

# Assessment of Marginal Bone Loss Around Morse Taper Connection and Platform Switching Dental Implant: Clinical Observational Study

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**Abstract-** Dental implant is now become a successful and wide spread used to replace missing teeth. Although studies is continue to enhance the success rate of this treatment and to overcome the considerable failure and limitation in its used. Several manufacturer companies recently advocate a new design like taper connection designs systems which make a considerable enhancement in overall success rate of dental implant .

**Index Terms-** Dental Implant; Mores taper connection ;Platform switching; Abutment Implant Connection; Marginal bone loss; Ossteointegration.

## I. INTRODUCTION

Dental implant is now is widely accepted solution for replacing missing teeth with high compatible titanium dental implant. The success of ossteointegraion of this material depend highly on mechanical stability between the implant abutment joint which should withstand forque and friction between both metal structures. <sup>[1]</sup>Recent development of dental implant with various shapes and internal configuration that help to decrease torque , enhance esthetic and mechanical strength and provide optimal tissue seal. <sup>[2]</sup>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. <sup>[3,4]</sup>Implant –abutment connection are one of factors advocated recently by many manufacturer to enhance the mechanical connection between implant and abutment that promote healing of bone and improve ossteointegration. <sup>[5]</sup>Maintaining the health of soft tissue is a criteria the should be put down in dental implant to enhance the mechanical and esthetic results of proestheis. This is similar to conventional prosthetic restoration because edentulous area has limitation related to the quality of bone and limited remodeling of bone and soft tissue that affect the esthetic. <sup>[6,7]</sup>Maintaining position of interdental papilla and health of hard and soft tissue for long time of dental implant are factors to be considered when considering the design of dental implant .Because loss of healthy interdental papilla lead to food accumulation ,poor esthetic and phonetic results. <sup>[8]</sup>Recent advancement in designs dental implant joint that provide improved success in mechanical and esthetic results of dental restoration by Jokstad et al .An example of currently available design is Morse

taper and internal hex design connection. <sup>[9]</sup>Special characterizes of Moser taper connections dental implant is internal joint with two conically contacting surfaces ,strength ,stability due the friction made by the locked taper and resist micromobiliy. <sup>[10]</sup>The breakdown of layer of surface oxide by the sliding surface of Morse taper dental implant abutment connection (IBC) help to minimize the gap formation and provide a tight seal against the invasion of bacteria between the two metal structures. <sup>[11]</sup>The connection of abutment with endosteal dental implant could be either external or internal connection. The internal connection lead to gap formation that carried high possibility of colonization of bacteria within this interface between the two metal components. This a dilemma in dentistry because it cause of Peri-implantitis. <sup>[12]</sup> <sup>[13]</sup>Implant Abutment connection(IAC) without consideration of it design , geometry and stabilization play a major role in development of inflammatory reaction around dental implant. <sup>[14]</sup> <sup>[1]</sup>The perfect seal of taper connected dental implant abutment joint and marginal fitness of any component of dental implant provide a light seal against the attachment of plaque with associated of microorganism around dental implant. <sup>[15]</sup>Studies proved that about >2 mm of marginal bone loss around the neck of dental implant and 0.2-1.5mm 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. <sup>[16]</sup> If the marginal bone loss exceed this level mechanical and microbial risk factors are causes for this loss which finally result in loss of dental implant. <sup>[17]</sup> Periodontal and prosthetic risk factors are associated with progression of marginal bone loss include position of dental implant ,design of prosthetic appliance and its retention. <sup>[18]</sup>when considering marginal bone loss around Morse taper implant abutment connection in which interface of abutment with dental implant is not happen at the level of marginal bone. This added another advantages to this design that less marginal bone loss when compared with conventional butt joint design. <sup>[19]</sup> Other properties of Morse taper implant abutment connection dental implant is shorter implant shoulder (0.5mm) in comparison with ordinary designs (1.8-2.8mm). This reduction increase the surface area of contact of dental implant with bone which consequently improve the ossteointegration. <sup>[20]</sup> <sup>[21]</sup>

## II. MATERIALS AND METHOD

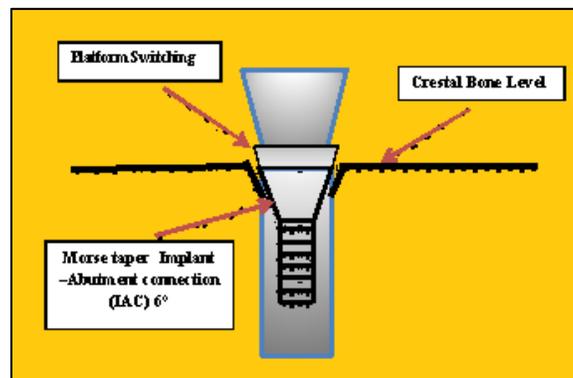
Prospective studies involve 845 patients , Male (425 ) and female ( 420),Age(12-75) years .This study done in specialized health center in department of dental implantology in Al-Ramadi city. The study was done between (July 2000-2018) . 1152 easy implant® by franch dental implants manufacturer with sandblast surface, cylindrical-conical with internal hexagon and Morse taper connection used to replace teeth in upper and lower Jaw. The patients were selected using special criteria prior to dental implant surgery which include:

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

### Exclusion criteria:

- a. Patient with poor systemic health.
- b. diabetic patients with poor glycemic control.
- c. poor oral care with periodontitis.
- d. poor bone quality and quantity with Inadequate tissue thickness.
- d. 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 elevator.Preparation of implant bed by use standardized surgical drills under continuous irrigation by normal saline. Then dental implant was placed at crestal bone level using variety of dental implant lengths and diameters .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). The patients were followed 2,6 and 12 month after dental implant placement. The criteria used to assess the success of dental implant is used include :no mobility ,no pain, no per-implant radiolucency and infection .The marginal bone loss is measured using a caliber (mm) from Dental implant platform (DIP) to crest bone level (CBL) (Figure (1)) mesially and distally around each dental implant during healing period (load free period) immediately after surgery and after load when dental implant under function load as abutment for fixed bridge ,partial and complete denture during follow up at 2<sup>nd</sup>,6<sup>th</sup> and 12<sup>th</sup> month 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 during these periods.



*Figure(1):Show Morse taper Implant -Abutment Connection(IAC) ,Platform switching,Crestal bone level.*

### Statistical analysis:

The statistical analysis was performed using the IBM SPSS statistics ,Version 21 software. Paired sample statistics . **Table (1)** ,**Table (2)**&**Figure(2)**show that the higher mean value of

marginal bone resorption was in 6th month ( $0.7885 \pm 0.35800$ ) when compared with mean marginal bone loss at 12<sup>th</sup> month period was ( $0.5905 \pm 0.15292$ ).The mean difference is significant at 0.01 level ( $P < 0.01$ ).

*Table(1): Paired sample statistics.*

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	twelve	.5905	1152	.15292	.00451
	sixth	.7885	1152	.35800	.01055

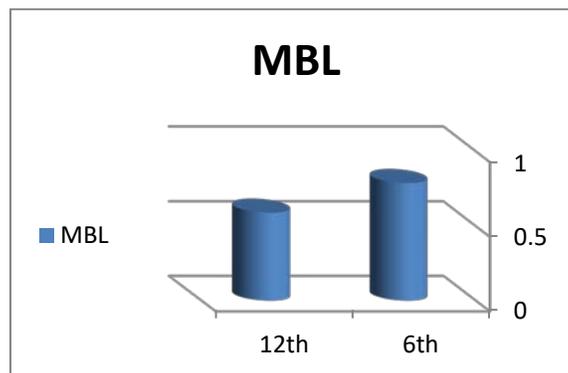
*Table(2): Paired Sample Test for the level of significance difference in mean MBL at 12<sup>th</sup> and 6<sup>th</sup> month .*

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 twelve - sixth	-.19800	.38971	.01148	-.22053	-.17548	-17.245	1151	.000

*Table(3): Paired Sample correlations.*

Paired Samples Correlations

	N	Correlation	Sig.
Pair 1 twelve & sixth	1152	-.003	.920



*Figure(2):: Show the relation between MBL at 6<sup>th</sup> and 12<sup>th</sup> month periods.*

Paired sample statistics in **Table (4)** ,**Table (6)** & **Figure(3)** show that the higher mean value of marginal bone loss was in 6th month ( $0.7885 \pm 0.35800$ ) when compared with mean value of marginal bone loss at 2<sup>nd</sup> month period ( $0.0234 \pm 0.02377$ ). The mean difference is significant at 0.01 level (**P<0.01**).

*Table(4):Paired Sample statistics .*

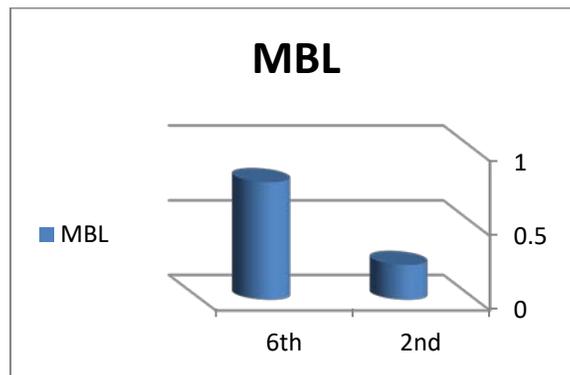
	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	second	.0234	1152	.02377
	sixth	.7885	1152	.35800

*Table(5):Paired Sample correlations.*

Paired Samples Correlations		N	Correlation	Sig.
Pair 1	second & sixth	1152	.190	.000

*Table(6):Paired sample Test for the level of significant difference in mean MBL at 2<sup>nd</sup> and 6<sup>th</sup> month .*

	Paired Differences					t	df	Sig. (2-tailed)	
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	second sixth	-.76501	.35426	.01044	-.78549	-.74453	-73.294	1151	.000



*Figure(3):Show the relation between MBL at 2<sup>nd</sup> and 6<sup>th</sup> month period.*

Paired sample statistics in **Table (7)** ,**Table (9)**&**Figure(4)**show that the higher mean value of marginal bone loss was in Zero period ( $0.6555 \pm 0.17589$ ) when compared with mean marginal bone loss at 2<sup>nd</sup> month period ( $0.0234 \pm 0.02377$ ).The mean difference is significant at 0.01 level ( $P < 0.01$ ) .

*Table(7):Paired sample statistics.*

	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	second	.0234	1152	.02377
	Zero	.6555	1152	.17589

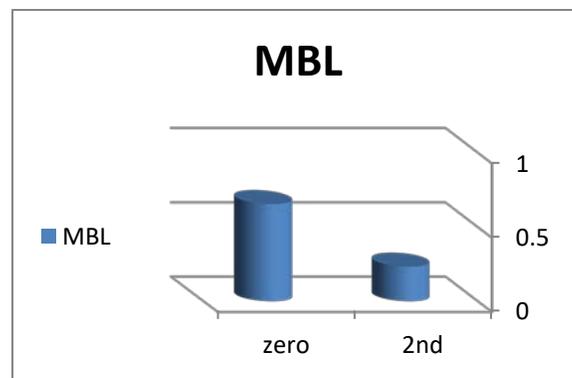
*Table(8): Paired Sample correlations.*

**Paired Samples Correlations**

	N	Correlation	Sig.
Pair 1 second & Zero	1152	-.101-	.001

*Table(9): Paired sample Test for the level of significance difference in mean MBL at 0 and 2nd month .*

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 second Zero	-.63206-	.17986	.00530	-.64245-	-.62166-	-119.274-	1151	.000



*Figure(4): Relation between MBL at 2<sup>nd</sup> month and zero period.*

Group and paired sample statistical analysis in **Table (10),Table (11),Table (9)&Figure(5)** showing that the higher mean value of marginal bone loss was at Zero period ( $0.6555 \pm 0.17589$ ) in comparison with mean marginal bone loss at 12<sup>th</sup> month ( $0.5905 \pm 0.15292$ ). The mean difference is significant at 0.01 level. ( $P < 0.01$ )

*Table(10): Paired sample statistics.*

	Mean	N	Std. Deviation	Std. Error Mean
Pair 1 twelve	.5905	1152	.15292	.00451
Zero	.6555	1152	.17589	.00518

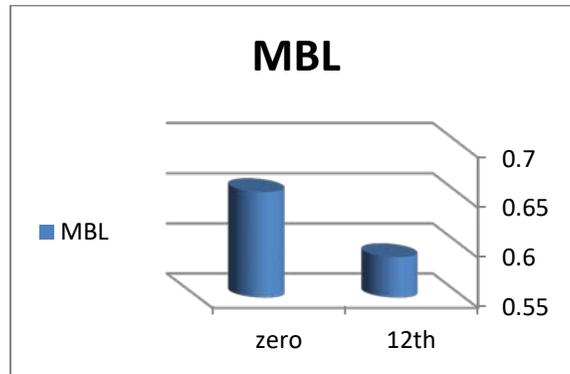
*Table(11): Paired Sample correlations.*

**Paired Samples Correlations**

	N	Correlation	Sig.
Pair 1 twelve & Zero	1152	-.010-	.729

**Table(12): Paired Sample Test of significant difference in MBL at zero and 12<sup>th</sup> month between upper and lower Arch.**

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 twelve Zero	-.06505	.23425	.00690	-.07859	-.05151	-9.426	1151	.000



**Figure (5): The relation between MBL at 12<sup>th</sup> month and Zero period.**

**Table(13): Group Statistics Table for Upper And Lower Arch.**

	TNO	N	Mean	Std. Deviation	Std. Error Mean
twelve	1.00	576	.5804	.14427	.00601
	2.00	576	.6005	.16060	.00669

**Table(14): Anova -test for the level of significance.**

		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
twelve	Equal variances assumed	15.898	.000	-2.239	1150	.025	-.02014	.00900
	Equal variances not assumed			-2.239	1137.035	.025	-.02014	.00900

Statistical analysis in **Table (15)&Table(16)** showing the descriptive statistics and correlation significance of the length and diameter of dental implant used in the study.

**Table (15): The Descriptive statistical table.**

	Mean	Std. Deviation	N
Length	9.1250	1.60959	1152
Diameter	4.2167	.65327	1152

**Table (16): Correlation test between Length And Diameter of Dental Implant.**

Correlations		Length	Diameter
Length	Pearson Correlation	1	-.240-**
	Sig. (2-tailed)		.000
	N	1152	1152
Diameter	Pearson Correlation	-.240-**	1
	Sig. (2-tailed)	.000	
	N	1152	1152

\*\* . Correlation is significant at the 0.01 level (2-tailed).

The statistical analysis of present study in **Table (17)& Table (18)** indicate that there is significant difference in mean Diameter of dental implant between upper and lower arch at 0.01 level (**P<0.01**).While there is no significant difference in mean of length of dental implant between upper and lower arch (**P>0.01**).

**Table(17):Showing the standard deviation in mean of Length and Diameter of upper and lower arch.**

	N	Mean	Std. Deviation	Std. Error	
Length	upper	576	9.0833	1.61945	.06748
	lower	576	9.1667	1.60000	.06667
	Total	1152	9.1250	1.60959	.04742
Diameter	upper	576	4.7667	.33027	.01376
	lower	576	3.6667	.37300	.01554
	Total	1152	4.2167	.65327	.01925

**Table(18):Anova –Test for the level of significance in mean diameter and length.**

	Sum of Squares	df	Mean Square	F	Sig.	
Length	Between Groups	2.000	1	2.000	.772	.380
	Within Groups	2980.000	1150	2.591		
	Total	2982.000	1151			
Diameter	Between Groups	348.480	1	348.480	2807.960	.000
	Within Groups	142.720	1150	.124		
	Total	491.200	1151			

### III. DISCUSSION

This study was made to evaluate the success rate of Morse taper connection and platform switching design of dental implant which enhances the overall success rate of dental implant by decreasing the marginal bone resorption. The use of Morse taper implant abutment connection provide wide contact area between the conical abutment and implant with minimal bacterial infiltrate than screw designs<sup>[22]</sup> The statistical analysis of the present study indicate that the success rate of Morse taper connection and platform switching dental implant according to the estimated mean value of Marginal bone loss of 0.6 mm is **98%**.The statistical analysis in **Table (1), Table (2 ) and Figures (3 )** indicate that the highest mean value of marginal bone loss was at 6<sup>th</sup> month ( 0.7885±0.35800)because at this period the dental implant is under

functional load after wearing the prosthetic appliance ,It is the period of greatest bone loss. After this period the bone fall in period of adaptation to the applied mechanical load over the denture. This mean that the mean marginal bone loss is decreases and become (0.5905±0.15292) at 12<sup>th</sup> month .The mean difference between the two period is significant at 0.01 level (**P<0.01**).While at 2<sup>nd</sup> month the mean value of marginal bone loss was (0.0234±0.02377 ) because it is the time at which bone healing occur after dental implant insertion surgical procedures. This is also a time at which the dental implant is free from applied mechanical load(load free period). The preparation of dental implant bed is associated with loss of bone due to heat generation . The measured bone loss at this time (Zero day) immediately after dental implant insertion was (0.6555 ± 0.17589) .The mean difference is significant at 0.01 level (**P<0.01**)**Table (7) ,Table**

**(9)&Figure(4).** This Results is consistent with the results conducted by **Canullo et al.( 2010),Lazzara et al.(2006)& Cassetta et al.(2016)** who indicate that the bone loss around dental implant occur after insertion of prosthetic restoration is related to location of implant abutment joint in relation to the level of marginal bone, Depth of Dental implant ,time of dental implant placement, dental implant diameter and position in upper and lower jaw. <sup>[23,24]</sup> **Table (17)& Table (18)** indicate that the difference is significant in mean diameter of dental implant between upper and lower arch at 0.01 level (**P<0.01**).The use of platform switching design displaced this joint (IAJ)to central location horizontally. <sup>[25]</sup> This location make the small movement between the implant and abutment and occlusal load occur away from the marginal bone and lead to inhibit invasion of bacteria that decreases the inflammatory reaction and the resulting bone loss. <sup>[26]</sup> Studies indicates that among these factors leading marginal bone loss is heat generation during surgery, implant design and position and smoking. <sup>[27]</sup> The distance position of implant abutment connection (IAC) from the crestal bone and the smooth narrow shoulder in Morse taper design offer important advantage when compared with the ordinary dental implant. <sup>[28]</sup> A 0.5mm narrow shoulder in Morse taper connection dental implant increases the surface area of bone to implant contact which increase the osseointegration.This improve the survival rate of short dental implant (8 mm) placed in posterior area of oral cavity. In such cases the bone crestal loss may reach 1mm after one year which is responsible for failure of dental implant.<sup>[29]</sup> The sub-crestal position of dental implant and type of connection is one of solution which control crestal bone loss in these area. <sup>[30]</sup> Maintenance of crestal bone level give considerable role in the esthetic of dental implant i.e. presence of gingival papilla and size of prosthetic crowns .And after healing it is responsible for stability of dental implant and favorable transmission of stress between denture and implant abutment connection. <sup>[31]</sup> Studies by **Becker et al.(2007)** proved the fact that platform switching dental implant associated with reduction of biological width which lead to reduction of marginal bone loss.**Sanjeev et al.(2014)** indicate that preserving the integrity of interpapillary gingiva is necessary for maintaining of marginal bone . <sup>[32]</sup> Platform switching has been introduced aiming to increase the success rate of dental implant and involve also using smaller diameter abutment (mismatch implant abutment diameter)and installation of implant abutment connection inward position horizontally way from the marginal bone which added improved success rate in bone regeneration especially if the mismatch implant abutment diameter >0.8 . <sup>[33]</sup> In contract to conventional plug designs ,the connection between abutment and implant demonstrate obvious gaps which filled by oral bacteria .The micro movement between the abutment and implant during chewing facilitate infiltration of bacteria and toxins between the abutment and implant which lead to bone loss and failure of dental implant. <sup>[34]</sup> The taper or conical abutment connection showing tight abutment implant -connection and absence of micro spaces and gaps preventing bacteria invasion and promote bone regeneration and demonstrate no movement which enhance the success rate of this design. <sup>[35]</sup> The concept behind the use of narrower abutment (mismatch )in relation to larger diameter implant lies in fact that these associated with less marginal bone loss than expected rates. It also improved bone and soft tissue regeneration during healing. <sup>[36]</sup> It also

minimizes the stress concentration on the marginal bone .The dissipation of occlusal load applied on the dentures by Platform switching design with internal junction along the long axis of dental implant which is more favorable .In spite of that the small diameter of abutment has less resistance to the applied load in posterior over dentures. <sup>[37]</sup> Studies indicate that stress of occlusion are concentrated away from abutment –implant connection in platform switching dental implant but these stress remain concentrated on abutment and abutment screw. <sup>[38]</sup> In spite of high success rate of Morse taper connection implant abutment but the danger of loosening of abutment may occur which necessate removing of abutment that may affect negatively the retention of dental implant system . <sup>[39]</sup> Also the taping forces applied intermittently during seating of abutment is necessary to achieve the required friction and pressure between the contact surface abutment and of dental implant. <sup>[40]</sup> This is unlike for screw retained abutment implant system in which screw is tightened by torque as provided by manufacturing company. <sup>[41,42]</sup>

#### IV. CONCLUSION

Morse taper connection and platform switching design added considerable success to dental implant in esthetic and posterior functional zone . It displaces the implant abutment joint which is the main area at which we focus because it added some increase in failure rate of dental implant due to micro movement between the two metal component and the micro spaces which allow infiltration of bacteria and their toxin. It improve bone and soft tissue healing and minimize the marginal bone resorption and improve healthy gingival tissue .

#### ACKNOWLEDGEMENT

Great thanks and respects to my supervisor and family who help and encourage me to finish this study.

#### RECOMMENDATIONS

Modification in design of dental implant is a new trend to minimize crestal bone loss and enhances the success rate of dental implant.

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