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Use of Oral Hygiene Parameters in Assessment of Marginal Bone Loss around Dental Implant and success of Ossteointegration

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ABSTRACT

Failure of dental implant treatment is commonly due to loss of marginal bone. It is important to consider it before we start this treatment to avoid the consequent health and economic complications. Age, oral hygiene and general systemic health are among most important factor which affect this treatment. Considering these factor of importance when we estimate the level of bone loss and the success rate of dental implant treatment.

Objectives: Estimation of marginal bone loss and its assessment using oral hygiene measures.

Materials and method: Prospective study involve (459) patients. Age (18-76 y) and involve male (240), female(219).This study done in specialized health center in department of dental implantology in Al-Ramadi city. The study was done between (July 2005-2017) .These patients seeking dental implant treatment to replace missing teeth. 750 easy implant®used for replacing teeth. The criteria used for selection of patient prior to dental implant surgery is used which include: The patients should be free from systemic diseases, Good glycemic control, good oral hygiene and adequate bone quantity, and should be advised to abstain from smoking 2 week before surgery. The patient undergo thorough medical, dental and radiographic examination and record before surgery. They were followed 2, 6 and 12 month. A caliber used to estimate marginal bone loss (mm) using standardized peri-apical radiograph.

Results: The statistical results in table (1)&figure(2)of our study indicate that the highest mean of marginal bone loss is (3.2551+/- 0.52562)) at 12th month .This value is related to lowest mean value of tooth brushing frequency (≤1).The results also indicate that the MBL value is low among patients with good oral care indicated by tooth brushing frequency (≥1) times per day at all study periods.

Conclusion: Oral hygiene has strong relation in marginal bone resorption around dental implant and therefore it affect the success of ossteointegration.

Keywords: Dental Implant, Marginal Bone Loss, Preimplantitis, Oral Hygiene, Ossteointegration, Tooth brushing frequency, Pre-implant health.

INTRODUCTION

Recent report indicate that the danger of increase inflammation around dental implant (peri-implantitis) associated with variable level of marginal bone loss around dental implant which made a serious consequent to ossteointegration. [(1)(2)(3)]In spite of the high success rate of dental implant, studies shown about 1.5-2 mm of marginal bone loss around the neck of dental implant and 0.2mm loss after first year. This bone loss is acceptable due to the force of occlusion applied against the bone, which then respond mechanically by remodeling process naturally.[(4)] It has been indicated that marginal bone change during 1st year <1.5mm,other suggest alveolar bone change <0.2 mm after 1styear. If the marginal bone loss exceed this level mechanical and biological risk factor is a cause for this loss which finally result in total loss of ossteointegration[(5).] Periodontal and prosthetic risk factors is associated with progression of marginal bone loss include position of dental implant ,design of prosthetic appliance and its retention.[(6)(7)] Careful preoperative planning as well as meticulous follow-up during healing period is necessary to evaluate the success of ossteointegration of dental implant.

A criteria used to evaluate success of dental implants which lie on the level of marginal bone loss.[8] Applying maintenance program for patients with dental implant means that the dentist s and health staff should advised the patient for the importance of plaque control as a maintenance care after dental implant treatment because these patients forget clean their teeth especially in edentulous patients. Good oral hygiene could be achieved through control the supra plaque tissue by patients themselves.[9] Treatment of peri-implantitis by local and systemic antimicrobials ,surgical ablations, laser therapy. Advanced cases treated by surgery to removed disease tissue and regenerative therapy to restore defects. [10] Standardized radiograph regularly during follow up, is used to diagnosed the per-implant radiolucency and the progression of marginal bone loss around dental implant. If more than1/2 of bone around it lost dental implant considered to be fail.[11] Alberktsson used special criteria to assess the success of dental implant include absence of mobility and per-implant infection and radiolucency and less <0. 2 mm loss in the vertical bone per year. Other criteria used to assess success of dental implant include pocket depth probing and bleeding.[12] Maintenance of bone level is main factor to be considered in implant prosthodontics.

The proesthodontist should made post-operative evaluation of marginal bone around dental implant.[13] Failure of dental implant represent complete loss of the implant or failure of ossteointegration. With clinical mobility, pain and infection and bone resorption. Factors contributed to marginal bone loss include: unfavorable occlusal load ,trauma from surgery, implant-abutmantmicrogarps lead bacteria to infiltrate lead to prei-implantitis.[14] The variation in the implant neck design and surface characteristics lead to reduction in marginal bone loss around dental implant.[15] The causes of marginal bone loss around dental implant and implant failure is not understood well may be due to surgical trauma, trauma from occlusion and bacterial infection.[16] Elevation of mucoperiosteal flap during surgery contribute to 1 mm loss of peri-implant bone level and saucerization around implant neck which occur during stage II surgery. Overheating of bone during surgery, technique of surgery, Tissue thickness, microcap formation and implant design. The low density of maxilla bone and alcohol and tobacco use by patients are other factor contribute to peri-implant bone loss.[17][18] It has claimed that loss of 2mm form the marginal bone after 1 year considered acceptable .Tissue stability should be considered after implant placement and loss of 0.2mm per year considered undersirable. Authors considered a loss of 1.5-2 a good outcome.[19] Recent trial advocate a new design of dental implant to reduce marginal bone loss, dental implant with platform switching and internal conical implant –abutment connection minimizes the marginal bone loss and able biologic width esthetic results.[20]

MATERIALS AND METHOD

Prospective study involve (459) patients. Age (18-76 y) and involve male (240), female(219). This study done in specialized health center in department of dental implantology in Al-Ramadi city. The study was done between (July 2009-2017) . 750 easy implant® by franch dental implants manufacturer with sandblast surface, cylindrical-conical with internal hexagon and morse taper connection used to replace teeth. The patients were selected using special criteria prior to dental implant surgery which include:

- Patients should be free from any systemic disease like heart disease,
- control blood sugar .
- good oral hygiene with no periodontal disease .
- good bone quality and tissue thickness.
- no smoking at least 2week before surgery .
- complaince for surgery with good economic and social level.

Exclusion criteria:

- Patient with poor systemic health.
- diabetic patients with poor glycemic control.
- poor oral care with periodontitis.
- poor bone quality and quantity with Inadequate tissue thickness.
- patient noncompliance to dental implant surgery with poor socioeconomic status.

The patient undergo thorough medical and dental evaluation for good oral hygiene and radiographic examination by OPG to check the bone density and location of adjacent vital structures like inferior dental canal , floor maxillary sinus and nasal cavity and recorded before surgery. The surgery is done under local anesthesia (2%xylocain and 80:000 adrenalin) using flap surgery. Three sided flap was made by scalpel .The flap was elevated using mucoperiosteal elevater. Preparation of implant bed by use standardized surgical drills under continuous irrigation by normal saline. Then dental implant was placed .The flap is replaced and sutured using 3/0 black silk suture. The implant was left for healing in load free period.

Antibiotic cover is prescribed after dental implant surgery (Amoxillicin 500mg × 3 day/week).These patients were followed up by standardized regular examination clinically and by OPG radiograph 2,6 and 12 month after surgery. The criteria used to assess the success of dental implant include : no mobility ,no pain, no peri-implant radiolucency and infection. A caliber (mm) used to measure level of marginal bone loss from two reference points (A) on dental implant shoulder (B) the level of marginal bone (Figure (1) mesial and distal around each implant at the time of implant placement (standard) and during follow up by one observer using standardized x-ray.For accuracy the measurements should be repeated 3 times before final record. Standardized radiographical technique and standardized exposure time, using film holder used to take radiograph at 2,6 and 12 month and compared with the standard x-ray. The mean MBL is calculated (mesial and distal).The marginal bone loss is a distance between implant shoulder and the level of alveolar bone around then recorded.

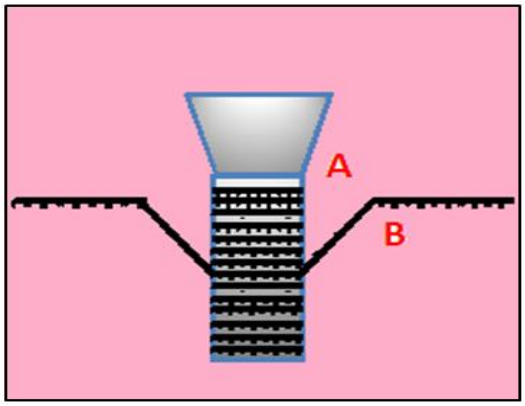

Figure (1): The marginal bone loss is a distance measured from (A) Dental implant shoulder (B) Level of marginal bone around.

STATISTICAL RESULTS

The statistical results of our study in Table (1) & figure (2) demonstrate the effect of oral hygiene variables indicated by tooth brushing frequency in the mean values of marginal bone loss at 2nd,6th,&12th month periods. At 12th month the higher mean value of MBL is (3.3543+/- 0.76175) is related with lowest mean value of tooth brushing frequency (≤1).While the lowest mean value MBL at same periods was(3.0000+/-0.0000) .This value related with high mean value of tooth brushing(≥1)times. At 6th month ,the higher mean value of MBL was(1.4486+/-0.33499) is also related with lowest mean value of tooth brushing(≤1).At same period the lowest mean value of MBL was(1.1075+/-0.48186) which is related with higher mean value of tooth brushing(≥1) .At 2nd month of study, the higher calculated mean value MBL was(0.4419+/-0.79547).While at similar period the lowest mean value MBL was (0.3293+/-0.47033).This variation in calculated mean values MBL is related with variation in mean value of tooth brushing similar to above . The mean difference is significant at 0.05 level.

Table (1): The mean and standard deviation of MBL and tooth brush at all study periods.

		N	Mean	Std. Deviation
MBL1	.00	266	3.2624	.51665
	1.00	81	3.3543	.76175
	2.00	20	3.2400	.39656
	3.00	92	3.0000	.00000
	Total	459	3.2251	.52562
MBL2	.00	266	1.4486	.33499
	1.00	81	1.3693	.16034
	2.00	20	1.1474	.25514
	3.00	92	1.1075	.48186
	Total	459	1.3531	.37089
MBL3	.00	266	.4419	.79547
	1.00	81	.3760	.26242
	2.00	20	.2910	.28678
	3.00	92	.3293	.47033
	Total	459	.4011	.65434

Table (2): Anova- test of analysis of variance in mean MBL at all study periods.

				Sum of Squares	df	Mean Square	F	Sig.
MBL1	Between Groups	(Combined)		6.389	3	2.130	8.065	.000
		Linear Term	Unweighted	4.189	1	4.189	15.866	.000
			Weighted	4.036	1	4.036	15.285	.000
			Deviation	2.353	2	1.176	4.455	.012
	Within Groups			120.144	455	.264		
	Total			126.533	458			
MBL2	Between Groups	(Combined)		8.842	3	2.947	24.760	.000
		Linear Term	Unweighted	7.992	1	7.992	67.137	.000
			Weighted	8.643	1	8.643	72.611	.000
			Deviation	.199	2	.099	.834	.435
	Within Groups			54.160	455	.119		
	Total			63.002	458			
MBL3	Between Groups	(Combined)		1.209	3	.403	.941	.421
		Linear Term	Unweighted	.921	1	.921	2.150	.143
			Weighted	1.067	1	1.067	2.492	.115
			Deviation	.142	2	.071	.166	.847
	Within Groups			194.888	455	.428		
	Total			196.097	458			

Table (3): Multiple comparison of tested values at all study periods.

Dependent Variable	(I) brush	(J) brush	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
MBL1	.00	1.00	-.09191-	.06521	.159	-.2201-	.0362
		2.00	.02241	.11914	.851	-.2117-	.2565
		3.00	.26241*	.06215	.000	.1403	.3845
	1.00	.00	.09191	.06521	.159	-.0362-	.2201
		2.00	.11432	.12831	.373	-.1378-	.3665
		3.00	.35432*	.07829	.000	.2005	.5082
	2.00	.00	-.02241-	.11914	.851	-.2565-	.2117
		1.00	-.11432-	.12831	.373	-.3665-	.1378
		3.00	.24000	.12678	.059	-.0091-	.4891
	3.00	.00	-.26241-*	.06215	.000	-.3845-	-.1403-
		1.00	-.35432-*	.07829	.000	-.5082-	-.2005-
		2.00	-.24000-	.12678	.059	-.4891-	.0091
MBL2	.00	1.00	.07930	.04378	.071	-.0067-	.1653
		2.00	.30126*	.07999	.000	.1441	.4585
		3.00	.34107*	.04173	.000	.2591	.4231
	1.00	.00	-.07930-	.04378	.071	-.1653-	.0067
		2.00	.22196*	.08615	.010	.0527	.3913
		3.00	.26177*	.05257	.000	.1585	.3651
	2.00	.00	-.30126-*	.07999	.000	-.4585-	-.1441-
		1.00	-.22196-*	.08615	.010	-.3913-	-.0527-
		3.00	.03981	.08512	.640	-.1275-	.2071
	3.00	.00	-.34107-*	.04173	.000	-.4231-	-.2591-
		1.00	-.26177-*	.05257	.000	-.3651-	-.1585-
		2.00	-.03981-	.08512	.640	-.2071-	.1275
MBL3	.00	1.00	.06583	.08306	.428	-.0974-	.2291
		2.00	.15088	.15174	.321	-.1473-	.4491
		3.00	.11253	.07916	.156	-.0430-	.2681
	1.00	.00	-.06583-	.08306	.428	-.2291-	.0974
		2.00	.08505	.16341	.603	-.2361-	.4062
		3.00	.04670	.09972	.640	-.1493-	.2427
	2.00	.00	-.15088-	.15174	.321	-.4491-	.1473

		1.00	-.08505-	.16341	.603	-.4062-	.2361
		3.00	-.03835-	.16147	.812	-.3557-	.2790
		.00	-.11253-	.07916	.156	-.2681-	.0430
	3.00	1.00	-.04670-	.09972	.640	-.2427-	.1493
		2.00	.03835	.16147	.812	-.2790-	.3557

***. The mean difference is significant at the 0.05 level.**

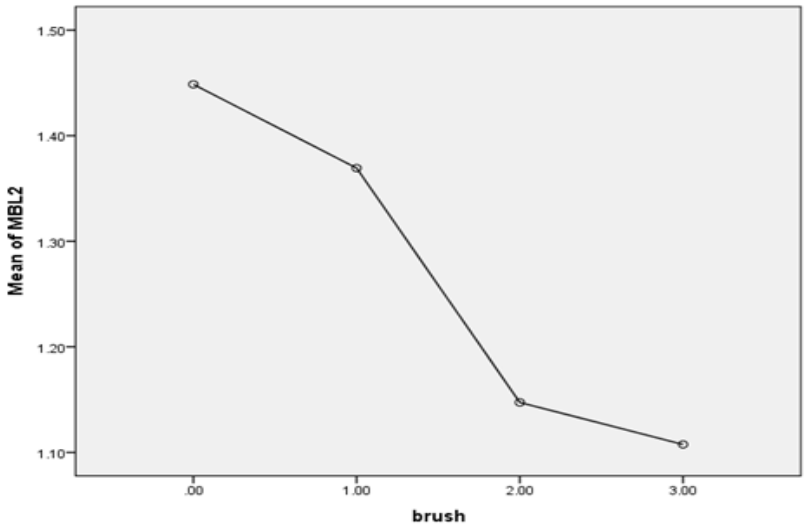

Figure (2): The relation between tooth MBL and brushing frequency.

The statistical results in Table (4,7) demonstrate calculated mean value of MBL (mm) around dental implant for (459) patients at 2nd, 6th and 12th month of treatment. The results indicate that MBL1 is the highest mean of marginal bone loss (3 .3543 +/- 0.76715) than MBL2&MBL3 (1.3531 +/- 0.37089) (0.4011+/-0.65434) respectively. The mean difference is significant at 0.01 level, see table(6,8).

Table (4): t –test of mean MBL at 2nd& 6th month period

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	MBL1	3.2251	459	.52562	.02453
	MBL2	1.3531	459	.37089	.01731

Table (5): The correlation test in mean MBL at 2nd& 6th month period

		N	Correlation	Sig.
Pair 1	MBL1 & MBL2	459	.044	.351

Table(6): t-test of mean MBL at 2nd& 6th month period.

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 MBL1 - MBL2	1.87193	.62994	.02940	1.81415	1.92971	63.664	458	.000

***The mean difference is significant at 0.01 level**.

Table (7): t-test of mean MBL at 2nd&12th month period

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	MBL1	3.2251	459	.52562	.02453
	MBL3	.4011	459	.65434	.03054

Table (8): The correlation test in mean MBL at 2nd & 12th month period

	N	Correlation	Sig.
Pair 1 MBL1 & MBL3	459	.025	.590

Table (9): t-test of level of significance in mean MBL at 2nd&12th month period

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 MBL1 - MBL3	2.82392	.82890	.03869	2.74789	2.89995	72.989	458	.000

* **The mean difference is significant at 0.01 level.**

Table (10): Chi-square test of the effect of sex in mean MBL at all study periods

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.523[a]	11	.755
Likelihood Ratio	9.450	11	.580
N of Valid Cases	459		

a. 17 cells (70.8%) have expected count less than 5.
The minimum expected count is .47.

DISCUSSION

This study was done to estimate the marginal bone loss around dental implant and to focus on the relation between the oral hygiene and peri-implant bone loss .The result is consistent to study conducted by **Giovanniet al (2004)** who indicate the strong relation between oral hygiene and marginal bone loss he indicate that estimation of this level is important for peri-implant health and success of dental implant stability and retention. Assessment of this level from time of dental implant placement and at different stagesof dental implant procedures is important to evaluate factors which contribute to bone resorption. [(21)]The statistical results in table (4,7)indicate that MBL1 is the highest mean value (3.2551+/- 0.52562) than MBL2 (1.3531 +/- 0.37089) & MBL3 (0.4011+/-0.65434).The mean difference is significant at 0.01 level.Table(1)&figure(2)indicate effect of tooth brush on the calculated mean value of MBL at all study periods. At 12th month ,those who perform tooth brushing frequency (≤1) times per day demonstrate the higher mean value of MBL (3 .3543 +/- 0.76175)than those patient with high standard of oral care (≥1) times per day who demonstrate the lowest mean value of marginal bone loss (3.0000+/-0.0000).

Because the high frequency of tooth brushing and oral care the low amount of accumulated plaque and bacteria around dental implant that cause dental implant failure **(Lindquist et al & Manish et al Eugene et al 2015)**. At 6th month period, the higher mean value of MBL is (1.4486+/-0.33499) among those patients with low tooth brushing frequency and oral care (≤1) times per day due to the increase amount of accumulated plaque and microbes which cause failure of ossteointegration. While those patients with high standard of oral care indicated by tooth brushing frequency (≥1) times per day show lowest mean value of MBL (1.1075+/-0.48186). At 2nd month the higher mean values of MBL was (0.4419+/-0.79547) and the lowest mean values of MBL is (0.2910+/-0.28678). This variation in mean MBL is also related with tooth brushing frequency. The effect of tooth brushing on the calculated mean values of MBL is the same at all study periods.

See figure (2).The mean difference is significant at 0.05 level, See Table (2,3) .Table(9)Chi –square test indicate that no effect of sex variables in calculated mean value of MBL. The calculated high mean value of MBL in this study explain the effect time factor because the effect of infection and occlusal load which contribute to implant failure increased with increase time. [(22)] Other factors like smoking, alcohol, osteoporosis, systemic disease, medications, and radiation therapy also contribute to marginal bone resorption. Estimation of marginal bone loss over the time of dental implant treatment is useful criteria to evaluate the health of dental implant and supporting structures. Because gradual loss of marginal bone lead finally to implant failure. Change in marginal bone initially is an adaptation of surrounding bone to applied load. [(23)]

Albertson et al (2007) indicate the criteria used to assess the success of and failure of osseointegration of dental implant. The success of dental implant treatment indicated now a day by survival rate, stability, bone loss by radiograph, infection in surrounding tissue of dental implant and function of appliance.[(24)]Plaque index mean measure the amount of biofilm accumulated around the marginal area of dental implant.[(25)] **Lindquist et al (2007)** assess the oral hygiene level by a scale involving three points. So it is necessary to monitor the oral hygiene habits(Tooth brushing) and estimate the amount of accumulated plaque due to strength of relation between oral hygiene and bone resorption.[(26)] Measuring degree of swelling and redness of gingiva, suppuration , pocket formation and bleeding on probing used for assessment marginal mucosal tissue is indicated by gingival index. [(24)] This index indicated by color of gingiva around failed dental implant, bleeding on probing by inserting a probe in the sulcus around the dental implant with light pressure whether bleeding is detected by this manipulation and recorded.[(25)] Peri-implant Probing depth also is used to indicate loss of attachment of peri-implant mucosal tissue and increase in pocket depth around failed dental implant .[(26)][(27)]

Manish et al (2008) indicate that success of dental implant depend on skill of dentist, bone quality and quantity and oral hygiene of patients.[(28)][(29)]Periodontal disease in smokers leading to loss of teeth . It decease tissue oxygenation and leading to local and systemic tissue injury and poor healing. It decrease RBC, fibroblast and macrophage proliferation and thereby affect wound healing. It increase platelet adhesion (clot) and reduce tissue perfusion. It induce release of adrenalin and cause vasoconstriction .[(30)][(31)]Studies by **Baig et al (2007)** indicate that smoking increase the incidence of complication of dental implant and leading to more marginal bone loss and cause peri-implantiris. Bone graft success is low. Protocol of smoking cessation considered to increase the success rate of ossteointegration among smokers include that patient should stop smoking at least before surgery 2 week to achieve normal blood viscosity. The patient should continue to stop tobacco 8 week after surgery, to allow bone healing to reach the osteoblastic phase and ossteointgration.[(32)][(33)] Peri-implantitis is pathological inflammatory infectious disease leading to bone destruction with subsequent failure of ossteointegration. Studies by **Jayachandran et al (2012**) claimed that peri-implantitis is like periodontitis , is results from microbial infection by spirochete and gram negative anaerobic bacteria leading to progressive and aggressive destruction of surrounding tissue around dental implant and subsequent implant failure. [(37)] Unequal occlusal stress distribution lead to implant failure.

Pablo et al (2015) indicate that marginal bone loss is due to mechanical and bacterial factors and a reaction similar to periodontitis happened around dental implant called peri-implantitis. Preservation of this level around ossteointegrated dental implant is important for success.[(38)] Assessment of this level is mean for detecting health and viability of peri-implant bone.[(39)] Signs of failure of dental implant clinically indicated by vertical bone loss which results in peri-implant pocket, bleeding on probing and suppuration and swelling of the soft tissue, radiographical vertical bone loss with formation of saucer shape defects, ossteointegration only present apically to dental implant.[(40)][(41)]

Eugene et al (2015) indicate that success of dental implant is increase in well-motivated ,nonsmoker, good health , good bone support ,no periodontitis, dental implant treatment perform by professional dentist use dental implant more >11 mm length.[(42)]Factors like systemic disease i.e. diabetes ,cardiovascular disease, osteoporosis, smoking, alcohol, radiotherapy, corticosteroid therapy, bad habits like bruxism cause dental implant failure.[(43)][(44)]The progressive marginal bone loss inperi-implantitis occur after phase of adaption usually during 1st year due to reaction between bacteria and host immune system. [(45)]Peri-implant disease caused by many factors like following periodontal disease, poor oral hygiene ,remaining cement,ciggarretsmoke,geneticcauses,diabetesmellitus,highocclusal stress and recently connective tissue disease – rheumatoid arthritis and alcohol intake. [(46)]Initially the loss of marginal bone around dental implant due to disturb vascular supply during surgery from elevated of periosteium, preparation of implant bed ,trauma during surgery and concentered stress during placement of dental implant from excessive tightening and bacterial infection which lead to implant failure. Loss of marginal bone due to pathological process around dental implant detected during follow-up period usually start around neck of dental implant and more than >50% bone around failed dental implant detected after 12 month recorded during 1st 3 month. [(47)].

This level is criteria for assessment the success and failure of dental implant treatment[(48)] Standardized radiograph taken during follow up is help for longitudinal evaluation of bone loss .Because of minimal distortion ,low exposure dose ,more sharp and resolution of image using standard long cone parallel technique, and more reproducible to measure distance.[(49)][(50)]

Occlusal, periodontal and prosthetic related factor ,location of dental implant, design of prosthetic appliance and retention are also contribute to marginal bone loss and its complication. Chronic progressive peri-implant infection with over load are important factor for failture. It has been considered that infection alone is not enough in fact to marginal bone loss and subsequent failure. [(51)]Among other factors contribute to MBL is implant design. The development of implant design with diminish width (platform switching design) in relation to prosthetic appliance, an internal connection for implant-abutment seem to reduce MBL.[(52)(53)]

CONCLUSION

Estimation of marginal bone loss and its evaluation using measures indicate oral health is useful method for assessment peri-implant health. Age, oral hygiene and systemic health of patients are among these factor that we take in consideration. Detection of this loss early is of importance to avoid failure of dental implant treatment finally with strict interest on the oral hygiene and the follow up during treatment.

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