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Fixed Prosthodontics With Different Types Of Support- A Pilot Study.

Svalina Zvonimir[1], Lončar Brzak Božana[2]*, Špalj Stjepan[3], Ćelić Robert[4], Terlević Diana[5], and Pelivan Ivica[4].

[1]Private dental practice, Zagreb, Croatia
[2]Department of Oral Medicine, School of Dental Medicine, University of Zagreb, Zagreb, Croatia
[3]Department of Orthodontics, School of Medicine, University of Rijeka, Rijeka, Croatia
[4] Department of Prosthodontics, School of Dental Medicine, University of Zagreb, Zagreb, Croatia
[5] Private dental practice, Ljubljana, Slovenia

ABSTRACT

The purpose of this study was to identify a potential correlation between biological and technical complications and dental implant treatment success. This study included 60 patients divided in three groups with 20 patients each. Each group comprised ten fixed dental prostheses with three members and ten fixed dental prostheses with four members, located in lateral segments of the jaws. Fixed dental prostheses were supported by implants, teeth or combined. All patients were clinically examined and their radiographic findings analysed after cementing/fixation of fixed dental prostheses in the mouth and then again at control examination, after 1-3 years, to estimate average bone loss during the period of observation. Statistical analysis were performed on SPSS 10.0 (SPSS Inc., Chicago, SAD) with the level of significance set at $p<0.05$. Fixed dental prostheses supported by implants had the lowest index of technical and biological complications, when compared to fixed dental prostheses supported by natural teeth alone and both by natural teeth and implants. Patients with fixed prosthodontics supported by implants alone had the lowest average plaque index and gingival index (average 0.52 and 0.74), the lowest pocket probing depth (average 2.76 mm) and the lowest level of clinical periodontal attachment loss (average 3.01 mm). However, differences among the groups have not reached level of significance. After implant placement, maintenance of proper oral hygiene and regular periodontal treatment in patients with previously diagnosed parodontitis is the most important factor for implant success.

Keywords: dental implants; dental prosthesis, fixed; periodontitis

Corresponding author

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INTRODUCTION

Data from the published literature show that the clinical success of the implants and its durability is achieved by controlled biomechanical occlusion. It is quite obvious that occlusal overload certainly influences implant treatment, however, other local and systemic factors might also contribute to the implant success/failure. It is interesting to note that only Chambrone et al.[1] claimed that there was no association between occlusal overload and the implant failure when no plaque was present. On the contrary, Miyata et al.[2]reported that bone resorption around the implant can be caused by excessive occlusal trauma without any tissue inflammation around implants. However, Fu et al.[3]stated that the occlusal overload is the primary cause of biomechanical complications related to the implant treatment, and Maximo et al.[4] found significant correlation between perimplantitis and the implant loading. Furthermore, Nagasawa et al.[5]reported disturbances in the regeneration of bone around the implant due to the excessive occlusal loading. Hsu et al.[6] stated that occlusal loading leads to the marginal bone loss, but also has a role inthe fracture of veneers and porcelain, or weakening or breakage of the abutment bolt. Gotfredsen et al.[7] reported that lateral implant loading can lead to loss of contact between the implant and the epithelium, which leads to the implant failure.

In accordance with this, several authors [8-10] concluded that normal functional implant loading does not lead to loss of the marginal bone.

Although many researchers have studied local and systemic factors which influence the dental implant survival, there is still need for studies which take into account various factors regarding the implant survival. Therefore, the purpose of this study was to evaluate a correlation between following covariates and dental implant treatment success, during the 1-3 years of follow-up:

1. influence of the type of the fixed dental prosthesis (number of units of the fixed prosthodontic appliance, type of support);
2. occurrence of screw leakage or screw fracture between dental implant and abutment, implant fracture, abutment fracture, veneering material fracture, loosening of the cement;
3. influence of oral hygiene, gingivitis and periodontitis;
4. influence of bone quality.

MATERIALS AND METHODS

This study was approved by the Ethical Committee of School of Dental Medicine, University of Zagreb, Croatia. Every participant signed informed consent according to Helsinki declaration. A total number of 60 partially edentulous patients were included in this study. Fixed dental prostheses had three or four units supported by teeth, dental implants or their combination. Patients were divided into three groups regarding the type of support:T-T (teeth),I-I (implants) and T-I (combination of the tooth and implant). There were 20 patients with 20 fixed dental prostheses in the group T-T (ten fixed dental prostheses with three members and ten fixed dental prostheses with four members; 20 patients with 20 fixed bridges in the group I-I (ten dental prostheses with three members and ten fixed dental prostheses with four members) and 20 patients with 20 bridges in the group T-I (ten dental prostheses with three members and ten fixed dental prostheses with four members). Total number of inserted implants was 66; in the group I-I 41 implant and in the group T-I 25 implants. Dental implants used were Astratech, Sweden, with length ranging from 9 to 13 mm. The implants were inserted into posterior parts of either maxilla or mandible within the height of the alveolar crest bone (bone level implants). All the inserted implants underwent healing period of 6 months in the maxilla and 3 months in the mandible. After osseo integration period has finished, fixed dental prostheses were fabricated.

All patients were clinically examined and their radiographic findings analysed. Clinical examinations were recorded as following: oral hygiene index according to Silnes & Löe[11] plaque index (PI) on the natural teeth whereas modified plaque index according to Mombelli et al.[12] was used around implants. Gingival inflammation was recorded according to Silness&Löe[11].Pocket probing depth (PPD)and periodontal attachment level (PAL)were recorded according to the Listgarten et al.[13].

Intraoral radiographic findings were obtained by use of GendexOralix AC, Gendex Dental Systems, Germany). Radiological assessment of alveolar bone was performed by programme WixWin pro Version 1.5,

after mesial and distal parts of the teeth or implants were recorded in order to find out average bone loss during the period of observation. Furthermore, qualitative analysis of the bone around implants (i.e. assessment of bone density) was performed according to Lekholm and Zarb[14]on the radiographic findings.

Statistical analysis was performed on SPSS 10.0 (SPSS Inc., Chicago, SAD) with the level of significance set at $p<0.05$. Data distribution was tested by means of descriptive statistics. Furthermore, statistical analysis included ANOVA which tested significant differences between various types of complications in all three studied groups of bridges (T-T, I-I, T-I). Afterwards, multiple regression analysis was performed for testing influence of various clinical and radiological findings (independent variables) on the occurrence of biological and technical complications (dependant variables) in all three groups of fixed dental prostheses.

RESULTS

The results of this study have shown that chipping of the ceramic occurred most frequently on the bridges supported by implants and natural teeth (20%). Screw loosening was also more frequent in the fixed dental prostheses supported by implants and natural teeth when compared to the fixed dental prostheses supported by implants(20% versus 10%). Furthermore, loosening of the cement occurred most frequently on the fixed dental prostheses supported by implants and natural teeth(10%) (Table1).

Table 1: Distribution of technical complications depending on the type of support

	Bridges on the implants (I-I)		Bridges on the implants and natural teeth (T-I)		Bridges on the natural teeth (T-T)	
	Number	%	Number	%	Number	%
Abutment fracture	1	5.0	1	5.0	1	5.0
Ceramic fracture	1	5.0	1	5.0	1	5.0
Chipping of the ceramics	3	15.0	4	20.0	3	15.0
Loosening of the abutment screw	2	10.0	4	20.0		
Cement loosening	1	5.0	2	10.0	1	5.0

Also, our results have shown that gingivitis/mucositis and periodontitis/peri-implant it is most frequently occurred on the fixed dental prostheses supported by implants and natural teeth (25% gingivitis/mucositis and 15% periodontitis/peri-implantitis), and the rarest on the fixed dental prostheses supported by implants (15% gingivitis/mucositis and 5% periodontitis/peri-implant it is) (Table 2).

Table 2: Distribution of biological complications regarding the type of support

	Bridges on implants (I-I)		Bridges on natural teeth and implants (T-I)		Bridges on natural teeth (T-T)	
	Number	%	Number	%	Number	%
Gingivitis/mucositis	3	15	5	25	4	20
Periodontitis/peri-implantitis	1	5	3	15	2	10

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Average plaque index – PI/mPI was highest in patients with fixed dental prostheses supported by implants and natural teeth and lowest in the patients with fixed dental prostheses supported only by implants (Table 3).

Table 3: Average values (x) and standard deviations (SD) of the examined variables according ot the type of support.

Variable		Bridges on implants (I-I)		Bridges on natural teeth and implants (T-I)		Bridges on natural teeth (I-I)	
	Number of participants	x	SD	x	SD	x	SD
Average PI/mPI	20	0.52	0.24	0.67	0.37	0.60	0.31
Average GI/mGI	20	0.74	0.30	0.78	0.38	0.77	0.29
Average pocket probing depth (PPD) (mm)	20	2.76	0.41	2.96	0.48	2.93	0.39
Average clinical periodontal attachment level (PAL) (mm)	20	3.01	0.48	3.12	0.47	3.02	0.44
Average gingival recession (mm)	20	0.66	0.52	0.84	0.58	0.84	0.44
Bone resorption around implant/tooth (average CBLE) (mm)	20	2.04	0.89	2.21	0.91	1.99	0.99
Bone density (Lekholm&Zarb[14])	20	2.40	0.82	2.60	0.75	2.50	0.83

Average gingival index – GI/mGI was also highest in patients with fixed dental prostheses supported by implants and natural teeth and lowest in patients with fixed dental prostheses supported only by implants (average 0.78 i.e. 0.74) (Table 3).

On the fixed dental prostheses supported by implants and natural teeth as well as on the fixed dental prostheses supported by natural teeth, increased pocket probing depth (PPD) was found (average 2.96 i.e. 2.93), while simultaneously PPD on the fixed dental prostheses supported by implants was lower (average 2.76 mm) (Table 3).

The level of clinical periodontal attachment while probing (PAL) was highest in patients with fixed dental prostheses supported by implants and natural teeth (average 3.12), while it was lower in patients with fixed dental prostheses supported by implants and fixed dental prostheses supported by natural teeth (average 3.01 mmi.e. 3.02 mm) (Table3).

Average gingival recession was equal in patients with fixed dental prostheses supported by implants and natural teeth and fixed dental prostheses supported by natural teeth, however, it was higher than average gingival recession on the fixed dental prostheses supported by implants (average 0.84 i.e. 0.66 mm) (Table 3).

Average bone resorption around natural teeth i.e. implants (crestal bone loss evaluation, CBLE) was highest in patients with fixed dental prostheses supported by implants and natural teeth (average 2.21 mm), slightly lower in patients with fixed dental prostheses supported by implants (average 2.04 mm), and lowest in patients with fixed dental prostheses on the natural teeth (average 1.99 mm) (Table 3).

Average value of bone density (classification according to Lekholm&Zarb[14]) was highest in patients with fixed dental prostheses supported on implants and natural teeth(average 2.6), slightly lower in patients with fixed dental prostheses supported by natural teeth(average 2.5), and lowest in patients with fixed dental prostheses supported by implants (average 2.4) (Table 3).

Index of technical complications included implant fracture, abutment fracture, screw loosening, fracture of the ceramic material, chipping of the ceramic material and loosening of the cement. For the natural teeth, index of technical complications included fracture of the ceramic material, chipping of the ceramic material and cement loosening. The results of this study have shown that highest index value was noticed on the fixed dental prostheses supported by implants and natural teeth, while the lowest index was on the fixed dental prostheses supported by the implants.

The results of statistical analysis (ANOVA) have shown that no significant differences between fixed dental prostheses supported by implants, natural teeth or both could be found. However, these differences exist but have not reached level of significance.

Within the group of fixed dental prostheses supported by the implants, the strongest influence on the occurrence of complications was bone resorption around implants, average CBLE(38%).

The results of multiple regression analysis showed that the strongest influence on the occurrence of complications on the fixed dental prostheses supported by the implants and natural teeth had bone resorption around implants/teeth (average CBLE was 51%).

Within fixed dental prostheses supported by the teeth, the most influential effect on the occurrence of complications had index of occlusal complications (14%). General medical index influenced with only 5%, whereas bone density (classification according to Lekholm&Zarb[14]), oral hygiene and bone resorption around carrier (implant or tooth)-average CBLE together influenced inonly 1%.

DISCUSSION

The results of this study have shown that no dental implant loss occurred during the period of monitoring which lasted 1-3 years (average 2.3 years). Loss of fixed dental prostheses due to the screw loosening on the implants or loss of cement was seen in 16.7% of this sample. Creugers et al.[15] performed meta-analysis upon longevity of conventional fixed dental prostheses on the teeth and included 42 scientific papers upon this topic. Long-term survival of 4.118 fixed dental prostheses was 95% after 5 years of follow-up, 90% after 10 years of follow-up and 75% after 15 years of follow-up. This is in concordance with many other studies which revealed that average biological and technical complications occur in 10-15% of the teeth after 5-10 years of follow-up. The most frequent technical complication seen in implant carrier is screw loosening between abutment and implant, cementation loss of fixed work and fracture of the veneering material which was also seen in this study. Furthermore, in this study fixed dental prostheses which had cantilevers showed more biological complications (up to 25%).

Generally, during the 10-15 years of follow-up, technical complications on the implant supported fixed dental prostheses are more frequent when compared to the fixed dental prostheses supported by natural teeth. The most usual technical complication is loosening of the screw between abutment and implant, loosening of the cement of the fixed bridge and chippingor fracture of the veneering material which was also seen in this study. Therefore, there were no significant differences between all tested groups. This is in concordance with Brägger et al.[16] who also reported that technical complications are more frequent in the cemented fixed dental prostheses (16.5%) when compared to the fixed dental prostheses retained with screws on the implants (11.5%) and the difference was not significant. The comparison between fixed dental prostheses supported only by the teeth and those supported by the implants did not reveal differences in the

bridge stability, survival rate or changes in the marginal bone during the period of 5 or more years (Brägger et al.[16], Sharma et al.[17], Jung et al.[18],Salvi et al.[19]) which is in concordance with our results.

Brägger et al.[20] performed a study on 85 patients in whom 103 implants were placed which altogether supported 116 fixed dental prostheses. During the five years follow-up, 9% of the patients developed peri-implantitis and 4% periodontitis. Berglundh et al.[21] performed systematic analysis of the published prospective studies and reported occurrence of peri-implantitis in 6% of the patients with fixed dental prostheses during the 5-year follow-up. However, it seems that biological complications are more prominent in these patients. Marrone et al.[22] reported that 60% of the patients had biological complications (38% mucositis and 23% peri-implantitis).Renvert and Poyzois[23] stated that biological complications are encountered in the range of 40-60%. However, criteria for determination of peri-implantitis are different, although the definition is inflammatory lesion which leads to the bone loss around implants. In this study the highest occurrence of biological complications was in the group where implants and teeth were carriers of fixed dental prostheses (gingivitis 25%, peri-implantitis 15%). There were no significant differences in the bone loss around implants which were measured on the x-ray findings within this study between the three studied groups.

Vanlioglu et al.[24] stated that after 5 years of follow-up, cumulative screw loosening was 0%. In 3.95% of all restorations fracture of the veneering material happened, however, no fractures of the superstructure occurred. Barrachina-Diez et al.[25] reported that the most freqeunt complications were the ones with the supra structure, screw loosening, soft-tissue complications, sensory disturbances, implant loss before loading and during function and implant fracture. The same authors[25]concluded that further trials are needed to provide different outcomes of different variables associated with the dental implants. Salvi and Brägger[26] highlighted that type of retention, the crown-implant ratio and number of implants supporting an fixed dental prosthesis were not connected with increased technical complications i.e. did not have impact on the implant survival and success rates, however, the the absence of metal framework in over dentures, presence of cantilever extension >15 mm, bruxism and length of reconstruction had association with increased technical complications. Jablonski[27] stated that best regions to install implants include the presinusal and inter for aminal regions. Bone atrophy was lower near screw implants (0.8 mm in region I, 0.7 mm in region II, 0.3 mm in sub mental region III and 1.3 mm in post for aminal region IV). On the other hand, greater atrophy occurred near blade implants (1.7 mm in region III and 3.3 mm in region IV). Twelve out of 331 implants were lost (3.6%)-seven during the healing process and five after placement of supra structures (all cylindrical), contributing to successful implant oprosthetic therapy in 96.4% of cases. One out of twelve implants was lost in the mandible and eleven in the maxilla indicating that the mandible is more suitable for implantation. De Souza et al.[28] reported that the greater bone loss around the implant was associated with prosthetic devices older than 4 years, and that the fixed partial dentures and total fixed prosthesis supported by implants had a higher rate of bone loss around implants to which they were attached. Passoni et al.[29] showed that more than 5 implants in total fixed rehabilitations seems to increase bone loss and the prevalence of implants affected with peri-implantitis. He et al.[30] evaluated the influence of local bone density on implant cumulative survival rates and risk factors associated with implant failure at sites with different bone density. Out of total number of 2,684 inserted implants, 45 were lost. Their results showed that failed osseo integration and occlusal overloading were the main reasons for implant failure. Thus, smoking, advanced age (> 50 years), non-threaded implants and immediate loading were risk factors for implants placed in the bone with low density. Based on studies of 3937 patients (12.465 implants), Goiato et al.[31] reported a success of the treatment regarding bone density: type I, 97.6%; type II, 96.2%; type III, 96.5%; and type IV, 88.8%.

Based on the results of this study, it seems that proper oral hygiene after implant placement is a key factor in treatment success. It should be noted that the maintenance of oral hygiene and periodontal treatment in patients who had data about the previous periodontitis are crucial for the success of the implant treatment. This is in concordance with literature results [32-34]. Roccuzzo et al.[32] stated that periodontal treatment after the implant placement is the most important factor in the success of the implant treatment. Serino and Strom[33] concluded that the local factors such as poor oral hygiene around implant placement were associated with the occurrence of perimplantitis. Cho-Yan Lee et al.[34] found that in people who had previously suffered from periodontal disease, the occurrence of perimplantitis was more associated with inadequate maintenance of oral hygiene in relation to previous data on periodontitis.

There are few studies in the literature considering the way of implant loading. Pjetrusson et al.[35] showed that the technical complications (ceramics fracture, screw loosening and loss of retention) occurred more frequently on the implants when compared to the teeth. Naert et al.[36] concluded that neither the location of the implant placement nor position in the jaw had significant influence on the implant success/failure. They do emphasize[36] that shorter implants, higher number of implants per patient, and higher number of implants per prosthetic superstructure lead to the higher implant loss. On the other hand, several authors confirmed that implants' characteristics could not be identified as risk factors for periimplantitis, as opposed to a history of periodontal disease[23,37,38], plaque accumulation and smoking[39-41].

CONCLUSION

The results of our study have shown that the fixed dental prostheses supported only by implants had the lowest index of technical and biological complications, when compared to fixed dental prostheses supported by natural teeth alone and both by natural teeth and implants. However, these differences have not reached level of significance. After implant placement, maintenance of proper oral hygiene and periodontal treatment in patients with positive an amnestic data is the most important factor for implant success.

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