Influence of implant misplacement on the success of the final prosthesis: Subjective evaluation by a prosthodontist of dental implants placed by an oral and maxillofacial surgeon

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Purpose: In many cases, the erroneous placement of a dental implant brings about undesirable results. Here, the effect of dental implant placement on the success of the final prosthesis was evaluated from the point of view of the prosthodontist.

Materials and Methods: All surgical operations were performed by the same oral surgeon with the same surgical protocol and all prosthodontic procedures were performed by the same prosthodontist. The problems faced by the prosthodontist, their causes, and their effect on prosthesis success were identified. The success of the final prostheses was evaluated by the same prosthodontist.

Results: Only 53% (238 implants in 105 patients) of dental implants were not associated with prosthodontic problems. Multiple implant placement (more than three implants) was associated more frequently with prosthodontic problems.

Conclusions: The data indicate that the satisfactory construction of a prosthesis is highly dependent on the placement of the dental implant in the best possible position. It is strongly recommended that the oral surgeon and the prosthodontist engage in pre-operative discussions to establish a top-down treatment plan, as this will improve implant placement and ultimately the success of the prosthesis.

Key words: Dental implant, Placement error, Prosthodontic problem

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Introduction

Implants are sometimes placed in inadequate locations. This can occur, for example, when the area that has been designated for implantation shows noticeable insufficiency of alveolar bone during the course of surgery that means implant stability would be compromised. While it is generally recommended in such situations that implant placement be delayed and/or a subsequent bone graft procedure should be considered, in many cases, clinicians abandon the originally planned position and instead place the implant on areas where sufficient bone exists. While the prosthodontist can then employ an angulated abutment to attach the prosthesis, some of these misplaced implant cannot be managed by prosthodontic approaches. Indeed, Kohner et al. have stated that it is impossible to fabricate the prosthesis if the direction of implantation is extremely unfavorable and that the malposed implant fixture may have to be removed[1].

This issue had arisen in part because of a widespread misunderstanding among oral surgeons that the problems associated with the misplacement of implants can be solved by prosthodontic methods, provided that there are no osseointegration problems[2]. Since the goal of implant surgery is to restore dental function, it is important that this issue is resolved. This could be achieved by ensuring that the oral surgeon consults with the prosthodontist and that a consensus on the planning and maintenance of implant treatment is obtained before surgery[3]. Chang *et al*. have examined the degree of satisfaction felt by patients and the prosthodontist with regard to the esthetic outcome of implant prostheses, many differences of which between them were found[4,5]. In contrast, while anecdotal evidence suggests that oral surgeons and prosthodontists may also differ in what they consider to be successful implant treatment, the degree of satisfaction the prosthodontist feels about implants placed by an oral surgeon has not yet been studied. To address this issue, we here evaluated the problems that prosthodontists face with regard to dental implants, their causes, and their effect on prosthesis success.

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Materials and Methods

This study was approved by the Institutional Review Board on Human Subjects of the Seoul National University Bundang Hospital (IRN No. B-0602-030-016). Edentulous patients who had undergone dental implant surgery at Seoul National University Bundang Hospital between June, 2004 and October, 2005 were included in this study. Patients suffering from systemic diseases were excluded to minimize differences between individuals. Two dental implant systems from Osstem® (Osstem Co., Busan, Korea) and Implantium® (Dentium Co., Yongin, Korea) were used. All operations in this study were performed by one oral surgeon with the same surgical protocol. All prosthodontic procedures were performed by one prosthodontist. The problems faced by the prosthodontist in fabricating the prostheses were assessed and the success of the final prostheses was evaluated by the prosthodontist subjectively.

The following factors were evaluated[6,7]

1. Problems confronted by the prosthodontist during the prosthodontic procedure

1) Misplacement

Inadequate depth, inadequate angulation, insufficient inter-implant space, inadequate buccolingual or mesiodistal position were evaluated.

2) Unsatisfactory supplementary procedure

Prosthodontist evaluated subjectively about the hard tissue and soft tissue management which were performed by surgeon.

3) Planning error

Inadequate cooperation between surgeon and prosthodontist was considered as planning error. And also inappropriate selection of implant system was considered as planning error.

2. Evaluation of the final prostheses by a prosthodontist

The status of the final prosthesis was evaluated subjectively by prosthodontist. These included poor soft tissue condition around the implant, esthetic dissatisfaction, exposure of implant threads, poor biomechanics, inadequate emergence profile, difficulties associated with oral hygiene care, adjacent teeth problem, plan change in the course of treatment, prolongation of total treatment time, sleeping implant, suprastructure failure, impossibility of screw-hole filling, continued cheek biting.

Results

Final prostheses were completed for 667 implant fixtures in 198 patients. Only 105 patients (53.3%) did not present the prosthodontist with any problems, and only 238 implant (35.7%) were seen as being satisfactory by the prosthodontist. As shown in Table 1, the majority of prosthodontic problems related to the misplacement of the implant, namely, inadequate depth (26 patients), inadequate angulation (15 patients), insufficient inter-implant space (12 patients), inadequate buccolingual position (11 patients), and inadequate mesiodistal position (9 patients). There were also problems relating to the unsatisfactory outcomes of supplementary hard tissue (20 patients) or soft tissue management procedures (17 patients). In addition, in a number of cases, there was inadequate consultation between the oral surgeon and the prosthodontist in terms of planning (10 patients), or the selection of the implant system was inappropriate (9 patients); these problems are listed in Table 1 under the title 'planning error' (Table 1) (Fig. 1-4).

With regard to the functional outcomes of the implants, 13 implants from 12 patients were removed in the functional implant-loading period. Two implant in one patient were fractured after a two-year use without functional problems and were removed and replaced by conventional removable partial dentures. Seven implants from seven patients were removed because of early failure and were planned to be replaced with new implants followed by prosthodontic treatment. Four implants from four patients failed early after placement and were removed but prosthodontic treatment was completed by using remaining implants (Table 2).

With regard to the final prostheses, the most common problem detected by the prosthodontist was poor soft tissue condi-

Table 1. Problems confronted by the prosthodontist.

problems		number of cases
A. Misplacement		73
inadequate depth	26	
inadequate angulation	15	
insufficient inter-implant space	12	
inadequate buccolingual position	11	
inadequate mesiodistal position	9	
B. Unsatisfactory supplementary procedure		37
unsatisfactory hard tissue management	20	
unsatisfactory soft tissue management	17	
C. Planning error		19
inadequate consultation in planning	10	
inappropriate selection of implant system	9	
Total		129

tion around the implant (25 patients). The next biggest problem was esthetic dissatisfaction (10 patients), which was followed by the exposure of implant threads (10 patients), poor biomechanics (9 patients), inadequate emergence profile (8 patients), and difficulties associated with oral hygiene care (7 patients) (Table 3) (Fig. 5 and 6).

Table 2. Management of implants that failed early after dental implant surgery.

method	number of patients (number of implants)
removal and replacement	7(7)
removal and fabrication of suprastructure	4(4)
removal after 2 years, RPD fabrication	1(2)
total	12(13)

Fig. 1. Inadequate depth.

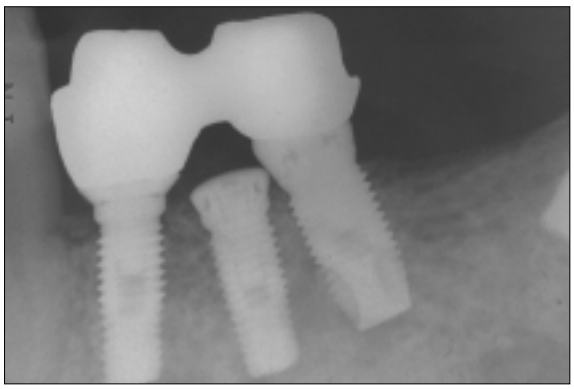

Fig. 2. Inadequate angulation.

Fig. 3. Insufficient inter-implant space.

Fig. 4. Inadequate buccolingual position.

Fig. 5. Soft tissue problem around implants.

Fig. 6. Esthetic dissatisfaction.

Table 3. Evaluation of the final prostheses by a prosthodontist.

evaluation of the final prostheses	number of cases
poor soft tissue condition around the implant	25
esthetic dissatisfaction	10
exposure of implant threads	10
poor biomechanics	9
inadequate emergence profile	8
difficulties associated with oral hygiene care	7
adjacent teeth problem	3
plan change in the course of treatment	3
prolongation of total treatment time	2
sleeping implant	2
suprastructure failure	1
impossibility of screw-hole filling	1
continued cheek biting	1

Discussion

To place implants correctly, many factors should be considered before surgery[8]. From the viewpoint of the prosthodontist, the angulation and position of the implant are the most critical factors that dictate the success of a prosthesis.

It is known that buccally tilted implants are associated with a high risk of gingival recession while lingually tilted implants are associated with unesthetic ridge-lap restoration or difficulties in oral hygiene care. Moreover, if an implant fixture is placed too closely to the adjacent tooth mesiodistally, excessive bone loss around the adjacent tooth as well as the loss of interdental papilla could occur[9]. These issues may affect the function and esthetics of the prosthesis in complex ways, such as inducing a poorly shaped embrasure, a poor emergence profile, or a long contact point. Deeply placed implants also sometimes induce abnormal bony resorption and plaque accumulation around the implant that is partially due to deficiencies in the attached gingiva[10,11]. Gingival recession and elongation of the prosthodontic suprastructure can result in the exposure of the metal margin, which is unaesthetic[12]. Implants are usually considered to have failed if they tilt by more than 25 degrees, as this makes it impossible to fabricate the prosthetic suprastructure[13]. While Balshi et al. have reported that angulated abutments do not critically affect the fabrication of the suprastructure or increase implant failure[14], two studies on angulated abutments using finite element analysis have suggested that excessive angulation increased the stress on an implant; as a result, occlusal loading imposes fatal lateral force and shear stress on the implant[15,26]. The inadequate angulation of an implant particularly affects posterior restoration, as this is where strong biting force is applied. It has also been shown that inadequate implant placement compromises not only prosthodontic treatment in most cases, it is also associated with a poor prognosis over the long term[17-19]. To improve the placement and angulation of implant, we strongly recommend the routine use of surgical stents. We also recommend that the guide pin in the surgical kit should be used several times during surgery to check the path of the implant.

It is also important that the space between implants or between an implant and the adjacent tooth is appropriate[9]. Excessive space between implants and adjacent teeth can cause problems, such as overloading of the implant fixtures resulting from cantilever,[20,21] while insufficient space between two implants can induce crestal bone resorption and oral hygiene difficulties. It has been reported that there should be at least 3.0 mm between an implant and the adjacent natural tooth and at least 3.0-5.0 mm between implants. Moreover, if the bone is dense, a space of at least 5.0 mm is desirable, while 3.0 mm is sufficient if the bone is soft[22].

An extremely important factor affecting the success of a prosthesis is the depth of the implant fixture at the crestal bone level, as this dictates the emergence profile and soft tissue management. Under-installation of fixture makes insufficient space for emergence profile, which results in overcontoured restoration that causes complications such as gingival recession, plaque accumulation, etc. Implant depth problems were found in 26 patients. In this investigation, these depth problems were largely related to under-implantation (25 patients), as only one patient had over-implantation. The reasons for not placing an implant with sufficient depth include the need to avoid damaging major anatomic structures like the inferior alveolar canal and maxillary sinus, insufficient tapping on high density bone, and irregular bucco-lingual or mesio-distal alveolar bone height.

The selection of an appropriate implant also plays a crucial role in prosthesis success. For example, the use of a large-diameter implant with a wide platform or wide neck for the anterior teeth area may result in an implant shoulder that is too close to the adjacent tooth or causes buccal tipping, which results in alveolar bone loss and gingival recession. In particular, it is important to select the right implant for zones like the upper anterior area that are associated with high esthetic expectations[23]. The placement depth of one-staged implants is determined by interocclusal space. It is well known that to place implants in a limited vertical space, at least 5.0 mm of height above the collar must be obtained and a wide neck implant should be used to generate an adequate emergence profile. In this study, we experienced difficulties in making the

prosthesis or were unable to fill the screw hole after one-stage implantation in limited interocclusal areas.

In this study, there are many limitations and problems because of subjective evaluation by one prosthodontist. So there were no standard about the esthetic and surrounding tissue evaluation. However, subjective evaluation by clinician and patient are very importane in clinical implant dentistry. The authors wrote this paper to emphasize the close cooperation between surgeon and prosthodontist.

Conclusions

To achieve optimal results in dental implant surgery, it is important that the oral surgeon, however experienced he or she may be, follows basic surgical procedure principles, since intuitively ignoring these principles in placing dental implants can lead to misplaced implants that cannot be used by the prosthodontist or lead to an unaesthetic outcome or functional overloading of the suprastructure. In particular, it is very important that oral surgeons and prosthodontists devise a top-down treatment plan together in close cooperation, as this will improve the placement of implants and the outcome of dental implant surgery.

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