Oral Rehabilitation with Dental Implants in Oligodontia Patients

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Purpose: The aim of this retrospective report was to evaluate the treatment outcome of oral rehabilitation with dental implants in oligodontia patients. ***Materials and Methods:*** Thirteen oligodontia patients treated with dental implants were examined clinically and radiographically (follow-up 3 ± 2 years, range 1 to 8 years). In addition, patient-mediated concerns of satisfaction, treatment experience, and level of impairment of oral functions were assessed with questionnaires. ***Results:*** In general, all patients were satisfied with the implant treatment and experienced the treatment as nonaggravating. There was significant functional improvement, with an implant survival rate of 86% and 96% for the maxilla and mandible, respectively. ***Conclusion:*** Dental implants can play an important role in the oral rehabilitation of patients with oligodontia. Patients were generally satisfied with the overall treatment experience and reported significant functional improvement. Implant survival rate was comparable with previous reports. *Int J Prosthodont 2005;18:203–209.*

Oligodontia is defined as the congenital absence of six or more permanent teeth, excluding third molars.[1] Its incidence rate has been reported to vary between 0.07% and 0.20%,[2] and although its etiology is not fully understood, it is generally agreed that an important genetic component is present.[2] Oligodontia can occur in isolated fashion or as part of a syndrome (eg, ectodermal dysplasia). In addition to the absence of permanent teeth, oligodontia may be characterized by defective dental development, retained deciduous teeth, displacement of existing permanent teeth, false diastemata (diastemata caused by the absence of teeth), growth impairment of the alveolar process, pseudoprognathism, and a deep overbite that results from a compromised vertical dimension of occlusion.[3] Prosthodontic treatment of oligodontia patients is therefore important for functional (eg, chewing, phonetics), esthetic, and psychologic reasons.[4,5]

These objectives can be achieved by teeth replacement that permits establishment of bilateral centric stops and a normal vertical dimension of occlusion and support for orofacial soft tissues.[6] Treatment options depend on the severity of the condition and patients' percieved need for care. Complex treatments require a team approach.[7–10] Common methods employed include fixed and removable partial dentures and, more recently, implant-supported prostheses with preprosthetic orthodontics frequently required for optimal results.[11–15] Guckes and coworkers[16,17] report that osseointegrated implants are helpful in the oral rehabilitation of ectodermal dysplasia patients, whereas other authors[3,6] draw attention to comparable therapeutic

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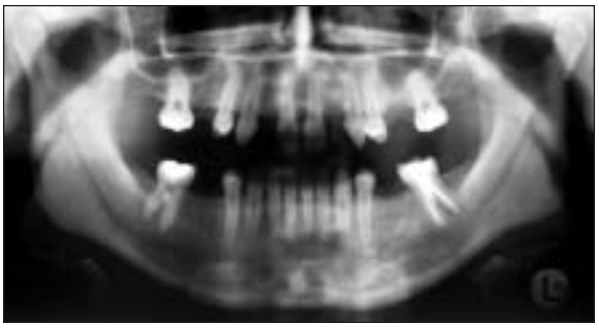


Fig 1a Orthopantomograph of 18-year-old patient with multiple missing teeth in the maxilla and mandible.

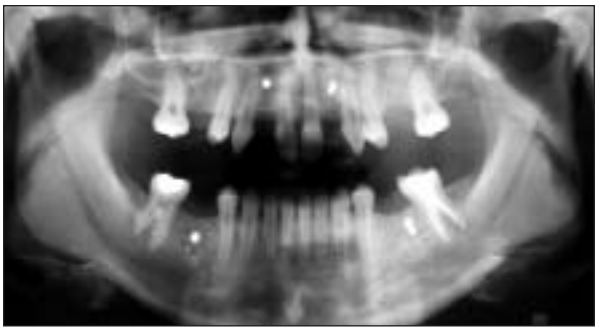


Fig 1b Orthopantomograph 3 months after reconstruction of the alveolar defects in the maxilla and mandible with autologous bone grafts (maxillary sinus floor elevation and buccal onlay grafts).

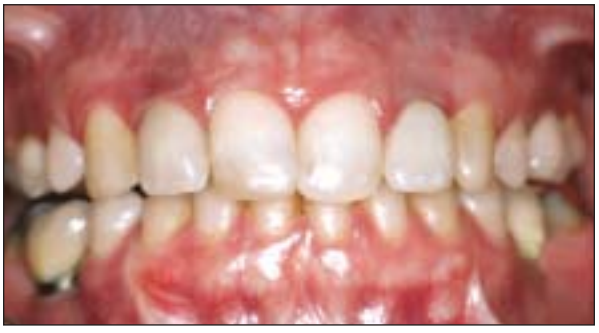
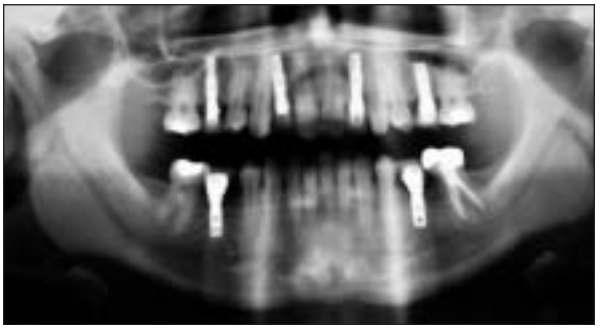


Fig 1c Clinical view 4 years after prosthodontic rehabilitation.



Fid 1d Orthopantomograph 4 years after prosthodontic rehabilitation shows stable peri-implant bone tissue around the implants.

methods and merits for patients with hereditary ectodermal dysplasia.

A common problem for managing these patients is the lack of sufficient bone for reliable implant placement that results from local to general decrease of growth stimuli of the jawbone because of the absence of a large number of teeth.[3] Such bone deficits can be rectified by augmentation procedures,[18] although the literature provides little statistical data or long-term efficacy and effectiveness data, and most studies describe rehabilitation of individual cases. Frequently, management of these patients demands several surgical interventions, which increases morbidity risks. Data regarding treatment experience, patient satisfaction, and functional improvement are also lacking. However, it is presumed that oligodontia patients could benefit considerably from implant prosthodontic rehabilitation given the satisfaction reported for the technique with routine patients.[19–22] The aim of the present study was to assess the efficacy of dental implants in a case series of oligodontia patients by means of clinical, radiographic, and patient-reported parameters.

Materials and Methods

Patients

Fifteen oligodontia patients treated with dental implants in the Department of Oral and Maxillofacial Surgery and Maxillofacial Prosthetics, University Hospital Groningen, the Netherlands, in the period from 1994 to 2002 were contacted, recalled, and asked to participate in a study on the treatment outcome of the implant prosthodontic rehabilitation. Thirteen patients, seven females and six males (mean age 20 $\pm$ 3 years, range 17 to 30 years at time of surgery), participated. In all 13 recalled patients, skeletal growth was complete at the time of implant placement, and remaining natural teeth and surrounding tissues were healthy (no pockets $>$ 3 mm). The other two patients had moved and could not be located. The mean follow-up after completion of the prosthodontic rehabilitation was 3 $\pm$ 2 years (range 1 to 8 years). An example of treatment of one of the patients is shown in Fig 1.

The patients congenitally lacked between 6 and 18 teeth (mean of 12 ± 4 teeth). In 11 of 13 patients, bone augmentation of local defects in the alveolar process was necessary. Autologous bone grafts were harvested from the chin (n = 3), retromolar region (n = 2), or iliac crest region (n = 6). A total of 87 Brånemark System implants (Nobel Biocare) were placed (mean of 6 ± 3 implants per patient, range 1 to 12).

The patients were examined clinically and radiographically and answered a questionnaire regarding their functional impairment, satisfaction, and experience with the overall treatment. Informed consent was obtained from each participant before initiation of the study.

Clinical Examination

The clinical examination included an assessment of soft tissues. At each single-tooth restoration, the highest score of the above-mentioned clinical parameters was used for further analysis. The following soft tissue indices were assessed:

- Bleeding Index: The reaction of the peri-implant mucosa on probing according to the method of Mombelli et al[23] (0 = no bleeding; 1 = isolated bleeding; 2 = confluent line of blood; 3 = heavy or profuse bleeding).
- Plaque Index: Plaque adherent to the single-tooth restorations was quantified using the Silness and Löe Plaque Index[24] (0 = no plaque in the gingival area; 1 = presence of film of plaque; 2 = moderate visible plaque accumulation; 3 = abundant plaque present).
- Gingival Index: Peri-implant mucosal inflammation was assessed using the Löe and Silness Gingival Index[25] (0 = normal mucosa; 1 = mild inflammation; 2 = moderate inflammation; 3 = severe inflammation).
- Probing depth: The tissues were lightly dried with compressed air. A periodontal probe was gently directed in the long axis of the implant between the mucosa and single-tooth restoration until resistance occurred. The probing depth was measured to the nearest 0.5 mm from the top of the restoration at four sites around each implant. The difference between the height from the top of the single-tooth restoration to the apical advancement of the probe tip and the height of the mucosa from the top of the single-tooth restoration constituted the probing depth.[26]

Radiographic Evaluation

At the recall visit, standardized intraoral radiographs were made of each implant using the long-cone technique.[27] Measurements were performed by means of a digital sliding gauge (Helios Digit E 2056, Schneider & Kern). Measurements were made mesial and distal of each implant from a fixed reference point (border of the flat table of the implant) to the marginal bone level, along the implant axis (Fig 2).[28] The measurements were performed twice by the same observer, with a 3-week time interval. The mean of the two measurements was used to describe peri-implant bone level.

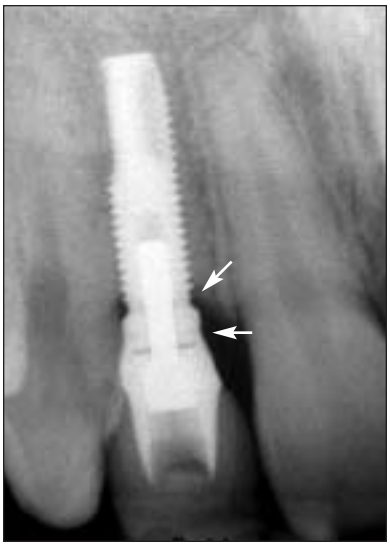


Fig 2 Radiograph of an implant as used for assessing the peri-implant bone level. Measurements were made mesially and distally from a fixed reference point (border of the flat table of the implant) to the marginal bone level *(arrows)*.

Assessment of Patient-Mediated Parameters

At the recall visit, each patient was asked to complete a questionnaire (Table 1) that focused on their perception of the surgical procedures (eg, disturbances in sensibility of skin and oral mucosa, postoperative pain at the augmentation site, perception of the bone augmentation and implant placement) and the results of treatment (eg, esthetics, self-confidence). In addition, the patient's overall treatment satisfaction was expressed on a 10-pointing rating scale (1 = very bad, 10 = excellent). Functional improvement was assessed using the Mandibular Function Impairment Questionnaire (MFIQ).[29] Patients were asked to assess their oral function before (memory recall) and after the dental implant rehabilitation. The MFIQ obtains feedback from patients regarding a range of questions that assess functional abilities. The MFIQ consists of 17 items, each presented with a five-point Likert scale on which the patient can indicate how much difficulty is experienced (0 = no difficulty; 1 = a little difficulty; 2 = quite a bit of

Table 1 Patient Satisfaction and Treatment Experience (n = 13)

Question	Outcome	No. of patients
1. Did you experience the bone augmentation as an aggravating operation?	No problem	5*
	Aggravating	4
	Very aggravating	2
2. Did you experience pain after the bone augmentation?	Much pain	2*
	A little pain	4
	(Almost) no pain	5
3. Do you experience persisting complaints at the augmentation site?	No	9*
	Yes	2 (1 loss of sensation,1 touch experienced as sensitive)
4. Do you still experience pain at the augmentation site?	No	10*
	Yes	0
	Sometimes	1 (during changes in weather)
5. Did your sensation change at the augmentation site?	More sensitive	1*
	Unaffected	9
	Less sensitive	1
	No feeling left	0
6. Did you experience the implant placement as aggravating?	No problem	8
	Aggravating	3
	Very aggravating	2
7. Do you still experience pain at the implant site:		
During biting?	Yes/no	1/12
During chewing?	Yes/no	1/12
Spontaneous?	Yes/no	0/13
Other?	Yes/no	2 (gingiva)/11
8. Are you satisfied with the esthetic result of the dental implant rehabilitation?	Very satisfied	5
	Satisfied	8
	Neither satisfied nor dissatisfied	0
	Dissatisfied	0
9. Are you satisfied with the prosthetic reconstruction(s)?	Very satisfied	4
	Satisfied	9
	Neither satisfied nor dissatisfied	0
	Dissatisfied	0
10. Are you satisfied with the shape of the prosthetic reconstruction(s)?	Satisfied	13
	Too big	0
	Too small	0
11. Are you satisfied with the color of the prosthetic reconstruction(s)?	Satisfied	11
	Too dark	2
	Too bright	0
12. Did your self-confidence increase following treatment?	Yes	9
	No	3
	Sometimes	1
13. Was the entire procedure in accordance with your expectations?	Turned out worse than expected	3
	Turned out as expected	8
	Turned out better than expected	2
14. How satisfied are you with the way you were treated (information/explanation)?	Very satisfied	5
	Satisfied	8
	Neither satisfied nor dissatisfied	0
	Dissatisfied	0
15. If necessary, would you undergo the dental implant treatment again?	Yes	13
	No	0

*In two patients, the pre-existing bone volume was sufficient for implant placement; therefore, bone augmentation was not performed in these patients.

difficulty; 3 = much difficulty; 4 = very difficult or impossible without help) performing a particular mandibular task (eg, chewing hard or soft food, laughing).

Statistical Analysis

Data were analyzed using either *t* tests for paired data or Pearson correlation tests for unpaired data (SPSS for Windows, version 11.5, SPSS). Values were described by their mean ± standard deviation. A significance level of $P < .050$ was predefined in all cases.

Results

Nine implants were lost in five patients, resulting in an implant survival rate of 86% and 96% for the maxilla and mandible, respectively. Loss of implants was equally distributed between bone graft–augmented sites and ungrafted sites. In three patients the lost implants (six implants) were successfully replaced by other implants, whereas in two other patients adjusting the prosthetic construction could compensate for the lost implants (three implants).

Table 2 Results of Plaque, Bleeding, and Gingival Indices

	Score (% of total)			
	0	1	2	3
Plaque Index	38.5	48.7	9.0	3.8
Bleeding Index	23.1	46.2	25.6	5.1
Gingival Index	42.3	35.9	19.2	2.6

Table 3 Results of Mandibular Function Impairment Questionnaire (MFIQ)[29]

	Level of functional impairment*		Qualitative level of functional impairment†	
Patient	Pretreatment	Posttreatment	Pretreatment	Posttreatment
1	3	0	2	1
2	3	1	2	1
3	3	1	2	1
4	1	0	1	1
5	3	0	2	1
6	3	0	2	1
7	3	0	2	1
8	1	0	1	1
9	3	1	2	1
10	1	0	1	1
11	0	0	1	1
12	5	1	3	1
13	0	0	1	1
Median	3	0	2	1

*Range 0 to 5.
†1 = low; 2 = moderate; 3 = severe.

Clinical Examination

Table 2 summarizes the results regarding the Plaque, Bleeding, and Gingival Indices and pocket probing depths. Ten implants revealed a pocket probing depth of more than 4 mm. Nine of these 10 implants showed signs of inflammation (Bleeding and Gingival Index $>$ 0). There was a positive correlation among Bleeding Index, Plaque Index, and pocket depth (Pearson correlation test, $P < .010$).

Radiographic Evaluation

When compared to the bone levels at the time of placement of the single-tooth restorations, a mean of 1.6 ± 0.9 mm of bone loss occurred during the mean functional period of 3 years. A positive correlation was observed between marginal bone level and Gingival Index (Pearson correlation test, $P < .050$). However, no correlation was observed between marginal bone level and pocket probing depth. Also, no differences were observed between marginal bone levels in augmented versus nonaugmented sites.

Assessment of Patient-Mediated Parameters

Patients were at least satisfied with the results of the dental implant rehabilitation (Table 1). Mean overall treatment appreciation was rated 8 on a 10-point scale (range 7 to 9). Nine of 13 patients reported their self-confidence had improved following the dental implant rehabilitation. In addition, patients generally did not experience treatment as very aggravating, with all patients reporting that they would undergo the procedure again. However, 2 of the 11 patients who received augmentation did experience persisting complaints related to the procedure. Patients reported a significant reduction in functional impairment following treatment with dental implants (Table 3). Both the level of functional impairment (paired t test, $P < .001$) and the qualitative level of functional impairment (paired t test, $P < .002$) improved significantly.

Discussion

This study's observations suggest that oral rehabilitation by means of dental implants is efficacious in the management of oligodontia patients. In addition to favorable outcomes with respect to the objective clinical and radiographic parameters, subjective outcomes indicated considerable improvements in function and good overall treatment satisfaction and experience with implant-based dental rehabilitation.

There are few reports on the survival rate of dental implants in oligodontia patients, particularly ectodermal dysplasia patients.[3,6,16,17] Durstberger et al[3]

reported an overall implant survival rate of 96% (13 patients and 69 implants), and Kearns et al[6] reported an implant survival rate of 94.7% for the maxilla and 100% for the mandible (6 patients and 41 implants). Finally, Guckes and coworkers[16,17] reported an implant survival rate of 76% for the maxilla and 91% for the mandible (51 patients and 243 implants). These data are in line with the implant survival rate observed in the present study. The above-mentioned studies report on implant treatment in different age groups (ie, children, adolescents, and adults). No significant differences were reported in implant survival among the different age groups in these studies. However, in general it is agreed that potential problems are associated with placing dental implants in growing patients (eg, submerged implants).[3,6,17] The present study was restricted to the evaluation of implant placement in patients with completed maxillomandibular growth.

No studies mention treatment experience and satisfaction of oligodontia patients with implant-based oral rehabilitation. The results of our study indicate that oligodontia patients are satisfied with dental implant–based oral rehabilitation and reported improvements in self-confidence following treatment. This is an important observation, as when compared with non–facially disfigured adults, individuals with congenital craniofacial anomalies report greater dissatisfaction with their facial appearance and lower self-esteem and quality of life.[30] In addition, the results of the MFIQ showed a considerable improvement of maxillofacial functional impairment following implant-based dental rehabilitation in oligodontia patients.

The Plaque, Bleeding, and Gingival Indices and pocket probing depth in the present study indicated healthy peri-implant tissues. These parameters have not been studied previously in oligodontia patients.[31] However, there may be little significance to employing surrogate periodontal indices for assessing implant treatment outcome.[31] The change in marginal bone level of 1.6 mm is in accordance with a study that reported a resorption of 0.40 to 1.50 mm in the first year following implant placement and thereafter a resorption of 0.05 to 0.10 mm annually.[32] No correlation was observed between peri-implant bone level and pocket probing depth. The latter finding is probably related to the recession of mucosa around the implants in these cases or a pseudopocket at that site.

The results of this study provide strong support for the use of dental implants in the oral rehabilitation of patients with oligodontia. Patients were satisfied, had a good overall treatment experience, and reported a significant improvement of oral functioning following treatment with dental implants. There is a need for well-designed, larger prospective studies to confirm the promising results of the present study.

References

1. Hobkirk JA, Brook AH. The management of patients with severe hypodontia. J Oral Rehabil 1980;7:289–298.
2. Schalk-Van Der Weide Y. Oligodontia: A Clinical, Radiographic and Genetic Evaluation [thesis]. Utrecht, The Netherlands: University of Utrecht, 1992.
3. Durstberger G, Celar A, Watzek G. Implant-surgical and prosthetic rehabilitation of patients with multiple dental aplasia: A clinical report. Int J Oral Maxillofac Implants 1999;14:417–423.
4. Pigno MA, Blackman RB, Cronin RJ, Cavazos E. Prosthodontic management of ectodermal dysplasia: A review of the literature. J Prosthet Dent 1996;76:541–545.
5. Hickey AJ, Vergo TJ. Prosthetic treatments for patients with ectodermal dysplasia. J Prosthet Dent 2001;86:364–368.
6. Kearns G, Sharma A, Perrot D, Schmidt B, Kaban L, Vargervik K. Placement of endosseous implants in children and adolescents with hereditary ectodermal dysplasia. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1999;88:5–10.
7. Bergendal B, Bergendal T, Hallonsten AL, Koch G, Kurol J, Kvint S. A multidisciplinary approach to oral rehabilitation with osseointegrated implants in childeren and adolescents with multiple aplasia. Eur J Orthod 1996;18:119–129.
8. Bishop K, Wragg P. Ectodermal dysplasia in adulthood: The restorative difficulties and management. Dent Update 1997;24:235–240.
9. Dhanrajani PJ, Jiffry AO. Management of ectodermal dyplasia: A literature review. Dent Update 1998;25:73–75.
10. Bergendal B. Prosthetic habilitation of a young patient with hypohidrotic ectodermal dysplasia and oligodontia: A case report of 20 years of treatment. Int J Prosthodont 2001;14:471–479.
11. Dario LJ, Aschaffenburg PH. Treating severe partial anodontia: A 10-year history of patient treatment. J Am Dent Assoc 1994;125: 1612–1614.
12. Dhanrajani PJ. Hypodontia: Etiology, clinical features, and management. Quintessence Int 2002;33:294–302.
13. Imirzalioglu P, Uckan S, Haydar SG. Surgical and prosthodontic treatment alternatives for childeren and adolescents with ectodermal dysplasia: A clinical report. J Prosthet Dent 2002;88:569–572.
14. Higuchi K. Hypodontia and oligodontia. In: Worthington P, Brånemark P-I (eds). Advanced Osseointegration Surgery. Application in the Maxillofacial Region. Berlin: Quintessence, 1992:248–525.
15. Dhanrajani PJ, Al Abdulkarim S. Management of severe hypodontia. Implant Dent 2002;11:338–342.
16. Guckes AD, Brahim JS, McCarthy GR, Rudy SF, Cooper LF. Using endosseous dental implants for patients with ectodermal dysplasia. J Am Dent Assoc 1991;122:59–62.
17. Guckes AD, Scurria MS, King TS, McCarthy GR, Brahim JS. Prospective clinical trial of dental implants in persons with ectodermal dysplasia. J Prosthet Dent 2002;88:21–25.
18. Garg AK. Treatment of congenitally missing maxillary lateral incisors: Orthodontics, bone grafts, and osseointegrated implants. Dent Implantol Update 2002;13:9–14.
19. Albrektsson T, Blomberg S, Brånemark P-I, Carlsson GE. Edentulousness: An oral handicap. J Oral Rehabil 1987;14:503–511.
20. Tavares M, Branch LG, Shulman L. Dental implant patients and their satisfaction with treatment. J Dent Educ 1990;54:670–679.
21. Yi SW, Carlsson GE, Ericsson I, Kim CK. Patient evaluation of treatment with fixed implant-supported partial dentures. J Oral Rehabil 2001;28:998–1002.
22. Meijer HJA, Raghoebar GM, van't Hof MA. Comparison of implant-retained mandibular overdentures and conventional complete dentures: A 10-year prospective study of clinical aspects and patient satisfaction. Int J Oral Maxillofac Implants 2003;18:879–885.

23. Mombelli A, Van Oosten MAC, Schürch E, Lang N. The microbiota associated with succesful or failing osseointegrated titanium implants. Oral Microbiol Immunol 1987;2:145–151.
24. Silness J, Löe H. Periodontal disease in pregnancy II. Correlation between oral hygiene and periodontal condition. Acta Odontol Scand 1964;22:121–135.
25. Löe H, Silness J. Periodontal disease in pregnancy I. Prevalence and severity. Acta Odontol Scand 1963;21:533–551.
26. Aspe P, Zarb GA, Schmitt A, Lewis DW. The longitudinal affectiveness of osseointegrated dental implants. The Toronto study: Peri-implant mucosal response. Int J Periodontics Restorative Dent 1991;11:94–111.
27. Meijer HJA, Steen WHA, Bosman F. Standardized radiographs of the alveolar crest around implants in the mandible. J Prosthet Dent 1992;68:318–321.
28. Meijer HJA, Steen WHA, Bosman F. A comparison of methods to assess marginal bone height around endosseous implants. J Clin Periodontol 1993;20:250–253.
29. Stegenga B, de Bont LGM, de Leeuw R, Boering G. Assessment of mandibular function impairment associated with temporomandibular joint osteoarthrosis and internal derangement. J Orofac Pain 1993;7:183–195.
30. Sarwer DB, Barlett SP, Whitaker LA, Paige KT, Pertschuk MJ, Wadden TA. Adult psychological functioning of individuals born with craniofacial anomalies. Plast Reconstr Surg 1999;103:412–418.
31. Towards optimized treatment outcomes for dental implants. Proceedings of the Toronto Symposium, 24–25 April 1998. Int J Prosthodont 1998;11:385–521.
32. Wyatt CC, Zarb GA. Bone level changes proximal to oral implants supporting fixed partial protheses. Clin Oral Implants Res 2002;13: 162–168.

Maxillomandibular relationship philosophies for prosthodontic treatment: A survey of dental educators

There are various philosophies regarding the need for coincidence of centric occlusion (CO) and maximum intercuspation (MI) in prosthodontic treatment. This study attempted to investigate philosophies of predoctoral and postdoctoral dental educators in the United States concerning the maxillomandibular relationship. A survey included 5 clinical situations where the patients demonstrated a difference between CO and MI. Questions were designed for each of the scenarios, requesting the preferred treatment position. This survey was sent to 171 practitioners involved in either predoctoral or postdoctoral teaching programs at 73 institutions. The results indicated that there was a wide range of philosophical differences in the treatment positions of the presented clinical situations. No statistically significant difference was observed between the predoctoral and postdoctoral clinicians. It appears there is still a lack of agreement among dental educators as to whether CO and MI should be coincident at the definitive treatment position.

Baker PS, Parker MH, Ivanhoe JR, Gardner FM. *J Prosthet Dent* 2005;93:86–90. **References:** 18. **Reprints:** Dr Philip S. Baker, Medical College of Georgia, School of Dentistry, 1120 15th St, Augusta, GA 30912-1250—*Ansgar C. Cheng, Singapore*

Morphologic comparison of two neutral zone impression techniques: A pilot study

This pilot study compared the shape of the phonetic and swallowing neutral zone impressions. Nine denture users with advanced mandibular alveolar ridge resorption were involved. Two acrylic resin impression trays were made for each individual. The neutral zones were recorded in tissue conditioning material using the phonetics method, and in modeling plastic impression compound using the swallowing method. The impressions were inverted onto graph paper, and the contour was outlined in pencil. One impression was made for each subject for each impression technique. A total of 18 impressions were made. The results indicated that: (1) the location of the phonetic neutral zone method was more buccal when compared to the swallowing method; (2) statistically significant differences were noted in the premolar and molar regions; (3) the swallowing neutral zone was located buccally to the phonetic neutral zone; (4) no significant difference was noted between the two techniques at the anterior area; and (5) the phonetic neutral zone was narrower posteriorly as compared to the swallowing neutral zone. Based on the result of this study, the shape of the recorded neutral zone is variable depending on the nature of the clinical technique used.

Makzoumé JE. *J Prosthet Dent* 2004;92:563–568. **References:** 21. **Reprints:** Dr Joseph E. Makzoumé, 25 I. Medawar Street, Badaro Center, Beirut 2058-7007, Lebanon—*Ansgar C. Cheng, Singapore*