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Mucosa-Supported Stereolithographic Surgical Guide Versus Conventional Surgical Stent in Implant Supported Overdenture

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MUCOSA-SUPPORTED STEREOLITHOGRAPHIC SURGICAL GUIDE VERSUS CONVENTIONAL SURGICAL STENT IN IMPLANT SUPPORTED OVERDENTURE

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ABSTRACT

Purpose: The aim of the study was to compare between the accuracy of mucosa-supported stereolithographic surgical guide versus conventional surgical stent in implant supported overdenture**.**

Materials and methods: Twelve patients with completely edentulous patients were selected for this study and divided into three groups. Group (A): 8 implants were placed in the mandible using conventional surgical stents during implant insertion. Group (B): 8 implants were placed in the mandible using partially limiting mucosa-supported stereolithographic (SLA) surgical guide during implant insertion. Group (C): 8 implants were placed in the mandible using completely limiting mucosa-supported stereolithographic (SLA) surgical guide during implant insertion. CBCT was taken following implant insertion to compare between the virtual implant location during the planning and the post insertion implant location in the patients' mouth to estimate the occurred deviation. Numerical data were explored for normality by checking the distribution of data. All data showed parametric distribution. Data were presented as mean and standard deviation (SD). One-way Analysis of Variance (ANOVA) was used to compare between the three groups. Bonferroni's post-hoc test was used for pair-wise comparisons when ANOVA test is significant.

Results: It was found that group C of the patients that used the completely limiting surgical guide was the most accurate one with little deviation in implant placement, Followed by group B of the patients that used the partially limiting surgical guide then the least accurate was for group A of the patients that used the conventional stent.

Conclusion: From the result obtained from this study, it could be concluded that the most accurate surgical guide to be used in implant placement is the completely limiting mucosa-supported stereolithographic surgical guide followed by the partially limiting design then conventional surgical stent was the least accurate in implant placement.

KEY WORDS: Implant accuracy, surgical guides

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INTRODUCTION

Edentulous patients are considered to have some form of physical impairment stated by the World Health Organization since they are impaired, to some degree, in their ability to perform a proper mastication and speech. Several treatment plans were proposed to treat complete edentulism. Implant supported overdenture is not only a better choice for edentulism but also an alternative to the conventional complete dentures, having better retention and stability, increased patients' satisfaction and chewing efficiency. For edentulous patients, implant supported overdentures have superior benefit psychologically and functionally. [1]

Ideal implant positioning recommend the use of surgical guides. These guides passed by several developments starting from the use of conventional surgical stent that was made using panoramic tomography which didn't provide any three-dimensional information of the patient's anatomy. However, it will direct the drill entry point and its angulations but without providing the exact 3D guidance.

The development of Cone Beam Computed Tomography, 3D implant planning software, and CAD/CAM (computer-aided design/computer-assisted manufacturing) provided the exact 3D implant guidance. Images produced are converted into a virtual 3D model providing a realistic view of the patient's bony anatomy, therefore permitting a virtual execution of an ideal surgery and placement of the implants according to the prosthetic driven manner using surgical guides. A 3D implant planning software helps to virtually plan the location, angle, depth, and diameter of the virtual implants, then this file is sent to a processing centre for 3D printing of stereo-lithographic surgical guide. This technique uses a laser beam for polymerization of a liquid resin, this processes is performed layer by layer until finishing the required shape of the guide. [2,3]

The fabrication of the surgical guide is based on the amount of surgical restriction as a non-limiting design, partially limiting design or completely limiting design. Non limiting design indicates only the ideal location of the implant showing where the proposed prosthesis is in relation to the selected implant site with no restriction on the drill angulation. Partially limiting design only directs the first drill for the osteotomy through a surgical guide, and the rest of the osteotomy and implant placement is freely done with no restrictions on the osteotomy depth. Completely limiting design restricts the osteotomy in a bucco-lingual and mesio-distal direction in addition to having a drill stops which limits the depth of the preparation. [4]

MATERIALS AND METHODS

12 Completely edentulous patients were selected from the out-patient clinic of Prosthodontics Department, Faculty of Dentistry, Ain Shams University. Group (A): 8 implants were placed in the mandible using conventional surgical stents during implant insertion that was fabricated through duplication of the patient's denture. Group (B): 8 implants were placed in the mandible using partially limiting mucosa-supported stereolithographic (SLA) surgical guide which have a metal sleeve that fits only the pilot drill. Group (C): 8 implants were placed in the mandible using completely limiting

Fig. (1) The In 2 Guide surgical guide with its universal kit

mucosa-supported stereolithographic (SLA) surgical guide that have different diameter drill keys to be fitted inside a metal sleeve. CBCT was taken following implant insertion to compare between the virtual implant location during the planning and the post insertion implant location in the patients' mouth to estimate the occurred coronal and apical deviation of the implant in addition to the angular deviation that occurred.

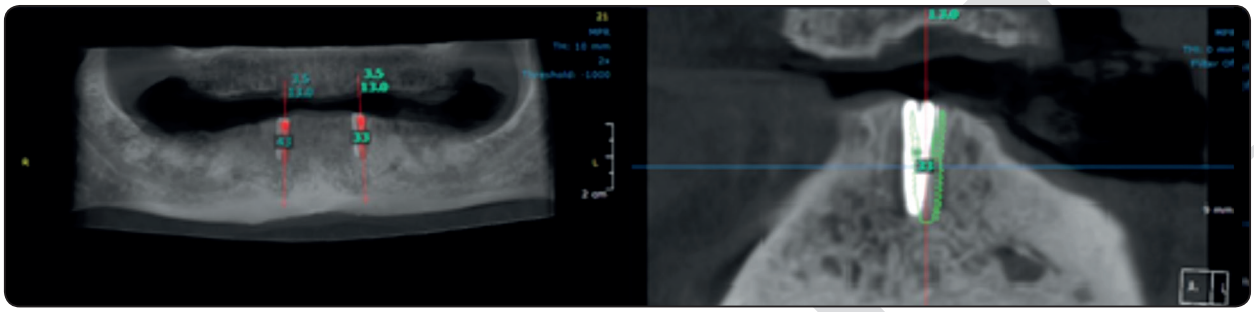

Fig. (2) After the superimposition of the actual implants over the planned ones.

RESULTS

TABLE (I): Descriptive statistics and results of one-way ANOVA test for the comparison between angular deviation in the three groups showing Mean, Standard deviation and P-value

Group	Mean	SD	Median	Minimum	Maximum	95% CI		*P*-value
						Lower bound	Upper bound	
Group A	17.46 ^{A}	3.14	16.92	13.27	22.89	14.84	20.09	<0.001*
Group B	9.85 ^{B}	2.28	10.19	6.73	12.85	7.94	11.75	
Group C	5.13 ^{C}	0.80	5.24	4.14	6.52	4.46	5.80	

: Significant at P ≤ 0.05, Different superscripts in the same column are statistically significantly different

TABLE (II): Descriptive statistics and results of one-way ANOVA test for the comparison between coronal deviation in the three groups showing Mean, Standard deviation and P-value

Group	Mean	SD	Median	Minimum	Maximum	95% CI		P-value
						Lower bound	Upper bound	
Group A	1.83 A	0.18	1.84	1.58	2.03	1.68	1.98	<0.001*
Group B	1.47 B	0.37	1.29	1.18	2.11	1.16	1.77	
Group C	0.94 C	0.27	0.98	0.35	1.28	0.71	1.16	

: Significant at P ≤ 0.05, Different superscripts in the same column are statistically significantly different

TABLE (III): Descriptive statistics and results of one-way ANOVA test for the comparison between apical deviation in the three groups showing Mean, Standard deviation and P-value

Group	Mean	SD	Median	Minimum	Maximum	95% CI		*P*-value
						Lower bound	Upper bound	
Group A	2.88 ^{A}	0.56	2.87	1.91	3.59	2.42	3.35	<0.001*
Group B	2.18 ^{B}	0.41	2.04	1.67	2.90	1.84	2.52	
Group C	1.45 ^{C}	0.39	1.46	0.91	2.02	1.13	1.78	

: Significant at P ≤ 0.05, Different superscripts in the same column are statistically significantly different

Concerning the angular deviation of the three groups; it was found that the conventional guide had the highest mean for angular deviation compared with using the partially limiting guide and completely limiting guide. Concerning the mean coronal deviation of the three groups**,** it was found that the conventional guide had the highest mean for coronal deviation compared with using the partially limiting guide and completely limiting guide. Concerning the mean apical deviation of the three groups**,** it was found that the conventional guide had the highest mean for apical deviation compared with using the partially limiting guide and completely limiting guide

DISCUSSION

CBCT was taken following implant insertion to compare between the virtual implant location during the planning and the post insertion implant location in the patients' mouth to determine the deviation that occurred. For Calculation of the deviation between the planned (virtual) implant and the placed (actual) implant, the preoperative CBCT with the planned implant sites and the post-operative CBCT were aligned automatically together for the superimposition by the fusion module of the On3Demand software until finding the best overlap of the two images, then the comparison was done in three planes X (Medio-lateral), Y (Antro-posterior), Z (depth deviation) in the coronal and the apical end to know the difference between the planned and the actual implants in three dimensional view and is called the total sum of the coronal or apical differences. Also the angular deviation which is the three dimensional angle between the long axis of the planned and the actual implant was calculated to determine the accuracy of the used surgical guide and estimate the amount of implant deviation.[5]From this study, data revealed that there was significant deviation occurred between the implants placed with the three types of surgical guides, with the highest deviation occurred with the conventional stent, then the partially limiting surgical guide, and the least deviation was for the completely limiting surgical guide. **Nickenig et al**[6] reported that implant placement using a surgical guide has more significant accuracy than with free-hand insertion technique. Concerning the angular deviation of the three groups; it was found that the conventional guide had the highest mean for angular deviation which is 17.46±3.14 degree compared with the partially limiting guide which is 9.85±2.28 degree and the completely limiting guide which is 5.13±0.80 degree. This was due to the amount of restriction offered by the guides that led to more accurate results for the complete restriction. This goes with the study of **Sun et al**[7] who found that when implants were inserted through mandibular mucosa supported SLA guide, there was angular deviation 4.05 ± 3.07 degrees. **Nickenig**

et al[6] found angular deviations 4.2 degrees for the completely limiting guide technique. **Ozan et al** [8] found a mean angular deviation of 4.51±2.7 using thirty completely limiting mucosa supported surgical guide. Concerning the mean coronal deviation of the three groups, it was found that the conventional guide had the highest mean for coronal deviation which is 1.83 ± 0.18 mm compared with the partially limiting guide which is 1.47 ± 0.37 mm and completely limiting guide which is 0.94 ± 0.27 mm. This goes with the study of **Sun et al** [7] who found that when implants were inserted through mandibular mucosa supported SLA guide, there was coronal deviation of 1.04 ± 0.94mm. **Ozan et al** [8] found a mean coronal deviation of 1.06 ± 0.6mm using thirty completely limiting mucosa supported surgical guide. Concerning the mean apical deviation of the three groups, it was found that the conventional guide had the highest mean for apical deviation which is 2.88 ± 0.56 mm compared with the partially limiting guide which is 2.18 ± 0.41 mm and completely limiting guide which is 1.45 ± 0.39 mm. **Sun et al** [7] found that when implants were inserted through mandibular mucosa supported SLA guide, there was apical deviation within 1 mm. **Ozan et al** [8] found a mean apical deviation of 1.06 ± 1.0 mm using thirty completely limiting mucosa supported surgical guide.

CONCLUSION

From the result obtained from this study, it could be concluded that the most accurate surgical guide to be used in implant placement is the completely limiting mucosa-supported stereolithographic surgical guide followed by the partially limiting design then conventional surgical stent was the least accurate in implant placement.

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