

The Symphyseal Single-tooth Implant for Anchorage of a Mandibular Complete Denture in Geriatric Patients: A Clinical Report

Gerald Krennmair, MD, DMD¹/Christian Ulm, MD, DMD²

Little information exists to define the minimum number of implants required for sufficient anchorage of mandibular overdentures. To date, 2 implants placed in the interforaminal region have been considered the minimum. The aim of this study was to examine whether a single symphyseal implant would suffice for adequate anchorage of a mandibular complete denture in elderly patients (octogenarians), and whether this surgically, prosthetically, and financially simple concept would also satisfy patients needing replacement of the mandibular dentition. Nine patients with a mean age of 82.2 years underwent placement of a single symphyseal endosseous implant and anchorage of a complete denture using a ball attachment. Standardized recall examinations, including patient response and inspections of the peri-implant soft tissue and bone conditions, were carried out at 3- to 6-month intervals for a period of 1½ years. It was found that anchorage with a single implant led to both a significant improvement in patients' subjective satisfaction ($P < .01$) and a significant reduction in reported symptoms ($P < .01$). During the observation phase, pocket depth and bone resorption initially increased around implants but stabilized after the sixth month. Denture management (placement and removal) also improved during the recall period ($P < .01$). The results of this study indicate that oral rehabilitation by mandibular complete dentures anchored on a single implant can be considered an economical therapeutic alternative to a conventional mandibular complete denture for very old (octogenarian) patients. (INT J ORAL MAXILLOFAC IMPLANTS 2001;16:98–104)

Key words: geriatric dentistry, implant-supported dental prosthesis, mandibular complete denture, mandibular symphysis, single-tooth dental implant

Endosseous implants have been used successfully for the oral rehabilitation of patients with edentulous mandibles for almost 35 years.¹ Numerous studies have reported high success rates with respect to the placement and osseointegration of endosseous implants, particularly in the interforaminal region.^{2,3} This kind of implant-related oral rehabilitation is particularly useful in geriatric patients, whose chief complaints are related to discomfort, instability, and lack of retention of a mandibular complete denture.^{2,4} Because clinical

long-term results have also demonstrated satisfactory function of implant-anchored dentures, this concept may be considered a safe and acceptable method for anchorage of denture prostheses used for the rehabilitation of edentulous patients.^{1–4} However, there appears to be no consensus regarding the number of implants required for the anchorage of dentures. Depending on the anatomic morphology of the mandible and the applied prosthetic concept, 2, 4, or 6 implants have been used to stabilize complete dentures.^{5,6} To date, 2 implants placed in the interforaminal region have been considered the minimum number of implants required for anchorage of an implant/mucosa-supported denture.^{4–7} However, in geriatric patients with severe mandibular atrophy, the minimum number of implants required is not clearly understood.^{6–8}

Results of the placement of implant-supported fixed prostheses in the mandibular anterior region indicate that implants placed in the symphyseal region enhance stability and function because of

¹Clinical Lecturer, Dental School, University of Vienna, Austria; and Private Practice, Wels, Austria.

²Associate Professor, Department of Oral Surgery, University of Vienna, Austria.

Reprint requests: Dr Gerald Krennmair, Trauneggssiedlung 8, 4600 Wels, Austria. Fax: +43-7243-518136. E-mail: krennmair@aon.at

favorable local bone quality and quantity.^{3,9} Cordoli and colleagues have suggested that single-implant-supported overdentures may be appropriate for the treatment of edentulism in geriatric patient groups because of diminished functional demands and the realization that implant/patient life expectancy is limited.⁸

The aim of this investigation was to examine whether adequate anchorage of a mandibular complete denture can be achieved by means of a single symphyseal implant in elderly (ie, octogenarian) patients with mandibular atrophy when patient satisfaction and prosthetic function were considered the criteria for successful treatment.

MATERIALS AND METHODS

Nine patients (7 females, 2 males) with a mean age of 82.2 ± 3.4 years (range 77 to 88) were included in this study. All patients had been edentulous in both the maxilla and the mandible for years, and both jaws had been treated with complete dentures. The duration of mandibular edentulism ranged from 12 to 30 years (mean 19.2 ± 7.2 years) and the duration of maxillary edentulism ranged from 12 to 22 years (mean 16.3 ± 4.6 years). The number of mandibular dentures varied from 3 to 5 (mean 3.8 ± 0.6), and the number of maxillary dentures ranged from 2 to 3 (mean 2.7 ± 0.7). The mean service time was 5.2 ± 1.3 years (range 4 to 8 years) for current mandibular dentures and 6.2 ± 1.4 years (range 4 to 8 years) for maxillary dentures.

The main clinical problem for all patients was inadequate mandibular denture retention. In all patients, the mandibular complete dentures had been rebased several times within a 1- to 6-month period, but this had not led to sufficient denture retention and patient satisfaction. Although almost all patients reported a history of relative risk factors such as hypertension, arteriosclerosis, and diabetes mellitus, none of these conditions were considered exclusion criteria for this prospective study. Patients with tumor, neurologic or cerebrovascular diseases, or hemorrhagic or severe cardiopulmonary disorders were excluded.

Criteria for inclusion in this clinical investigation were severe atrophy (Cawood and Howell 1988,¹⁰ Classes V, VI) in the posterior and anterior region and treatment planned with an identical prosthetic concept. All patients were scheduled to undergo treatment with an implant-anchored, mucosa-supported prosthesis. All patients underwent placement of a single symphyseal implant, either IMZ (n = 7; Interpore International, Irvine, CA) or Frialit-2 (n =

How satisfied are you:

- with dentures (in general)?
- with the maxillary denture (in general)?
- with the fit of the maxillary denture?
- with the mandibular denture (in general)?
- with the fit of the mandibular denture?
- with speech?
- with the dentures' appearance?
- with chewing ability (eating)?

Are there:

- functional complaints (during speech, eating, smiling)?
- with the complete dentures in general?
- in connection with the maxillary denture?
- in connection with the mandibular denture?
- physiognomic complaints (pinched mouth)?
- lip and/or cheek biting?
- esthetic appearance of the dentures?

Fig 1 Questionnaire used for evaluating patients' satisfaction/complaints before and after anchorage of the mandibular denture by means of a ball attachment (scores 1 to 5, with 1 as "most satisfaction/fewest complaints" and 5 denoting "unsatisfactory/severe complaints").

2; Friatec, Mannheim, Germany), for better anchorage of the denture. After a 3-month healing period, the implants were supplied with a healing abutment for 2 to 4 weeks. The mandibular denture was then newly fabricated or newly adapted and anchored by means of a ball attachment (Friatec).

The study incorporated a preoperative assessment of patients who were dissatisfied with the retention of renewed (rebased) well-made conventional mandibular dentures. The initially dissatisfied patients were examined and evaluated for subjective parameters before implant placement and after placement of the denture by means of a standardized questionnaire (Fig 1). Recall examinations were carried out at 3, 6, 12, and 18 months after placement of the denture.⁴ In these recall examinations, patients' satisfaction and complaints were assessed and compared with the dissatisfied baseline data. To quantify the level of satisfaction/complaints, a scale ranging from 1 to 5 ("very good/good/satisfactory/sufficient/not satisfactory" and "no/mild/moderate/severe/very severe complaints") was used to evaluate the subjective data.

With special consideration of the use of a single-tooth implant for denture anchorage, patients were queried regarding denture handling (placement and removal) and possible disturbing rotation effects on the other. Again, a score ranging from 1 to 5 ("not difficult to handle" to "very difficult to handle" and

“not disturbing” to “very disturbing”) was used to evaluate the success of treatment.

To assess the peri-implant conditions, measurements of pocket depth (mean, in mm) at 4 locations at each site (buccal, anterior, posterior, lingual) were carried out with a calibrated periodontal probe (Hu-Friedy, 16-88-1, Chicago, IL), and bleeding and plaque indices were determined.^{8,11,12} To evaluate the conditions at the bone-implant interface, the discernible bone resorption (mm) was measured radiographically by means of the right angle technique. For this purpose, the distance from the implant surface to the alveolar ridge was measured. In addition, Periotest values (Siemens, Bensheim, Germany) for all implants were assessed¹³ at every recall examination.

Mean values were compared by means of Student's *t* test. *P* values < .05 were considered statistically significant.

RESULTS

All 9 patients met the morphologic and prosthetic inclusion criteria. All patients showed atrophy¹⁰ in the mandibular posterior and anterior regions and were scheduled to be treated or had been treated with the same prosthetic concept (implant/mucosa-supported denture). A single implant was placed in the symphyseal region in a single, brief surgical procedure. Because of the minimum access required and thus minimum trauma to the surrounding tissue, the patients reported either no or only minimal complaints in the postoperative period.

All 9 implants (9 patients)—7 IMZ implants (6 were 13 mm long, and 1 was 15 mm long) and 2 Frialit-2 implants (both 13 mm long)—became osseointegrated and subsequently supported mandibular dentures retained by ball attachments (7 newly fabricated dentures, 2 re-adaptations of existing dentures). All patients were available for recall examinations at 3-month intervals.

Figures 2a to 2c show a typical treatment situation. Table 1 lists the mean values of the subjective satisfaction and complaint scores, taken both preoperatively and after anchorage of the denture on the ball attachment at the recall examinations at 3, 6, 12, and 18 months. It was found that symphyseal anchorage of the mandibular complete denture resulted in a significant increase (*P* < .01) in patients' subjective satisfaction and a significant decrease (*P* < .01) in complaints over the entire observation period (1.5 years). Figure 3 presents the overall satisfaction and complaints before and after anchorage of the complete dentures by means of a single ball attachment.

The evaluation of denture handling, ie, denture removal and placement, revealed an overall improvement (*P* < .01) after initial moderate difficulties (Fig 4). A significant (*P* < .01) improvement in denture handling was achieved from about the sixth month on by repeated practice and active involvement of the patients (Fig 4). Only 1 patient experienced disturbing rotational movements, which were remedied by sublingual extensions of the denture base.

During the whole observation period, peri-implant pocket depths varied between 1.8 and 4.4 mm, with a general mean value of 2.6 ± 0.7 mm, but showed no statistically significant differences over time (Fig 5). Compared with the initial situation (0.8 ± 0.3 mm), bone resorption increased by 0.8 to 1.5 mm up to the sixth month but remained almost stable from the second recall examination (6 months) and after (Fig 5). While the mean Bleeding Index was generally low (0.5 ± 0.4), the Plaque Index increased over time (2.4 ± 0.8 ; Fig 6). The mean Periotest values for all implants were always negative and ranged from -2 to -6, with a mean value of -3.4 ± 1.1 . The Periotest values revealed no significant differences with respect to the type or length of implant used (Table 2).

DISCUSSION

Traditionally, 2, 4, or 6 implants have been used for anchorage of dentures in the edentulous mandible to enhance retention.^{5,6,14,15} Various bar configurations connecting implants using different retention elements or single ball attachments have been used as anchorage modalities.^{4,16-18} Numerous authors have reported on osseointegration, the service time of implants, and long-term success rates of implant-supported dentures.^{1,3,5,19} However, opinions vary as to the minimum number of implants required for adequate anchorage of a complete denture, depending on the prosthetic concept used.^{1,5-8,20} At least 4 implants are generally required for the support of a completely implant-supported prosthesis.^{1,5,19} For severe mandibular atrophy, the prosthetic concept of implant-supported overdentures is frequently used.^{5,21} In this concept, the denture is usually anchored to at least 2 interforaminal implants, which may be connected by a bar.^{1,5-7} One disadvantage of bar constructions is limited hygiene and the possible development of mucosal hyperplasia.^{2,14,22} If sufficient local bone volume is available posteriorly, anterior anchorage and the existing rotational axis may cause further atrophy because of pressure in the posterior areas resulting from the extension base support.²³ Since

Fig 2a Orthopantomogram of patient with a symphyseal single-tooth implant placed in an atrophic mandible.

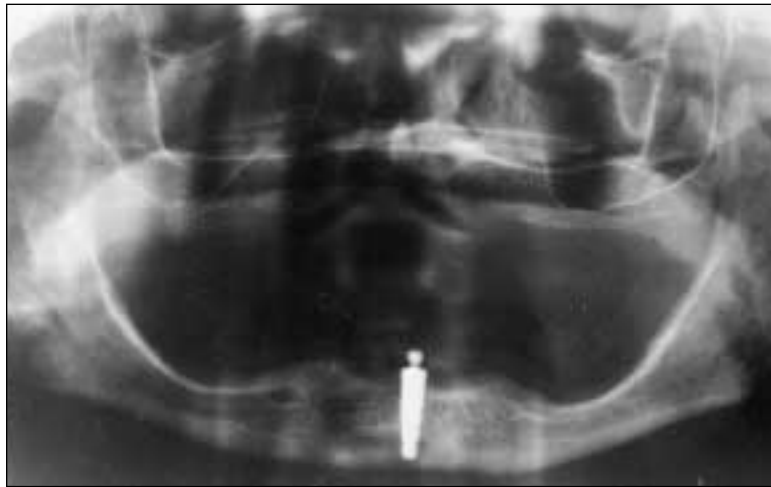


Fig 2b Ball attachment in the symphyseal region.



Fig 2c Mandibular complete denture with attachment.

Table 1 Patients' Subjective Evaluation of Their Satisfaction/Complaints Before and After Anchorage of the Mandibular Denture by Means of Ball Attachment (Score 1–5; Mean \pm SD)

Factor evaluated	Preoperatively	Recall			
		3 months	6 months	12 months	18 months
Satisfaction (1–5: very satisfied to not satisfied)					
With the dentures (in general)	3.4 \pm 0.5	1.4 \pm 0.5	1.3 \pm 0.5	1.5 \pm 0.5	1.2 \pm 0.4
With the maxillary denture (in general)	2.5 \pm 0.5	1.6 \pm 0.5	1.5 \pm 0.5	1.5 \pm 0.5	1.4 \pm 0.5
With the fit of the maxillary denture	1.8 \pm 0.5	1.9 \pm 0.3	1.8 \pm 0.5	1.8 \pm 0.5	1.9 \pm 0.4
With the mandibular denture (in general)	4.1 \pm 0.5	1.3 \pm 0.5	1.3 \pm 0.5	1.4 \pm 0.5	1.4 \pm 0.5
With the fit of the mandibular denture	4.1 \pm 0.5	1.0	1.0	1.0	1.0
With speech	3.7 \pm 0.5	1.2 \pm 0.4	1.2 \pm 0.4	1.4 \pm 0.5	1.2 \pm 0.4
With their appearance	3.7 \pm 0.8	1.2 \pm 0.4	1.2 \pm 0.4	1.4 \pm 0.5	1.4 \pm 0.5
With their chewing ability (eating)	4.4 \pm 0.5	1.0	1.0	1.0	1.0
Complaints (1–5: no complaints to very severe complaints)					
Functional complaints (during speech, eating, smiling)					
With the complete dentures in general	3.7 \pm 0.5	1.6 \pm 0.7	1.5 \pm 0.5	1.5 \pm 0.5	1.8 \pm 0.6
In connection with the maxillary denture	2.2 \pm 0.5	1.4 \pm 0.7	1.3 \pm 0.5	1.3 \pm 0.5	1.4 \pm 0.5
In connection with the mandibular denture	5.0	1.0	1.0	1.0	1.0
Physiognomic complaints (pinched mouth)	3.8 \pm 0.7	1.4 \pm 0.6	1.7 \pm 0.5	1.5 \pm 0.5	1.7 \pm 0.5
Lip and/or cheek biting	3.4 \pm 0.5	1.2 \pm 0.4	1.2 \pm 0.4	1.1 \pm 0.5	1.1 \pm 0.3
Esthetic appearance of the dentures	3.1 \pm 0.5	1.0	1.0	1.0	1.0

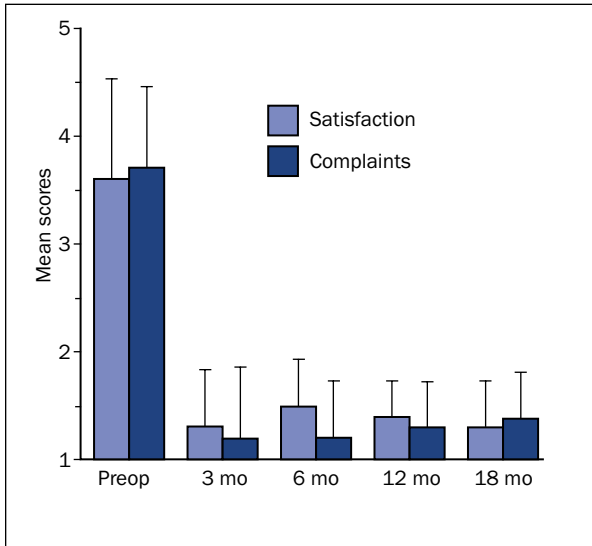


Fig 3 Mean scores for patient satisfaction and complaints before (preop) and after anchorage of the complete dentures by means of a single ball attachment (3, 6, 12, and 18 months post-operative). 1 = "most satisfaction/fewest complaints" and 5 = "unsatisfactory/severe complaints."

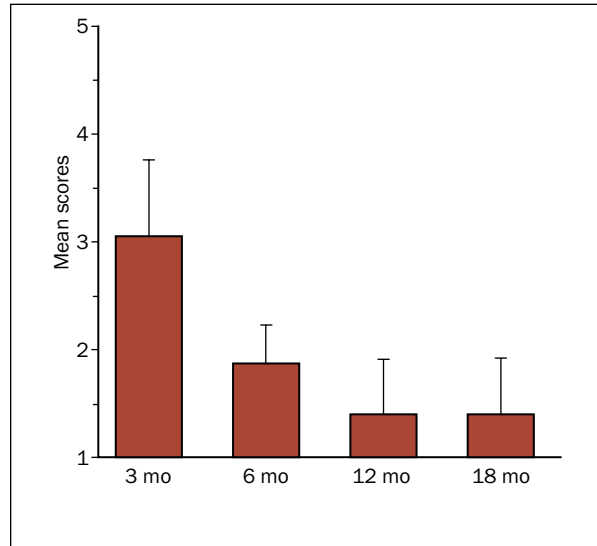


Fig 4 Mean scores for denture handling (placement onto and removal from the ball attachment) (1 = "not difficult to handle" to 5 = "very difficult to handle").

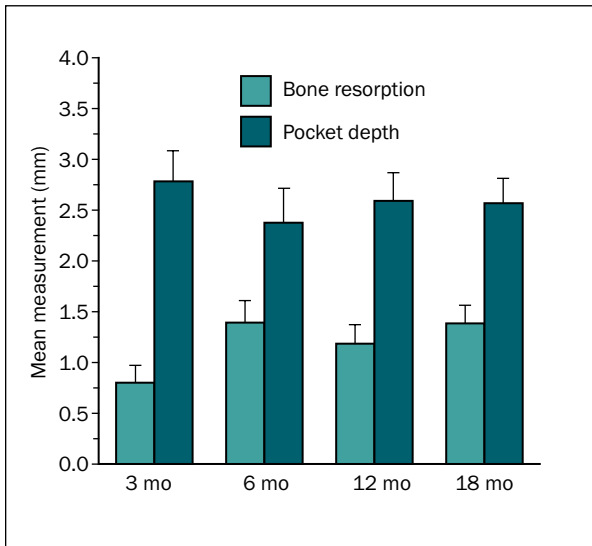


Fig 5 Mean values (in mm) for peri-implant bone resorption and pocket depth during the observation period.

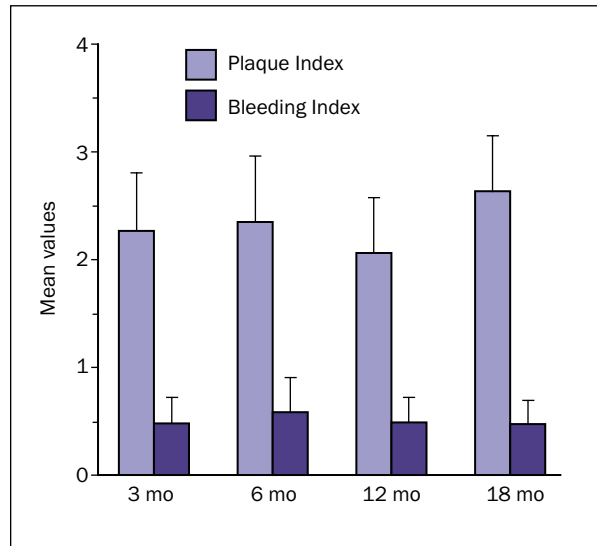


Fig 6 Mean values for plaque and bleeding indices at the symphyseal single-tooth implant.

Table 2 Damping Behavior (Periotest Values) of Symphyseal Single Implants

Patient	Implant type	Implant length	Periotest values			
			3 mo	6 mo	12 mo	18 mo
1	IMZ	13 mm	-3	-3	-3	-4
2	IMZ	13 mm	-2	-2	-3	-3
3	IMZ	13 mm	-4	-4	-6	-6
4	IMZ	13 mm	-4	-4	-4	-5
5	IMZ	13 mm	-2	-2	-2	-2
6	IMZ	13 mm	-3	-2	-3	-3
7	IMZ	15 mm	-3	-4	-4	-4
8	Frialit-2	13 mm	-2	-3	-3	-3
9	Frialit-2	13 mm	-5	-5	-4	-5

atrophy is simultaneously limited in the anterior mandibular region as a result of the remodeling stimulus around the implants, an imbalance develops between the anterior and the posterior region.²³ Modifications of bar morphology (eg, angular bar, posterior extensions) have made it possible to achieve some protection from rotation even with a small number of implants.^{5,6}

The disadvantages of connection bars have led to the use of ball attachments for denture anchorage.^{7,16-18} The fact that button or ball attachments result in sufficient anchorage of dentures is known from conventional and implant prosthetics. This type of anchorage makes peri-implant hygiene easier for older patients and also reduces the potential for mucosal hyperplasia. The resting pressure of the denture can also be used to avoid the development of an imbalance between the anterior and the posterior region.^{6,16,17} However, a disadvantage is the formation of various rotational axes that may result in tilting movements.

In the present study, this simple type of anchorage was attempted to achieve a minimum variant by using 1 single-tooth implant only. The present results indicate that it is possible to successfully use a single implant in combination with a button anchor for denture retention in special cases. The values obtained with regard to the patients' subjective satisfaction about the retention and fit of their dentures, functions such as speech and eating, and improved general facial esthetics were satisfactory and may not differ from those of prosthetic anchorage modalities that employ a greater number of implants.^{4,24} Particularly in patients ranging in age from 80 to 90 years who meet the anatomic and prosthetic requirements for this type of treatment, restoration can be a relatively inexpensive and a sur-

gically and prosthetically simple way of retaining a complete denture. The use of a single implant is justified because of the fact that, in patients with a mean age of 80 years, implant service time is probably limited and, in case of failure, the costs and the repetition of the procedure may not be prohibitive for the patient.

As far as the location of the single-tooth implant is concerned, the symphysis has both advantages and disadvantages. One advantage of the median position is that the symphysis constitutes an excellent host site for an implant in terms of bone quantity and quality.^{25,26} This region is also easily accessible, demanding minimal time and surgical trauma (eg, only local anesthesia is necessary), with the result that few perioperative complications are seen. For the clinician, too, the brief and simple surgical procedure required is advantageous in geriatric patients with general medical risk factors. One disadvantage of median button anchorage and implant position is the development of sagittal, transverse, and vertical rotational axes. This problem can be solved relatively easily and successfully during prosthetic treatment by increasing lateral (sublingual) extensions²⁷ when possible. Also, the patient must be manually able to facilitate handling (ie, insertion and removal) of the denture. After initial problems, this handling was achieved by repeated training of the patients.

The results of this investigation indicate that elderly patients with mandibular atrophy ranging between about 80 and 90 years of age can be restored by means of minimum surgical and prosthetic treatment. Patient responses indicating satisfactory results, particularly regarding the patients' subjective satisfaction, support further application of this method, but only after a strict determination of indication.

CONCLUSION

Oral rehabilitation with mandibular overdentures anchored to a single symphyseal implant can be a therapeutic alternative for elderly patients (about 80 to 90 years of age) experiencing discomfort and functional difficulties with conventional mandibular complete dentures. The results of this study show that this simplified procedure, which involves very minor surgery at a low cost of total treatment, can lead to a remarkable improvement in prosthesis stability and function as well as general oral comfort. Single-implant-supported overdentures may be appropriate for the treatment of edentulism in geriatric patient groups because of diminished functional demands and the realization that implant/patient life expectancy is limited.

REFERENCES

- 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.
- Enquist B, Bergendal T, Kallus T, Lindén U. A retrospective multicenter evaluation of osseointegrated implants supporting overdentures. *Int J Oral Maxillofac Implants* 1988;3:129-134.
- Lill W, Thornton B, Reichstaler J, Schneider B. Statistical analysis of the success potential of osseointegrated implants: A retrospective single dimension statistical analysis. *J Prosthet Dent* 1993;69:176-185.
- Burns DR, Unger JW, Elswick RK Jr, Giglio JA. Prospective clinical evaluation of mandibular implant overdenture: Part II—Patient satisfaction and preference. *J Prosthet Dent* 1995;73:364-369.
- Spiekermann H, Jansen VK, Richter EJ. A 10-year follow up study of IMZ and TPS implants in the edentulous mandible using bar retained overdentures. *Int J Oral Maxillofac Implants* 1995;10:231-243.
- Mericske-Stern R, Assal P, Buerger W. Simultaneous force measurements in 3 dimensions on oral endosseous implants in vitro and in vivo. A methodological study. *Clin Oral Implants Res* 1996;7:378-386.
- Hotmann M. Die totalprothetische Versorgung des alten Menschen. *ZWR* 1997;106:614-624.
- Cordioli G, Majzoub Z, Castagna S. Mandibular overdentures anchored to single implants: A five-year prospective study. *J Prosthet Dent* 1997;78:159-165.
- Haas R, Mendsdorff-Pouilly N, Mailath G, Watzek G, Brånemark single-tooth implants: A preliminary report of 76 implants. *J Prosthet Dent* 1996;73:274-279.
- Cawood JI, Howell RA. A classification of the dentulous jaws. *Int J Oral Maxillofac Surg* 1988;17:232-236.
- Silness J, Løe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. *Acta Odontol Scand* 1964;22:121-135.
- Mombelli A, Van Oosteen MA, Schurch E, Land NP. The microbiota associated with successful or failing osseointegrated titanium implants. *Oral Microbiol Immunol* 1987;2:145-151.
- Haas R, Saba M, Mendsdorff-Pouilly N, Mailath G. Examination of the damping behavior of IMZ implants. *Int J Oral Maxillofac Implants* 1995;10:410-413.
- Naert I, Quirynen M, Theuniers G, van Steenberghe D. Prosthetic aspects of osseointegrated fixtures supporting overdentures. A 4-year report. *J Prosthet Dent* 1991;65:671-680.
- Kalk W, van Waas MA, Engels SE. A comparison of different treatment strategies in patients with atrophic mandibles: A clinical evaluation after 6.5 years. *Int J Prosthodont* 1992;5:277-283.
- Donatsky O. Osseointegrated dental implants with ball attachments supporting overdentures in patients with mandibular alveolar ridge atrophy. *Int J Oral Maxillofac Implants* 1988;8:162-168.
- Owall B. Precision attachment-retained removable partial dentures: Part 2. Long-term study of ball attachment. *Int J Prosthodont* 1995;8:21-28.
- Setz J, Lee SH, Engel E. Retention of prefabricated attachments for implant stabilized overdentures in the edentulous mandible: An in vitro study. *J Prosthet Dent* 1998;80:323-329.
- Albrektsson T, Zarb G, Worthington P, Ericsson AR. The long-term efficacy of currently used dental implants: A review and proposed criteria of success. *Int J Oral Maxillofac Implants* 1986;1:11-25.
- Spiekermann H, Donath K, Jovanovic S, Richter J (eds). *Implantologie*. Stuttgart, New York: Thieme, 1995.
- Mericske-Stern R. Clinical evaluation of overdenture restorations supported by osseointegrated titanium implants: A retrospective study. *Int J Oral Maxillofac Implants* 1990;5:375-383.
- Wright PS, Watson RM, Heath MR. The effects of prefabricated bar design on the success of overdentures stabilized by implants. *Int J Oral Maxillofac Implants* 1995;10:79-87.
- Jacobs R, Schotte A, van Steenberghe D, Quirynen M, Naert I. Posterior jaw resorption in osseointegrated implant supported overdentures. *Clin Oral Implants Res* 1992;3:63-70.
- Wismeijer D, Vermeeren JI, van Waas MA. Patient satisfaction with overdentures supported by one stage TPS implants. *Int J Oral Maxillofac Implants* 1992;7:51-55.
- Ulm C, Solar P, Blahout R, Matejka M, Gruber H. Reduction of the compact and cancellous bone substance of the edentulous mandible caused by resorption. *Oral Surg Oral Med Oral Pathol* 1992;74:131-136.
- Van den Bergh JPA, ten Bruggenkate CM, Tuinzing DB. Preimplant surgery of the bony tissue. *J Prosthet Dent* 1998;80:175-183.
- Jooste CH, Thomas CJ. The influence of the retromylohyoid extension on mandibular complete denture stability. *Int J Prosthodont* 1992;5:34-38.