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Efficacy of Bone Track Drill in Accurate Positioning of Immediate Implant in Anterior Zone

Ahmed Mohammed Ramadan [1], Mohammad Abdelhamied Shuman [2], Ahmed Mohamed Esmael [3]
1 Dentist in the Egyptian Ministry of Health and Population
2 Professor of Oral and Maxillofacial surgery, Faculty of Dental Medicine, AL-Azhar University (Assiut)
3 lecturer of Oral and Maxillofacial surgery, Faculty of Dental Medicine, AL-Azhar University (Assiut)
Corresponding author: Ahmed Mohammed Ramadan

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Abstract
Objective*: evaluation of efficacy of Bone Track Drill in accurate positioning of immediate dental implant in anterior zone.*
Patients and methods*: the accuracy of immediate implant positioning in anterior zone is determined by using multiple measurements comparing the position of planned virtual implant in pre-operative CBCT by actual implant position in post-operative CBCT , those measurements were applied to two groups of twenty implants for patients eligible for immediate implant in upper anterior zone, a study group of ten implants in which Bone Track was used in addition to usual twisted drills, and control group of ten implants in which only usual twisted drills was used*
Results*: Regarding the measurements used in this study there was no statistically remarkable difference between the position of virtual and actual implants for both study and control group.*
Conclusion*: The accuracy of immediate implant positioning using Bone Track Drill with usual twisted drills in study group was similar to using only usual twisted drills in control group.*
KEY WORDS*: CBCT, Bone Track Drill, immediate implant, anterior zone, virtual implant, accurate implant position*

Introduction

An implant placement in fresh extraction sockets has been a popular procedure among dentists. This is due to introduction of new implant designs with rapid osseointegration and better primary stability.[(1)] Numerous studies show high survival rates of immediate implant with a lot of advantages compared to delayed implants. These include improved flapless healing, less treatment time and surgical procedures, less discomfort, and less cost.(2–7)

Unfortunately, complications can occur with the immediate implant, as all implant placement protocols. One of the most common complications that occur with immediate implant is implant mispositioning.(8) During the immediate implant procedures in anterior maxilla, there is a big problem which occurs due to the anatomy of the socket. This problem is that drills and implants are likely to follow the pathway with the least resistance, which results in facial implant position compared to the virtual plan.

This facial mispositioning is one of the main factors that cause gingival recession which considered an esthetic disaster as it has been claimed that three times recession occur in implants with facially positioned shoulder when compared with those with palatally positioned shoulder. This demonstrates the importance of accurate transfer of virtually planed implant position to the actual implant osteotomy which not only optimizes the esthetic outcome but also allows protecting vital structures and providing better functional and esthetic outcomes.(9)

Several techniques have been introduced in the literature to overcome facial malpositioning problem in immediate implant in anterior maxilla. Those techniques include round bur technique, trephine bur technique,**(10)** long drill key with surgical guide, (11) And using only final one or two drills and bone tape for thick palatal bone together with computer aided plan.(12)

Recently, a new technique is introduced called bone track method to deal with mispositioning problem. This technique utilizes Bone Track drill* which is a new registered product specifically designed to simplify the immediate implant placement in a good position. It is characterized by a diamond cutting body and a non-cutting tip. This allows identifying the anatomy of the socket and drilling towards the palatal bone to create a track on the palatal bone after the use of twisted drills, and finally inserting the implant in the proper planed position following the track created by the drill on palatal bone. (13)

Patients and Methods

1. **Study design.**

This Study was designed as Prospective randomized controlled clinical study. The study was carried out in the Oral and Maxillofacial department - Faculty of Dental Medicine – al Azhar university (Assiut branch).

2. **Samples grouping**

To evaluate efficacy of Bone Track Drill in accurate positioning of immediate dental implant in anterior zone, a total of 20 inserted immediate implants for patients eligible for immediate implant in anterior zone were divided into two main groups (ten implants in each group).

Group 1: study group (in which Bone Track Drill was used with usual twisted drills)
Group 2: control group (in which only usual twisted drills was used)

3. **Inclusion criteria**

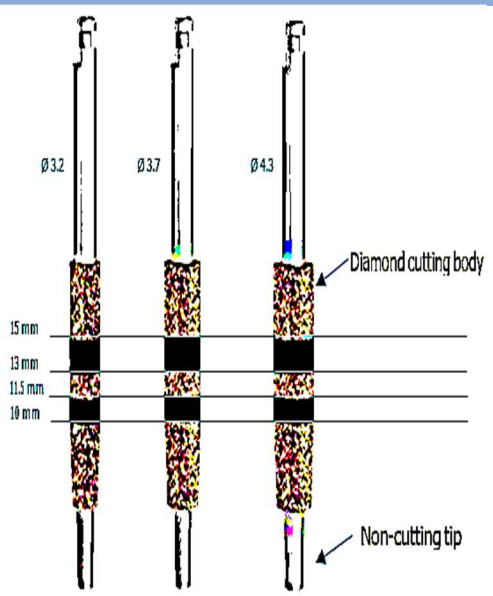
- Adult Patients from (18 years or older).
- Good general health.
- Good oral hygiene.
- An intact labial plate of bone.

4. **Exclusion criteria**

- Heavy smokers, drug or alcohol abuse and Patients with very bad oral hygiene.
- Patients unable to undergo implant surgery due to uncontrolled systemic diseases.
- Patients with local factors affecting the success of immediate implants such as, Sockets with acute infection, any socket with wall defect.
- Uncooperative patients.
- Patients with parafunctional habits such as bruxism and clenching.

5. **Surgical equibment used in study**

- Surgical micro-motor (Model X-CUBE Motot; KOREA; Website; SRN-XCUBE-BL-R03)
- Bone track drill TM(JDentalCare. Via del Tirassegno 41/N41122 Modena)
- Implant (Two-stage screw Neobiotic Is II active System) (Neobiotic Egypt LAMA Medical, KOREA)
- Implant surgical kit(Neobiotic Egypt LAMA Medical, KOREA).
- Sterile surgical towels for draping the patients.
- Minnesota cheek retractor
- Local anesthetic syringe, carpules and needles
- Periotome (Sedra dent Egypt Ar instrument)
- Upper anterior forceps
- Surgical bone curette.
- Needle holder.



(Fig.1) Photograph showing Bone Track Drill with different sizes.

6. Preoperative evaluation of patients

Each patient in both groups was inspected to make sure that was indicated to be candidate of this study by taking personal data , medical history, dental history , climical examination and radiographic examination using peri-apical radiograph, panoramic radiograph and CBCT.

7. Virtual planning of implant position on CBCT.

In both groups CBCT was used to evaluate buccal cortical bone, bone density, virtual planning of implant size, position and angulation as following for both groups. And Romexis 6 app.*TM was used in all planning and measurement procedures as following:

.

- Virtual planning of immediate implant position by making a panoramic curve approximately in the middle of implant site and adjacent teeth facio-lingually on axial view (figure 2)

- The bucco- lingual width and apico coronal length was measured to determine the proper implant diameter and length of virtual custom implant.

- The position of virtual implant was planned for free hand implant placement so that it is inserted in palatal bone with depth 2 to 3 mm from buccal plate and minimum of 1.5 mm between virtual custom implant and adjacent teeth and 3mm between virtual implant and another implant also the angulation of the virtual implant adjusted so that the Centre of the implant was in the cingulum area (figure 3 A,B)

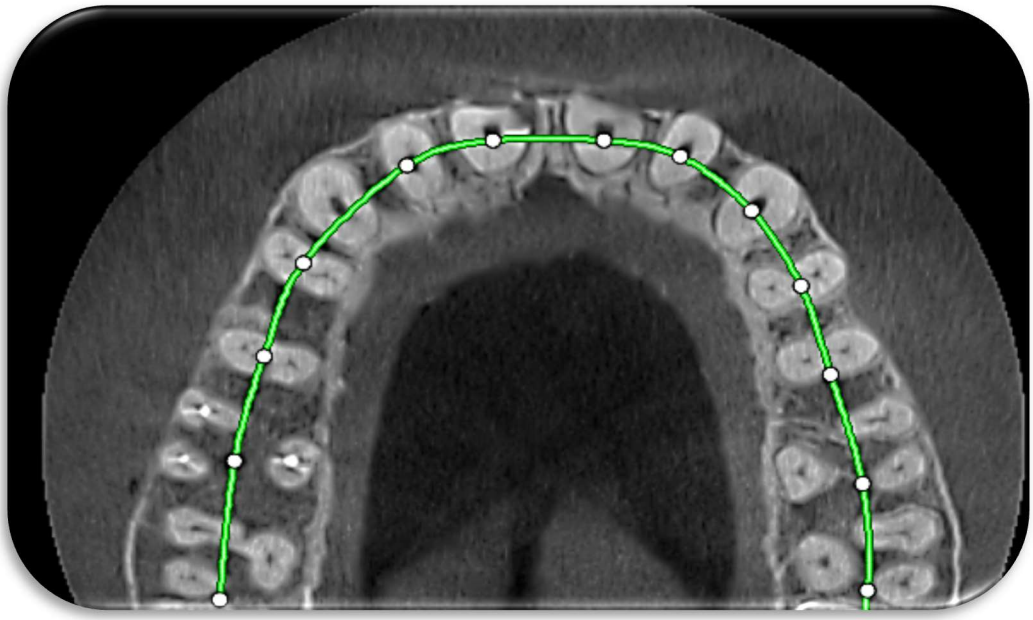
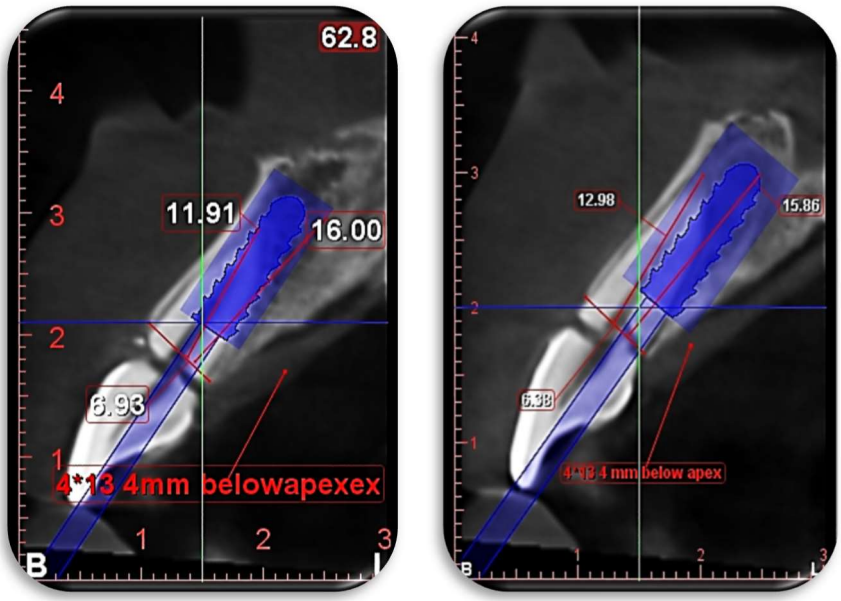


Fig. (2): Photograph showing drawing panoramic curve in pre-operative CBCT



A B

(Fig. 3): Photograph showing pre-operative virtual planning for both groups (A) for Study group and (B) for control group.

8. **Atraumatic tooth extraction.**

In both groups Patients were instructed to rinse with Hexitol(: Chlorhexidine glyconate 0.125 % Adco company.) mouth wash before surgery. Surgical area was swapped with Betadine(povidone 50 mg iodine 50 mg Mundi/Nile company) mouth gargle, then local anesthesia infiltration using Articaine HCL 2% with adrenaline 1:100 000. (Alex company) The implants were done according to type of groups

The extractions were performed a traumatically using manual periotome in order to avoid alveolar ridge alterations at the time of the extraction then tooth delivery done using anterior forceps, and. A thorough alveolar curettage was subsequently carried out.(figure 4 A,B)

A B

(Fig.4) Photograph showing (A)Cutting periodontal ligament using periotome (B)tooth delivery using forceps

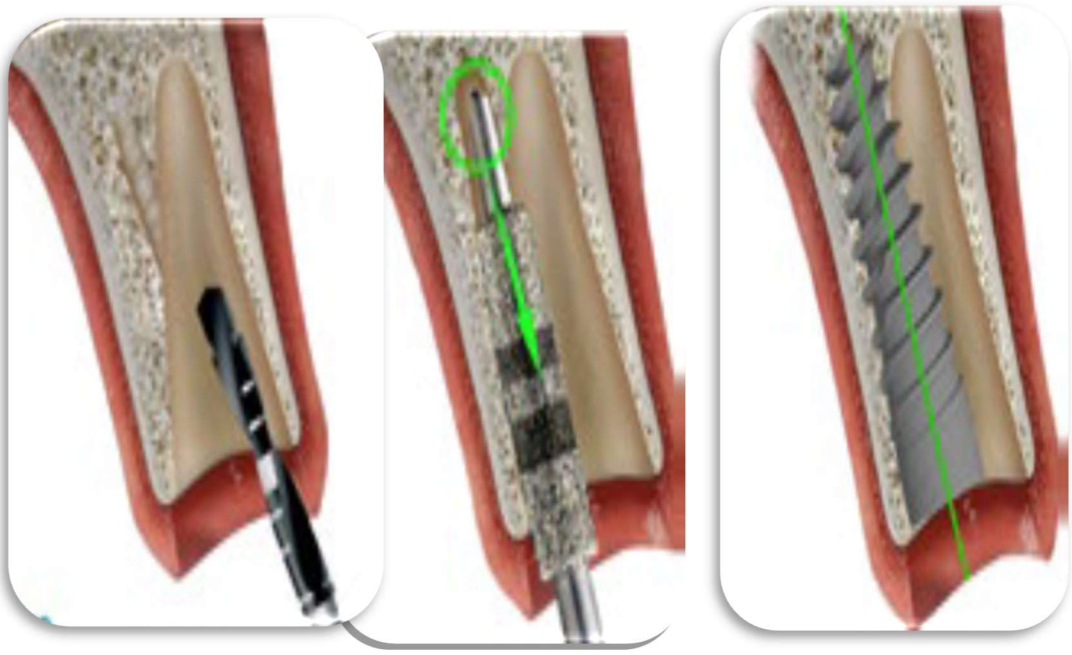
9. **Implant osteotomy preparation and insertion.**

In study group Drilling for implant placement with conventional usual twisted drills in 1000 RPM speed and 50 N/CM Torque (figure 6 B)followed by using bone track drill in the same speed and torque with applying bone trach method protocol(figure 5,7) as following:

1. In palatal bone undersized osteotomy is created using twisted drills so that the size of prepared new apex corresponds to the diameter of implant tip being inserted.
2. In order to create a track on the palatal bone clinician should Insert the non-cutting tip of the JD Bone Track Drill into the osteotomy on 1000 rpm speed and push the drill palatall.
3. Insert the implant leaving the correct vestibular gap (13)

Then the implant was placed in fresh extracted socket by free hand using implant ratchet.but in control group all the previous steps is applied without using Bone track method protocol(figure 6A). Ratchet was used to insert the implant and tight in its bed in a clockwise direction to the determine length. The tightening of implant using torque wrench and insertion torque was measured in both group (figure 8-11).

smart peg with 3.5mm diameter and type 05 was applied to implant to determine and read the primary stability with Osstell machine immediately and after six months. (Fig. 11-12) the cover screw was removed from the top of the implant vial by a hex tool and screwed into the implant body. The buccal and the palatal soft tissue were sutured by figure 8 suture in both groups.

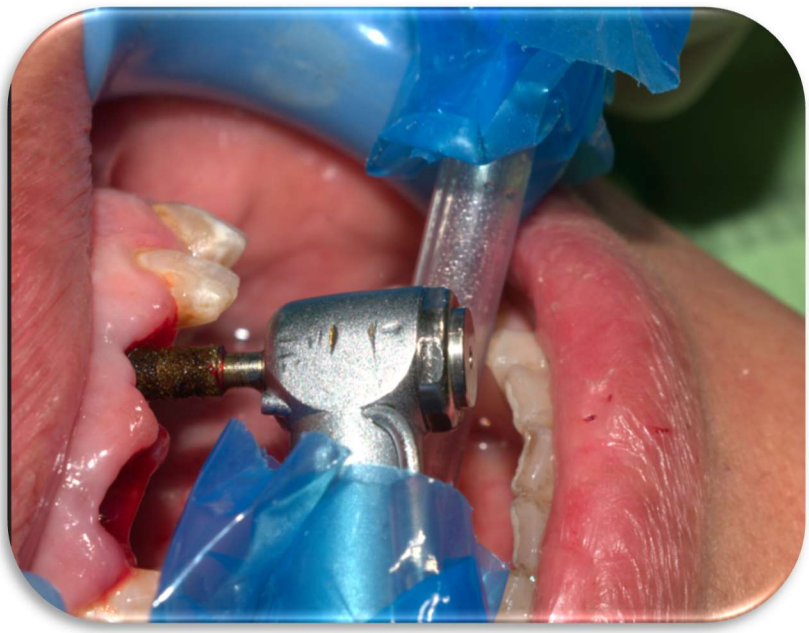


(1) (2) (3)

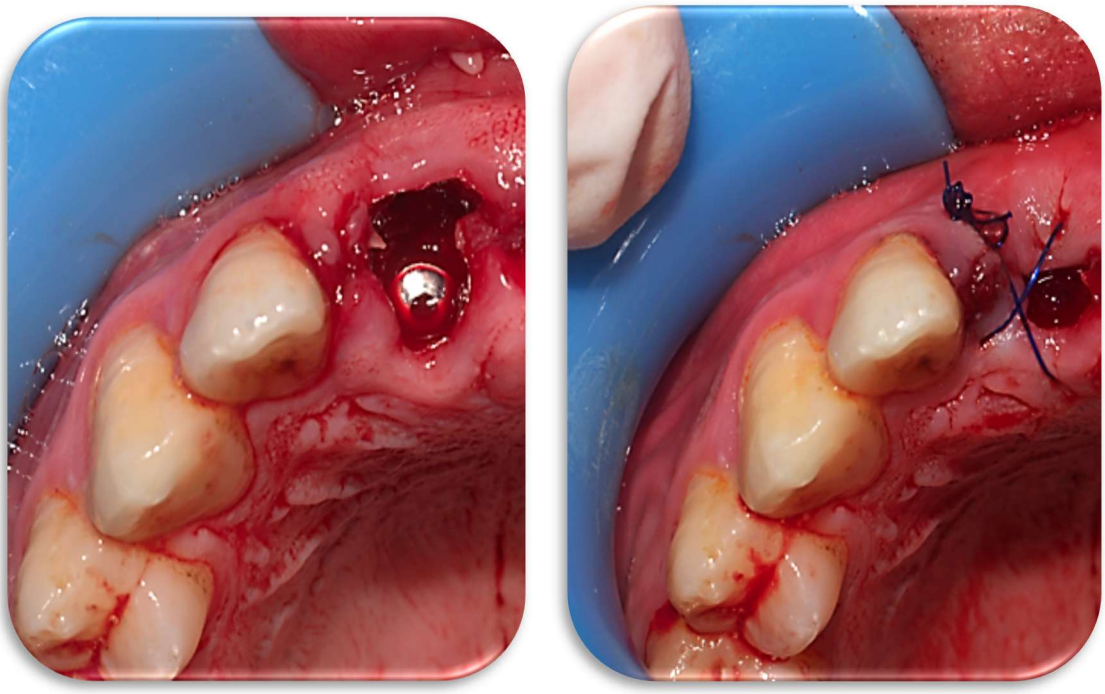
(Fig.5): A photograph showing the steps of bone track method.

A B

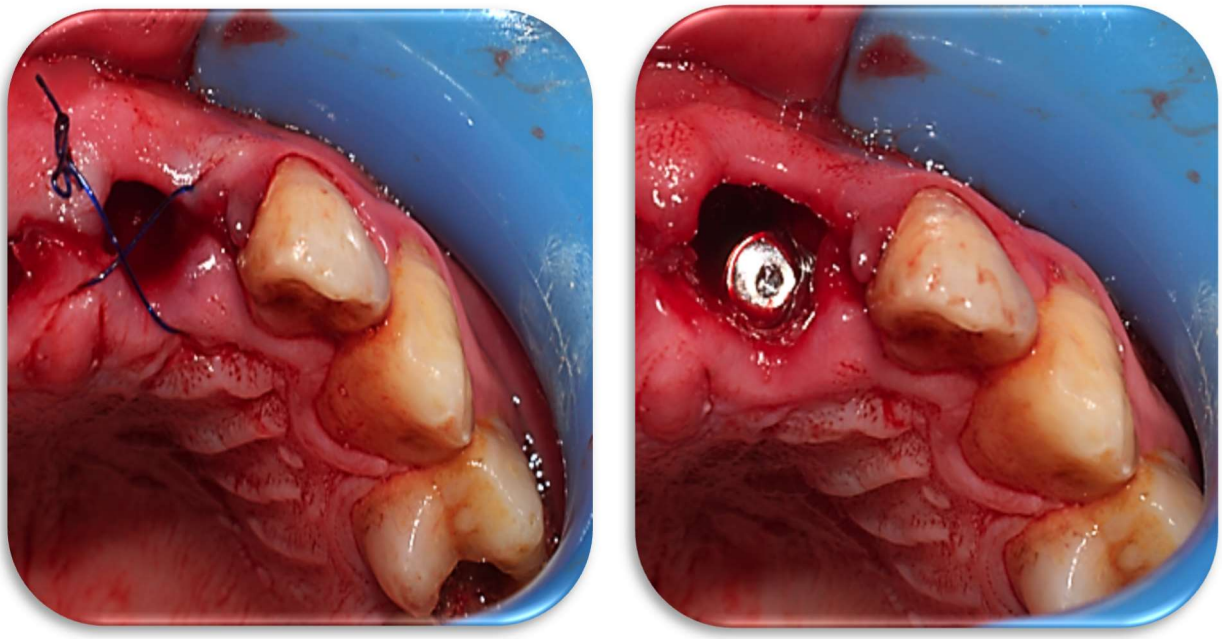
(Fig.6) Photograph showing osteotomy preparation using twisted drill (A) for control group (B) for study group.



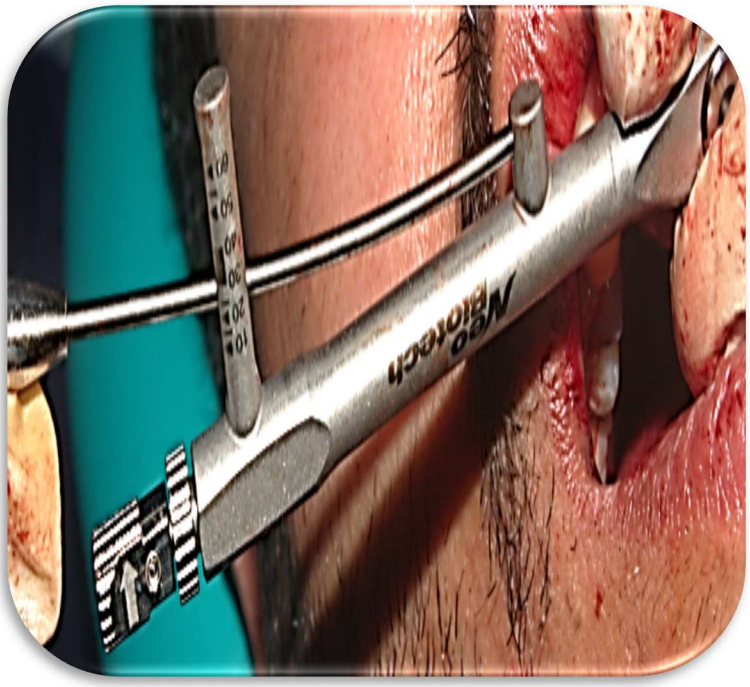
(Fig.7) Photograph showing osteotomy preparation using bone track drill.



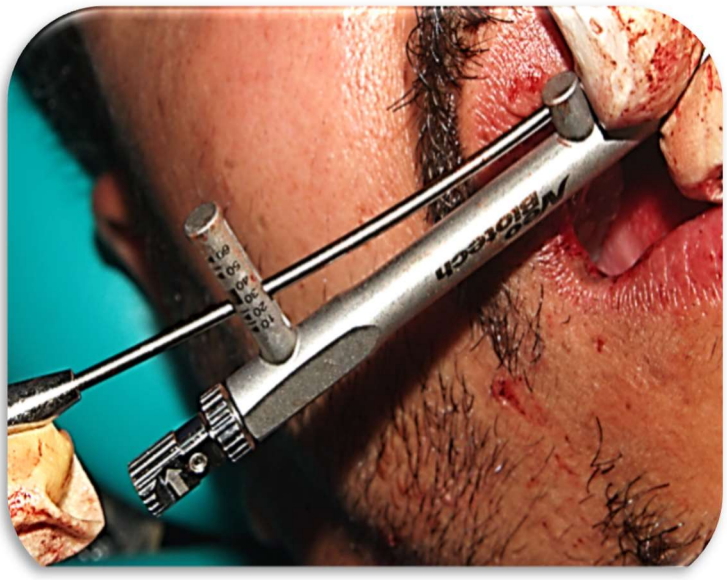
(Fig.8) Photographs showing final implant position and suturing with figure 8 suture in study group implant.



(Fig.9) Photograph showing final implant position and suturing with figure 8 suture in control group implant.



(Fig.10) Photograph showing torque measurement after implant insertion using torque wrench in study group implant.



(Fig.11) Photograph showing torque measurement after implant insertion using torque wrench in control group implants.

(Fig.12) Photograph showing smart peg was applied to implant to determine and read the primary stability with Osstell machine within one week for study group.

(Fig.13) Photograph showing smart peg was applied to implant to determine and read the primary stability with osstell machine within one week for control group

10. **Post-operative assessment**

A. Primary stability measurement using Osstell®

Osstell® was used to assess implant stability immediately and after 6 months in both groups (figure 14-15).

A B

(Fig.14) Photograph showing smart peg was applied to implant to determine and read the primary stability with osstell machine after 6 months interval(A) for study group (B) for control group

B. Radiographic parameter ((CBCT) (fig 15-26):

In both groups Cone-beam was done pre-operatively, within a week post-operatively and after 6 months to assess the difference in position between virtually positioned and actually positioned implant using the imagining software Romexis 6. TM.

In both pre-operative and post-operative CBCT a panoramic curve approximately in the middle of implant site and adjacent teeth facio-lingually and the following measurements will be calculated for the virtual and actual implant and the following measurements taking the adjacent teeth or implants as a reference was done:

a) Mesio-distal position: by measuring the distance between the most cervical part of the virtual implant and the adjacent teeth through the following steps using imagining software in both radiographs.

1- On axial cut of both radiographs one of the teeth adjacent to virtual and actual implant was taken as a reference and both sagittal and coronal planes was adjusted to be perpendicular on it and in the same time the coronal plane passing through the actual or virtual implant and the tooth or implant adjacent to it.

2-After that all cuts was adjusted for both radiographs so that the axial plane was at the reference tooth apex and both sagittal and coronal planes passing as much as possible with the center of reference tooth and nearly all cuts was having the same relation to the planes horizontally and vertically.

3-In pre-operative CBCT coronal cut the axial plane is moved cervically through multiple mouse clicks on arrow moving the axial plane cervically until the axial plane reach the first thread in virtual implant and the same number of clicks is used to move the axial plane cervically in post-operative CBCT and then the distance between the center of adjacent teeth and the center of both virtual and actual implants was measured mesially and distally.

b) Facio-lingual position: by measuring the distance between the cervical part of the virtual implant and the horizontal plane made by the most lingual part of adjacent teeth with the following steps:

1- In both pre-optative and post-operative CBCT axial cut adjusted during mesiodistal position measurement a horizontal plane is made between the most lingual part of adjacent teeth

2- The faciolingual position of the cervical third of both virtual and actual implant is determined by measuring the distance between the center of virtual and the horizontal plane created in the previous step.

c) Facio-lingual angulations: of the virtual implant by taking the tooth next to implant site as a reference by the following steps.

1- After measurement of the faciolingual position and mesiodistal position the position of both cuts and planes

is restored to default position before any measurements for both pre-operative and post-operative CBCT.

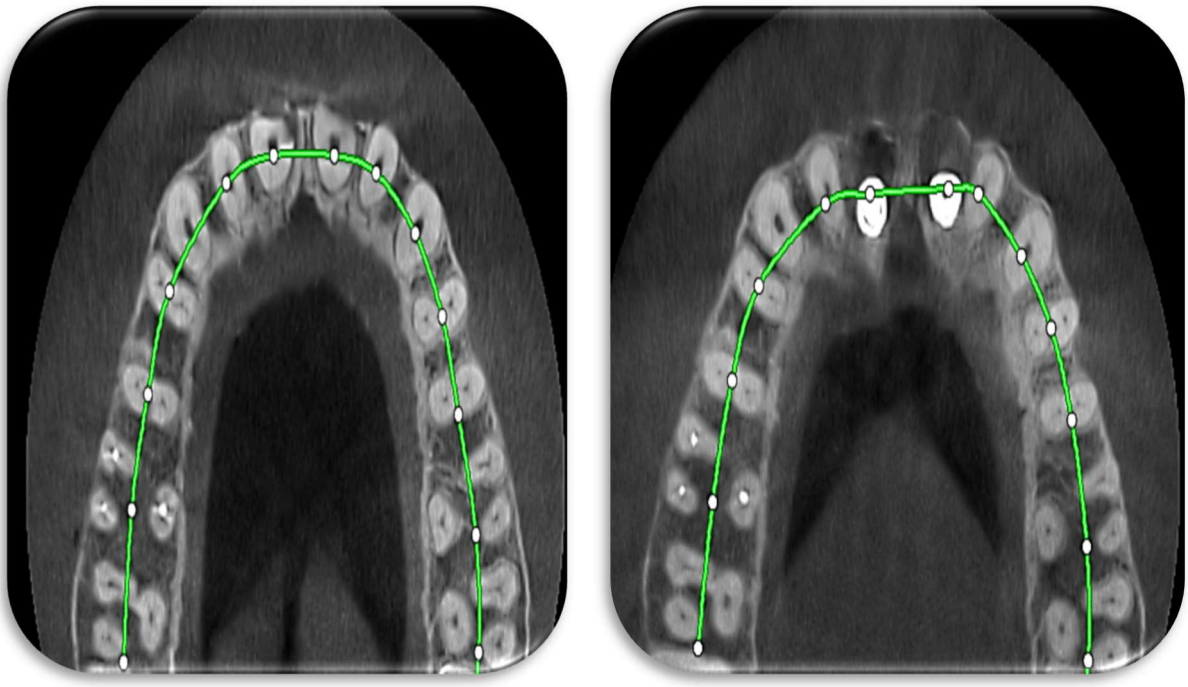
2- In both radiographs the axial cut is moved so that the sagittal plane was passed through the reference tooth and the other cuts was moved so that the other planes would pass through other cuts in the same manner.

3- The axial plane was moved to be at or near the apex of the reference tooth so that the axial plane will be in the same position in both radiographs so that the axial plane would be in the same level for both.

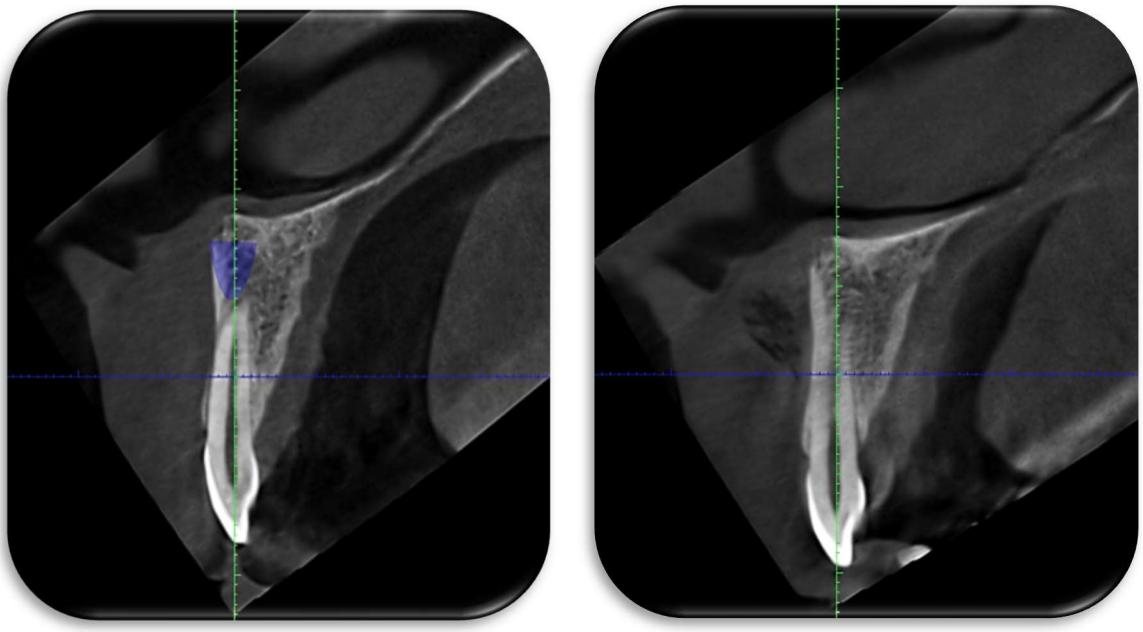
4- The axial cut in both radiographs was re-checked for similarity in their shape for vertical and horizontal position in relation to sagittal and coronal planes if any discrepancies was found re-adjustment of all cuts was done until gaining the maximum possible similarity between cuts in both radiographs.

5- In axial cut an angle is measured between the center of reference tooth and the center of virtual and actual implants with the head of the angle is the inter-section point between sagittal and coronal planes representing the facio-lingual angulation apically.

6- In the same cut the axial plane moved as cervically as possible and another similar angle is measured between the center of the reference tooth and the center of virtual and actual implant cervically with the head of the angle is the inter-section point between sagittal and coronal planes representing the facio-lingual angulation cervically.

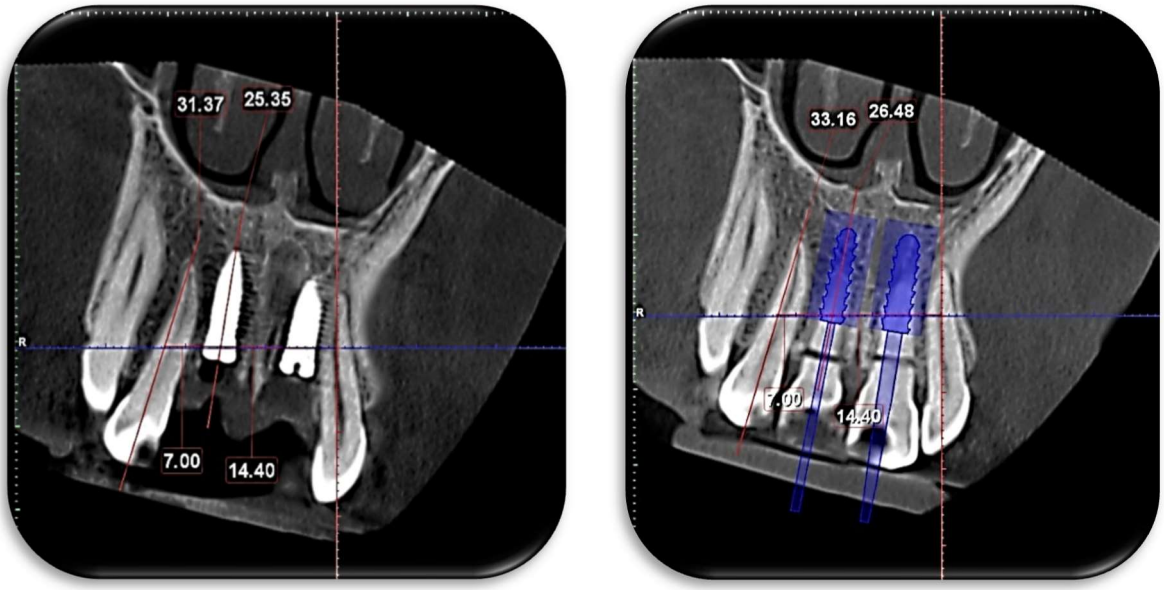


(Fig. 15) photograph showing drawing of panoramic curve in pre and post- operative radiograph for study group.



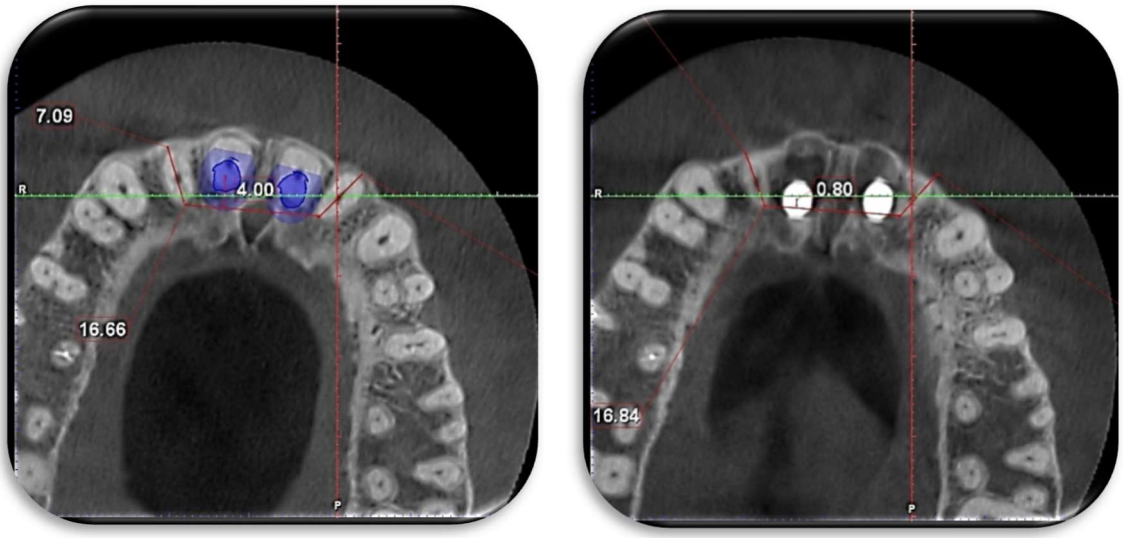
(A) (B)

(Fig. 16) Photograph showing sagittal view of the reference tooth with coronal and axial view is perpendicular to it (A) preoperative (B) post operative for study group.



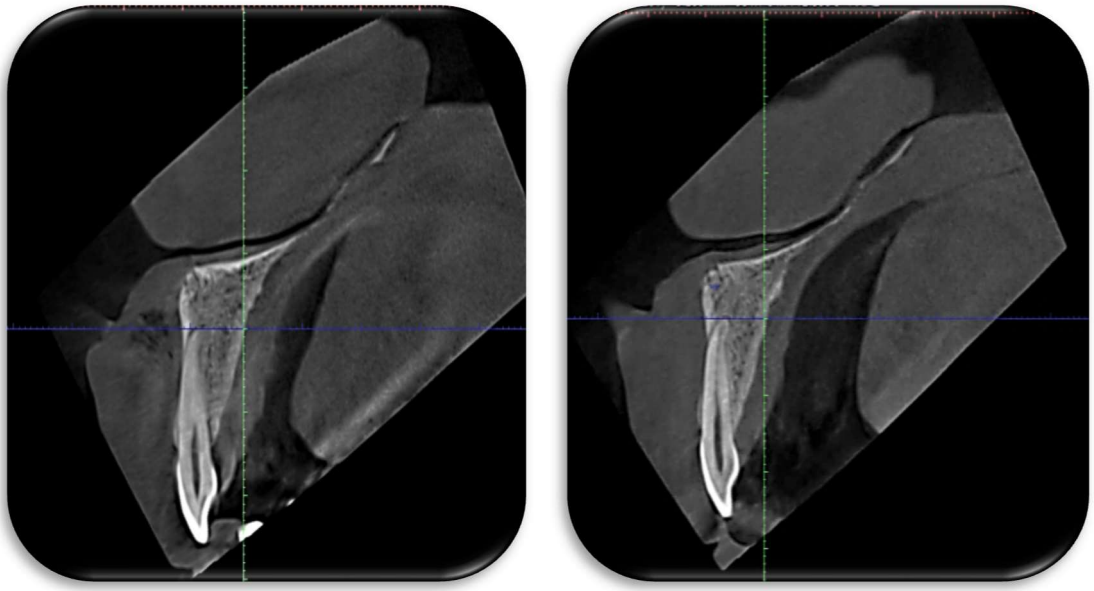
(A) (B)

(Fig. 17) Photograph showing mesiodistal position measurement pre-operatively and post-operatively (A) for actual implant (B) for virtual implant for study group.



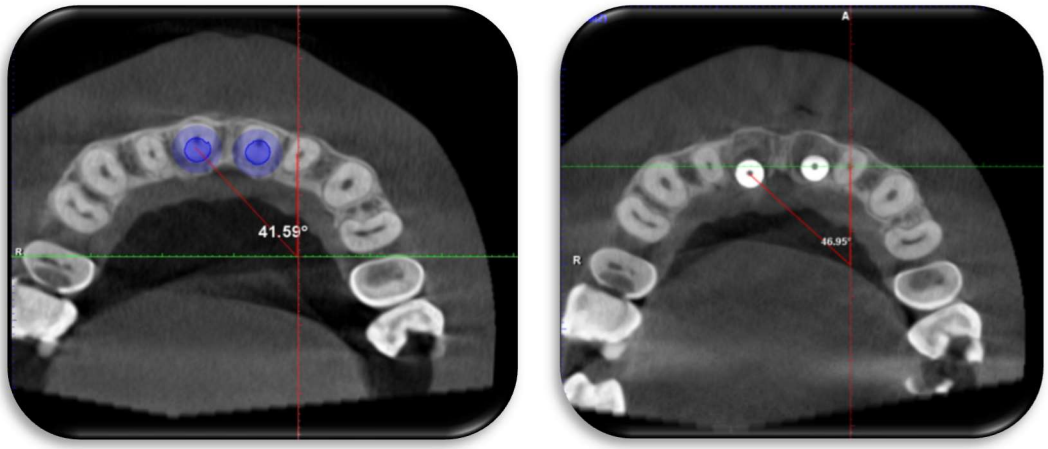
(A) (B)

(Fig. 18) photograph showing facio-lingual measurement pre-operatively and post-operatively (A) for virtual implant (B) for actual implant for study group.



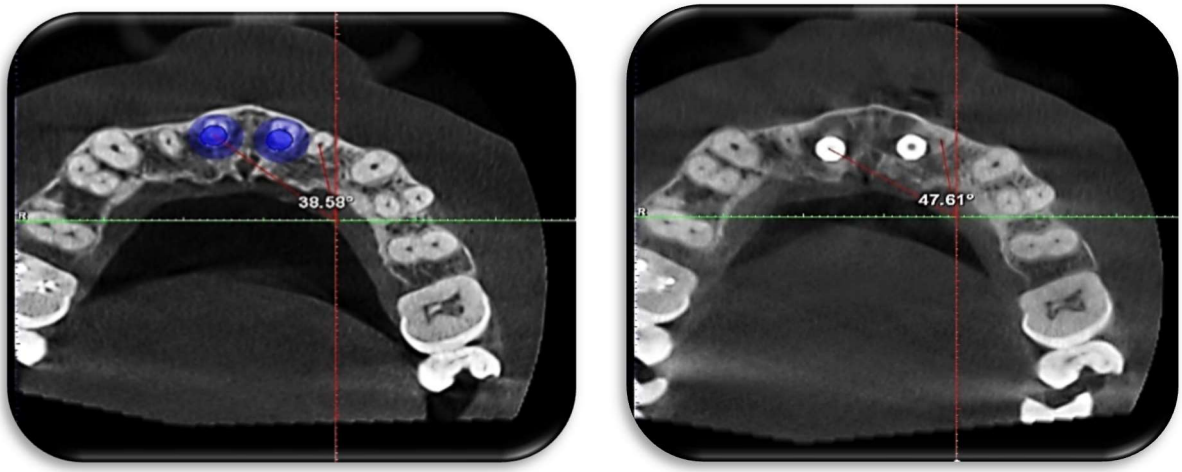
(A) (B)

(Fig. 19) photograph showing sagittal cuts with the axial plane at the apex of reference tooth and coronal plane passing through both cuts in the same manner(A) pre-operatively and (B) post-operatively for study group.



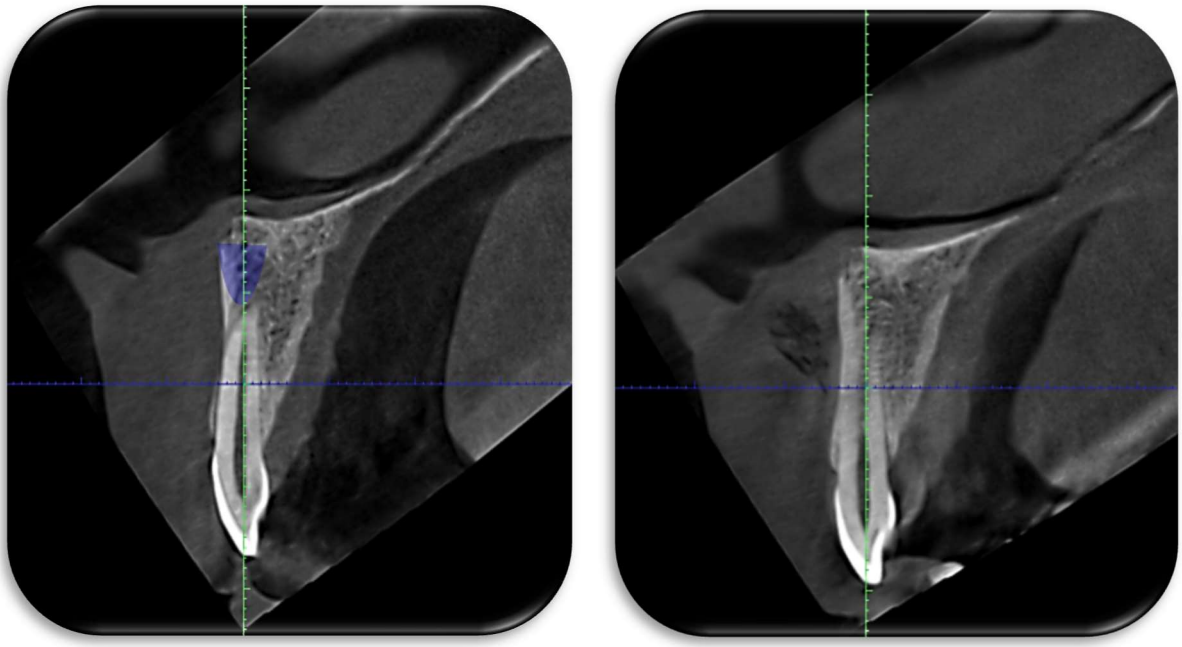
(A) (B)

(Fig. 20) Photograph showing sagittal cuts with the axial plane at the apex of reference tooth and coronal plane passing through both cuts in the same manner (A) pre-operatively and (B) post-operatively for study group.



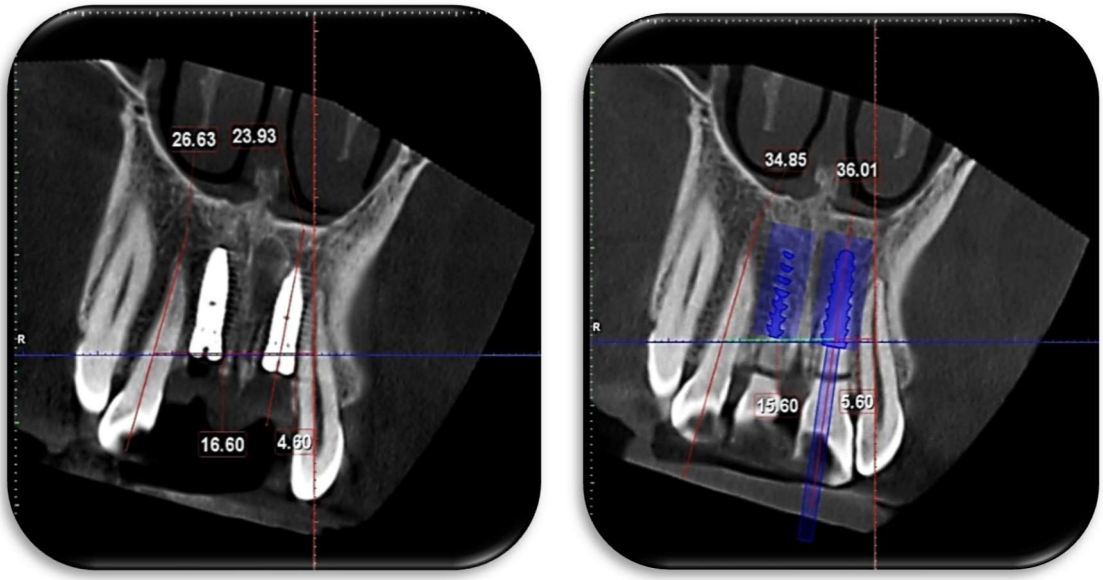
(A) (B)

(Fig 21) photograph showing facio-lingual measurement coronally on axial cut with the maximum possible similarity between cuts (A) for virtual implant (B) for actual implant.



(A) (B)

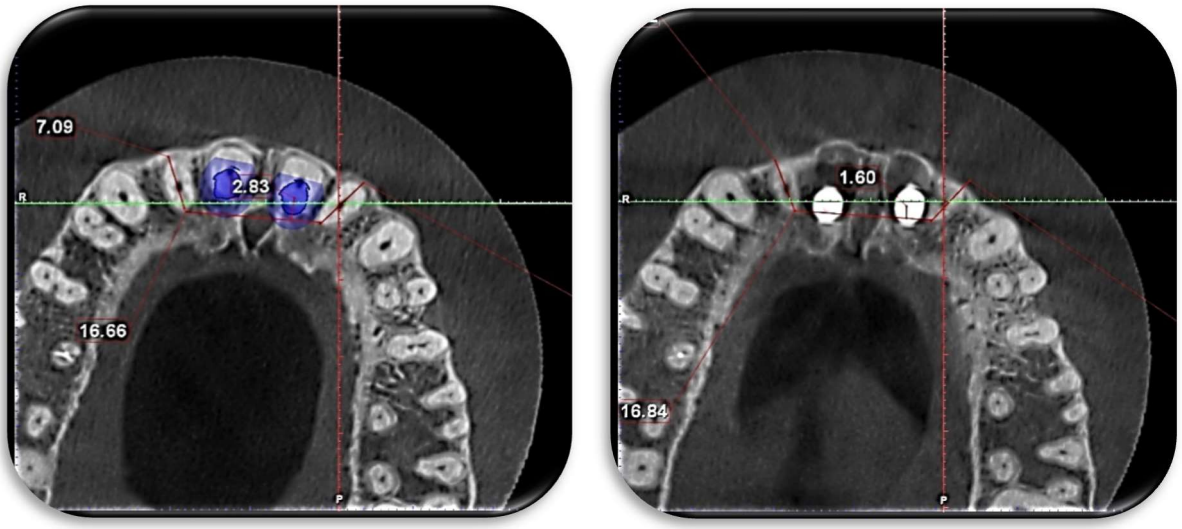
(Fig. 22) Photograph showing sagittal view of the reference tooth with coronal and axial view is perpendicular to it (A) preoperative (B) post-operative for control group.



(A)

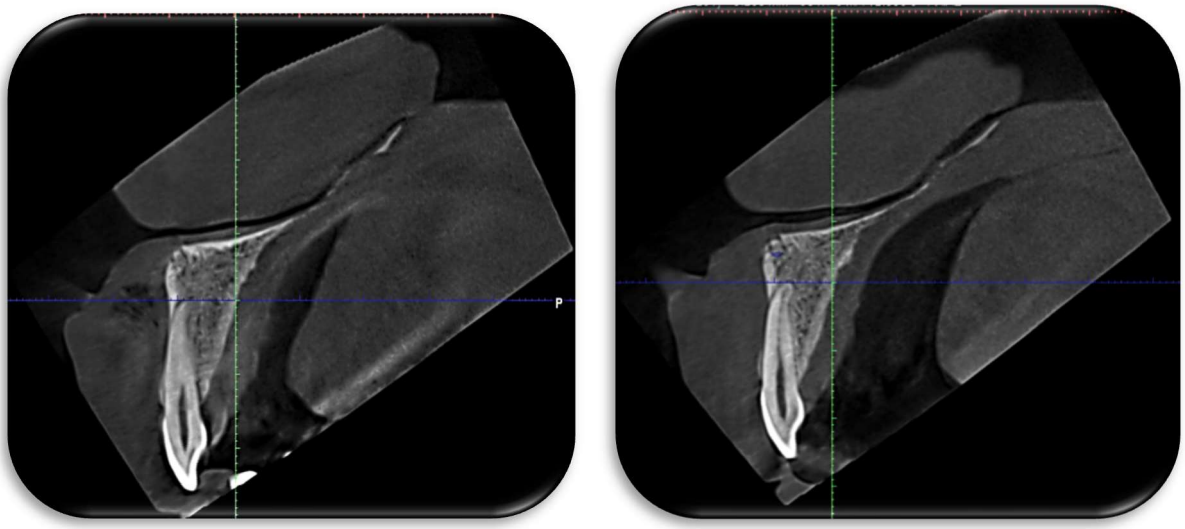
(B)

(Fig. 22) Photograph showing mesiodistal position measurement pre-operatively and post-operatively (A) for actual implant (B) for virtual implant for control group .



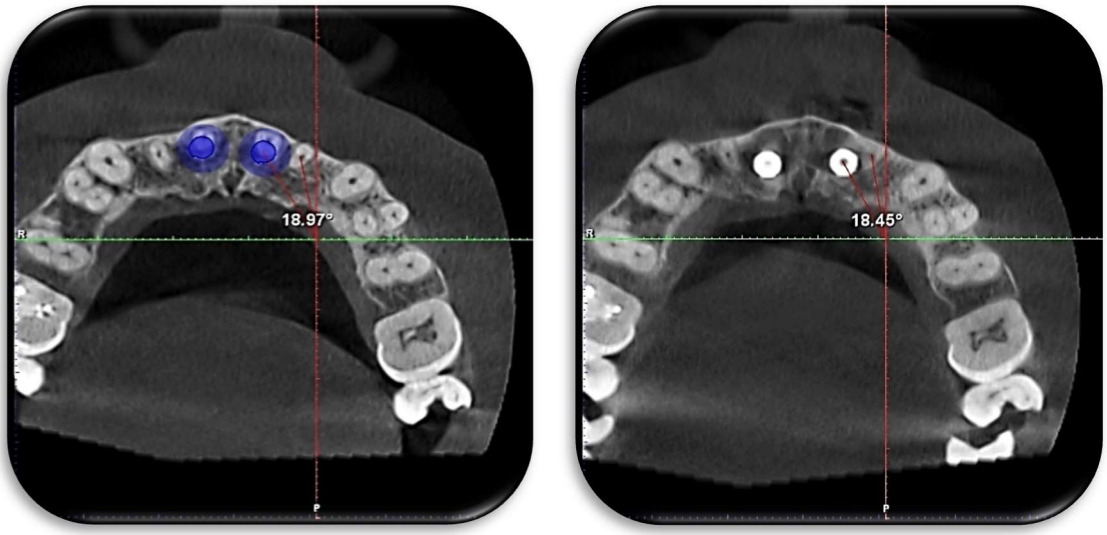
(A) (B)

(Fig 23) Photograph showing facio-lingual measurement pre-operatively and post-operatively (A) for virtual implant (B) for actual implant for control group.



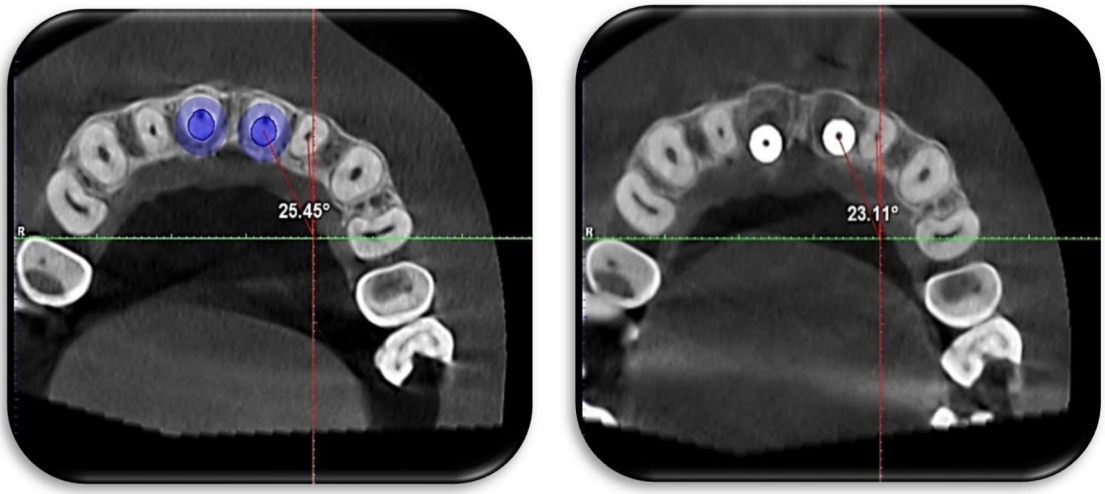
(A) (B)

(Fig.24) Photograph showing sagittal cuts with the axial plane at the apex of reference tooth and coronal plane passing through both cuts in the same manner (A) pre-operatively and (B) post-operatively for control group.



(A) (B)

(Fig.25) photograph showing sagittal cuts with the axial plane at the apex of reference tooth and coronal plane passing through both cuts in the same manner (A) pre-operatively and (B) post-operatively for control group.



(A) (B)

(Fig.26) Photograph showing facio-lingual measurement coronally on axial cut with the maximum possible similarity between cuts (A) for virtual implant (B) for actual implant for control group.

11. **Postoperative instructions:**

The patients informed to bite on the pack for 30 min. and then remove it. Cold fomentation for (10 minutes on every 30 minutes) for 6 hours. Never to eat hard, spicy foods, hot drinks or smoking. Chlorhexidine gluconate mouth wash 0.1% was used. At 2nd day, the patients instructed to do hot fomentation for 5 minutes 5 times daily.

12. **Data management and analysis:**

The data was collected, tabulated, computed, and analyzed using a (SPSS version 23) statistical program.

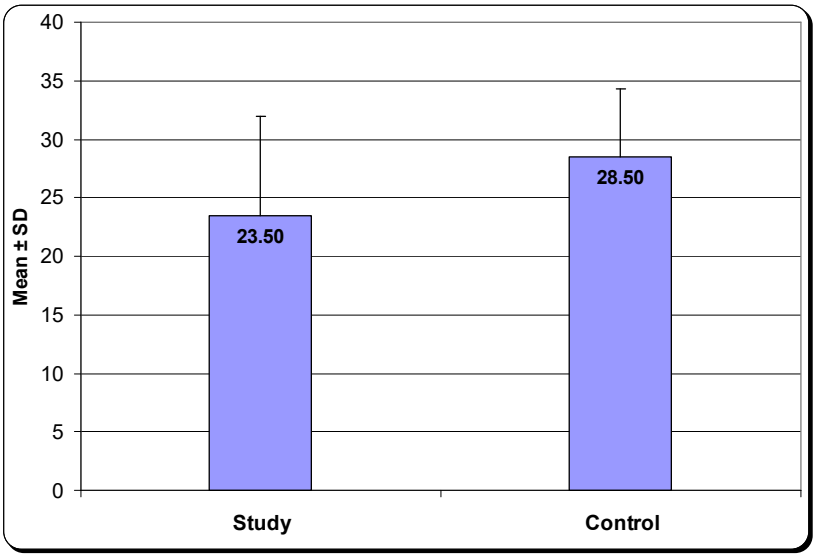
Results

1. **Torque measurement:**

There was no statistically significant difference in mean torque measurement between both groups

(Table 1): Table Showing Torque measurement

Torque	Study	Control	P-value
Mean ± SD	23.50 ± 8.51	28.50 ± 5.80	0.142
Range	10.0-40.0	20.0-35.0	



(Fig. 27): Bar chart showing Comparison between the two groups according to torque measurements.

2. **Implant stability using Osstell®:**

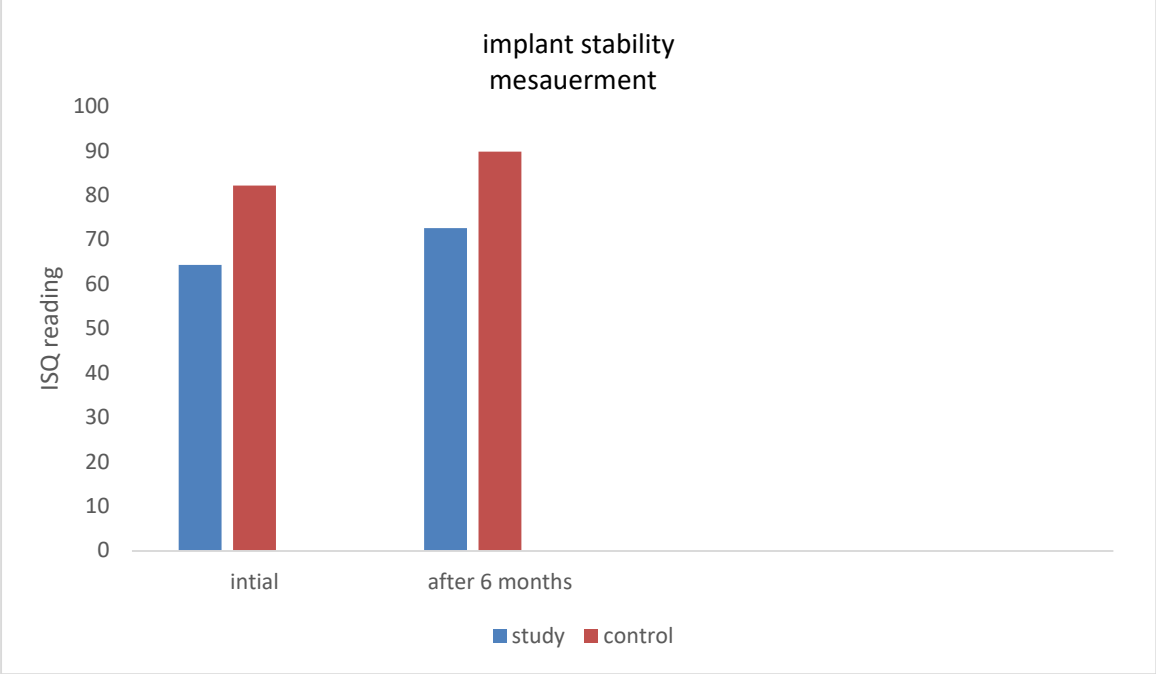
There was no statistically significant difference in mean implant stability measurement after 6 months between both groups. Study and conrol group (Table 2,3) showing increase in mean implant stability reading after 6 months with statistically significant difference (p value=0.00) for both groups.

(Table 2): Table Showing Descriptive statistics showing minimum, maximum, means, median and standard deviations of implant stability reading in each studied group at immediate and 6 months postoperative

Groups	Time	Implant stability		
		Min	**Max**	**Mean ± SD**
Study	**Initial**	42	85.3	64.32 ± 15.12
	After 6 Months	64	95	82.2±10.8
Control	**Initial**	59	94.7	72.62 ± 9.71
	After 6 Months	80	98.5	89.81±6.4

(Table 3): Table Showing Comparison between different periods in each group according to Iimplant stability reading, along with significance level.

Group	Implant stability reading		P-value1
	Initial	After 6 Months	
Study	64.32 ± 15.12	82.2±10.8	0.00
Control	72.62 ± 9.71	89.81±6.4	0.00
P value2	0.13	0.07	



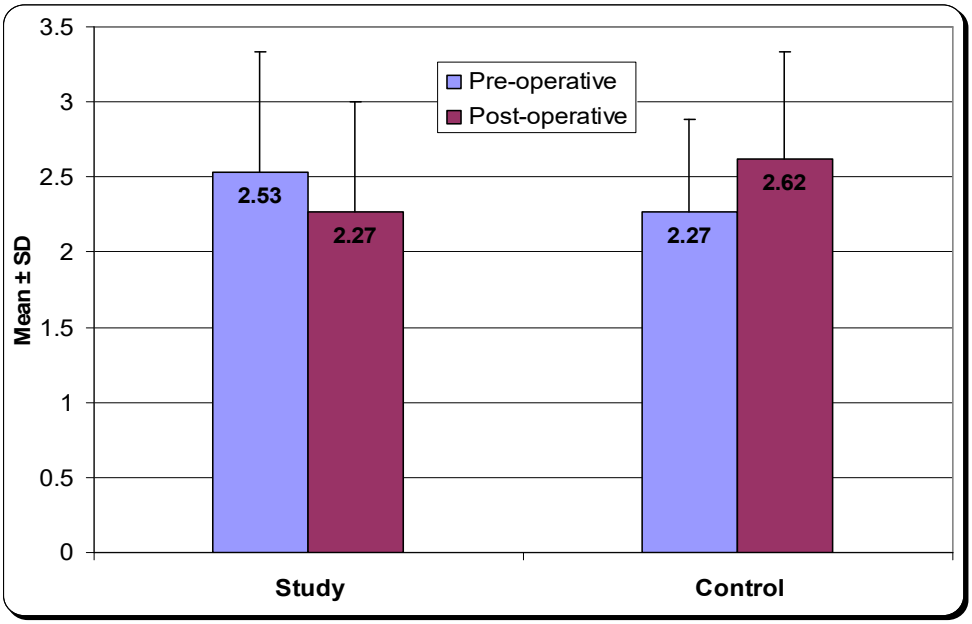
(Fig. 28): Bar chart showing Comparison between the two groups according to implant stability measurements.

3. Faciolingual position:

There was no statistically significant difference in mean difference of facio-lingual position measurement between both groups.

(Table 4): Table Showing comparison between the two groups according to Faciolingual position.

	Study	**Control**	**P-value[1]**
Pre-operative:			
Mean ± SD	2.53 ± 0.80	2.27 ± 0.61	0.431
Range	1.2-4.0	1.4-3.2	
Post-operative:			
Mean ± SD	2.27 ± 0.73	2.62 ± 0.71	0.287
Range	0.8-3.4	1.6-3.2	
P-value[2]	0.517	0.195	
Mean difference:			
Mean ± SD	0.26 ± 1.21	-0.35 ± 0.79	0.082
Median (Range)	0.1 (-1.6-3.2)	-0.3 (-1.8-1.2)	



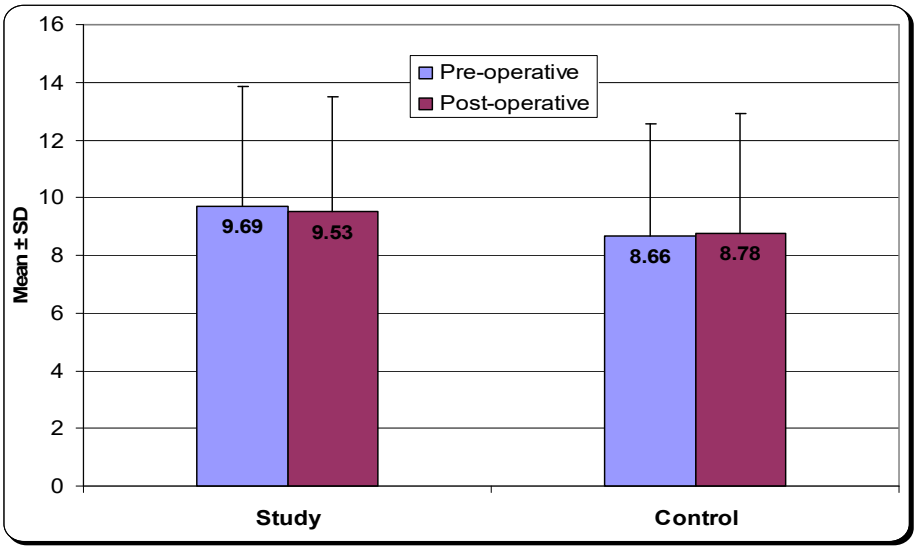
(Fig28): Bar chart showing Comparison between the two groups according to faciolingual position measurements.

4. Mesiodistal psition (Mesial):

There was no statistically significant difference in mean difference of mesiodistal position (mesial) measurement between both groups.

(Table 5): Table Showing comparison between the two groups according to Mesiodistal position (Mesial)

	Study	Control	P-value1
Pre-operative:			
Mean ± SD	9.69 ± 4.18	8.66 ± 3.90	0.576
Range	5.4-14.8	5.2-15.6	
Post-operative:			
Mean ± SD	9.53 ± 3.97	8.78 ± 4.12	0.683
Range	5.0-14.6	5.6-16.6	
P-value[2]	0.337	0.394	
Mean difference:			
Mean ± SD	0.16 ± 0.50	-0.12 ± 0.42	0.437
Median (Range)	0.0 (-0.2-1.4)	0.0 (-1.0-0.4)	



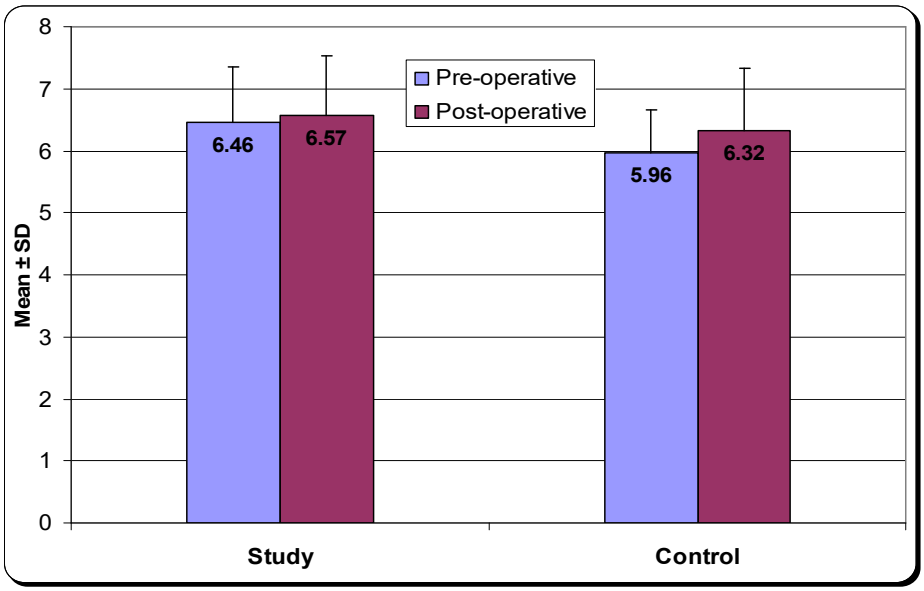
(Fig.29): Bar chart showing Comparison between the two groups according to mesiodistal position (mesial) measurements.

5. Mesiodistal position (Distal):

There was no statistically significant difference in mean difference of mesiodistal position (Distal) measurement between both groups.

(Table 6): Table Showing comparison between the two groups according to Mesiodistal position (Distal)

	Study	Control	P-value[1]
Pre-operative:			
Mean ± SD	6.46 ± 0.90	5.96 ± 0.71	0.185
Range	5.2-7.8	5.2-7.6	
Post-operative:			
Mean ± SD	6.57 ± 0.97	6.32 ± 1.01	0.579
Range	5.2-7.8	4.6-7.6	
P-value[2]	0.534	0.293	
Mean difference:			
Mean ± SD	-0.11 ± 0.54	-0.36 ± 1.02	0.534
Median (Range)	0.1 (-1.4-0.4)	0.0 (-2.4-0.8)	



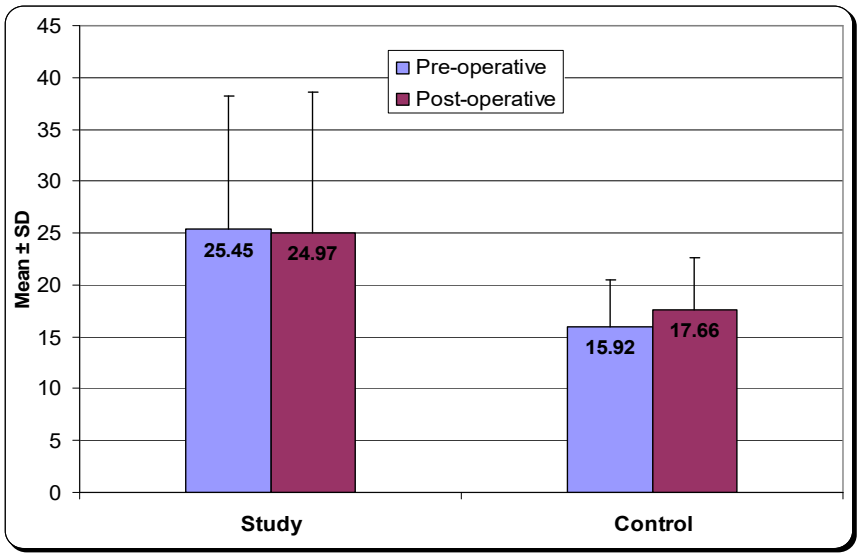
(Fig. 30): Bar chart showing Comparison between the two groups according to mesiodistal position (Distal) measurements.

6. Faciolingual angulation (apical):

There was a statistically significant difference in mean difference Faciolingual angulation (apical) measurement between both groups.

(Table 7): Table Showing comparison between the two groups according to Faciolingual angulation (apical)

	Study	**Control**	**P-value[1]**
Pre-operative:			
Mean ± SD	25.45 ± 12.77	15.92 ± 4.58	**0.040***
Range	11.1-47.1	9.2-25.7	
Post-operative:			
Mean ± SD	24.97 ± 13.67	17.66 ± 4.97	0.130
Range	11.9-47.6	13.2-29.4	
P-value[2]	0.698	**0.007***	
Mean difference:			
Mean ± SD	0.48 ± 3.79	-1.74 ± 1.59	**0.026***
Median (Range)	1.7 (-9.0-4.9)	-1.1 (-4.0-0.5)	



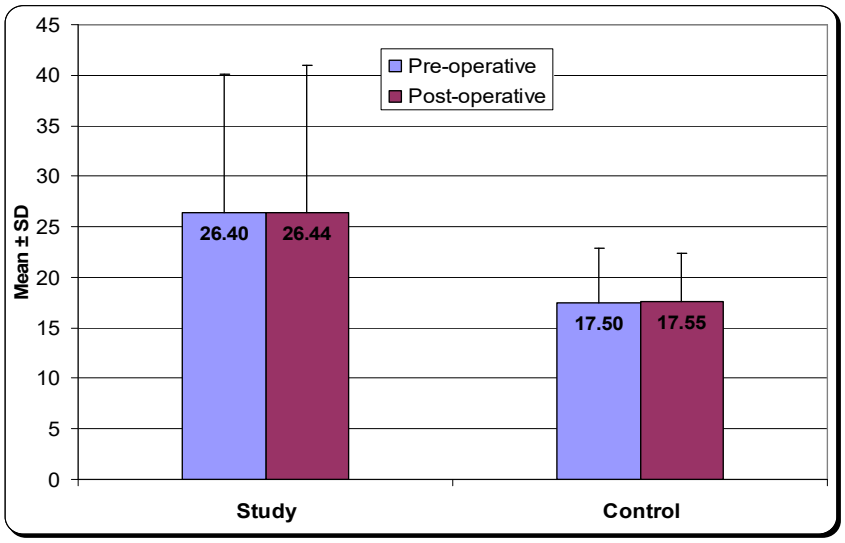
(Fig. 31): Bar chart showing Comparison between the two groups according to Faciolingual angulation (apical) measurements.

7. Faciolingual angulation (coronal)

There was no statistically significant difference in mean difference of Faciolingual angulation (coronal) measurement between both groups.

(Table 8): Table Showing comparison between the two groups according to Faciolingual angulation (coronal).

	Study	Control	P-value[1]
Pre-operative:			
Mean ± SD	26.40 ± 13.71	17.50 ± 5.33	0.072
Range	11.6-46.6	11.0-26.8	
Post-operative:			
Mean ± SD	26.44 ± 14.60	17.55 ± 4.79	0.084
Range	11.6-51.2	11.6-27.0	
P-value[2]	0.958	0.931	
Mean difference:			
Mean ± SD	-0.04 ± 2.25	-0.05 ± 1.81	0.791
Median (Range)	-0.2 (-4.6-3.2)	-0.2 (-3.3-2.3)	



(Fig. 32): Bar chart showing Comparison between the two groups according to Faciolingual angulation (coronal) measurements.

Discussion

Based on our results, Bone Track Drill used in study group can be used to simplify the immediate implant positioning in anterior esthetic zone in a good position palatally especially in apical part. Also, when comparing the implants positioned in study group by those in control group, we noticed that implants placed after using Bone Track Drill in study group showed a tendency either to be in a very close position to virtual plan or more palatal to it while in control group the implants showed a tendency to be either in a very close position to virtual plan or more

labial to it. It's also noticed that there is a tendency for a distal displacement from virtual implant position in control group more than study group which may complicate prosthetic phase especially in a single implant with misaligned or crowded adjacent teeth.

The usage of Bone Track Drill can provide a good accuracy for immediate implant positioning in anterior esthetic zone in a simpler manner with small deviations from virtual implant position in study group but when comparing the accuracy of implant positioning in study group by that in control group no significant difference was found regarding accuracy except in the position of apical part of implant which was more accurate in the study group. Also, less bone loss and probing depth is found in study group which may affect esthetics in the future.

In the present study two cases have shown early failure after one month of implant insertion. It is suggested that failure occurred in one case due to low primary stability and the other case due to severe vitamin D deficiency. Both cases weren't excluded because post operative CBCT was made just postoperatively with no need for more follow up according to research methodology.

Our results in control group were similar to eight cases of immediate implants in maxillary anterior region studied by Edelmann, Alexander R., et al., (14) who describing the use of three dimensional implant planning program to determine whether the immediate implant could be positioned accurately or not using the program 3D planning coupled with one to two drills osteotomy preparation protocol without guided surgery and the accuracy was determined by using measurements of variations between the planned virtual implant position and the actual implant position in the pre-operative and post operative CBCT scans. The measurements used in this study were similar to those used in our study. Similar to our results no statically significant difference between the virtually planned implant and actually position was found in the study done by Edelmann, Alexander R., et al.

In our study a good accuracy in implant placement position is found after using bone track drill compared by virtual plan. Also, lower initial stability is found after using bone track method compared to only twisted drills. After, comparing these results by those gained by Liu, Quan, et al. (15)who compare the accuracy of s-CAIS and d-CAIS in implant placement in esthetic zone. And, they found that both have a good accuracy compared to virtual plan but they suggest that s-CAIS is better in immediate implant because it has better initial stability, It is found that all three methods (bone track drill, s-CAIS, d-CAIS) show a good accuracy compared to virtual plan. Both s-CAIS and d-CAIS showed disadvantages. when comparing the bone track method results in our study by s-CAIS and d-CAIS in esthetic zone. It is found that all disadvantages of them like cost, time consuming preoperative preparation, impaired irrigation and some significant implant positioning errors which can be disguised only postoperatively are not found in bone track method.(16-18)

It was found that when comparing guided surgery with non-guided free hand surgery in immediate implant placement in anterior maxilla a greater accuracy was found for guided surgery but even in guided surgery, they found that there is more tendency for buccal displacement from virtual plan. These results are against our results that show more palatal displacement when using bone track drill this may be due to the palatal pressure applied by bone track drill during osteotomy preparation and bone track method show a comparable accuracy compared to free hand twisted drills only. (19)

Conclusion

Based on the findings of this study, the following conclusions indicate that:

1- Using Bone track drill simplify immediate implant positioning in anterior esthetic zone in a good accuracy compared to the planned virtual implant position

2- No statically significant difference in implant positioning accuracy between using only free hand twisted drills and free hand twisted drills together with Bone Track Drill

Recommendation

the authors recommend additional in vivo studies to compare implant positioning accuracy between Bone Track Drill, static and dynamic computer assisted surgeries using one standardized measurement index by operators of different experience levels.

limitations

there was no standardized index used to measure the accuracy of implantation and different methods were not equal, thus complicating the comparison among different researches This considered one of the limitations of this study. Another limitation of this study is that all implants placed under the supervision of one experienced operator which is considered as another limitation. As the experience level of operator may affect the accuracy of implant positioning when compared with virtually planned position.

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