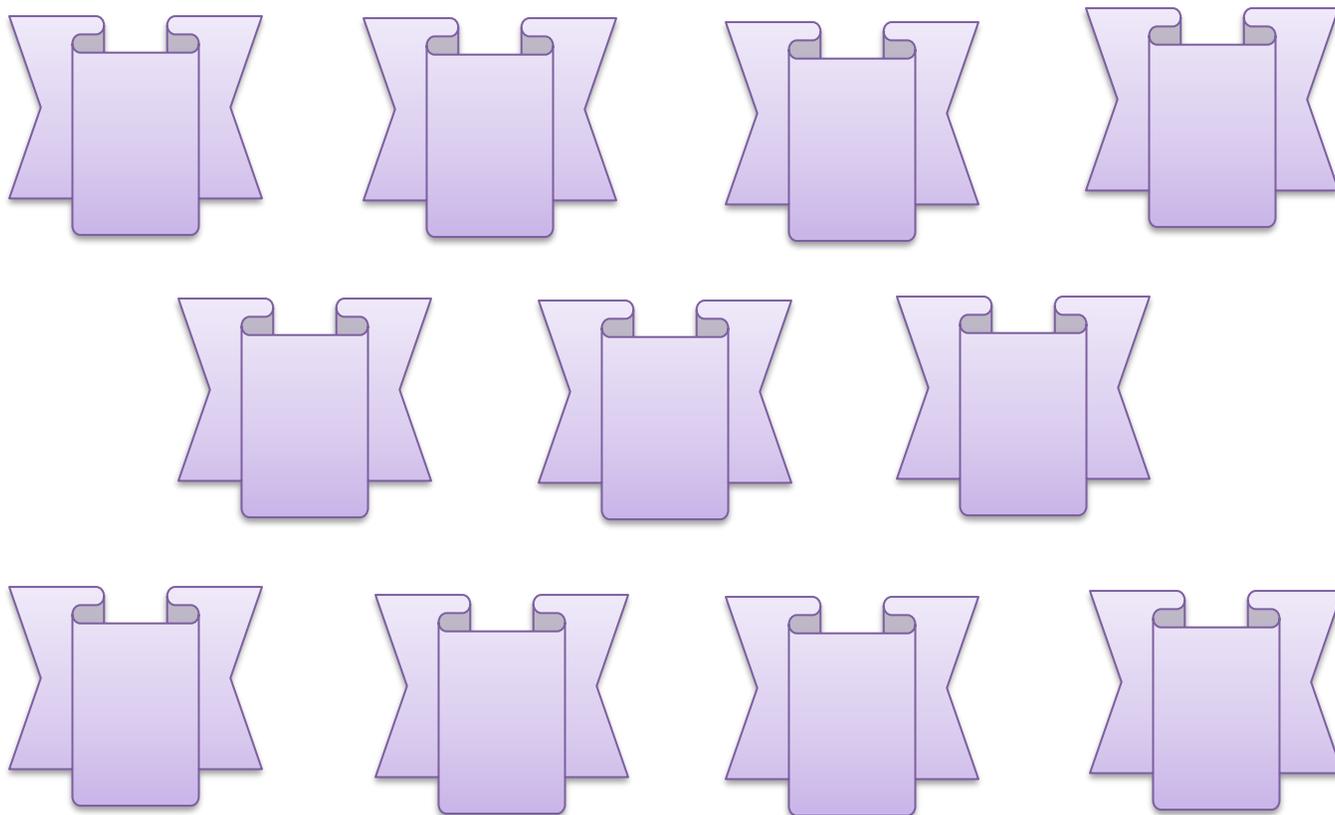


INTERNATIONAL JOURNAL OF MEDICAL ARTS



Volume 5, Issue 11, November 2023

<https://ijma.journals.ekb.eg/>



Print ISSN: 2636-4174

Online ISSN: 2682-3780



Available online at Journal Website
<https://ijma.journals.ekb.eg/>
Main Subject [Dentistry]



Original Article

Implant Survival in The Anterior Mandible: A Retrospective Cohort Study

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ABSTRACT

Article information

Received: 07-08-2023

Accepted: 26-11-2023

DOI:
10.21608/IJMA.2023.227801.1765.

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Citation: Sougei A, Eshaweirf E. Implant Survival in The Anterior Mandible: A Retrospective Cohort Study. IJMA 2023 November; 5 [11]: 3832-3837. doi: 10.21608/IJMA.2023.227801.1765.

Background: Dental implants are used to replace missing teeth. They are developed using a process called osseointegration, which helps the implants fuse with the jawbone. The anterior part of the lower jaw is of utmost importance in dental implantology, as it poses distinctive difficulties and factors that affect the long-term effectiveness.

The Aim of the work: This study aims to report the implant survival rate of dental implants of partially dentate patients in the anterior mandible and the potential risk indicators for implant failure.

Methods: We examined patients who had artificial teeth implanted in their lower front jaw. We recorded information about the patients, when the implant was placed, how it was loaded, and any problems that occurred during their last visit for check-up. We checked how likely an implant is to stay in place, how well it works, and any signs that it could fail.

Results: We found that 30 out of 300 implants were not successful. This means that the overall success rate was 98%. Additionally, we looked into how certain factors may affect the survival of the implants. We looked at how different factors such as implant position and implant diameter affected the chances of an implant surviving using a statistical model. We discovered that the only important factor was the 2-stage procedure.

Conclusion: The main result of this study was that 98% of the people who participated in the study were still alive after 10 years. Having surgery in two stages greatly increased the chances of the implant not working properly. Gender, age, size, length, type of device, location, timing of surgery, bone graft, and type of restoration have no impact on how well the treatment worked. We need to do more research with more people to find out the main factors that affect how well the treatment works.

Keywords: Anterior implant; Survival; Success; Failure.



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INTRODUCTION

The front part of the lower jaw is structurally prone to excessive bone loss after removing a tooth. This makes it a special area in the mouth where dental implants can be placed. The thick outer layer of bone and the way the ridges form after losing a tooth can greatly affect where dental implants are placed and how well they work. So, if a tooth is considered hopeless, the plan for placing an implant and attaching a replacement tooth should start before the tooth is taken out ^[1].

Several things about the front lower jaw area can make it difficult to replace teeth with dental implants. First, the roots of the lower incisor teeth are narrow at the top and often not in the right position for an implant. Second, the bone in this area is structured in a way that makes it hard for the implant to stay in place without additional treatment to build up the bone. Third, the gums in this area are thin and the bone on the outside is thin as well, which can cause the bone to break down after a tooth is removed. Fourth, this area is used a lot for speaking and chewing, so there are strong forces on the implant. Fifth, some people want the implant to look very natural, which can be difficult to achieve. Sixth, there are also some anatomy limitations in this area, like the position of certain nerves ^[2].

Basically, dental implants usually last a long time, but a recent review found that there isn't enough information about how well single implants in the front lower jaw work for people who are missing some teeth. In general, there isn't much specific information about how well implants in the front lower jaw work ^[3].

Many doctors believe that replacing teeth in this area is an easy process. This idea is about helping people who have lost all their teeth. When the jawbone has shrunk and there is only a little bit left at the bottom, it can be a good place to put dental implants ^[4].

PATIENTS AND METHODS

In this study, 200 patients who had dental implants to restore either one or more teeth in the front lower jaw were examined. We recorded information about the patients, when the implant was placed, and how it was loaded. We also noted any problems that occurred during the follow-up visit. We calculated the

chances of survival, success, and risk indicators for implant failure.

Inclusion criteria: The study included patients who got Oneplant® implants, who had the implants in for more than 5 years, and who had enough dental records and x-rays to track their condition after getting the implant.

Study Variables

In this study, the researchers looked at nine different things: [1] whether the patient was male or female, [2] how old the patient was when they got a dental implant, [3] whether the patient had some or all of their teeth missing in their lower jaw, [4] where in the jaw the implant was placed [front or back], [5] whether the implant was put in right away or after a delay, [6] the size and type of implant used, [7] the quality of the bone in the jaw, [8] the type of false teeth used, and [9] whether one or more implants were put in. We collected information about the implants when they were put in or when the artificial teeth were installed.

The front teeth are called anterior teeth and include those from canine to canine. The back teeth are called posterior teeth and include premolars and molars. Mandibular edentulism means not having any teeth in the lower jaw, regardless of whether the person has teeth in the upper jaw or not.

Surgical protocols

An experienced gum specialist at the Periodontology Department did all the surgeries. The dentist installed the implant fixture after lifting the gum and raising the sinus or adding more bone. They also used gum grafts depending on what the patient needed. When the bone had grown enough, the healed ridge was opened up, water was used to clean out the area, and a metal piece was put in place. If the twisting force when putting something in was not very strong, then a surgery was done in two steps. Otherwise, the surgery was done in one step. To make up for a lack of bone in a ridge, a bone enhancement procedure was done before or at the same time as the implantation. To quickly put in the implant, the flap was moved into position without lifting it after the tooth was removed.

Three different types of Oneplant® implants from Warantec in Seoul, Korea were used. The

first type has a hexagonal connection on the outside. The second type has an octagonal connection on the inside. The third type is a bone-level implant with a roughened surface and a special thread design that allows for self-cutting. The thread on this type of implant gets deeper towards the end.

Outcome Variable: The outcome variable was implant survival rate and failures.

Statistical analysis: We analyzed the data using a computer program called SPSS version 25.0 made by IBM in Armonk, NY, USA. We used Kaplan-Meier analysis to calculate the CSR. The chi-square tests and multiple Cox proportional hazard models were used to figure out what factors were impacting how well the implants were staying in place. The factors that were studied were age, sex, size of the implant, length of the implant, type of fixture, location where the implant was placed, the surgical procedure, timing of the surgery, guided bone regeneration [GBR], sinus graft, and the type of restoration used. In all the statistical analyses, we considered a value of P less than 0.05 to be significant.

RESULTS

In the study, we looked at 200 cases. Out of these, 65% were male and 35% were female. Most of the cases were aged between 51 and 70 years [48% of the total]. Among them, 43% were smokers. We also found other health conditions in some of the cases. 40% had obesity, 12% had diabetes [DM], 35% had high blood pressure [HTN], 15% had cardiovascular diseases [CVD], 6% had osteoporosis, and 4% had arthritis. However, 17% of the cases were healthy and didn't have any medical conditions, as shown in table [1].

In simpler terms, there were a total of 300 implants. Out of these, 65% had a diameter smaller than 3.3 mm, 7% had a diameter between 3.3 and 4.1 mm, and 25% had a diameter greater than 4.1 mm. 3% of the implants had missing information. As for the implant manufacturers, 84% were made by Straumann, 15% were made by Nobel, and 1% were made by other companies.

The position of the implant in the mouth was mainly in the second tooth on the bottom right side in 25% of the cases. The type of implant used was mainly a fixed partial denture in 74% of the cases. The way the prosthesis [implant-supported tooth] was held in place was

mainly through cement in 44% of the cases. Regarding the surgical procedure, 70% were done in one stage and 30% were done in two stages. In 94% of cases, the timing of the surgery was delayed, while in 6% it was done immediately. Guided bone regeneration without any additional grafting was done in 85% of cases, while grafting was done in 15%. A lateral approach was used for sinus grafting in 7% of cases, and a crestal approach was used in an unspecified percentage. In simpler terms, 68% of the restoration type used was a splinted crown, as shown in table [2].

The risk of implant failure was significantly higher when the surgery was done in two stages compared to other methods [hazard ratio: 4.769, P=0.039]. Other things like gender, age, size, length, type of fixture, location, timing of surgery, GBR, sinus graft, and type of restoration didn't have a big impact on the survival rate.

Cumulative success rate and implant failure: Out of 300 implants, 30 were not successful. The overall success rate was 98%, as shown in table 3. We also looked at how these factors might affect the success of the implant. We looked at how different factors affected the survival rates of implants. After comparing various factors using a statistical model, we found that the only important factor affecting survival was the two-stage procedure. This means that the likelihood of survival was significantly influenced by whether the implant was done in two stages or not.

Evaluation of the effectiveness of implants in the lower jaw in relation to different factors, nine in total: The data reveals the effectiveness of lower jaw implants based on various factors. The overall success rate is high for both males and females [98.0%], with a slight difference in significance [p=0.141]. Implants in the age group 20-39 have a 100% success rate, while those in 40-59 and 60 have high success rates. Diameter [3.3 mm and 3.6 mm] and length [8.5 mm] have 100% success rates, respectively. External and One-body fixture types have high success rates [97.6% and 100%, respectively], while Internal 1 fixture type has a high success rate [98.2%]. The data also shows high success rates in various locations, with mandibular anterior implants having a 100% success rate. However, some differences are observed in the maxillary and mandibular regions, but overall success rates are high.

Table [1]: Demographic data in the Studied group

Parameter	Studied patients [n=200]	
Gender, n [%]	Males	130 [65%]
	Females	70 [35%]
Age [years]	≤30	10 [5%]
	31–50	54 [27%]
	51–70	96 [48%]
	≥71	40 [20%]
Smoking status	Non-smoker	114 [57%]
	Smokers	86 [43%]
Systemic disease	Obesity [BMI > 25]	80 [40%]
	Diabetes	24 [12%]
	Hypertension	38 [35%]
	Cardiovascular disease	30 [15%]
	Osteoporosis	12 [6%]
	Arthritis	8 [4%]
	Healthy without any medical condition	34 [17%]

Table [2]: The implant characteristics

Parameter	Implant No. [n=300]	
Implant diameter	≤3.3 mm	195 [65%]
	3.3–4.1 mm	21 [7%]
	≥4.1 mm	75 [25%]
	Lack of information	9 [3%]
Implant manufacturer	Straumann	252 [84%]
	Nobel	45 [15%]
	Other	3 [1%]
Implant Position in arch	#22	57 [19%]
	#23	60 [20%]
	#24	30 [10%]
	#25	24 [8%]
	#26	75 [25%]
	#27	54 [18%]
Implant prosthetic design	Fixed partial denture	222 [74%]
	Single crown	60 [20%]
	Failed before loading	18 [6%]
Prosthesis retention type	Screw-retained	114 [38%]
	Cement-retained	132 [44%]
	Hybrid	9 [3%]
	Unknown	45 [15%]
Surgical procedure	1-stage	210 [70%]
	2-stage	90 [30%]
Surgical timing	Delayed	282 [94%]
	Immediate	18 [6%]
Guided bone regeneration	No grafting	255 [85%]
	Grafting	45 [15%]
Sinus graft	No graft	270 [90%]
	Lateral approach	21 [7%]
	Crestal approach	9 [3%]
Restoration type	Single	54 [18%]
	Splinted crown	204 [68%]
	Bridge	42 [14%]

Table [3]: Cumulative survival rates according to variables and a Cox proportional model of implant survival for 5 years via backward stepwise regression

Variables		No. of placed implants [n=300]	No. of failed implants [n=30]	CSR [%]	Significance	Exp [B]	95% CI	
							Lower bound	Upper bound
Sex	Male	183	18	98.0	Reference	-	-	-
	Female	117	12	97.9	0.141	0.269	0.047	1.544
Age [yr.]	20–39	9	0	100	Reference	-	-	-
	40–59	176	21	97.6	0.960	590	0.000	6.86E+109
	60	115	9	98.4	0.960	555	0.000	6.46E+109
Diameter [mm]	3.3	25	0	100	Reference	-	-	-
	3.6	16	0	100	0.984	0.014	0.000	2.57E+176
	4.1	14	3	95.7	0.979	112	0.000	3.92E+156
	4.3	218	21	98.0	0.984	37.7	0.000	1.33E+156
	5.3	27	6	95.6	0.982	54.6	0.000	1.92E+156
Length [mm]	8.5	21	3	97.1	Reference	-	-	-
	10	97	9	98.1	0.773	0.702	0.063	7.788
	11.5	162	12	98.5	0.841	0.793	0.083	7.580
	13	20	6	93.8	0.092	10.282	0.684	154.638
Fixture type	External	177	21	97.6	Reference	-	-	-
	Internal 1	101	9	98.2	0.923	0.929	0.208	4.149
	One-body	22	0	100	0.983	0.015	0.000	2.22E+165
Location								
Maxillary anterior		31	0	100	Reference	-	-	-
Maxillary pre-molar		54	3	98.9	0.912	1.044	0.000	2.85E+56
Maxillary molar		103	12	97.6	0.912	1.016	0.000	2.74E+56
Mandibular anterior		8	0	100	0.987	8.559	0.000	3.14E+117
Mandibular pre-molar		30	6	96.0	0.895	3.957	0.000	1.07E+57
Mandibular molar		74	9	97.5	0.905	1.845	0.000	5.00E+56

Table [4]: Evaluation of the effectiveness of implants in the anterior part of the lower jaw

Evaluation Criteria	Successful Implants [n=270]	Unsuccessful Implants [n=30]	Success Rate [%]
Absence of Radiolucency around Implant	90%	0%	100%
Assessment of Natural-looking Gingival Contours	85%	10%	90%

DISCUSSION

In this study, they found 30 failures out of 300 implants, with an overall success rate of 98%. **Nam et al.** [5] found that the dental implants had a 97.9%. The customer satisfaction rates [CSRs] for both external and internal CSRs were 98.2% and 97.6% respectively. There was no noticeable difference between the two types [P=0.670].

Compared to a study by **Pedrinaci et al.** [6] in 2023 where the cumulative survival rate after 11.3 years was 90.9%, it is difficult to compare this with existing scientific evidence because there are not many studies that provide specific data on implant survival in the front part of the lower jaw in patients who are missing some teeth.

A systematic review [7] reported a weighted mean survival rate of 98.5%–100% for a total of 42 implants corresponding to the anterior mandible, although none of the studies reporting data on the anterior mandible [8, 9] were specifically designed to evaluate exclusively this region. The high survival rates reported in this systematic review are similar to another systematic review [10] assessing a 10-year

implant survival rate considering implants placed in all areas of the mouth, reporting 96.4% [95% CI 95.2%–97.5%]. We also looked into how these factors could affect the success of the implant. After studying the chances of survival based on different factors using a statistical model, we discovered that the only important factor affecting the success of implant surgery was the two-stage procedure.

If the implant procedure is not stable enough at the beginning or if a large bone graft is needed, it is better to use the submerged method. In a study by **Troiano et al.** [11] in 2008, they found that when a healing technique called submerged healing was used, there were fewer cases of early implant failure compared to a different healing technique called non-submerged healing. They also found that submerged healing was better for early bone remodeling.

The reason why submerged healing didn't work well in this study is because the second surgery was done in a place with weak bones. If the implant is not stable at the beginning, there is a high chance it will fail quickly, but we don't know if it will fail later on. Some main reasons for implants failing later on include putting too much pressure on them, having an infection

near the implant, and not making the replacement teeth correctly. More studies are necessary to understand what happens to people with weak bones when micro-threads are used over a long period of time.

When comparing the implant survival rates of the submerged protocol [2-stage surgery] and the transmucosal protocol [1-stage surgery], **Flores-Guillen et al.** [12] showed no significant difference in the survival rate in a 5-year randomized clinical trial, and **Sanz et al.** [13] reported radiographically significant changes in crestal bone level in a 3-year randomized clinical trial. Likewise, no significant difference was found in implants with or without bone grafts, similar to the results observed in other studies [14].

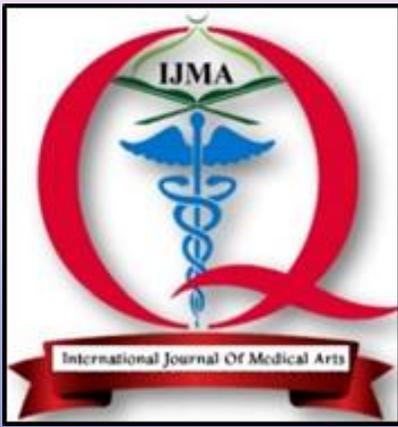
According to this research, implants in the lower jaw seem to have a good overall effectiveness across several parameters. The use of one-stage surgery is advantageous because it consistently achieves high success rates in different patient populations, implant sizes, fixture types, and sites. Nevertheless, the choice between one-stage and two-stage surgery should take into account supplementary clinical criteria, patient-specific attributes, and the preferences of both the practitioner and the patient. It is crucial to evaluate the advantages and possible hazards linked to each method within the framework of specific instances. Furthermore, it is imperative to engage in a consultation with the patient and take into account their preferences and level of comfort in order to arrive at a well-informed conclusion.

Conclusion: Our research significantly enhances the comprehension of implant survival dynamics, highlighting the crucial significance of surgical methodology. These findings have significance for evidence-based clinical decision-making, allowing practitioners to optimize treatment regimens for improved implant outcomes. We should continue conducting research to investigate the changing elements that affect the outcomes of implantology and improve our methods for assuring long-term success of implants in various patient groups.

Financial and non-financial relations and activities of interest: None

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International Journal

<https://ijma.journals.ekb.eg/>

Print ISSN: 2636-4174

Online ISSN: 2682-3780

of Medical Arts