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Comparison of the reproducibility of results of a new peri-implantitis assessment system (implant success index) with the Misch classification

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Abstract (J Korean Assoc Oral Maxillofac Surg 2014;40:61-67)

Objectives: The present study was conducted to determine the reproducibility of peri-implant tissue assessment using the new implant success index (ISI) in comparison with the Misch classification.

Materials and Methods: In this descriptive study, 22 cases of peri-implant soft tissue with different conditions were selected, and color slides were prepared from them. The slides were shown to periodontists, maxillofacial surgeons, prosthodontists and general dentists, and these professionals were asked to score the images according to the Misch classification and ISI. The intra- and inter-observer reproducibility scores of the viewers were assessed and reported using kappa and weighted kappa (WK) tests.

Results: Inter-observer reproducibility of the ISI technique between the prosthodontists-periodontists (WK=0.85), prosthodontists-maxillofacial surgeons (WK=0.86) and periodontists-maxillofacial surgeons (WK=0.9) was better than that between general dentists and other specialists. In the two groups of general dentists and maxillofacial surgeons, ISI was more reproducible than the Misch classification system (WK=0.99 versus WK non-calculable, WK=1 and WK=0.86). The intra-observer reproducibility of both methods was equally excellent among periodontists (WK=1). For prosthodontists, the WK was not calculable via any of the methods.

Conclusion: The intra-observer reproducibility of both the ISI and Misch classification techniques depends on the specialty and expertise of the clinician. Although ISI has more classes, it also has higher reproducibility than simpler classifications due to its ability to provide more detail.

Key words: Peri-implantitis, Classification, Reproducibility, Bone loss

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I. Introduction

At present, the use of dental implants as optimal substitutes for lost teeth in oral rehabilitation is increasing[1]. More than one million implants are placed annually[2]. Osseointegrated implants have a high success rate. Clinical research has estimated the 5-year success rate of dental implants to be 95%-99%[3-5]. Despite their success, dental implants are susceptible to complications that can lead to failure[6]. Thus, it is necessary to recognize problems and influential factors of peri-implant disease. Implant therapy, like other surgical procedures, can have complications, such as bone loss, pocket formation, pus, exudation, mobility, sensitivity to percussion, peri-implant pain and bleeding, which can lead to implant failure[7,8]. Based on the severity of tissue involvement, peri-implant diseases are classified into two main groups: peri-implantitis and peri-implant mucositis[9].

The prevalence of peri-implant mucositis and peri-implantitis has been reported to be 8%-44% and 0.14%-4%, respectively. Mucositis refers to reversible inflammation of the peri-implant soft tissue, and peri-implantitis represents irreversible progressive peri-implant bone loss along with soft tissue inflammation[10,11]. Generally, peri-implantitis develops at the coronal sites of an implant after osseointegration during the loading phase. At the final stage of the disease, bone loss involves almost all the implant surface, and the implant becomes mobile[12]. It is difficult to manage these lesions, which eventually lead to implant loss[10,13]. The etiology of peri-implant diseases is usually multi-factorial, but bacterial

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infection and excessive biomechanical forces are reported as the major causes. Although dental implant treatment usually has an excellent prognosis, more recent studies on long-term success show a higher prevalence for peri-implantitis[14]. In the Sixth European Workshop on Periodontology, the prevalence of peri-implantitis was reported to be 28%-56% (12%-40% of the implant sites)[15]. In the past, peri-implant tissue status was assessed using various criteria[16]. Researchers developed their own specific criteria in their studies as their standard reference for the assessment of peri-implant tissues. This non-standardized process created problems for comparing the results of different studies in the diagnostic or treatment phase. The Misch classification is a system that has been previously used in numerous studies[17]. In this classification, assessment of peri-implant tissue status is done using a combination of qualitative and quantitative criteria to differentiate between 4 classes. In the implant success index (ISI) classification, which was designed by Kadkhodazadeh and Amid[18] in 2012, peri-implant tissue status is given a score from 1 to 9 based upon quantitative criteria. The present study sought to assess the reproducibility of this new peri-implantitis assessment technique compared to the Misch system.

II. Materials and Methods

This descriptive study was conducted at Shahid Beheshti Dental School (Tehran, Iran) from June 2012 to February 2013. Twenty-two cases of peri-implant complications in different stages were selected to cover different types of mucositis and peri-implantitis. The samples were chosen by five periodontists with a minimum of 7 years of experience in implant dentistry. They were provided with radiographs and photographs of the implants as well as data regarding probing depth, bleeding on probing, pus formation and bone loss in patients. The exact values of probing depth (mm), bleeding (+/-), bone loss (mm) and pus (+/-) were written below the figures to reduce the risk of information and selection bias. The slides included clinical photographs, clinical data (probing depth, bleeding, bone loss and pus) and radiographic views prepared in similar sizes. The slides were printed in color and delivered to 10 periodontists, 10 maxillofacial surgeons and 10 prosthodontists as well as 30 general dentists who had been practicing dental implant therapy for at least five years.(Fig. 1) The aforementioned groups were asked to make a diagnosis using the provided data and to classify the cases (images) based on the Misch classification and ISI systems.(Tables 1, 2) Both the Misch and ISI systems had been previously explained to participants by one of the clinicians who was not involved in the study, and they were also provided with a copy of a related article. Specialists and general dentists scored the peri-implant status based on the descriptions for both classification systems. This process was repeated 4 weeks later and the reproducibility of the results was compared. Statistical analysis was performed using PASW Statistics 18.0 software (IBM Co., Armonk, NY, USA). Based on the study design and qualitative results of both the Misch and ISI systems for outcome estimation, intra-observer and inter-observer reproducibility were calculated and compared using kappa and weighted kappa (WK) tests (kappa=1: complete agreement, kappa=0: no agreement).

III. Results

Regardless of the field of specialty, the inter-observer re-

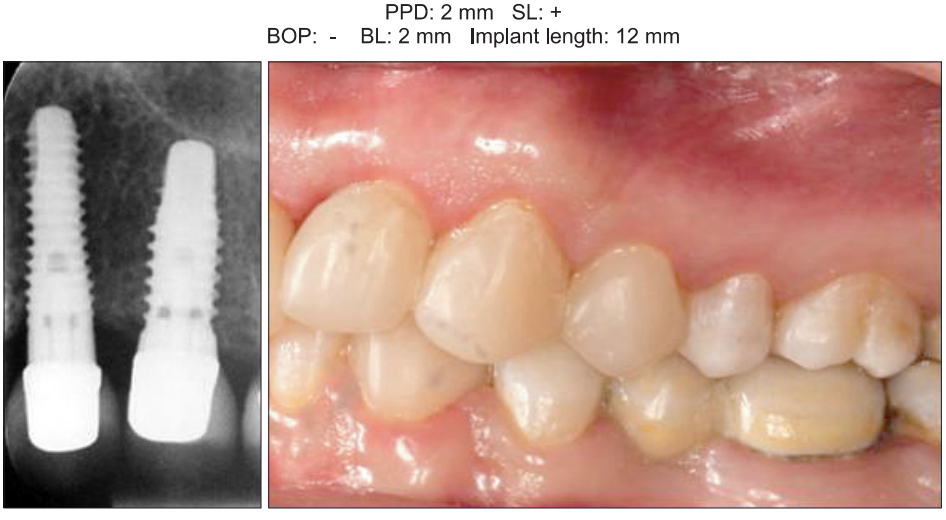

Fig. 1. A slide with clinical and radiographic views and required clinical data representing a case of class I Misch and class IV implant success index (PPD: probing pocket depth, SL: soft tissue level, BOP: bleeding on probing, BL: bone loss).
Mohammad Reza Abrishami et al: Comparison of the reproducibility of results of a new peri-implantitis assessment system (implant success index) with the Misch classification. J Korean Assoc Oral Maxillofac Surg 2014

Table 1. Implant success index (ISI)

Score	SL	HL	Clinical finding
ISI I	SL+, PPD ≤4 mm, BOP-	HL+	Clinically healthy
ISI II	SL+, PPD ≤4 mm, BOP+	HL+	Soft tissue inflammation
ISI III	SL+, PPD >4 mm, BOP+	HL+	Deep soft tissue pocket
ISI IV	SL+	HL-, RBL ≤2 mm (≤20%)	Initiation of hard tissue breakdown
ISI V	SL-	HL-, RBL ≤2 mm (≤20%)	Hard tissue breakdown plus Soft tissue recession
ISI VI	SL+	HL-, RBL: 2-4 mm (<40%)	Notable hard tissue breakdown
ISI VII	SL-	HL-, RBL: 2-4 mm (<40%)	Notable hard tissue breakdown Plus soft tissue recession
ISI VIII	-	RBL ≥40%	Severe bone loss
ISI IX	-	Clinical mobility	Clinical failure

(SL: soft tissue level, HL: hard tissue level, PPD: probing pocket depth, BOP: bleeding on probing, RBL: radiographic bone loss detected via long cone parallel peri-apical technique, +: tissue level located at or coronal to the reference line, -: level apical to the reference line)
If the peri-apical area of implants has a bone loss/radiolucent view (retrograde peri-implantitis), it is identified by placing the letter R (e.g., ISI IR, ISI IIR, ISI IIIR, etc.).
Mohammad Reza Abrishami et al: Comparison of the reproducibility of results of a new peri-implantitis assessment system (implant success index) with the Misch classification. J Korean Assoc Oral Maxillofac Surg 2014

Table 2. Misch classification

Group	Management	Clinical condition
I	Normal maintenance	No pain or tenderness upon function 0 mobility <2 mm radiographic bone loss from initial surgery Probing depth <5 mm No exudate history
II	Reduction of stress Shorter intervals between dental hygiene appointments Gingivoplasty Yearly radiographs	No pain 0 mobility 2 to 4 mm radiographic bone loss Probing depth 5 to 7 mm No exudate history
III	Reduction of stress Drug therapy (antibiotics, chlorhexidine) Surgical reentry and revision Change in prosthesis or implants	No pain upon function 0 mobility Radiographic bone loss >4 mm Probing depth >7 mm May have history of exudate
IV	Removal of implants	Any of the following: Pain upon function Mobility Radiographic bone loss >1/2 the length of the implant Uncontrolled exudate No longer in mouth

Group I: success (optimum health), Group II: survival (satisfactory health), Group III: survival (compromised health), Group IV: failure (clinical or absolute failure).
Mohammad Reza Abrishami et al: Comparison of the reproducibility of results of a new peri-implantitis assessment system (implant success index) with the Misch classification. J Korean Assoc Oral Maxillofac Surg 2014

producibility of the ISI method was more acceptable than that for the Misch classification. When the observer's specialty was considered, the inter-observer reproducibility of the ISI system between the prosthodontists-periodontists (WK=0.85), prosthodontists-maxillofacial surgeons (WK=0.86) and periodontists-maxillofacial surgeons (WK=0.9) was better than the inter-observer reproducibility between the general dentists and other specialists.(Table 3)

In the two groups of general dentists and maxillofacial surgeons, the ISI system was more reproducible than the Misch system (WK=0.99 versus WK not calculable, WK=1 and WK=0.86). Among periodontists, the intra-observer reproducibility of both methods was equally excellent (WK=1). In the prosthodontists group, the WK was not calculable in either method. Thus, we may conclude that the intra-observer reproducibility in both the ISI and Misch systems depends on the specialty, expertise and skills of the clinicians.(Table 4)

Table 3. The results of the comparison of inter-observer reproducibility

Group	ISI			Misch		
	Kappa value	*P*-value	Weighted kappa	Kappa value	*P*-value	Weighted kappa
Dentist-dentist	0.61	0.001	0.69	0.56	0.001	0.62
Dentist-periodontist	0.56	0.05	0.63	0.48	0.01	0.55
Dentist-prosthodontist	0.59	0.05	0.68	0.51	0.001	0.59
Dentist-maxillofacial surgeon	0.51	0.05	0.75	0.46	0.001	0.60
Periodontist-periodontist	0.79	0.001	0.87	0.73	0.001	0.81
Periodontist-prosthodontist	0.53	0.001	0.85	0.65	0.001	0.76
Periodontist-maxillofacial surgeon	0.44	0.001	0.90	0.41	0.001	0.83
Prosthodontist-prosthodontist	0.63	0.001	0.75	0.57	0.001	0.65
Prosthodontist-maxillofacial surgeon	0.58	0.001	0.86	0.45	0.01	0.69
Maxillofacial surgeon-maxillofacial surgeon	0.89	0.001	0.95	0.78	0.01	0.84

(ISI: implant success index)
Mohammad Reza Abrishami et al: Comparison of the reproducibility of results of a new peri-implantitis assessment system (implant success index) with the Misch classification. J Korean Assoc Oral Maxillofac Surg 2014

Table 4. The results of the comparison of intra-observer reproducibility

Group	ISI			Misch		
	Kappa value	*P*-value	Weighted kappa	Kappa value	*P*-value	Weighted kappa
Dentist	0.89	0.001	0.99	0.75	0.001	0.83
Periodontist	1.00	0.001	1.00	1.00	0.001	1.00
Prosthodontist	0.82	0.001	0.91	0.78	0.001	0.84
Maxillofacial surgeon	1.00	0.001	1.00	0.80	0.001	0.86

(ISI: implant success index)
Mohammad Reza Abrishami et al: Comparison of the reproducibility of results of a new peri-implantitis assessment system (implant success index) with the Misch classification. J Korean Assoc Oral Maxillofac Surg 2014

IV. Discussion

Previous studies have suggested some criteria for the assessment of implant success. The Misch classification for dental implant success has had the highest acceptance among the suggested systems[19]. This classification is based on the clinical examination of implants, and it can assist in implant status assessment in terms of health or disease. From a diagnostic point of view, critics believe that the Misch classification has some shortcomings since it does not provide the clinician with any information on the extensiveness or severity of the disease. This system also suffers from other drawbacks; for instance, the disease stage (mucositis or peri-implantitis) is not included in this classification.

There is an important point to note in statistical analyses of studies like this one. We used three different approaches to design a proper study for comparing the efficacy of the classification methods: intra-observer, inter-observer and inter-method reproducibility. The latter can be used only to compare classifications that have similar categories. As the Misch and ISI systems have different items, we assessed their intra-observer and inter-observer reproducibility. The sample size in these studies refers to cases rather than test participants. We selected 22 cases for the final analysis[20].

A new classification system for the success assessment of dental implants is needed, and its validity and reliability should be confirmed in the clinical setting; it will also need to gain global acceptance. The ISI was designed based on the following criteria: bleeding on probing, probing pocket depth, radiographic bone loss and loss of function (mobility). Our study compared the reproducibility of a new peri-implantitis assessment system (ISI) with the Misch system. Our results revealed that overall, regardless of the specialty of the clinicians, inter-observer reproducibility of the ISI system was more acceptable than that of the Misch system. With regard to clinician specialty, it was noted that the inter-observer reproducibility of the ISI method between the prosthodontists-periodontists (WK=0.85), prosthodontists-maxillofacial surgeons (WK=0.86) and periodontists-maxillofacial surgeons (WK=0.9) was better than the inter-observer reproducibility between dentists and other specialists. This issue may be attributed to the inability of general dentists to accurately assess the criteria.

For the calculation of Kappa as the reliability (reproducibility) index, the classification method (Misch or ISI) should have an equal number of intra- and inter-observer categories. Thus,

even if only one category is lost due to the lack of reporting by an observer, the kappa and WK cannot be calculated.

Additionally, in the two groups of general dentists and maxillofacial surgeons, the ISI system was more reproducible than the Misch system (WK=0.99 versus WK not calculable, WK=1 and WK=0.86, respectively). Among periodontists, the intra-observer reproducibility of both systems was equally excellent (WK=1). For prosthodontists, the WK was not calculable in either system. Thus, we may conclude that the intra-observer reproducibility in both Misch and ISI depends on the specialty, expertise and skills of clinicians. Determination of the level of significance was not indicated when we calculated the WK (rather than the kappa) for data analysis. Thus, a higher WK coefficient directly represented higher reproducibility.

It appears that the high reproducibility of the ISI system was due to it having more details in comparison to the Misch system; the ISI has 9 categories versus 4 in the Misch system. Generally, periodontists and oral surgeons have been involved in evaluating implants placed in hard tissue. However, many prosthodontists are more concerned with the biomechanical complications associated with the supra structure. Thus, they are not as familiar with implant success criteria in comparison to the other two groups.

Only one previous study is available on the ISI system. In that study, researchers evaluated and compared the acceptability of this new system for the success of dental implants with the Misch classification and showed significant differences between the two in terms of primary diagnosis, efficacy for follow-up examinations, reproducibility, design and lack of overestimation based on quantitative variables; the mean scores of ISI were significantly higher than those of Misch[21].

In 1997, Murphy[22] determined 4 characteristics required for a classification system for implant success: usefulness, comprehensiveness, relevance and disjointedness (one participant cannot be classified into two groups) and simplicity. The ISI possesses all these characteristics and eliminates the need for further diagnostic workup in the most comprehensive way possible. It has an easy application for estimation of the presence or absence of comprehensiveness, as it is not possible to group one patient into more than one category. Using this classification system, the clinician can observe and record the presence or absence of the respective factors. Undoubtedly, the ISI system is not as simple as the Misch classification system, but it has greater clarity due to its use of 9 criteria versus the 4 in the Misch system.

In the ISI, both the extensiveness and the severity of disease are addressed. The degree of disease in this system in terms of extensiveness and the results of clinical examinations can be classified as mild, moderate or severe. ISI can therefore be used for the determination of the outcome of different implant treatments. Differentiation of the prevalence of peri-implantitis and the number of required treatments indicate over-estimation of the prevalence of peri-implantitis. Over-estimation suggests that the disease has a prevalence higher than the actual rate. There is no doubt that the implant success classification should be able to estimate the actual incidence of the disease and its severity to reduce the risk of excess treatment and associated costs.

The ability for early diagnosis of disease is an important characteristic for a diagnostic system and helps reduce the prevalence of disease. However, the number of diagnostic systems capable of early diagnosis of disease is limited, and those that are available have a low efficacy with limited clinical applications. In general, early diagnosis of peri-implantitis by the clinician can have significant effects on the treatment outcome and the economic burden of disease. Considering the reproducibility of the ISI, this system is fully capable of fulfilling this criterion. The maintenance phase is of special significance. Recording some of the patient-related factors before patient registry for implant is necessary. Available clinical and radiographic data should be routinely collected after implant loading to obtain a baseline for the diagnosis of peri-implantitis during the maintenance phase of patients. The results of pocket probing, mucosal margin position and radiographic margins of the proximal bone should also be recorded. Maintenance and treatment of peri-implantitis must be evidence-based[23]. Furthermore, the ISI system has to be employed for primary assessment in implant therapy and should also be used in the maintenance phase. The efficacy of this system for determining the outcome of particular treatments by the allocation of pre- and post-treatment scores has been confirmed[21].

The ISI system has a quantitative base for estimation of the implant success rate. This system is distinctively different from the qualitative systems used to assess and classify treatment success based on patient comfort and satisfaction. Comparison of these systems based on their flexibility revealed that the ISI had greater flexibility for different implant systems in comparison to the Misch classification. Additionally, the high reproducibility of the ISI system is associated with its detail orientation.

One limitation of our present study was the lack of response of participants to some of the questions, which meant

that the kappa and WK could not be calculated in some cases. In all diagnostic and classification systems, every question needs to be answered. As the ISI system has only been recently introduced, further studies with larger sample sizes will be required for ISI evaluation. The role of inflammatory biomarkers at different levels, the effects of time and different treatment protocols will need to be investigated in prospective studies as well. With these methods, the applicability of this system in daily clinical practice will be determined.

Long-term studies on dental implants should be carried out according to the specific conditions accepted by scientific organizations. Some of these principles emphasize that studies should be conducted on an adequate number of patients and treatment success or failure criteria should be better defined. Furthermore, failed implants must be analyzed in these studies, and the duration of assessment should be 2-5 years[24]. The critical period for implant survival usually starts from implant placement and continues to one year after the exertion of occlusal forces (loading). Thus, after the completion of the first year, the clinicians can, to a great extent, decide on the success or failure of the implant[24]. In general, differences between the results of various studies regarding implant success and peri-implant hard and soft tissue status can be attributed to factors such as the type of implants used, the surgeon's experience and skills, the number of understudy samples (sample size), oral hygiene status, number of follow-up sessions, the maintenance phase, duration of implant service, type of bone and bone grafts and criteria for implant assessment.

V. Conclusion

Although the Misch classification has 4 and the ISI system has 9 categories, it appears that the ISI system has higher reproducibility than the Misch system due to its greater attention to detail. Further studies are required to assess the validity of changes in the ISI score at different loading times and treatment procedures for failing implants.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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References

1. Albrektsson T, Isidor F. Consensus report: implant therapy. In: Lang NP, Karring T, eds. Proceeding of the 1st European Workshop on Periodontology. Berlin: Quintessence; 1994:365-9.
2. Le Guéhennec L, Soueidan A, Layrolle P, Amouriq Y. Surface treatments of titanium dental implants for rapid osseointegration. Dent Mater 2007;23:844-54.
3. Davarpanah M, Martinez H, Etienne D, Zabalegui I, Mattout P, Chiche F, et al. A prospective multicenter evaluation of 1,583 3i implants: 1- to 5-year data. Int J Oral Maxillofac Implants 2002;17:820-8.
4. Astrand P, Engquist B, Dahlgren S, Gröndahl K, Engquist E, Feldmann H. Astra Tech and Brånemark system implants: a 5-year prospective study of marginal bone reactions. Clin Oral Implants Res 2004;15:413-20.
5. Nelson K, Semper W, Hildebrand D, Ozyuvaci H. A retrospective analysis of sandblasted, acid-etched implants with reduced healing times with an observation period of up to 5 years. Int J Oral Maxillofac Implants 2008;23:726-32.
6. Tonetti MS. Risk factors for osseodisintegration. Periodontol 2000 1998;17:55-62.
7. Berglundh T, Lindhe J, Marinello C, Ericsson I, Liljenberg B. Soft tissue reaction to de novo plaque formation on implants and teeth. An experimental study in the dog. Clin Oral Implants Res 1992;3:1-8.
8. Ericsson I, Berglundh T, Marinello C, Liljenberg B, Lindhe J. Long-standing plaque and gingivitis at implants and teeth in the dog. Clin Oral Implants Res 1992;3:99-103.
9. Zitzmann NU, Berglundh T. Definition and prevalence of peri-implant diseases. J Clin Periodontol 2008;35(8 Suppl):286-91.
10. Leonhardt A, Dahlén G, Renvert S. Five-year clinical, microbiological, and radiological outcome following treatment of peri-implantitis in man. J Periodontol 2003;74:1415-22.
11. Behneke A, Behneke N, d'Hoedt B, Wagner W. Hard and soft tissue reactions to ITI screw implants: 3-year longitudinal results of a prospective study. Int J Oral Maxillofac Implants 1997;12:749-57.
12. Jovanovic SA. The management of peri-implant breakdown around functioning osseointegrated dental implants. J Periodontol 1993;64(11 Suppl):1176-83.
13. Roos-Jansåker AM, Lindahl C, Renvert H, Renvert S. Nine- to fourteen-year follow-up of implant treatment. Part II: presence of peri-implant lesions. J Clin Periodontol 2006;33:290-5.
14. Offenbacher S. Periodontal diseases: pathogenesis. Ann Periodontol 1996;1:821-78.
15. Albandar JM. Global risk factors and risk indicators for periodontal diseases. Periodontol 2000 2002;29:177-206.
16. Mombelli A, Lang NP. The diagnosis and treatment of peri-implantitis. Periodontol 2000 1998;17:63-76.
17. Brägger U, Aeschlimann S, Bürgin W, Hämmerle CH, Lang NP. Biological and technical complications and failures with fixed partial dentures (FPD) on implants and teeth after four to five years of function. Clin Oral Implants Res 2001;12:26-34.
18. Kadkhodazadeh M, Amid R. Evaluation of peri-implant tissue health using a scoring system. JIACD 2012;4:51-7.
19. Misch CE, Perel ML, Wang HL, Sammartino G, Galindo-Moreno P, Trisi P, et al. Implant success, survival, and failure: the International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference. Implant Dent 2008;17:5-15.
20. Rothman KJ, Greenland S, Lash TL. Modern epidemiology. 3rd ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2008:307-8.
21. Kadkhodazadeh M, Esfahrood ZR, Amid R, Zarnegarnia P. Comparison of the acceptability of a new scoring system with Misch's classification for dental implant success determination. J Long Term Eff Med Implants 2012;22:85-93.
22. Murphy EA. The logic of medicine. 2nd ed. Baltimore: Johns Hop-

kins University Press; 1997:119-36.
23. Abrahamsson I, Berglundh T, Wennström J, Lindhe J. The peri-implant hard and soft tissues at different implant systems. A comparative study in the dog. Clin Oral Implants Res 1996;7:212-9.
24. Buser D, Mericske-Stern R, Bernard JP, Behneke A, Behneke N, Hirt HP, 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;8:161-72.