ELSEVIER
SAUNDERS

Dent Clin N Am 50 (2006) 451–461

THE DENTAL
CLINICS
OF NORTH AMERICA

Evidence-Based Decision-Making: Implants Versus Natural Teeth

Mark V. Thomas, DMD[a,*],
Jay R. Beagle, DMD, MSD[a,b]

[a]*University of Kentucky College of Dentistry, 800 Rose Street, Lexington, KY 40536-0297, USA*
[b]*Practice Limited to Periodontics and Dental Implant Surgery, 3003 East 98th Street, Suite 200, Indianapolis, IN 46280, USA*

The pioneering work of Brånemark ushered in a new era in dental prosthetic treatment. It is not hyperbole to state that osseointegration and root-form implants have revolutionized dental treatment. In the course of treatment planning, however, questions often arise as to the predictability of implant-borne prostheses vis-à-vis other forms of dental treatment. In particular, data regarding the relative predictability and longevity of fixed partial dentures, removable partial dentures, endodontic treatment, and conventional dentures are often needed to make evidence-based treatment decisions. Unfortunately and somewhat surprisingly, few efforts have been made to compare such treatment modalities with implant outcomes. This article compares the outcomes of selected treatment modalities with regard to their relative predictability and longevity. Specifically, outcomes for endodontic treatments are compared with those for single-tooth ITI Dental Implant System implants, and outcomes for conventional mandibular dentures are compared with those for implant-retained overdentures.

Endodontic treatment outcomes

Initial nonsurgical endodontic treatment

A common clinical decision-making situation exists when a tooth is found to be nonvital. Often, the decision the clinician must make is whether to extract the tooth and place an implant or perform endodontic treatment.

* Corresponding author.
E-mail address: mvthom0@uky.edu (M.V. Thomas).

doi:10.1016/j.cden.2006.05.001 *dental.theclinics.com*

Although some investigators have attempted to provide guidelines for clinical decision-making [1,2], outcomes studies that provide evidence for clinical guidance are not plentiful. One very large epidemiological study is that of Salehrabi and colleagues [3], who reported on nonsurgical endodontic treatment outcomes in 1,462,936 teeth in 1,126,288 patients. The study sample is based on the records of the Delta Dental Insurance Data Center and reflects the claims experiences of the insured. Patients included in the study were insured by Delta continuously from 1995 to 2002. The study showed that 97% of the teeth were retained 8 years after the teeth were initially treated with conventional nonsurgical endodontic techniques. Only 3% of the teeth experienced suboptimal outcomes, such as re-treatment, extraction, or apical surgery. Meanwhile, 85% of teeth requiring extraction did not receive full coronal coverage.

Closely related to the above study is an earlier report by Lazarski and colleagues [4]. They used the same Delta Dental claims database to assess outcomes following 110,766 nonsurgical endodontic procedures. The patient population was enrolled in Delta Dental continuously from January 1, 1993, through December 31, 1998. Thus, a large proportion of the data set from the Lazarski report is a subset of the data set in the Salehrabi study. Accordingly, in any systematic review, these studies should not be counted as distinct and discrete. In the study by Lazarski and colleagues, 44,613 cases showed ''incidences of extraction, re-treatment, and periradicular surgery equal to 5.56%, 2.47%, and 1.41%, respectively.'' All teeth in this study had at least 2 years' follow-up. Thus, the outcomes for 9.44% of the teeth might be considered suboptimal, while approximately 90% of the teeth healed uneventfully. Over a mean follow-up period of 3.5 years, 94.44% of the treated teeth remained functional.

Collectively, these studies suggest that nonsurgical endodontic treatment enjoys a high degree of predictability. However, this interpretation has some potential problems. When the investigators state that 97% of the teeth were retained, they mean that there is no record in the Delta Dental database of these teeth being extracted or re-treated. It is possible, if unlikely, that some needed treatment was never provided. Perhaps, also, some treatment was provided but not submitted to the insurance carrier. Validation of a small, randomly selected subset of this population may have been worthwhile, especially since some prospective studies have reported contradictory findings. One simple (though imperfect) method of cross-checking the data might involve checking to see if claims for fixed–partial-denture pontics were ever submitted for any of the treated teeth (thus implying that the teeth in question were extracted).

Tilashalski and colleagues [5] conducted a prospective cohort study of 873 subjects. An in-person interview and clinical examination were conducted at baseline, 24 months after baseline, and 48 months after baseline, with telephone follow-up at 6-month intervals. Seventy-five teeth received nonsurgical endodontic treatment and were followed for at least 1 year or

until extraction. Mean follow-up time was 24.8 months. Definitive restorations were placed in 79% of the teeth at a mean time of 4.4 months postendodontic therapy. Following endodontic therapy, 81% of the teeth were retained and 19% were extracted, a much higher failure rate than reported by Salehrabi and colleagues despite a much shorter follow-up time.

The so-called "Toronto Study" is an attempt to assess the long-term outcomes of initial nonsurgical endodontic treatment [6–9]. This study is being conducted and reported in phases. All treatment was performed by graduate students who were supervised by practicing specialists in endodontics. In Phase I of the study, 450 teeth were treated with either the Schilder vertical condensation technique or the step-back, lateral-condensation approach. Teeth were assessed clinically and radiographically for evidence of periapical healing. At the conclusion of the follow-up period, only 120 teeth were available for examination. The overall "healed" rate was 81%. The healed rate for teeth without radiographic evidence of periapical pathology at initial presentation was higher (92%) than for teeth with periapical lesions (74%). The primary predictor of healing response was the presence or absence of periapical pathology.

The latest report from the Toronto Study gives the combined outcomes of Phase I through III and includes a treatment group of 532 teeth [6]. Somewhat surprisingly, only 132 of the original 532 teeth were available for reexamination. The excluded teeth included 142 dropouts, 10 extractions, and 248 "discontinuers." An analysis of the overall combined data from all phases showed the treatment success of the vertical condensation technique is 89% while that of the lateral condensation technique is only 73%. Single-rooted teeth had a higher success rate than did multirooted teeth (92% versus 83%) and teeth with preexisting periapical pathology had a lower success rate (80%) than those that did not have such findings (93%). Similarly, teeth that experienced intraoperative complications had a lowered success rate (76%) than those without complications (88%).

As an aside, it is difficult to reconcile the various numbers used in these reports of the Toronto Study. For instance, Marquis and colleagues [6] refer to a total of 532 teeth, while Farzaneh and colleagues [7] state that "the inception cohort consisted of 523 teeth in 444 patients." Of greater concern is the difficulty in ascertaining the number of teeth extracted and the timing of the extractions. Farzaneh and colleagues [7] state that 395 teeth were lost to follow-up, including "25 extracted" teeth. Marquis and colleagues [6] state that 10 teeth were extracted. Furthermore, it is not clear why extracted teeth were not counted among the failures, since it appears these teeth received treatment (although it is not absolutely clear that this is the case).

Lastly, it is well recognized that patient follow-up is often difficult in long-term cohort studies. Nevertheless, the low rate of teeth and subjects available for reexamination is a matter of concern. Certainly, this group includes successfully treated patients who have moved, for example, but it may also include patients who have had teeth extracted due to endodontic

or restorative complications. Indeed, dissatisfaction with treatment may be a reason for patients to leave a study.

In contrast to the low follow-up observed in the Toronto Study, Ørstavik and colleagues [10] reported a comparatively low attrition rate of 135/810 roots (i.e., dropouts accounted for 135 of 810 roots). These investigators reported an overall success rate of 90%. Those teeth that initially presented with chronic apical periodontitis had a success rate of 79%. Those teeth without such a history had a 94% success rate. The classification of "chronic apical periodontitis" was made based on the radiographic appearance of the periapical tissues.

It is difficult to explain the disparate results reported in the studies cited above. Yet conclusions must be drawn to formulate guidelines for clinical decision-making. On the one hand, the two insurance-based studies came from extremely large sample sizes. On the other hand, samples of these studies overlapped considerably and they are both retrospective studies based on data mining, as opposed to prospective studies, such as the Toronto Study and the work of Tilashalski and colleagues. One of the most fundamental tools of evidence-based medicine is the hierarchy of evidence. Simply stated, some studies are more compelling than others. Systematic reviews and meta-analyses of well-designed clinical trials constitute the highest level of evidence. Next are individual randomized controlled trials. According to a generally accepted principle of ranking evidence, prospective studies are more compelling than are retrospective studies involving data mining. It is, therefore, appropriate to rank those studies that are prospective (Table 1) above retrospective studies. Even so, the extremely large sample size and the private-practice setting make the Delta studies compelling. In the end, no simple formula determines which of these groups of studies is more valid. If one accepts the prospective studies cited in this review, the overall success rate of endodontic therapy is significantly less than the rate in those studies

Table 1
Endodontic outcomes

Study	Success (no periaptical [PA] pathology) %	Study design
Salehrabi et al [3] (includes some of Lazarski et al [4] sample)	97	Retrospective (data mining of insurance claims database)
Lazarski et al [4] (includes some of Salehrabi et al [3] sample)	94	Retrospective (data mining of insurance claims database)
Tilashalski et al [5]	81	Prospective
Toronto Study (vertical condensation) [6]	89	Prospective
Toronto Study (lateral condensation) [6]	73	Prospective
Ørstavik et al (no chronic PA lesion) [10]	94	Prospective
Ørstavik et al (chronic PA lesion) [10]	79	Prospective

using the Delta database. Therefore, the issue as to the predictability of initial, nonsurgical endodontic therapy must await additional studies or, perhaps, additional analysis of the Delta database.

Endodontic re-treatment

In considering treatment guidelines, it is also necessary to consider the predictability of endodontic re-treatment. Some studies suggest that persistent periapical infection may persist or emerge following endodontic treatment in as many as 30% of endodontically treated teeth [11]. Re-treatment of such teeth is much less successful than initial treatment. Friedman stresses the need for good information upon which to base clinical decisions in such cases and has especially recommended that a careful cost–benefit analysis be used in making such decisions. Hepworth and Friedman [12] reviewed the extant endodontic outcomes literature in 1997 and reported overall success rates for nonsurgical re-treatment of 66% compared with 59% for apical surgery. These numbers may have less relevance today, given the technical advances during the intervening years.

Endodontic outcomes: summary

It is likely that multiple factors are involved in determining endodontic outcomes. Although a number of these have been reported [13], the authors lack good models to forecast outcomes accurately. Such information could be of great interest to the dental profession as well as third-party payers [14]. From the works cited above, it seems reasonable to assess the risk of failure as higher when certain conditions are present. These include chronic periapical infection or radiolucency, previously unsuccessful endodontic treatment, presence of multiple roots, and coexisting periodontal disease. In particular, re-treatment of teeth that have been previously treated endodontically seems to be often associated with poor outcomes. More well-designed studies are needed to quantify the risk of endodontic treatment failure in various clinical situations.

Single-tooth implant restorations

This article is limited to studies of single-tooth, implant-supported crowns (Table 2). Bragger and colleagues [15] studied a group of 48 patients who had 69 single crowns installed on 69 ITI implants over 10 years. Five implants were lost due to biological issues and 2 crowns had to be remade due to technical failures, for a total failure rate of 10%. Levine and colleagues [16] reported the results of a retrospective evaluation of ITI implants placed in 12 centers throughout the United States involving 174 implants placed in 129 patients. All implants functioned for 2 years or more. An overall survival rate of 95.2% was reported.

Table 2
Implant outcomes (ITI dental implant system)

Study	Success or survival rate	Study design
Bragger et al	90	Prospective
Levine et al	95	Prospective
Ferrigno et al	91	Prospective
Astrand et al	97	Prospective
Lambrecht et al	99	Prospective
Fuggazotto et al	97	Prospective
Buser et al	97	Prospective

Ferrigno and colleagues [17] report good results after placement of ITI implants in the posterior maxilla using the osteotome sinus lift technique. These workers placed 588 implants and report a cumulative survival rate of 94.8% and a cumulative success rate of 90.8%. Interestingly, short implants (ie, 8 mm) had success rates equal to longer implants (ie, 10 and 12 mm).

Astrand and colleagues [18] report 3-year results on a group of 77 ITI implants. The survival rate was 97.3%. This was one of the few randomized controlled trials to compare implant systems. In this study, Brånemark implants were compared with ITI implants in a group of 28 patients. Both systems experienced a 97.3% survival rate and minimal postloading bone-loss was noted in both groups.

Lambrecht and colleagues conducted a study of 468 ITI implants [19]. This included a small number studied retrospectively and larger number studied prospectively. The investigators calculated 10-year cumulative survival and success rates. These rates were 99.2% and 96.4%, respectively.

In a multicenter study reported by Fugazzotto and colleagues [20], 979 implants having a length $\geq$9 mm were inserted in maxillary molar positions and restored following 12 weeks of healing with individual crowns. The implant surfaces were either plasma-sprayed titanium (TPS) or sandblasted acid-etched (SLA) and were followed up to 84 months. A cumulative success of 94.5% and 98.7% were reported for maxillary first molars and maxillary second molars, respectively.

Although not limited to single-tooth restorations, Buser and colleagues [21] conducted a long-term evaluation of 2359 nonsubmerged ITI implants. In Part I of the multicenter study, teeth in 1003 patients were treated and restored with 393 removable and 758 fixed restorations. All implants were documented annually up to 8 years with a cumulative survival rate of 96.7% and cumulative success rate of 93.3%.

A meta-analysis was undertaken by Lindh and colleagues [22] to assess the survival of implants in partially edentulous patients. Although not limited to ITI implants, this meta-analysis is worthy of inclusion. These investigators reviewed 66 studies published between 1986 and 1996. Of these, only 19 studies met the inclusion criteria. Those studies included data from 2686 implants, including 570 single units and 2116 fixed

partial-denture abutments. Life-table analysis was used. The survival rate for fixed–partial-denture abutments was 93.6% after 6 to 7 years of service. The corresponding value for single crowns was 97.5%.

Summary and clinical application

Implant-supported single crowns seem to have a success rate that is generally superior to the success rate associated with nonsurgical endodontic therapy. Indeed, if one limited the analysis to prospective studies only, implant therapy appears more predictable. In situations where the risk of endodontic failure is higher (eg, chronic periapical infection), implant therapy seems to be more predictable. This may also be true of endodontic re-treatment. Clearly, further studies are needed to provide better guidance as to when an implant is preferable to endontic therapy. Even so, from the evidence in this article, some general guidelines emerge, particularly with regard to endodontic therapy. Some of the above-cited studies show that significant periapical radiolucencies are associated with suboptimal outcomes. Similarly, multirooted teeth have a poorer prognosis, as do teeth that experienced an ''intraoperative complication.'' Also, recrudescent periapical infection in a previously obturated tooth is associated with a poor prognosis. Any of these circumstances may cause the clinician to consider the implant alternative.

Implant-supported mandibular dentures vis-à-vis conventional dentures

Overview

Investigators at McGill University have conducted a series of interesting studies on patient outcomes with implant-retained overdentures vis-à-vis conventional mandibular dentures. In one of their investigations, 60 edentulous subjects were randomly assigned to receive either a conventional mandibular denture or an implant-supported overdenture [23]. The implant-supported prosthesis was supported by two ITI implants with ''ball-shaped retentive anchors.'' Overall satisfaction was approximately 36% higher in the implant group and this difference increased with time. Chewing satisfaction was also higher in the implant group. Although this study employed dentures retained by two implants with ball attachments, high satisfaction has also been reported with dentures retained by a bar connecting two implants [24]. Awad and colleagues [25] have reported similar short-term results, although this may represent findings from the same sample. A study of prosthodontists indicated that implant overdentures (IODs) were easier to fabricate than conventional dentures [26].

Morais and colleagues [27] studied the effect of denture type on nutritional status. These investigators reported that the implant-retained overdenture (IOD) patients scored better in several areas, including percent

body fat, skin-fold thickness, waist–hip ratio, girth, serum albumin, hemoglobin, and serum B12 levels. These investigators suggest that IOD treatment may enhance the nutritional status of edentulous patients. It has been suggested that these differences are due to adverse dietary selection by wearers of conventional dentures [28]. Because of chewing inefficiency, such individuals are unable to chew hard or tough foods and this limitation results in certain dietary problems.

Heydecke and colleagues [29], also of the McGill group, examined differences in social and sexual satisfaction between conventional and implant-borne dentures. In this study, 102 subjects were randomly assigned to receive either conventional mandibular dentures or overdentures retained by two implants. The impact of the dentures on various social and sexual activities was assessed at baseline and 2 months after completion of treatment. Subjects in the IOD group experienced significant improvements in eating and in kissing and other sexual activity, as compared with the conventional denture group.

The same group [30] examined the cost and effectiveness of the two types of dentures in a group of 60 subjects, 30 of whom received IODs, while 30 received conventional dentures. These investigators compared the actual costs of providing the service versus the perceived value of the service by the patient and determined that the IOD was a cost-effective intervention.

The treatment time involved in delivering services is of great interest to practicing clinicians and those who pay for their services. In that vein, it seems appropriate to compare treatment times involved in delivering implant-borne dentures versus conventional dentures. One recent study reported the time required for implant placement until the time of preliminary impressions (referred to by the authors as the ''surgical phase''). Treatment was performed by a surgeon and prosthodontist [31]. Patients required a mean of four visits to the surgeon. These visits took a total mean time of 109 minutes (and 125 minutes for the surgical assistant). Mean time spent with the prosthodontist was 46 minutes (with a mean of two visits). In addition to scheduled visits, prosthodontists required a mean fabrication time of 296 minutes for an IOD versus 282 minutes for a conventional denture. The time included all time required from preliminary impressions through 6-month follow-up. The mean number of appointments required was 10.1 for the IOD group and 10.8 for the conventional denture group.

Based on these and other findings, the McGill group has suggested that the implant-supported overdenture be considered the standard of care for edentulous adults [32].

General satisfaction with implants vis-à-vis natural teeth

Pjetursson and colleagues [33] conducted a study of patients' satisfaction with implant treatment 10 years following implant placement. The study was part of a longitudinal cohort of implant patients and included 104

implant patients who had a total of 214 implants placed 5 to 15 years previously (mean: 10.2 years). A visual analog scale was used as the survey instrument. This study found that 97% of the subjects were satisfied or highly satisfied with function and chewing comfort. Meanwhile, 72.1% perceived no difference in chewing comfort experienced with teeth or implants, with 17.3% feeling more secure with teeth and 7.7% feeling more secure with implants. Over 95% were satisfied or highly satisfied with phonetics and esthetics. Similar percentages indicated that they would elect to have implants placed again.

Summary and clinical application

On the basis of their work, the McGill group recommended that the implant-retained overdenture be considered the first-choice, standard-of-care treatment for the edentulous mandible [32,34]. This group has made a convincing argument through a thoughtful analysis of their research results.

Summary

There are many difficulties in comparing implant outcomes studies with other treatment modalities (or even with other implant studies). Chief among these are the differences in study methodology and statistical analysis. One especially troublesome point concerns the criteria used to determine success. While some studies look at such criteria as chewing satisfaction, appearance, comfort and similar factors as advocated by Albrektsson and colleagues [35], other studies consider only survival (i.e., how long the implant remains in the mouth). This makes comparisons difficult. Additionally, while many studies employ well-recognized statistical techniques of survival analysis, others do not. Lastly, it seems problematic to lump all implant systems together. While it is often stated that there seems to be a rough equivalence between many root-form, titanium implant systems, little actual evidence supports this position. Indeed, given the diversity of implant surfaces and designs, such differences seem highly likely. Evidence of such differences is sometimes reported in the literature, although such studies are rare [36]. Even in implants of similar design, manufacturing differences could conceivably play a role in determining clinical outcomes. In this brief article, the authors attempted to compensate for potential differences between systems by confining the review to one system. Further work needs to be done in this area. Unfortunately, such comparisons are unlikely to be funded and such studies, however desirable, are unlikely to be forthcoming. One notable exception is the work of the McGill group. This series of studies is an elegant comparison of two dental treatments and is an example of the type of trial that is needed.

As dental implants have become more predictable, the clinician is often confronted with the dilemma of whether to use implants or other modalities. The survival and success rates reported by many implant investigators often

exceed the success rates of some forms of traditional dental treatment. In particular, it could be argued that implant-borne prostheses have better outcomes than apical surgery, conventional endodontic re-treatment, and conventional dentures. More and better outcomes studies are needed to provide survival and success rates for conventional dental therapy.

References

[1] Salinas TJ, Block MS, Sadan A. Fixed partial denture or single-tooth implant restoration? Statistical considerations for sequencing and treatment. J Oral Maxillofac Surg 2004;62 (9, Suppl 2):2–16.
[2] Kvist T. Endodontic retreatment. Aspects of decision making and clinical outcome. Swed Dent J Suppl 2001;(144):1–57.
[3] Salehrabi R, Rotstein I. Endodontic treatment outcomes in a large patient population in the USA: an epidemiological study. J Endod 2004;30(12):846–50.
[4] Lazarski MP, Walker WA III, Flores CM, et al. Epidemiological evaluation of the outcomes of nonsurgical root canal treatment in a large cohort of insured dental patients. J Endod 2001;27(12):791–6.
[5] Tilashalski KR, Gilbert GH, Boykin MJ, et al. Root canal treatment in a population-based adult sample: status of teeth after endodontic treatment. J Endod 2004;30(8): 577–81.
[6] Marquis VL, Dao T, Farzaneh M, et al. Treatment outcome in endodontics: the Toronto Study. Phase III: initial treatment. J Endod 2006;32(4):299–306.
[7] Farzaneh M, Abitbol S, Friedman S. Treatment outcome in endodontics: the Toronto Study. Phases I and II: orthograde retreatment. J Endod 2004;30(9):627–33.
[8] Farzaneh M, Abitbol S, Lawrence HP, et al. Treatment outcome in endodontics—the Toronto Study. Phase II: initial treatment. J Endod 2004;30(5):302–9.
[9] Friedman S, Abitbol S, Lawrence HP. Treatment outcome in endodontics: the Toronto Study. Phase 1: initial treatment. J Endod 2003;29(12):787–93.
[10] Orstavik D, Qvist V, Stoltze K. A multivariate analysis of the outcome of endodontic treatment. Eur J Oral Sci 2004;112(3):224–30.
[11] Friedman S. Management of post-treatment endodontic disease: a current concept of case selection. Aust Endod J 2000;26(3):104–9.
[12] Hepworth MJ, Friedman S. Treatment outcome of surgical and non-surgical management of endodontic failures. J Can Dent Assoc 1997;63(5):364–71.
[13] Chugal NM, Clive JM, Spangberg LS. Endodontic infection: some biologic and treatment factors associated with outcome. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2003;96(1):81–90.
[14] Bader JD, Shugars DA, White BA, et al. Development of effectiveness of care and use of services measures for dental care plans. J Public Health Dent 1999;59(3):142–9.
[15] Bragger U, Karoussis I, Persson R, et al. Technical and biological complications/failures with single crowns and fixed partial dentures on implants: a 10-year prospective cohort study. Clin Oral Implants Res 2005;16(3):326–34.
[16] Levine RA, Clem DS III, Wilson TG Jr, et al. Multicenter retrospective analysis of the ITI implant system used for single-tooth replacements: results of loading for 2 or more years. Int J Oral Maxillofac Implants 1999;14(4):516–20.
[17] Ferrigno N, Laureti M, Fanali S. Dental implants placement in conjunction with osteotome sinus floor elevation: a 12-year life-table analysis from a prospective study on 588 ITI implants. Clin Oral Implants Res 2006;17(2):194–205.
[18] Astrand P, Engquist B, Anzen B, et al. A three-year follow-up report of a comparative study of ITI Dental Implants and Branemark System implants in the treatment of the partially edentulous maxilla. Clin Implant Dent Relat Res 2004;6(3):130–41.

[19] Lambrecht JT, Filippi A, Kunzel AR, et al. Long-term evaluation of submerged and nonsubmerged ITI solid-screw titanium implants: a 10-year life table analysis of 468 implants. Int J Oral Maxillofac Implants 2003;18(6):826–34.
[20] Fugazzotto PA, Beagle JR, Ganeles J, et al. Success and failure rates of 9 mm or shorter implants in the replacement of missing maxillary molars when restored with individual crowns: preliminary results 0 to 84 months in function. A retrospective study. J Periodontol 2004;75(2):327–32.
[21] Buser D, Mericske-Stern R, Bernard JP, et al. Long-term evaluation of non-submerged ITI implants. Part 1: 8-year life table analysis of a prospective multi-center study with 2359 implants. Clin Oral Implants Res 1997;8(3):161–72.
[22] Lindh T, Gunne J, Tillberg A, et al. A meta-analysis of implants in partial edentulism. Clin Oral Implants Res 1998;9(2):80–90.
[23] Thomason JM, Lund JP, Chehade A, et al. Patient satisfaction with mandibular implant overdentures and conventional dentures 6 months after delivery. Int J Prosthodont 2003; 16(5):467–73.
[24] Awad MA, Lund JP, Dufresne E, et al. Comparing the efficacy of mandibular implant-retained overdentures and conventional dentures among middle-aged edentulous patients: satisfaction and functional assessment. Int J Prosthodont 2003;16(2):117–22.
[25] Awad MA, Lund JP, Shapiro SH, et al. Oral health status and treatment satisfaction with mandibular implant overdentures and conventional dentures: a randomized clinical trial in a senior population. Int J Prosthodont 2003;16(4):390–6.
[26] Heydecke G, Klemetti E, Awad MA, et al. Relationship between prosthodontic evaluation and patient ratings of mandibular conventional and implant prostheses. Int J Prosthodont 2003;16(3):307–12.
[27] Morais JA, Heydecke G, Pawliuk J, et al. The effects of mandibular two-implant overdentures on nutrition in elderly edentulous individuals. J Dent Res 2003;82(1): 53–8.
[28] Hutton B, Feine J, Morais J. Is there an association between edentulism and nutritional state? J Can Dent Assoc 2002;68(3):182–7.
[29] Heydecke G, Thomason JM, Lund JP, et al. The impact of conventional and implant supported prostheses on social and sexual activities in edentulous adults. Results from a randomized trial 2 months after treatment. J Dent 2005;33(8):649–57.
[30] Heydecke G, Penrod JR, Takanashi Y, et al. Cost-effectiveness of mandibular two-implant overdentures and conventional dentures in the edentulous elderly. J Dent Res 2005;84(9): 794–9.
[31] Takanashi Y, Penrod JR, Chehade A, et al. Surgical placement of two implants in the anterior edentulous mandible—how much time does it take? Clin Oral Implants Res 2003;14(2): 188–92.
[32] Feine JS, Carlsson GE, Awad MA, et al. The McGill consensus statement on overdentures. Mandibular two-implant overdentures as first choice standard of care for edentulous patients. Montreal, Quebec, May 24–25, 2002. Int J Oral Maxillofac Implants 2002;17(4): 601–2.
[33] Pjetursson BE, Karoussis I, Burgin W, et al. Patients' satisfaction following implant therapy. A 10-year prospective cohort study. Clin Oral Implants Res 2005;16(2):185–93.
[34] Feine J, Carlsson GE. Implant overdentures: the standard of care for edentulous patients. Chicago: Quintessence; 2003.
[35] Albrektsson T, Zarb G, Worthington P, et al. The long-term efficacy of currently used dental implants: a review and proposed criteria of success. Int J Oral Maxillofac Implants 1986;1(1): 11–25.
[36] Pinholt EM. Branemark and ITI dental implants in the human bone-grafted maxilla: a comparative evaluation. Clin Oral Implants Res 2003;14(5):584–92.