STABILITY OF DENTAL IMPLANTS PLACED IN PATIENTS WITH VITAMIN D DEFICIENCY USING SEQUENTIAL DRILLING VERSUS A NEW ONE SINGLE DRILLING DESIGN: A RANDOMIZED CLINICAL TRIAL

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Abstract

Background: Implant stability can greatly impact implant clinical outcomes, the present article evaluated implant stability using sequential drill versus a new one single drill on patients with vitamin D deficiency.

Methods: Thirty patients with vitamin D deficiency participated in this study (17 Females and 13 Males), fifteen patients went for sequential drilling technique (group A) and fifteen patients went for single drill technique (group B). Implant stability was
measured using (Periotest M) at baseline and after six months. All patients underwent vitamin D supplements.

**Results:** Patients in both groups showed implant success after six months of follow-up except for one patient in (group A) showed implant failure with a deficiency in vitamin D serum level after supplementation. Absence of significant difference between the new design single drill technique and sequential drilling technique for osteotomy preparation in healed bony site for staged implant placement regarding implant osseointegration, Periotest record, and crestal bone loss. Vitamin D supplementation increased vitamin D serum level in patients with vitamin D deficiency resulting in better bone-implant contact and subsequently increasing implant success.

**Conclusions:** Absence of significant difference between single and sequential drills for osteotomy preparation and implant osseointegration in patients with vitamin D deficiency, though single drill was 4 minutes faster.

**Key words:** Single drill, single drilling, Sequential drilling, Vitamin D, and vitamin D deficiency.

**Introduction:**

Dental implants consider as one of the most successful treatment options for Tooth rehabilitation with a success rate of more than 98%. Implant Osseointegration with bone considers as the first step of success in this type of treatment, which was defined as direct contact between the bone tissue and the implant without the presence of fibers soft tissue \(^1\).
Dental Implant osteotomy plays an important key role in osseointegration development because it allows preparing an implant bone bed suitable for the dental implant fixture dimensions ensuring optimum primary dental implant stability [2].

There is an increasing interest in the scientific community for the investigation of different drills design and osteotomy protocols regarding bone trauma and its final effects on bone healing [3].

The use of the single drill for bone osteotomy is less invasive and could promote successful dental implant osseointegration. Besides, the accuracy of site preparation for dental implant placement is better when the single-drill surgical procedure is used [4].

It was found that the osteotomy preparation performed by sequential drilling surgical procedures is time-consuming. Bettach et al. published a human study showing that a single drill is less time-consuming with a high success rate for implants osseointegration [4,5]. Thus Clinicians should have a balance between the ideal Positioning required by the implant in terms of the diameter, accurate inclination, and final shape of the osteotomy preparation, thus seeking an ideal anchorage (stability) of the implants and rationing of the total time necessary to perform it, in the patient, with vitamin D deficiency [6,7].

Vitamin D has an important role in bone mineral homeostasis also plays an important role in bone mineralization by activation of bone deposition depending on osteoblasts and bone-resorbing by osteoclastic cells as a result active forms of vitamin D (VD3) enhance bone quality. So, vitamin D supplement is highly recommended in patients with low bone quality as in patients with vitamin D deficiency and bone osteoporosis [8].
Most studies that investigated the different roles of vitamin D on the osseointegration of dental implants indicated a positive effect of vitamin D \[^9\]. But clinical peri-implant bone tissue complete healing is not yet entirely clear depending on vitamin D supplementation \[^10\]. A recent review of the literature carried by Javed et al. showed that vitamin D supplementation can stimulate new bone formation and increase the contact between the bone and the surface of titanium implants \[^9\]. We can also find in a study carried by Kelly et al. that vitamin D deficiency could significantly hinder the establishment of osseointegration of Ti6Al4V dental implants and bone \[^11\].

**Materials and methods:**

1 - **Study design and patient population**

The present study is a randomized, controlled, parallel-grouped clinical trial that included 30 patients with vitamin D deficiency; each patient participated with a single experimental site having a single missed tooth premolar/molar. Patients were randomly assigned into two equal groups: (Group A) in which osteotomy was done by sequential drilling technique. (Group B) the osteotomy was done by a single drilling technique. Subjects were selected from the outpatient clinic, Department of Oral Medicine and Periodontology, Faculty of Dentistry, Cairo University between December 2018, and December 2019, patient’s screening was continued until the target sample was achieved, identifying, and recruiting potential subjects was achieved through patients’ database.

2- **Inclusion and exclusion criteria**

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: 18-70.</td>
<td>Systemic disease that contraindicates implant placement or surgical procedures.</td>
</tr>
<tr>
<td>Patients with vitamin D deficiency (&lt; 30 ng/ml)</td>
<td>Poor patient’s compliance</td>
</tr>
<tr>
<td>Patients with single or multi e missed</td>
<td>Psychological problem</td>
</tr>
</tbody>
</table>
teeth in upper / lower premolar/ molar area.

<table>
<thead>
<tr>
<th>Patients with adequate bone volume for the dental implant procedure.</th>
<th>Pathology at the site of intervention.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient with sufficient Inter-arch space</td>
<td></td>
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<tr>
<td>Patients consent approval and signing.</td>
<td></td>
</tr>
</tbody>
</table>

3-Osteotomy technique

The study groups osteotomy was carried out as follows:

- Group A (control): osteotomy was done by sequential drilling technique in healed bony sites.
- Group B (test): osteotomy was done by single drill technique Ultra drill 3.25 mm in healed bony sites.

In group A the implant was placed into the prepared osteotomy and screwed manually until resistance was met, then the implant was seated using the wrench. The implant platform was placed flushed with crestal bone, after that the dental implant initial stability was checked using a torque wrench tool, attaining primary stability of over 30Ncm.

In group B the implant was placed into the prepared osteotomy and screwed manually until resistance was met, then the implant was seated using the wrench. The implant platform was placed flushed with crestal bone. After that dental implant initial stability was checked using a torque wrench tool attaining primary stability of over 30Ncm.

In both groups, a periapical radiograph was carried to check the final implant position and to estimate the initial bone level around the implant.

Vitamin D supplements Osteocare R5 1000 IU per day was taken from day one up to six months. Patients in both groups were received restorative restoration after the
Implant being Osteointegration. Following surgery Augmentin™ 8 (gsk Glaxo-smith Kline) 1gm tablet twice daily for five days and Ibuprofen 12 9 600mg tablets twice daily for three days.

4-Restoration

After six months, implant exposure was performed, a healing cap was placed then implant stability was measured by the Periotest-M.

A healing abutment was placed for soft tissue molding for 2 weeks till the desired emergence profile was obtained and a rubber base impression was performed for the fabrication of the final implant zirconia crown. Then, the patients were recalled every 3 months for supportive periodontal therapy which involved supragingival scaling and reinforcement of the oral hygiene instructions.

5. Data collection and follow-up

Patients were followed up for six months after implant restoration.

Implant stability was recorded at surgery time then it was measured at six months, Crestal bone resorption was recorded by standard digital radiography, Patient satisfaction using a 5-point scale, Vitamin D level test at three and five months, and Required Drilling time.

6. Radiographic evaluation

Standardized periapical x-rays films were taken immediately after implant insertion, three and six months postoperatively to detect crestal bone level.

7. Patient satisfaction:

Patient satisfaction was evaluated using a questionnaire that was based on a visual analog scale (VAS). A horizontal VAS bar using a 5-point scale, the left anchor
labeled no pain which is marked by zero and the right anchor labeled worst pain which is marked by (5) was used.

Three questions were formulated to record the patient’s satisfaction in terms of pain intensity and satisfaction (Appendix 6, 7). Participants were asked about pain intensity and satisfaction and their answers were recorded on the horizontal line \[12\].

**Results**

**Demographic and implant data:**

**1- Age, Gender, Implant site, Implant Diameter, and length:**

A total of 30 participants have enrolled in this study and all of them attended the 6-months follow-up period. The mean, standard deviation (SD), frequencies (n), percentages (%), and P-value for demographic data of all participants are presented in (Table 1). The mean age of patients in the sequential drilling group was 34.1 years (±11.8) and for the single drilling, the group was 32 (±11.3) years. As for gender distribution, the sequential drilling group included 6 males (40%) and 9 females (60%), for the single drilling group 7 males (46.7%) and 8 females (53.3%).

Regarding implant site, sequential drilling group encompassed 7 upper left premolars (46.7%) and 8 upper right premolars (53.3%), for single drilling group 6 upper left premolars (40%) and 9 upper right premolars (60%). As for implant diameter, in sequential drilling group mean and SD=4.05 (±0.38), for single drilling mean and SD was 3.75 (±0). As for implant length, in the sequential drilling group, the mean was 13 (±0), for single drilling, the mean was 13 (±0).

Results of the current study showed that there was no statistically significant difference between mean age values in the two groups. In addition, there was no statistically significant difference between gender and implant sites distributions in the
two groups. The sequential drilling group showed a statistically significantly higher mean implant diameter than the single drilling group. Both groups had the same implant length in all cases, so no statistical comparison between implant lengths in the two groups was performed.

Table (1): Mean, standard deviation (SD), frequencies (n), percentages and results of Student’s t-test and Chi-square test for comparisons of demographic and implant data in the two groups.

<table>
<thead>
<tr>
<th></th>
<th>Sequential drilling (n = 15)</th>
<th>Single drilling (n = 15)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>34.1 (11.8)</td>
<td>32 (11.3)</td>
<td>0.628</td>
</tr>
<tr>
<td>Gender [n (%)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>6 (40%)</td>
<td>7 (46.7%)</td>
<td>0.713</td>
</tr>
<tr>
<td>Female</td>
<td>9 (60%)</td>
<td>8 (53.3%)</td>
<td></td>
</tr>
<tr>
<td>Site [n (%)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper left premolar</td>
<td>7 (46.7%)</td>
<td>6 (40%)</td>
<td>0.713</td>
</tr>
<tr>
<td>Upper right premolar</td>
<td>8 (53.3%)</td>
<td>9 (60%)</td>
<td></td>
</tr>
<tr>
<td>Implant diameter (mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>4.05 (0.38)</td>
<td>3.75 (0)</td>
<td>0.005*</td>
</tr>
<tr>
<td>Implant length (mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>13 (0)</td>
<td>13 (0)</td>
<td>Not computed</td>
</tr>
</tbody>
</table>

*: Significant at P ≤ 0.05

2. Periotest score

a. Comparison between the two groups:

The median, mean, standard deviation (SD), frequencies (n), P-value data for periotest score are presented in (Table 2). At the time of surgery as well as after six months; there was no statistically significant difference between Periotest scores in the two groups (P-value = 0.157, Effect size = 0.533) and (P-value = 0.775, Effect size = 0.106), respectively.

Table (2): Descriptive statistics and results of Mann-Whitney U test for comparison between Periotest scores in the two groups.
b. Changes within each group

In both groups; there was a statistically significant decrease in median Periotest scores after six months (P-value = 0.001, Effect size = 3.737) and (P-value = 0.001, Effect size = 3.738), respectively. (We can say decrease in the score because -2.75 is less than -1.8 or we can say increase in negativity of Periotest score)

2. Vitamin D level (ng/ml):

The mean, standard deviation (SD) and P-value data for Vitamin D levels are presented in (Tables 3).

Table (3): Descriptive statistics and results of repeated measures ANOVA test for comparison between Vitamin D levels (ng/ml) in the two groups.

<table>
<thead>
<tr>
<th>Time</th>
<th>Sequential drilling (n = 15)</th>
<th>Single drilling (n = 15)</th>
<th>P-value</th>
<th>Effect size (Partial Eta Squared)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At surgery</td>
<td>12.07 (2.94)</td>
<td>10.4 (1.24)</td>
<td>0.053</td>
<td>0.128</td>
</tr>
<tr>
<td>3 months</td>
<td>17.53 (3.2)</td>
<td>16.2 (2.81)</td>
<td>0.236</td>
<td>0.05</td>
</tr>
<tr>
<td>5 months</td>
<td>34.33 (6.55)</td>
<td>39.4 (4.19)</td>
<td>0.018*</td>
<td>0.185</td>
</tr>
</tbody>
</table>

*a: Significant at P ≤ 0.05

a. Comparison between the two groups

At the time of surgery as well as after three months; there was no statistically significant difference between mean Vitamin D levels in the two groups (P-value = 0.053, Effect size = 0.128) and (P-value = 0.236, Effect size = 0.05), respectively.

After five months, the sequential drilling group showed a statistically significantly lower mean Vitamin D level than the single drilling group (P-value = 0.018, Effect size = 0.185).
b. Changes within each group

In both groups, there was a statistically significant change in mean Vitamin D levels by time (P-value < 0.001, Effect size = 0.924) and (P-value < 0.001, Effect size = 0.955), respectively. Pair-wise comparisons between time periods revealed that there was a statistically significant increase in mean Vitamin D levels after three months as well as from three to five months.

3. Vitamin D categories

At the time of surgery, all cases in the two groups had deficient Vitamin D, so no statistical comparison was performed.

After three as well as five months, there was no statistically significant difference between Vitamin D categories in the two groups (P-value = 1, Effect size = 0.722) and (P-value = 1, Effect size = 2.071), respectively.

4. Crestal bone loss (mm):

The mean, standard deviation (SD), and P-value for crestal bone loss data are presented in (Table 4).

Table (4): Descriptive statistics and results of repeated measures ANOVA test for comparison between crestal bone loss (mm) in the two groups.

<table>
<thead>
<tr>
<th>Time</th>
<th>Sequential drilling (n = 15)</th>
<th>Single drilling (n = 15)</th>
<th>P-value</th>
<th>Effect size (Partial Eta Squared)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>3 months</td>
<td>1.56</td>
<td>0.15</td>
<td>1.57</td>
<td>0.14</td>
</tr>
<tr>
<td>6 months</td>
<td>2.01</td>
<td>0.31</td>
<td>1.84</td>
<td>0.17</td>
</tr>
</tbody>
</table>

*: Significant at P ≤ 0.05

a. Comparison between the two groups
After three as well as six months, there was no statistically significant difference between mean crestal bone loss in the two groups ($P$-value = 0.861, Effect size = 0.001) and ($P$-value = 0.067, Effect size = 0.119), respectively.

**b. Changes within each group**

In both groups, there was a statistically significant increase in mean crestal bone loss after six months ($P$-value <0.001, Effect size = 0.676) and ($P$-value <0.001, Effect size = 0.444), respectively.

**5. Pain (VAS) scores**

The median, mean, standard deviation (SD), and $P$-value for Pain VAS scores data are presented in (Table 5).

Our results showed that there was no statistically significant difference between pain (VAS) scores in the two groups ($P$-value = 0.522, Effect size = 0.229).

<table>
<thead>
<tr>
<th>Sequential drilling (n = 15)</th>
<th>Single drilling (n = 15)</th>
<th>$P$-value</th>
<th>Effect size (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median (Range)</td>
<td>Mean (SD)</td>
<td>Median (Range)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>3 (1 – 7)</td>
<td>3.33 (1.45)</td>
<td>3 (1 – 5)</td>
<td>3 (1.31)</td>
</tr>
</tbody>
</table>

*: Significant at $P \leq 0.05$

**6. Patient satisfaction (VAS) scores**

The median, mean, standard deviation (SD), and $P$-value for patient satisfaction data showed that

The Sequential drilling group was statistically significantly higher median patient satisfaction (VAS) scores than the single drilling group ($P$-value = 0.005, Effect size = 1.064).

**7. Implant success**
The frequencies (n), percentages (%), and P-value for implant success showed that there was no statistically significant difference between implant success in the two groups (P-value = 1, Effect size = 0.2071).

8-Drilling time (Seconds)

The mean, standard deviation (SD), and P-value for drilling time data are presented in (Table 6).

Results of the current study revealed that the Sequential drilling group showed a statistically significantly higher mean drilling time than the single drilling group.

<table>
<thead>
<tr>
<th></th>
<th>Sequential drilling (n = 15)</th>
<th>Single drilling (n = 15)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>276 (±28.2)</td>
<td>68.2 (±7.2)</td>
<td>&lt;0.001*</td>
<td></td>
</tr>
</tbody>
</table>

*: Significant at P ≤ 0.05

Discussion

It was believed that implant placement in patients with low bone density, as in patients with vitamin D deficiency and patients with osteoporosis, may negatively affect implant primary stability, (BIC) and finally implant osseointegration [9]. Implant placement in patients with low bone density seems to be acceptable with a certain precaution to enhance implant primary stability, preventing marginal bone loss around dental implants as in normal bone and preventing early failure [13].

This randomized clinical trial was designed to evaluate implant stability in patients with vitamin D deficiency using sequential drilling technique versus a new design single drill technique (Ultra Drill 3.25mm) in patients with vitamin D deficiency.
All patients in both groups have vitamin D deficiency with vitamin D serum levels less than 30ng/ml. According to Holick, (2009), vitamin D serum levels are deficient when less than or equal to 20 ng/ml, insufficient when between 21 ng/ml and 29 ng/ml, and sufficient when more than 30 ng/ml [14].

Patients suffering from systemic diseases that contraindicate implant placement or surgical procedures, Poor patient’s compliance, psychological problems, Pathology at the site of intervention were excluded from this study. This was according to a study performed by Gomez de Diego et al. (2014) [15].

In Group A patient’s osteotomy preparation was made using a sequential drilling technique [16] and for Group B the patient’s osteotomy preparation was made by a single drill technique [17,18].

Both techniques were able to achieve the planned goal for osteotomy preparation for implant placement with clinical success and no major complications were found.

Regarding the surgical procedures, all included patients were subjected to delicate and atraumatic surgery using sequential drilling osteotomy in (group A) and single drilling osteotomy in (group B). A minimally traumatic procedure was used for preserving the healing potential of bone as much as possible and to reduce crestal bone loss as well. Hence implant site preparation becomes critical for achieving predictable osseointegration and for obtaining a pleasing natural implant restoration [17].

As regards surgical time, the Single drilling technique showed significant advantages to both the patient and the clinician. Less time is needed for surgical procedures, three to four minutes faster than the traditional sequential drilling technique. Also, this technique avoids excessive temperature generation, mechanical damage, and high frictional forces during surgical drilling. According to Penarrocha et al. (2006)
Tissue exposure for a long time will harm postoperative healing course due to the increased production of pro-inflammatory cytokines with an intense inflammatory response. Many publications suggested that reducing the number of drilling steps will not hinder clinical results limiting the overall duration of surgical intervention to better healing and more patient satisfaction.

The current study results were in accordance with Guazzi et al. (2015) who showed that the clinical outcome of implants placed with a simplified protocol of one large single drill versus multiple conventional drilling steps had less postoperative morbidity in the test group.

Regarding the time of the surgical procedure, the speed was surely appreciated by both patient and by surgeon especially on placing more than one implant knowing that fast drilling phase will result in decreasing the overall procedure time, reduces the overall tissue morbidity; reduce post-operative discomfort and better patient acceptance for implant treatment option and these results are similar to Guazzi et al. (2015) who showed that the clinical outcome of implants placed with a simplified protocol of one large single drill versus multiple conventional drilling steps had less surgical time in the test group. Also, these results coincide with Zahran et al. (2017) who showed that both techniques were able to achieve the planned goal for osteotomy preparation for implant placement with clinical success and no major complications.

The usage of a single drill with high rotation speed combined with a properly applied force allowed faster site preparation with minimum heat generation compared with Sequential drilling and low applied pressure that will result in more heat generation and a prolonged time for bone osteotomy and subsequently will result in implant loss.
These results agree with those of Giro et al. (2013) [20], Guazzi et al. (2015) [17], and Senada et al. (2020) [23].

Implant stability was measured using Periotest–M at surgery time and six months postoperative. Periotest was chosen as a reliable and non-invasive tool to assess implant stability variation over time. Periotest values (PTV) can reveal the increased stiffness over time of the dental implant-bone continuum. Accurate dental implant reading reactions and dental implant primary stability can be obtained by the Periotest M device regarding a defined certain impact load [24, 25].

Periotest M was used in this study instead of torque wrench as a tool for measuring dental implant initial stability which is not available in the surgical kits of many dental implant systems. Periotest M gives more accurate readings than the classic Periotest as it can measure in a decimal number, this apparatus is widely used to assess implant outcome and provides a measurement of the implant reaction to a defined impact load and can be used for the assessment of primary stability [24, 25].

Regarding implant stability the results of the present study, there was no significant difference between the two groups. These results are similar to Gehrke et al. (2018) [1] who didn’t find differences in implant stability between implants inserted with a drill sequence or single large drill. Implant primary stability depends on several factors: material, surface, diameter, and shape of the dental implant itself as well as practical factors during the surgery correct use and drilling technique for insertion of the dental implant [26,27].

Regarding the presence of pain, Pain was evaluated daily for two weeks using the visual analog scale (VAS) from 0 to 10 (“0” is pain-free and "10" is unbearable
pain). After surgery, all patients in both groups experienced mild pain (VAS=2-5), except for one patient in (group A) who experienced moderate pain (VAS=7). These results coincide with studies previously performed by Hashem et al. (2006) [28] and Karabuda et al. (2007) [29].

All patients in this study showed no swelling in the operated area for up to six months. However lack of oral hygiene maintenance by the patient may lead to early swelling and implant failure and so infection occurred despite the instructions given, Al-Sabbagh and Bhavsar, (2015) [30] stated that the clinical signs of peri-implant infection are associated with implant failures.

Regarding crestal bone level after three as well as six months; there was no statistically significant difference between mean crestal bone loss in both groups. These results are in agreement with Guazzi et al. (2015) [17] who examined the use of single drill versus sequential drilling for osteotomy preparation with no statistically significant differences for marginal bone level changes between the single drill group and sequential drills group (difference 0.13 mm, 95% CI -0.21; 0.47, P = 0.108), with average bone loss (1.57 mm and 1.56mm ) of crestal bone loss after three months follow-up and (2.01mm and 1.84mm) after six months follow for single drill technique group and sequential drill technique group respectively.

In the current study, all patients were given Vitamin D supplements with a dosage of 1000IU per day for 5 months till the vitamin D level reached 30ng/ml or more. Vitamin D supplements with dosages ranging from 25 – 100 micrograms, equivalent to 1000 to 4000 IU, was sufficient to raise vitamin D serum level in vitamin D deficient patients to 30ng/ml and
more, knowing that 4000 IU per day is the safest upper limit according to the Institute of Medicine (IOM) \cite{31}.

Regarding implant osseointegration, all patients with vitamin D serum levels of 30 ng/ml or more showed successful implant osseointegration up to six months follow-up except for one patient.

In (Group A) with vitamin D serum level 15 ng/ml had implant failure. These results coincide with Koshak et al. (2017) \cite{32} and Trybek et al. (2018) \cite{33} who showed Implant failure is more common in patients with low vitamin D serum levels. Patients with higher vitamin D levels showed a higher implant success rate.

In the present study vitamin D supplementation for patients was done starting from day one after implant placement due to its role in enhancing intestinal calcium absorption, bone turnover, decrease post-operative inflammation and finally implant osseointegration, and this was in accordance to Perzanowska and Marcinowska, (2012) \cite{34} who reported that vitamin D has active absorption of Calcium and Phosphate from the intestine that occurs in two ways. The first way directly includes structural alteration of the phospholipid membrane inside the cells of enterocytes without receptor involvement. This structural alteration will increase membrane permeability to calcium ions. The second indirect way of vitamin D mechanism involves activation of genes responsible for calcium-binding protein – CaBP synthesis. This activation will result in the synthesis of these de novo proteins and enables more efficient absorption of calcium ions from the intestines \cite{35}.

In the current study, supplements for vitamin D were administered by deficient patients starting from day one after implant placement. Schulze et al. (2016) \cite{10} reported that vitamin D has a positive effect on implant osseointegration, by promoting
the healing of peri-implant bone tissue clinically. Similar results were reported by Zhou et al. (2012) [36] and Wu et al. (2013) [37] who demonstrated an increase in the percentage of contact between bone and implant in diabetic rats given vitamin D supplements. In patients with severe deficiency states, in these patients, vitamin D supplementation should be maintained for the whole life, to guarantee a good remodeling of the bone around the implant [38].

Conclusions:

Within the limitations of this randomized clinical trial, there was no significant difference between a single drill and sequential drills for osteotomy preparation and implant osseointegration in patients with vitamin D deficiency with Vitamin D patient supplementation, but a single drill was 4 minutes faster.

References:


