Soft Tissue Esthetic using Pink esthetic score with Autogenous Dentin Chips and Immediate Implantation versus Conventional Immediate Implantation with Xenograft in Thin Buccal Bone: (Randomized Controlled clinical trial)

Mona Aly Shoeib (mona.shoeib78@gmail.com)
departement of oral medecine & periodontoloy faculty of dentistry cairo university https://orcid.org/0000-0003-1735-8917

cherine emad mahmoud mohamed hamada
departement of oral medecine & periodontology faculty of dentistry october university for modern sciences & arts university https://orcid.org/0000-0001-5711-2386

Ahmed Reda Abdelrahman
departement of oral medecine & periodontoloy faculty of dentistry cairo university

Research Article

Keywords: Dentine, immediate implant, xenograft, autogenous tooth graft, thin buccal bone

Posted Date: October 18th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-2176620/v1

Abstract

Objective: When restoring teeth in the aesthetic zone, soft tissue aesthetics for an immediate implant is considered challenging. This study aimed to evaluate soft tissue aesthetics around immediate dental implants with dentin chips and xenograft in thin buccal bone.

Methodology: 16 patients with non-restorable teeth were recruited in this study for immediate implant placement with augmentation. Patients were randomly assigned into two equal groups; dentin chips group with immediate implant and xenograft group with immediate implant also. Pink aesthetic scores are recorded on loading at 6 months & after 1 year of implant insertion according to Vanlıoğlu. Also, buccal bone and crestal bone resorption were measured using CBCT at 6 months & 1 year; implant stability was measured using osstel immediately on implant insertion & before loading, and pain is recorded as a Numerical rating scale according to Breivik.

Results: In the present study, both groups showed better PES after 6 months and 1 year *P*-value = 0.343; *P*-value = 0.199 ; nearly same level of crestal bone & buccal bone at 6 months & 1 year *P-value = 0.031; P-value = 0.029 P*-value = 0.546; *P*-value = 0.268 ; implant stability is better at 6 months and one year *P*-value = 0.514; *P*-value = 0.340 and reduction in the post-operative pain within 1 week following implant placement with but with statistically significant difference within each group and also between both groups.

Conclusions: The use of autogenous dentin chips proved to be a valid alternative to bone grafting materials to fill the jumping gap in conjunction with immediate implants in the aesthetic zone.

PES, the overall difference between the control and the intervention groups showed no statistical significance.

Introduction

After tooth extraction, host bone resorption and atrophy of the alveolar ridge may be observed. Sutton et al. classified different degrees of alveolar ridge atrophy. Bone resorption occurs especially in the incisors and premolar area of the jaw in the region of thin buccal lamella which may lead to a change in contour. Total clinical bone loss height of approximately 2-5 mm at first 6 months may be observed in a vertical dimension, after 12 months alveolar ridge may lose up to 50 % of its width. (1)

Dentin composes more than 85% of tooth structure and can serve as native bone grafting material. Teeth become grafts that gradually and slowly being replaced by bone. (2)

Chemically dentin shows a close relationship to bone and showed good osseous regeneration in animals.

It is cost-effective because there are no expenses for graft material and also Decreases postoperative infection in patients using their tooth structure.

Recently augmentation with bone grafting became one of the most common techniques surgically; progressive bone resorption may be prevented by using augmentation procedures with the use of graft materials. The gold standard in regenerative procedures is autogenous bone graft because of osteoinduction, osteoconduction, and osseointegration properties required in regeneration. In an autogenous bone graft, there is a need for a

second surgical site, and donor site morbidity and limited availability will lead to challenges for alternative biomaterials (3)

Extracted healthy nonfunctional teeth from humans are considered to be dental waste all over the world. A high proportion of extracted sockets are left untreated for physiological healing. Inadequate or failure of bone healing in sockets has been seen due to the absence of bone graft material. The human tooth is rich in stem cells, matrix, trace metal ions, and growth factors. Bone and dentin tissue structures are different but the ratio of components is similar (mineral 70%, collagen 20%, and body fluid 10% by weight). Dentin after demineralization is mainly composed of type 1 collagen 95% and non-collagenous proteins as growth factors (3)

Teeth, jaw bones and alveolar bone develop from cells of neural crest origin and many proteins common to dentine, bone, and cementum. Not surprising that Previous studies have shown methods of processing bovine dentin into particulate and sterile grafting material for the preservation of alveolar ridge described and tried in animals. Root-canaled teeth should not be employed in this procedure because of contamination with foreign materials. But crown and fillings can be removed and clean dentin of tooth crown may be used for immediate grafting (2)

Different methods of alveolar ridge preservation have been described to prevent this bone atrophy and resorption. Augmentation of extracted sockets with bone is well known and it is the gold standard. Clinical techniques like socket shields were also performed to prevent alveolar bone resorption. Studies have shown osseointegration of implants inserted indicating biocompatibility of autologous tooth material. Applying dentin as a bone substitute for augmentation may be useful to become an alternative to allogenic materials. (1)

Study design and registration

The current study was designed as a single-blind, randomized, parallel arms-controlled clinical trial, in compliance with the EQUATOR guidelines, with a 1:1 allocation ratio to compare (dentine chips group) to xenograft (control group).

The research protocol was registered on www.clinicaltr ials.gov in May 2018 (NCT03544580). Research protocol, informed consent templates, and biological sample collection requests were approved by the Research Ethics Committee, Faculty of Dentistry, Cairo University, in September 2018 (IRB number: 18|09|09).

The study was carried out in compliance with the ethical principles of the Helsinki Declaration for medical research involving human subjects as revised in Seoul, 2008.

Recruitment of participants

The study was conducted at the Faculty of Dentistry, Cairo University, Egypt. Participants were recruited from the outpatient clinic, and study procedures were conducted at the postgraduate periodontology clinic at the Department of Oral Medicine and Periodontology, Faculty of Dentistry, Cairo University.

Potential applicants are systemically fit to undergo minor oral surgical procedures free from any systemic diseases or drugs that may contraindicate dental implant therapy.

Non-restorable tooth/teeth in the maxillary aesthetic zone, Thin facial plate of bone (thin < 2mm), Free from any pathology, Having a sufficient periapical bone to gain primary stability for the immediate implant.

Smokers, Pregnant women, and those with Teeth that have to be extracted due to advanced periodontal bone loss**,** Trauma in an aesthetic area, or Periapical infection at the site of extraction were excluded.

Sample size determination

Based on a previous study by Arora & Ivanovski 2017 the difference in PES between 2 groups is 1 ± 0.59

Using power 80% and 5% significance level we will need to study 7 in each group this number has been increased to a sample size of 8 in each group to adjust for using a nonparametric test. The number is increased again to 10 in each group to compensate for losses during follow-up. Sample size calculation was achieved using PS: Power and Sample Size Calculation software version 3.12 (Vanderbilt University, Nashville, Tennessee, USA)

Randomization

Extraction sites were randomly assigned to undergo atraumatic extraction then either Dentin chips with immediate implantation (dentin chips group) or Xenograft with immediate implantation (control group) with a 1:1 allocation ratio.

Sequence generation and concealment were carried out by a single investigator (MS) using www.random.org. Allocation was concealed in serially numbered, identical, and opaque sealed envelopes. AR was responsible for assigning the allocation of participants into the corresponding study group. All participants were enrolled and equally prepared for the surgical procedure by a single investigator (CH). After tooth extraction and grinding, the intervention allocation was revealed (AR) to the investigator (CH) according to the sequence generated.

Blinding

Study participants were blinded to the treatment received. Blinding of the investigator was not applicable. Outcome assessors and biostatisticians were blinded. Participants' identity and their corresponding study groups were concealed by assigning an identification number to all data files and reports for the transfer of data to and from assessors.

Preoperative phase

Following inclusion, the medical history of the patients was documented, teeth of interest were clinically examined, and initial periapical radiographs were taken. Following a detailed explanation of the aim of the study, benefits to participants, surgical procedures, harms, and timeline, participants read and undersigned informed consents.

Professional periodontal debridement was performed, and oral hygiene techniques were explained and emphasized. CBCT ^{scan} using On Demand 3D[1] is performed to record preoperative ridge width and height measurements and specially crestal bone in the aesthetic area.

Surgical procedures

The main operator (C.H) performed all procedures under local anesthesia[2] (4% articaine with 1/200 000 adrenaline Solution), using a local infiltration technique.

A 1 capsule loading dose of Antibiotic 875 mg of Amoxicillin and 125 mg of Clavulanic acid tablet (1 g Amoxicillin Clavulanate)[3] are given orally to the patient 1 hour before the procedure for insuring aseptic condition for the surgery.

Dentin chips group:

Starting with the extraction of a non-restorable tooth (fig.1& 2) atraumatically using a periotome then the root is scraped with a curette to clean it from any periodontal ligament remnants and a bur is used to remove cementum, enamel, and pulp or endo filling. (Fig.3)

Followed by dentin is cut into small blocks, and milled in a bone mill to obtain dentin chips used after implant placement.

Dentin particles are immersed in 70 % ethanol[4] (El-Gomhouria CO. Egypt) in a sterile container for 10 minutes to remove any soft tissue remnants, bacteria, and smear layer (defatting and sterilization). (Fig.4)

Tooth particles are demineralized using 37% HCL[5] (El-Gomhouria CO. Egypt) for 20 minutes to expose the dentin organic matrix. (Fig 5)

The bacteria-free particulate dentin is washed with phosphate-buffered saline[6] (El-Gomhouria CO. Egypt) twice for 5 minutes to restore the pH balance (Fig 6 & 7)

Then osteotomy site is done using appropriate drill sizes

A paralleling pin is applied to assure the implant's future position behind the dentin chips (Fig.8) and a periapical x-ray is taken

Implant [7](Neobiotech USA. Inc., Korea) is inserted in place submerged 2mm under bone crest flapless technique and also put dentin chips in the jumping gap (Fig.9) and another periapical is then taken. we always use a smaller diameter of the implant to leave a great space for graft

Control group:

Same as the dentin chips group, but we used xenograft [8](Bio-Oss®.) instead of dentin chips in the jumping gap between the implant and buccal bone (Fig.12-17)

Postoperative care and follow-up

Post-surgically patients are prescribed cold therapy immediately after the surgery. 1 g Amoxicillin Clavulanate (875 mg of Amoxicillin and 125 mg of Clavulanic acid tablet)[9] twice daily for 7 days, anti-inflammatory tablet

(50mg Diclofenac) (Cataflam 50mg)[10] three times daily and Povidone Iodine (1%) mouthwash (Betadine mouthwash)[11] twice daily are prescribed.

Immediately after the surgery standardized radiographic is performed indicating the position of the dentin chips. Again a CBCT is taken after 6 and 12 months to ensure that dentin chips are replaced by bone or not and the amount of buccal bone resorption width gained with the level of crestal bone. Also, pain scales are assessed during a such appointments. (Fig.16,17)

1. On-Demand 3D, Cybermed Inc., Techno Ville, Gasan-dong, Geumcheon-gu, Seoul, South Korea
2. Septodont, France
3. Hibiotic 1 gm, Amoun pharmaceuticals, El Obour city, Cairo, Egypt.
4. (El-Gomhouria CO. Egypt)
5. (El-Gomhouria CO. Egypt)
6. (El-Gomhouria CO. Egypt)
7. Neobiotech USA. Inc., Korea
8. Geistlich Pharma AG Bahnhofstrasse 40 CH - 6110 Wolhusen
9. Hibiotic 1 gm, Amoun pharmaceuticals, El Obour city, Cairo, Egypt.
10. Cataflam 50mg, Novartis Pharma S.A.E, El Sawah St., El Amriya, Cairo, Egypt
11. Betadine mouthwash, El Nile, licensed Mundipharma AG, 41 Farid St., Heliopolis, Cairo, Egypt.

Appointments are assigned once weekly for the next 2 weeks to assess the pain and swelling and collection of the assessment records at the end of the 2 weeks.

After 6 months we started exposure of implants and prosthetic parts in form of a zirconium crown.

Outcomes :

1. Pink aesthetic score

Is measured using photos preoperatively, 6 months & 1 year as follows

- mesial papilla
- distal papilla
- the curvature of the facial mucosa and the level of the facial mucosa
- root convexity
- soft tissue color and texture at the facial aspect of the implant site (4)

and a score is given of 2, 1, or 0 is assigned to each of the five PES parameters with maximum total PES of 10 possible.

2. Buccal bone resorption, crestal bone

Both are measured on CBCT preoperatively, 6 months & 1 year as follows

Buccal bone: in the middle of the root before extraction & in the middle of an implant after placement as shown in the picture

Crestal bone:

Is measured from the bone crest to the end of the root before extraction & after extraction from the crest to the end of the implant

3. Implant stability

Using osstel

4. Pain

Using a score

Results

Groups characteristics

Participants were recruited, treated, and followed up between July 2018 and January 2020. All participants in both groups completed the follow-up period and were included in the analysis.

Two failed implants of our patients were observed.

Sixteen participants with single-rooted teeth indicated for extraction were randomly allocated into the test (DC with immediate implant) and control group (xenograft with immediate implant) with 8 participants per group.

Reasons for extraction were advanced caries or fracture of teeth beyond restoration.

The dentin chips group included 5 females and 3 males with a mean age of 34.4 ± 11.3 years, while the control group included 0 males and 8 females with a mean age of 37.1 ± 7.5 years.

Regarding extracted teeth distribution, the dentin chips group included 8 maxillaries with 6 sites in the anterior teeth segment and 2 in the premolar segment.

For the control group, 6 maxillaries with 0 anterior and 8 premolar extraction sites. There was no statistically significant difference between mean age values in the two groups. Also, no statistically significant difference was found between gender distributions in the two groups.

1. Pink Esthetic Score (PES)

a. Comparison between the groups

Pre-operatively, after 6 as well as 12 months; there was no statistically significant difference between PES scores in the two groups (*P*-value = 0.227, Effect size = 0.574), (*P*-value = 0.343, Effect size = 0.458) and (*P*-value = 0.199, Effect size = 0.544). (Table.2)

b. Changes within each group

In both groups; there was a statistically significant change in median PES scores by time (*P*-value = 0.010, Effect size = 0.581) and (*P*-value = 0.003, Effect size = 0.74), respectively. Pair-wise comparisons between periods revealed that there was a statistically significant decrease in median PES scores after 6 months followed by a non-statistically significant change from 6 to 12 months. The median PES score after 12 months showed a statistically significantly lower median score than the pre-operative score. (Fig.18)

2. Buccal bone resorption (mm)

a. Comparison between the groups

After 6 as well as 12 months; there was no statistically significant difference between buccal bone resorption in the two groups (*P*-value = 0.546, Effect size = 0.292) and (*P*-value = 0.268, Effect size = 0.486). (Table .3)

b. Changes within each group

In both groups; there was no statistically significant change in median buccal bone resorption by time (*P*-value = 0.071, Effect size = 1.661) and (*P*-value = 0.293, Effect size = 0.801), respectively. (Fig.19)

3. Crestal bone loss (mm)

a. Comparison between the groups

After 6 as well as 12 months; intervention group showed statistically significantly lower median crestal bone loss than control group (*P*-value = 0.031, Effect size = 1.277) and (*P*-value = 0.029, Effect size = 1.277), respectively. (Table .4)

b. Changes within each group

In both groups; there was a statistically significant decrease in median crestal bone loss after 12 months (*P*-value = 0.021, Effect size = 3.955) and (*P*-value = 0.012, Effect size = 3.932), respectively. (Fig.20)

4. Implant stability

a. Comparison between the groups

After 6 as well as 12 months; there was no statistically significant difference between mean implant stability values in the two groups (*P*-value = 0.514, Effect size = 0.036) and (*P*-value = 0.340, Effect size = 0.076), respectively.

b. Changes within each group

In both groups; there was a statistically significant increase in mean implant stability value on loading (*P*-value <0.001, Effect size = 0.893) and (*P*-value <0.001, Effect size = 0.862), respectively. (Fig.21)

5. Pain (VAS) scores

a. Comparison between the groups

After one day, two, three, four, five, six as well as seven days; there was no statistically significant difference between pain (VAS) scores in the two groups (*P*-value = 0.436, Effect size = 0.374), (*P*-value = 0.436, Effect size = 0.374), (*P*-value = 1, Effect size = 0), (*P*-value = 1, Effect size = 0), (*P*-value = 0.903, Effect size = 0.053), (*P*-value = 0.136, Effect size = 0.758) and (*P*-value = 0.268, Effect size = 0.486), respectively.

Changes within each group

In the intervention group; there was a statistically significant change in median VAS scores over time (*P*-value <0.001, Effect size = 0.981). Pair-wise comparisons between periods revealed that there was a statistically significant decrease in median VAS scores on day 2, from day 2 to 3, 3 to 4, 4 to 5, 5 to 6 as well as 6 to day 7. In the control group; there was a statistically significant change in median VAS scores over time (*P*-value <0.001, Effect size = 0.942). Pair-wise comparisons between periods revealed that there was a statistically significant decrease in median VAS scores on day 2, from day 2 to 3, 3 to 4 as well as from day 4 to day 5. From day 5 to day 6, there was no statistically significant change in median pain scores followed by a statistically significant decrease in median pain scores on day 7. (Fig.22)

Harms

Any temporary or permanent adverse effect will be recorded and documented.

Discussion

The present study aimed to compare the autogenous demineralized dentin graft (ADDG) versus xenograft (Bioss) for their effect on PES after 6 months and one year also on Buccal bone resorption, crestal bone volumetric changes assessed by 3D cone beam computed tomography (CBCT) & Implant stability using osstel.

To minimize confounders, different measures for the selection of participants have been taken in the study. Smokers were excluded because smoking has unfavorable effects on bone healing, not only it adversely affects host cells function and causes alternations to the inflammatory response, but also it reduces the blood supply which leads to a decrease in tissue perfusion and ischemia and turns, negatively affects healing processes following tooth extraction (5). Clinically, smoking can increase the post-extraction alveolar crest loss by 0.5 mm (6). Pregnant females were excluded to avoid the teratogenic effect of high radiation exposure when performing CBCT scans (7).

Some metabolic diseases such as diabetes or hyperthyroidism as well as systemic medications such as chemotherapy or bisphosphonates are further known to affect bone remodeling (6). Accordingly, patients reporting having any of these conditions were excluded.

only patients over 18 years were included to be able to provide informed consent and to avoid the effect of bone growth and passive eruption of teeth on the quantitative measurements.

In addition to the above-mentioned general exclusion criteria, local site-specific criteria have been set as well. The exclusion of molars was done because bone quality as well as the size and configuration of molar sockets

are different than single-rooted teeth and consequently, healing time and processes are considered dissimilar (8), (9).

Damaged extraction sockets are generally believed not to be suitable for supporting graft material and require wall replacement by block graft (10) and therefore, such defects were excluded (2)

Finally, local infection at the site of extraction is known to delay healing, the high acidity is due to inflammation and bacterial byproducts can cause graft particles to dissolve via a cell-mediated process or solution-mediated process (11), and hence no infected site was included.

For the surgical technique used in this study, the flapless approach was chosen since flap elevation is known to cause crestal bone resorption due to the transient deprivation of osteogenic cells and blood supply (12) In a systematic review it was concluded that leaving the periosteum undisturbed through a flapless approach shows the less alveolar bone height and width resorption in comparison to flap elevation, making it the recommended approach to preserve the bone crest (9)

The choice of Periotomes was made as they serve the goal of atraumatic extraction by cutting periodontal ligament attachment along the root surface thus decreasing the tooth resistance to extraction forces. They also minimally dilate the extraction socket thus initiating tooth luxation and permitting an easier path of removal and at the same time, avoiding trauma to the alveolar process and the adjacent teeth. (13)

When compared to the conventional forceps, periotomes required more surgical time but resulted in less buccal bone fracture, less root fracture, less soft tissue laceration, and less postoperative pain (7).

After extraction, teeth were cleaned from caries which can act as a bacterial reservoir, restorations were removed to avoid foreign body reactions or inflammatory effects to the healing site and soft tissue attachment, and their insertion in cementum was removed as they hinder the access of disinfectant or demineralizing agents to the tooth surface. A hand-driven bone mill is a tool used to grind autogenous bone for various applications. Its use for chairside preparation of tooth-bone graft (TBG) has been reported ((1) (14) & (13)). Unlike the bulky and expensive automated mills, it is a convenient and available tool that can be used in everyday clinical scenarios.

Hydrochloric acid (HCl) was used for the preparation of the ADDG as it is one of the strongest demineralizing agents, it has a germicidal effect and at the same time, it does not cause denaturation of collagen fibrils in the dentin matrix, hereby it is the most commonly employed acid in clinical use (16). The graft particles were immersed in 0.6N HCl for 30 minutes as recommended by (17)which reported that there was a significant difference concerning graft mineral content and crystalline structure between 10 minutes and 30 minutes of acid application, but there was not any different when increasing the demineralized period beyond that. The same acid and time application was experimented with in ARP clinically by (18) and showed to be an effective processing technique for ADDG.

Asepsis is essential for adequate healing; bacterial virulence factors can cause fibrinolysis and disintegration of the formed blood clot, raising the local cytokines that can cause local matrix degradation and hence compromise the healing outcomes. (4). It is common practice then to prescribe antibiotics post-operatively to avert any negative effects of bacteria during the blood clot phase till the beginning of granulation tissue

formation which is less impervious and followed by epithelial closure (19) and therefore; antibiotics were prescribed during the early phase of healing for all participants.

Participants were advised to stop using the toothbrush and chewing at the surgical site. They were also advised to follow a soft and cold diet to avoid any undesired trauma to the surgical site, ice packs surgical site, Chlorhexidine mouthwash was used and was used as it has been proven to be antiseptic, reduce biofilm buildup and gingival inflammation following dental surgeries (20)

Esthetic-outcome assessment has been an emerging area of focus in implant dentistry. To sustain an esthetic appearance, it is essential to consider the characteristics of the surrounding soft and hard tissues. (21) therefore The pink esthetic score (PES) was used to evaluate the esthetic outcomes with the clinical photographs before the treatment and after the follow-up period. The PES includes seven variables (the mesial papilla, the distal papilla, the midfacial level, the midfacial contour, the alveolar process deficiency, the soft tissue color, and the soft tissue texture), and was assessed by using a 0-1-2 score, with 0 = lowest score, and 14 = highest score. (22)

The PES is a tool for reproducibly evaluating the esthetic appearance of the soft tissue around single-tooth implant crowns. (22)

Pink esthetic in our study is statistically non-significant between immediate implants with dentin chips & immediate implants with xenograft in 6 months & 12 months.

To our knowledge, there has not been any published comparison between dentin chips and other grafts with immediate implants.

A significant decrease of PES was observed in each group at 6 and 12 months with no clinical relevance which is inconsistent with (23)who said that the esthetic outcome of soft tissue around the single-tooth implant had improved significantly at follow-up compared with baseline according to PES assessment. As that may be explained by the immediate restoration of immediate implants in his study. His results suggested that the potential for significant changes in soft-tissue levels after restorative therapy needs to be considered for single-implant therapy in the anterior maxilla.

Crestal bone loss showed statistically significant more bone loss from 0-6 months than from 6-12 months in the two groups statistically significant bone loss was observed in the control group than in the interventional group which is inconsistent with (24)Showed that implants placed in post-extraction sockets augmented with DFDBA exhibited minimal marginal bone loss similar to implants placed in native bone.

Our results are in contrast to (25) reported that No matter using autogenous tooth bone or xenogenous bone, the horizontal bone loss at the first or the latter 6 months was almost the same in the level 0 mm, 3mm and 6mm of the implant facial part and No matter what the follow-up period is, and bone graft material used, the horizontal bone loss at the level of 6mm was much less than the level of 0mm and 3mm in the facial of the implant. All implants achieved the success criteria without (24) claiming that grafting of extraction sockets is beneficial in terms of limiting the dimensional changes of the alveolar ridge following tooth/teeth extraction.

Implant stability in our study increased at 6 months than upon insertion which may be consistent with a systematic review of (26) who claimed that primary implant stability can be influenced by the macro design of dental implants, and roughness-enhancing surface treatments can increase ISQ values in later osseointegration phases, improving secondary implant stability. Primary implant stability is lesser with lower bone density and may be enhanced by the utilization of thinner drills (under preparation) or osteotomes when the bone density is inadequate.

Primary and secondary stability of immediately loaded group comparison has shown that there was a significant statistical difference and early loaded group comparison has shown that there was a significant statistical difference. But when differences in primary and secondary stability of immediate loaded and early loaded group comparison have shown that after osseointegration there is no difference in stability (27).

But we have an implant that failed after 1 month due to trauma the patient faced in intervention & another one failed after 6 months before loading may of unknown Even asymptomatic endodontically treated teeth with a normal periapical radiographic appearance could be the cause of an implant failure. They also suggested that microorganisms may persist, even though the endodontic treatment is considered radiographically successful, because of inadequate obturation or an incomplete seal. (28)

In our present study pain (VAS) scores successfully decrease day to day.

A study was conducted in past in implant surgery and found that the female gender was significantly associated with pain (29), and another study claimed that women had a significantly higher anxiety level than men and that this again led to more pain (30). Accordingly, in our study, women experienced more pain than men on the second postoperative day. However, other studies found no difference between genders in pain perception (31). In many experimental studies on pain, though, women reported more severe pain and a longer duration of pain than men. (32)

In our study we had a success rate of almost 94% which nearly the same as (33) results was a higher failure rate was found for the implants in the posterior region of the maxilla, and when periodontitis was cited as a reason for tooth extraction. The overall success rates were 93.4% and 95.7% in the immediate and delayed implant placement groups, respectively, after a 2-year follow-up. No obvious relationship between success rate was observed with the implant placement method, cause of tooth extraction, and implants' position.

With all of the advantages of the ATG, it also exhibits limitations. The process of chairside preparation includes cleaning, grinding, and disinfection which requires time and effort. As an autogenous graft, it is only available in limited quantity. It requires the extraction of a tooth for graft preparation and hence cannot be used in individuals that do not have any teeth indicated for the extraction or in completely edentulous subjects. A possible solution to this problem can be done by using tooth-derived graft materials obtained from allogenic sources but the practice of using allogenic tooth-bone graft has been only investigated in a handful of clinical studies with concerns about effective preparation and donor screening for commercial release. (34)

AWTG or ADDG employed in ARP is equally effective at reducing dimensional losses after 6 months, with no adverse effects. Histologically, both grafts were biocompatible and osteoconductive, with ADDG seeming to exert higher osteoinductive properties. Chairside preparation and application of ATG are feasible, and cost-

effective and can provide an alternative source to commercially available grafting materials. Further investigations are needed to optimize the two graft preparation techniques and explore and compare their effects in different clinical scenarios in the oral cavity. (35)

Conclusions

1. The use of autogenous dentin chips proved to be a valid alternative to bone grafting materials to fill the jumping gap in conjunction with immediate implants in the aesthetic zone.

2. The use of slowly resorbing grafting substitutes as said by *Kim et al. 2010* simultaneously with immediate implants helped to preserve the contour of the facial bone plate in the aesthetic zone.

3. Autogenous dentin chips when used with immediate implants decrease the crestal bone loss more than Bio-Oss®.

4. Although the total time for the procedure in the intervention group was slightly longer than that for the control group, no statistical significance existed between both groups regarding the pain reported by the patients enrolled in each group.

5. Regarding the (PES), the overall difference between the control and the intervention groups showed no statistical significance.

List Of Abbreviations

- ADDG: autogenous demineralized dentin graft
- ARP: alveolar ridge preservation
- ATG: autogenous dentin matrix
- AWTG: autogenous whole tooth graft
- H: Cherine Hamada
- DFDBA: demineralized freeze-dried bone allograft
- PES: Pink esthetic score
- TBG: tooth bone graft

Declarations

Protocol Registration

The study was registered on https://clinicaltrials.gov/

ClinicalTrials.gov Protocol Registration and Results System (PRS) Receipt
Release Date: June 2, 2018

ClinicalTrials.gov ID: NCT03544580

Study Identification

Unique Protocol ID:	CEBD-CU-2018-05-01
Brief Title:	Soft Tissue Esthetic With Autogenous Dentin Chips and Immediate Implantation Versus Conventional Immediate Implantation With Xenograft in Thin Buccal Bone
Official Title:	Soft Tissue Esthetic With Autogenous Dentin Chips and Immediate Implantation Versus Conventional Immediate Implantation With Xenograft in Thin Buccal Bone: (Randomized Controlled Clinical Trial)
Secondary IDs:	

Study Status

Record Verification:	June 2018
Overall Status:	Not yet recruiting
Study Start:	June 15, 2018 [Anticipated]
Primary Completion:	August 30, 2019 [Anticipated]
Study Completion:	December 30, 2019 [Anticipated]

Funding

Self-funding

ACKNOWLEDGMENTS

The authors would like to sincerely thank Dr. Abdullah Mattar for his support during the clinical evaluation. This study was self-funded

CONFLICT OF INTEREST

All authors explicitly state that they have no conflicts of interest with this article.

all data sets used and/or analyzed during the current study are available from the corresponding author on reasonable request".

Conflict of Interest Statement

All authors explicitly state that they have no conflicts of interest with this article.

References

1. Valdec S, Pasic P, Soltermann A, Thoma D, Stadler B, Rücker M. Alveolar ridge preservation with autologous parparticulatentin—a case series. Int J Implant Dent [Internet]. 2017;3(1):12. Available from: http://journalimplantdent.springeropen.com/articles/10.1186/s40729-017-0071-9

2. Gideon Hallel IB. A Novel Procedure to Process Extracted Teeth for Immediate Grafting of Autogenous Dentin. JBR J Interdiscip Med Dent Sci. 2014;02(06):2–6.
3. Kabir MA, Murata M, Kusano K, Akazawa T, Shibata T. Autogenous Demineralized Dentin Graft for Third Molar Socket Regeneration - A Case Report. Dentistry. 2015;5(11):9–13.
4. Mamoun J. Dry socket etiology, diagnosis, and clinical treatment techniques. J Korean Assoc Oral Maxillofac Surg. 2018;44(2):52–8.
5. Ozkan A, Bayar GR, Altug HA, Sencimen M, Dogan N, Gunaydin Y. The effect of cigarette smoking on the healing of extraction sockets: An immunohistochemical study. J Craniofac Surg. 2014;25(4):397–402.
6. Vos MD, Raghoebar GM, Wal JE Van Der, Kalk WWI, Vissink A. Autogenous femoral head as grafting material for mandibular augmentation. 2009;(Aatb 1996):1320–3.
7. Pal U, Sharma N, Singh R, Singh N, Mahammad S, Mandhyan D, et al. Direct vs. indirect sinus lift procedure: A comparison. Natl J Maxillofac Surg [Internet]. 2012;3(1):31. Available from: http://www.njms.in/text.asp?2012/3/1/31/102148
8. Dawson D V. Effect of Alveolar Ridge Preservation After Tooth Extraction : A Systematic Review. 2014;950–8.
9. Lee JH, Kim DH, Jeong SN, Choi SH. Detection and diagnosis of dental caries using a deep learning-based convolutional neural network algorithm. J Dent. 2018;77(2):106–11.
10. Jamjoom A, Cohen RE. Grafts for Ridge Preservation. 2015;833–48.
11. Akashi M, Tanaka K, Kusumoto J, Furudoi S, Hosoda K, Komori T. Brain Abscess Potentially Resulting from Odontogenic Focus: Report of Three Cases and a Literature Review. J Maxillofac Oral Surg. 2017;16(1):58–64.
12. Tavtigian R. The Height of the Facial Radicular Alveolar Crest Following Apically Positioned Flap Operations. J Periodontol. 1970;41(7):412–8.
13. Jones SA. Atraumatic extractions with Luxator Periotome. In 2012.
14. Upadhyay P, Blaggana V, Tripathi P, Jindal M. Treatment of Furcation Involvement Using Autogenous Tooth Graft With 1-Year Follow-Up: A Case Series. Clin Adv periodontics. 2019;9(1):4–8.
15. KHANIJOU M, ZHANG R, BOONSIRISETH K, SRISATJALUK RL, SUPHANGUL S, PAIRUCHVEJ V, et al. Physicochemical and osteogenic properties of chairside processed tooth derived bone substitute and bone graft materials. Dent Mater J. 2020;(October).
16. Gharpure AS, Bhatavadekar NB. Clinical efficacy of tooth-bone graft: A systematic review and risk of bias analysis of randomized control trials and observational studies. Implant Dent. 2018;27(1):119–34.
17. Park S min, Kim DH, Pang EK. Bone formation of demineralized human dentin block graft with different demineralization time: In vitro and in vivo study. J Cranio-Maxillofacial Surg [Internet]. 2017;45(6):903–12. Available from: http://dx.doi.org/10.1016/j.jcms.2017.03.007
18. Um IW, Kim YK, Park JC, Lee JH. Clinical application of autogenous demineralized dentin matrix loaded with recombinant human bone morphogenetic-2 for socket preservation: A case series. Clin Implant Dent Relat Res. 2019;21(1):4–10.
19. Horváth A, Mardas N, Mezzomo LA, Needleman IG, Donos N. Alveolar ridge preservation. A systematic review. Clin Oral Investig. 2013;17(2):341–63.

20. James P, Worthington H V., Parnell C, Harding M, Lamont T, Cheung A, et al. Chlorhexidine mouth rinse as an adjunctive treatment for gingival health. Cochrane Database Syst Rev. 2017;2017(3).
21. Belser UC, Grütter L, Vailati F, Bornstein MM, Weber H-P, Buser D. Outcome Evaluation of Early Placed Maxillary Anterior Single-Tooth Implants Using Objective Esthetic Criteria: A Cross-Sectional, Retrospective Study in 45 Patients With a 2- to 4-Year Follow-Up Using Pink and White Esthetic Scores. J Periodontol. 2009;80(1):140–51.
22. Fürhauser R, Florescu D, Benesch T, Haas R, Mailath G, Watzek G. Evaluation of soft tissue around single-tooth implant crowns: The pink esthetic score. Clin Oral Implants Res. 2005;16(6):639–44.
23. Lai H, Zhang Z, Zhuang L. Evaluation of soft-tissue alteration around implant-supported single-tooth restoration in the anterior maxilla : the pink esthetic score. 2008;560–4.
24. Koutouzis T. Crestal Bone Level Alterations in Implant Therapy. Implant Dent - A Rapidly Evol Pract. 2011; (August 2011).
25. Wu D, Zhou L, Lin J, Chen J, Huang W, Chen Y. Immediate implant placement in anterior teeth with grafting material of autogenous tooth bone vs xenogenic bone. 2019;1–11.
26. Manzano-Moreno FJ, Herrera-Briones FJ, Bassam T, Vallecillo-Capilla MF, Reyes-Botella C. Factors affecting dental implant stability measured using the steel mentor device: A systematic review. Implant Dent. 2015;24(5):565–77.
27. Bajaj G, Bathiya A, Gade J, Mahale Y, Ulemale M, Atulkar M. ORIGINAL RESEARCH P primary versus Ssecondaryy Iimplantt Sstabilityy in immediate and E arly L loaded Implants. 2017;3(5):49–54.
28. BRISMAN DL, BRISMAN AS, MOSES MS. Implant failures associated with asymptomatic endodontically treated teeth. J Am Dent Assoc [Internet]. 2001 Feb 1;132(2):191–5. Available from: https://doi.org/10.14219/jada.archive.2001.0154
29. Al-Khabbaz AK, Griffin TJ, Al-Shammari KF. Assessment of Pain Associated With the Surgical Placement of Dental Implants. J Periodontol. 2007;78(2):239–46.
30. Eli I, Baht R, Kozlovsky A, Simon H. Effect of gender on acute pain prediction and memory in periodontal surgery. Eur J Oral Sci. 2000;108(2):99–103.
31. Santana HG, Diago MP, Carbó JG, Martínez JB. Estudio del dolor e inflamación en 41 pacientes tras la colocación de 131 implantes dentales Pain and infl ammation in 41 patients following the placement of 131 dental implants. Med Oral. 2004;258–63.
32. Unruh AM. Gender variations in the clinical pain experience. Pain [Internet]. 1996;65(2). Available from: https://journals.lww.com/pain/Fulltext/1996/05000/Gender_variations_in_clinical_pain_experience.3.aspx
33. Simsek B, Simsek S. Evaluation of success rates of immediate and delayed implants after tooth extraction. Chin Med J (Engl). 2003 Aug;116(8):1216–9.
34. Joshi GP, Kehlet H, Beloeil H, Bonnet F, Fischer B, Hill A, et al. Guidelines for perioperative pain management: Need for re-evaluation. Br J Anaesth. 2017;119(4):720–2.
35. Elfana A, El-Kholy S, Ahmed Saleh H, Fawzy El-Sayed K. Alveolar Ridge Preservation using Autogenous Whole-Tooth versus Demineralized Dentin Grafts: A Randomized Controlled Clinical Trial. Clin Oral Implants Res. 2021;(September 2020):1–10.

Tables

Table 1: Mean, frequencies (n), percentages, and results of Student's t-test and Fisher's Exact tests for comparisons of demographic data in the two groups

	Intervention (n = 8)	Control (n = 8)	*P*-value
Age (Years)			
Mean (SD)	34.4 (11.3)	37.1 (7.5)	0.576
Gender [n (%)]			0.200
Male	3 (37.5)	0 (0)	
Female	5 (62.5)	8 (100)	

**: Significant at P ≤ 0.05*

Table 2: Descriptive statistics and results of Mann-Whitney U test for comparison between PES scores in the two groups

Time	*Intervention (n = 8)*	*Control (n = 8)*	*95% CI for the mean difference*		*P-value*	*Effect size (d)*
	Median (IQR)	*Median (IQR)*	*Lower limit*	*Upper limit*		
Pre-operative	*9 (9-9.75)*	*10 (9-10)*	*-1.1*	*0.4*	*0.227*	*0.574*
6 months	*8 (1.75-9)*	*8.5 (8-9)*	*-5.1*	*0.9*	*0.343*	*0.458*
12 months	*8 (2-8)*	*8 (8-8.75)*	*-5*	*0.8*	*0.199*	*0.544*

**: Significant at P ≤ 0.05*

Table 3: Descriptive statistics and results of Friedman's test for comparison between PES scores at different times within each group

Time	Intervention (n = 8)	Control (n = 8)
	Median (IQR)	Median (IQR)
Pre-operative	9 (9-9.75) [A]	10 (9-10) [A]
6 months	8 (1.75-9) [B]	8.5 (8-9) [B]
12 months	8 (2-8) [B]	8 (8-8.75) [B]
P-value	0.010*	0.003*
Effect size (*w*)	0.581	0.74

**: Significant at P ≤ 0.05, Different superscripts in the same column indicate statistically significant changes by the time*

Table 4: Descriptive statistics and results Hoffmann-Whitney U test for comparison between buccal bone resorption (mm) in the two groups

Time	Intervention (n = 8)	Control (n = 8)	95% CI for the mean difference		*P*-value	*Effect size (d)*
	Median (IQR)	Median (IQR)	Lower limit	Upper limit		
6 months	0.15 (0-0.2)	0.1 (0-0.19)	-0.08	0.14	0.546	0.292
12 months	0 (0-0.08)	0.05 (0-0.1)	-0.08	0.03	0.268	0.486

**: Significant at P ≤ 0.05*

Table 5: Descriptive statistics and results from Wilcoxon signed-rank test for comparison between buccal bone resorption (mm) at different times within each group

Time	Intervention (n = 8)	Control (n = 8)
	Median (IQR)	Median (IQR)
6 months	0.15 (0-0.2)	0.1 (0-0.19)
12 months	0 (0-0.08)	0.05 (0-0.1)
P-value	0.071	0.293
Effect size (*d*)	1.661	0.801

**: Significant at P ≤ 0.05*

Table 6: Descriptive statistics and results of Mann-Whitney U test for comparison between crestal bone loss (mm) in the two groups

Time	Intervention (n = 8)	Control (n = 8)	95% CI for the mean difference		*P*-value	*Effect size (d)*
	Median (IQR)	Median (IQR)	Lower limit	Upper limit		
6 months	0.33 (0.21-0.58)	0.85 (0.45-1.08)	-0.72	-0.05	0.031*	1.277
12 months	0.1 (0-0.14)	0.2 (0.13-0.39)	-0.33	0.04	0.029*	1.277

**: Significant at P ≤ 0.05*

Table 7: Descriptive statistics and results of Wilcoxon signed-rank test for comparison between crestal bone loss (mm) at different times within each group

Time	Intervention (n = 8)	Control (n = 8)
	Median (IQR)	Median (IQR)
6 months	0.33 (0.21-0.58)	0.85 (0.45-1.08)
12 months	0.1 (0-0.14)	0.2 (0.13-0.39)
P-value	0.021*	0.012*
Effect size (*d*)	3.955	3.932

**: Significant at P ≤ 0.05*

Table 8: Descriptive statistics and results of repeated measures ANOVA test for comparison between implant stability in the two groups

Time	Intervention (n = 8)	Control (n = 8)	95% CI for the mean difference		*P*-value	*Effect size (Partial Eta Squared)*
	Mean	Mean	Lower limit	Upper limit		
On insertion	68	65	-12.7	6.7	0.514	0.036
On loading	74.8	70.1	-15	5.6	0.340	0.076

**: Significant at P ≤ 0.05*

Table 9: Descriptive statistics and results of repeated measures ANOVA test for comparison between implant stability at different times within each group

Time	Intervention (n = 8)	Control (n = 8)
	Mean	Mean
On insertion	68	65
On loading	74.8	70.1
P-value	<0.001*	<0.001*
Effect size *(Partial Eta Squared)*	0.893	0.862

**: Significant at P ≤ 0.05*

Table 10: Descriptive statistics and results of Mann-Whitney U test for comparison between pain (VAS) scores in the two groups

Time	Intervention (n = 8)	Control (n = 8)	95% CI for the mean difference		*P*-value	*Effect size (d)*
	Median (IQR)	Median (IQR)	Lower limit	Upper limit		
Day 1	8 (7.25-9)	8.5 (8-9)	-1.3	0.6	0.436	0.374
Day 2	7 (6-7.75)	6.5 (6-7)	-0.6	1.3	0.436	0.374
Day 3	5 (5-6)	5 (5-6)	-0.6	0.6	1	0
Day 4	4 (4-5)	4 (4-5)	-0.8	0.8	1	0
Day 5	3 (3-3.75)	3 (3-3.75)	-0.7	1	0.903	0.053
Day 6	1.5 (1-2)	2.5 (1.25-3)	-2.3	0.3	0.136	0.758
Day 7	0 (0-0.75)	0.5 (0-1)	-1	0.3	0.268	0.486

**: Significant at P ≤ 0.05*

Table 11: Descriptive statistics and results of Friedman's test for comparison between pain (VAS) scores at different times within each group

Time	Intervention (n = 8)	Control (n = 8)
	Median (IQR)	Median (IQR)
Day 1	8 (7.25-9) ^{A}	8.5 (8-9) ^{A}
Day 2	7 (6-7.75) ^{B}	6.5 (6-7) ^{B}
Day 3	5 (5-6) ^{C}	5 (5-6) ^{C}
Day 4	4 (4-5) ^{D}	4 (4-5) ^{D}
Day 5	3 (3-3.75) ^{E}	3 (3-3.75) ^{E}
Day 6	1.5 (1-2) ^{F}	2.5 (1.25-3) ^{E}
Day 7	0 (0-0.75) ^{G}	0.5 (0-1) ^{F}
P-value	<0.001*	<0.001*
Effect size (*w*)	0.981	0.942

**: Significant at P ≤ 0.05, Different superscripts in the same column indicate statistically significant changes by the time*

Figures

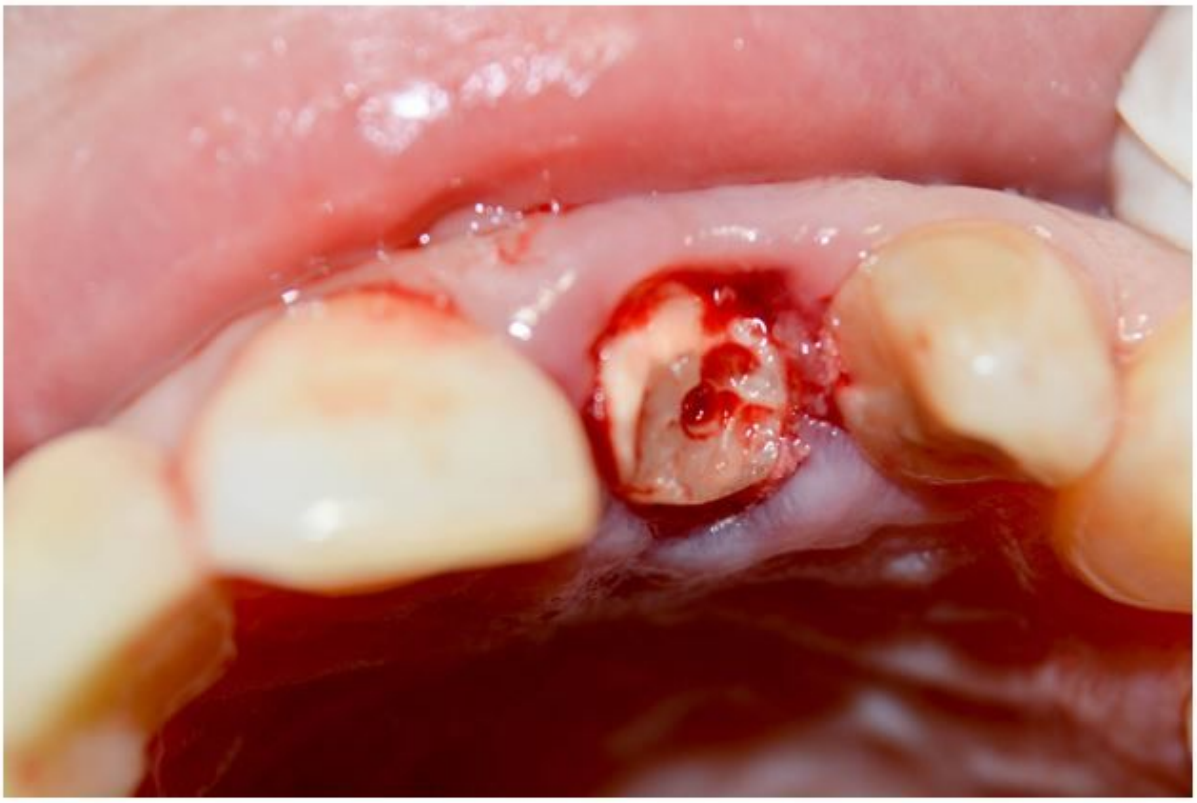

Figure 1

Clinical picture showing the preoperative view immediately before extraction

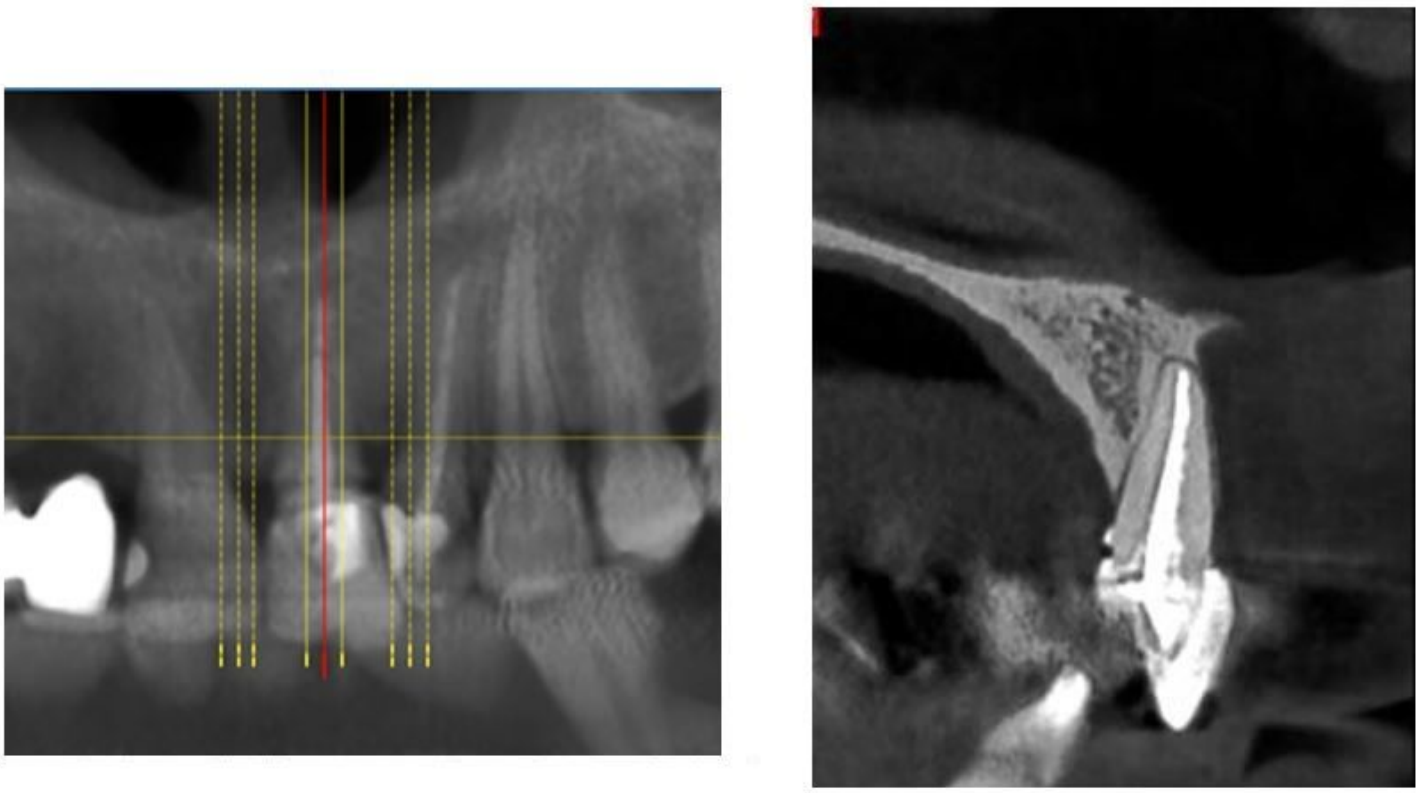

Figure 2

CBCT preoperative for implant size determination

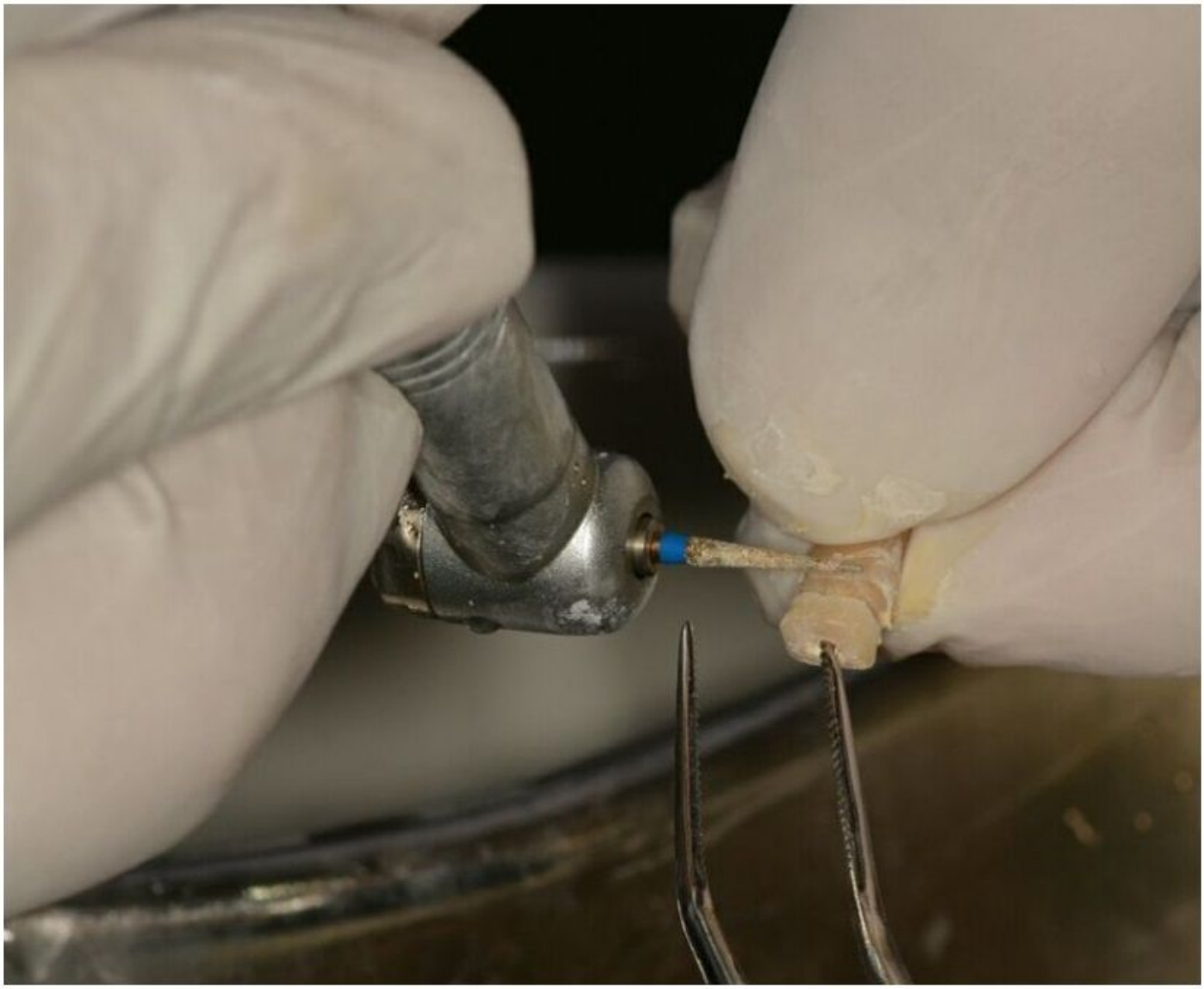

Figure 3

removing all cementum & enamel & PDL then cutting dentin into cuts

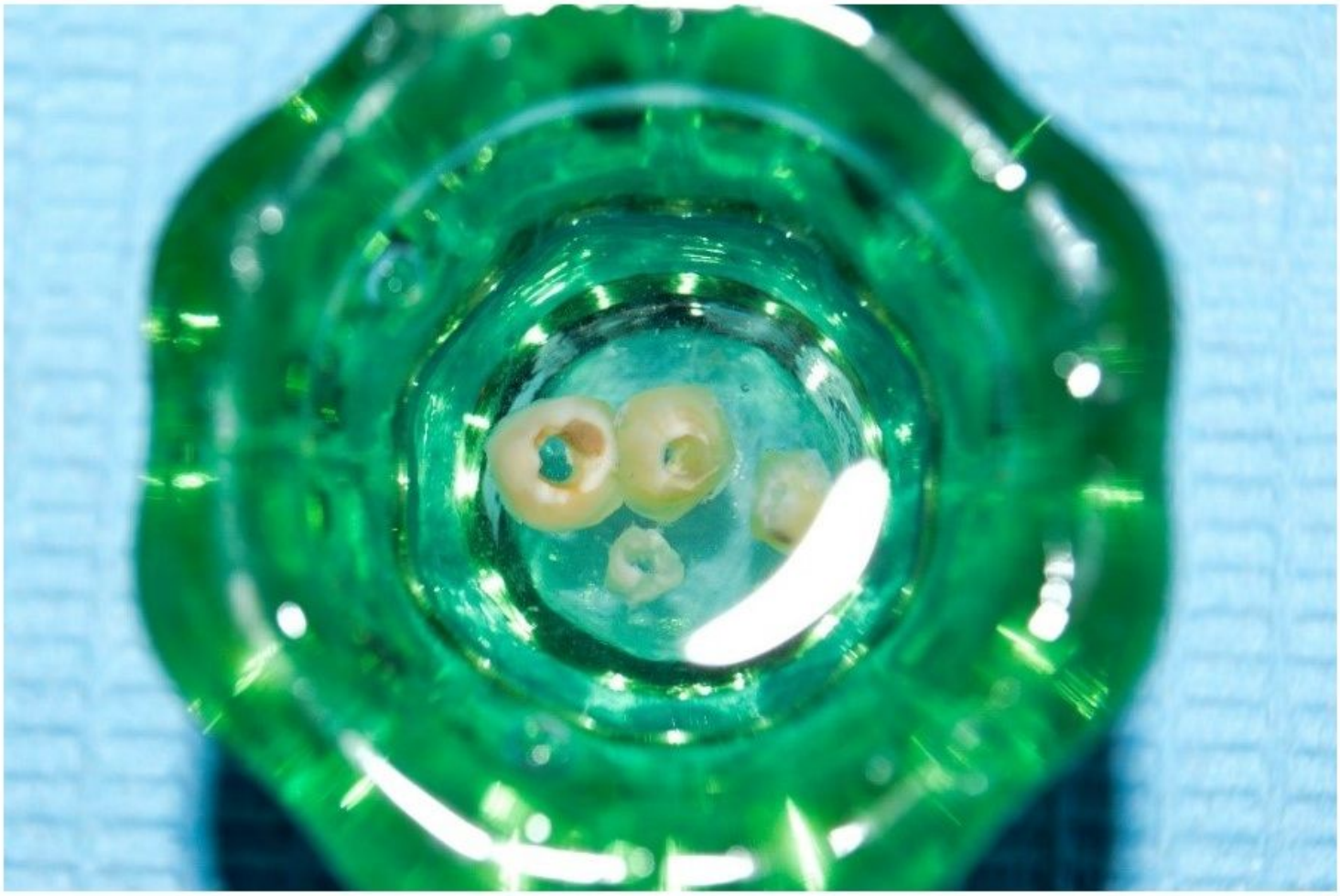

Figure 4

Dentin particles will is immersed in 70 % ethanol [2] in a sterile container for 10 minutes to remove any soft tissue remnants, bacteria and smear layer (defatting and sterilization).

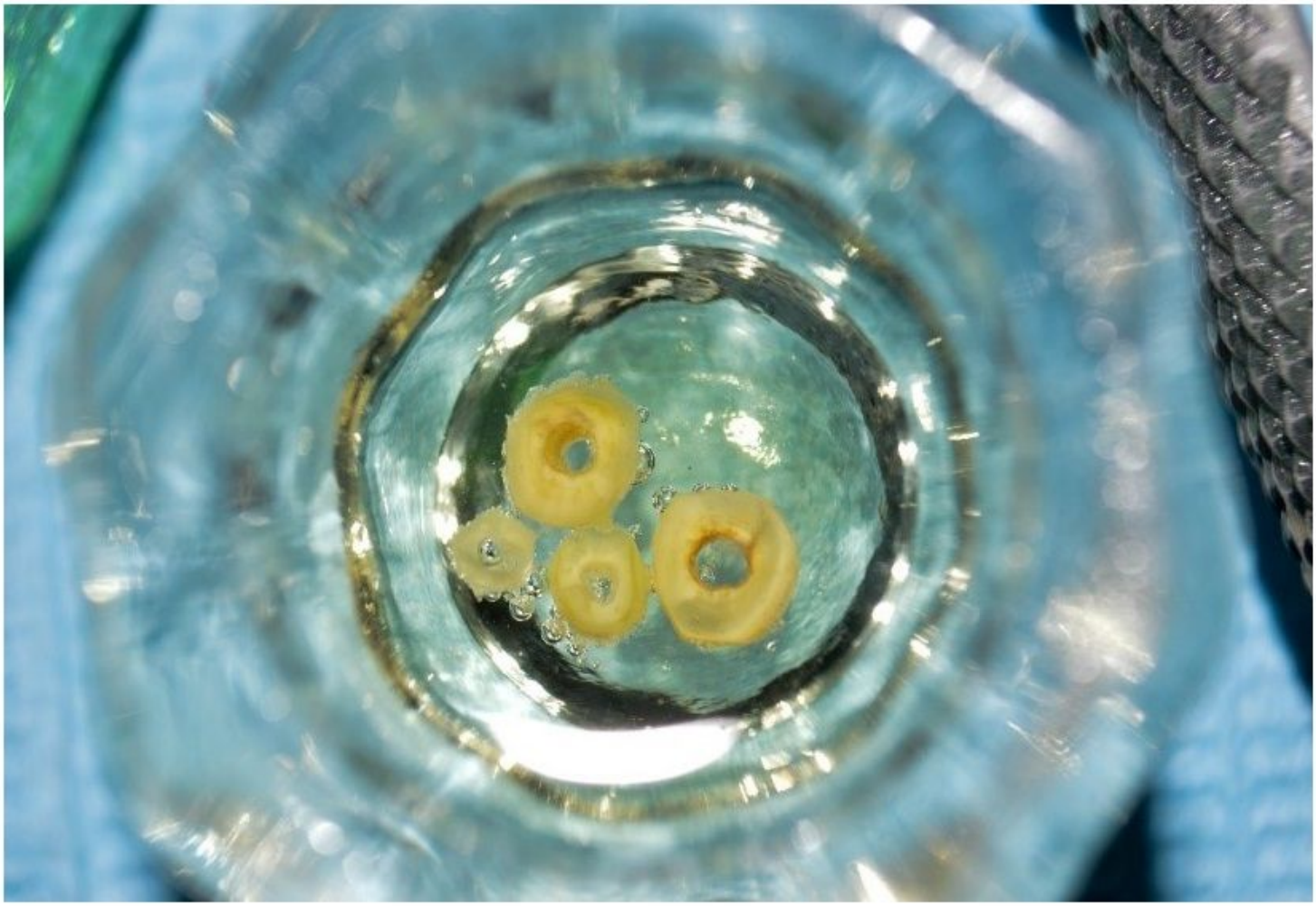

Figure 5

Tooth particles is demineralized using HCL^3 for 20 minutes to expose the dentin organic matrix.

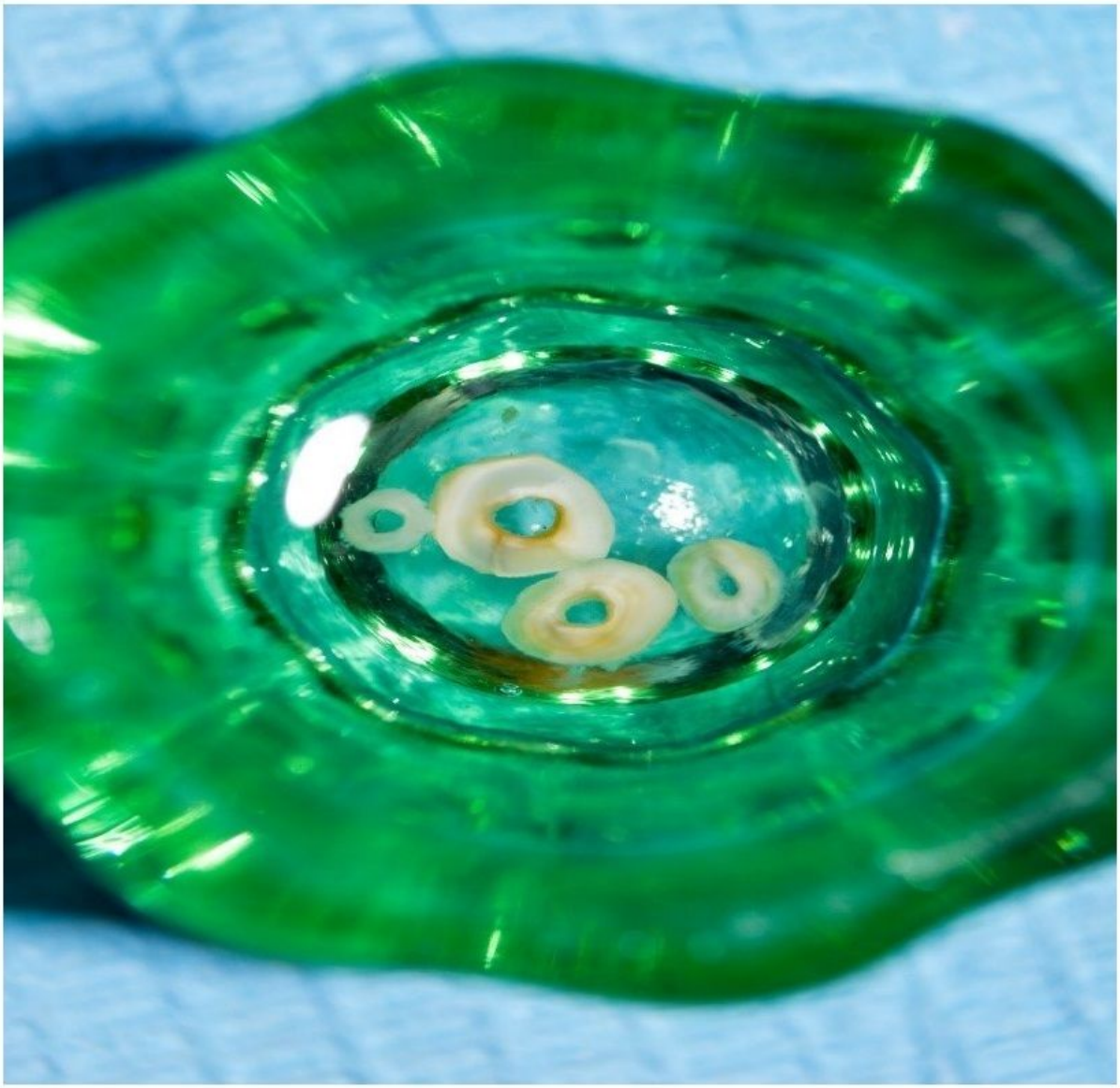

Fig.6 The bacteria-free particulate dentin will be washed with phosphate buffered saline [4] twice for 5 minutes to restore the pH balance

Figure 6

See image above for figure legend.

Figure 7

Cut the dentin into small blocks , milling it in a bone mill to obtain dentin chips used after implant placement.

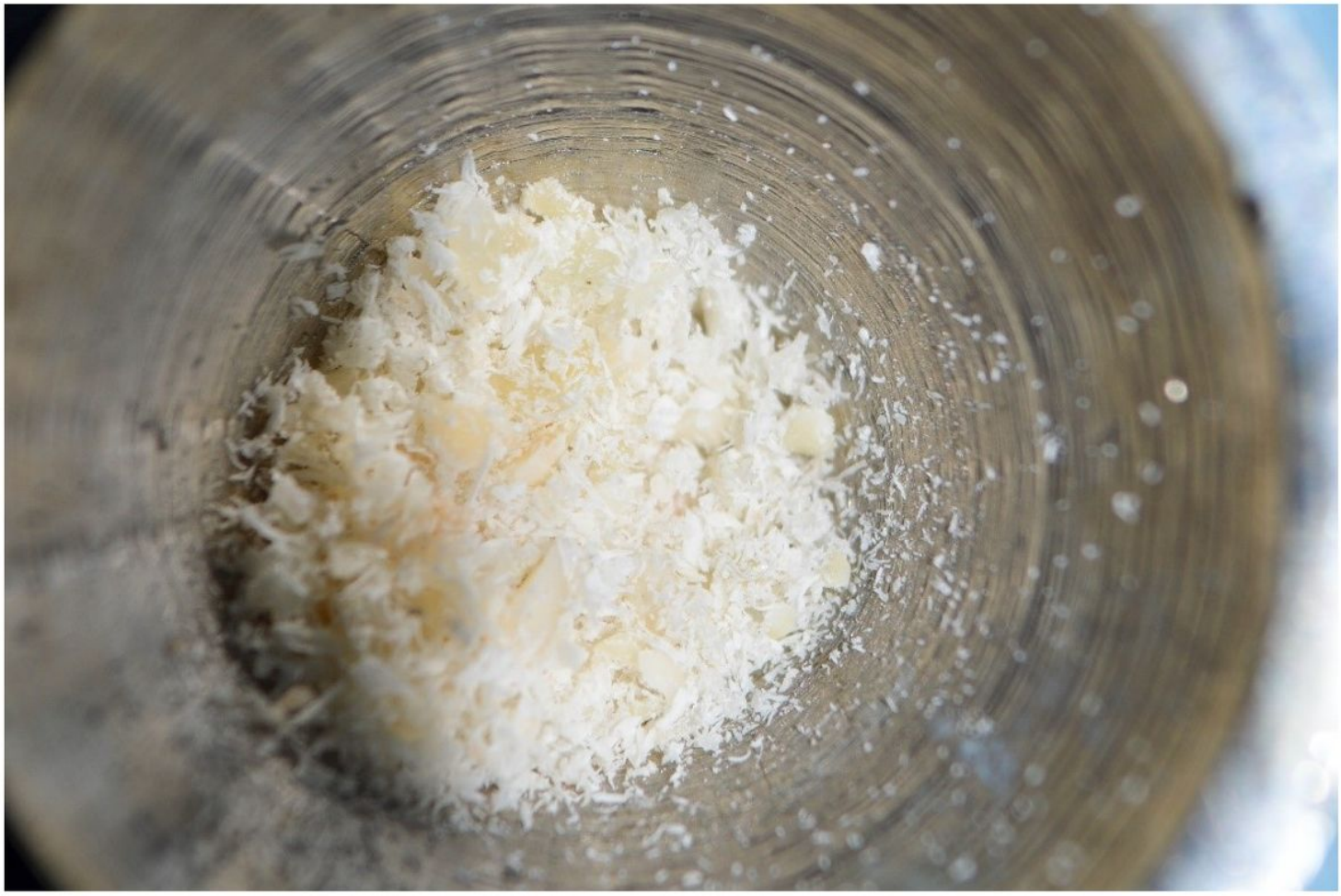

Figure 8

dentin chips

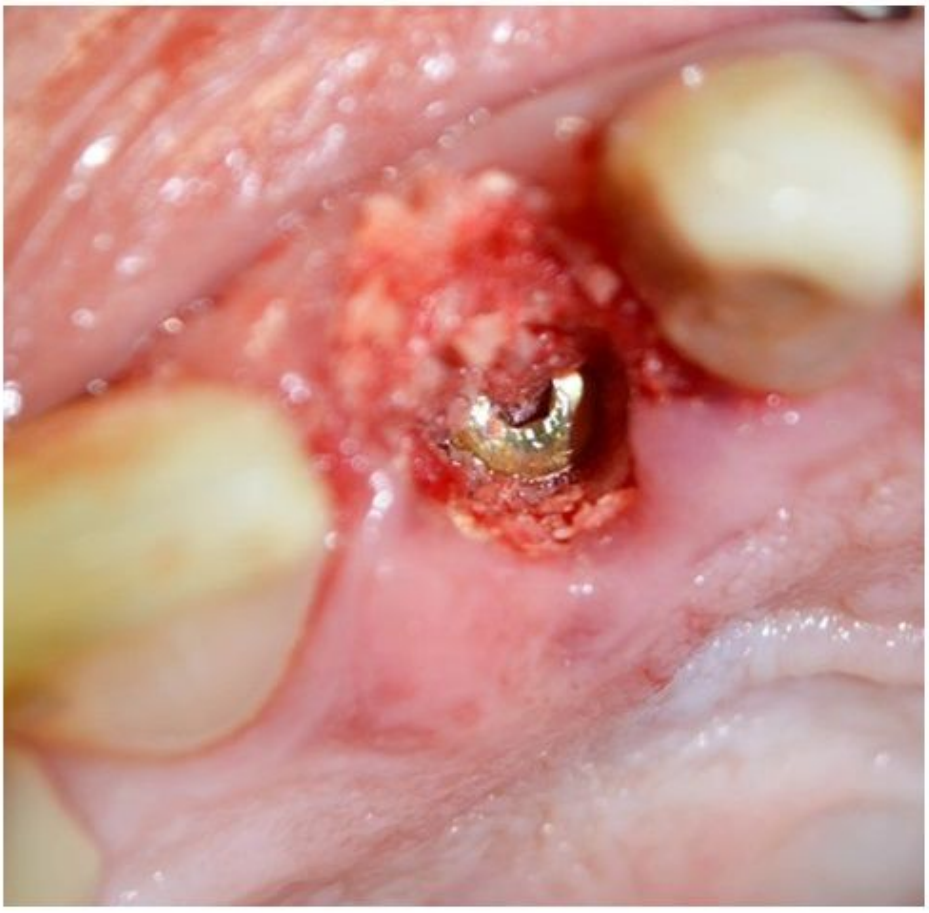

Figure 9

Clinical picture of Dentin chips overfill jumping gap

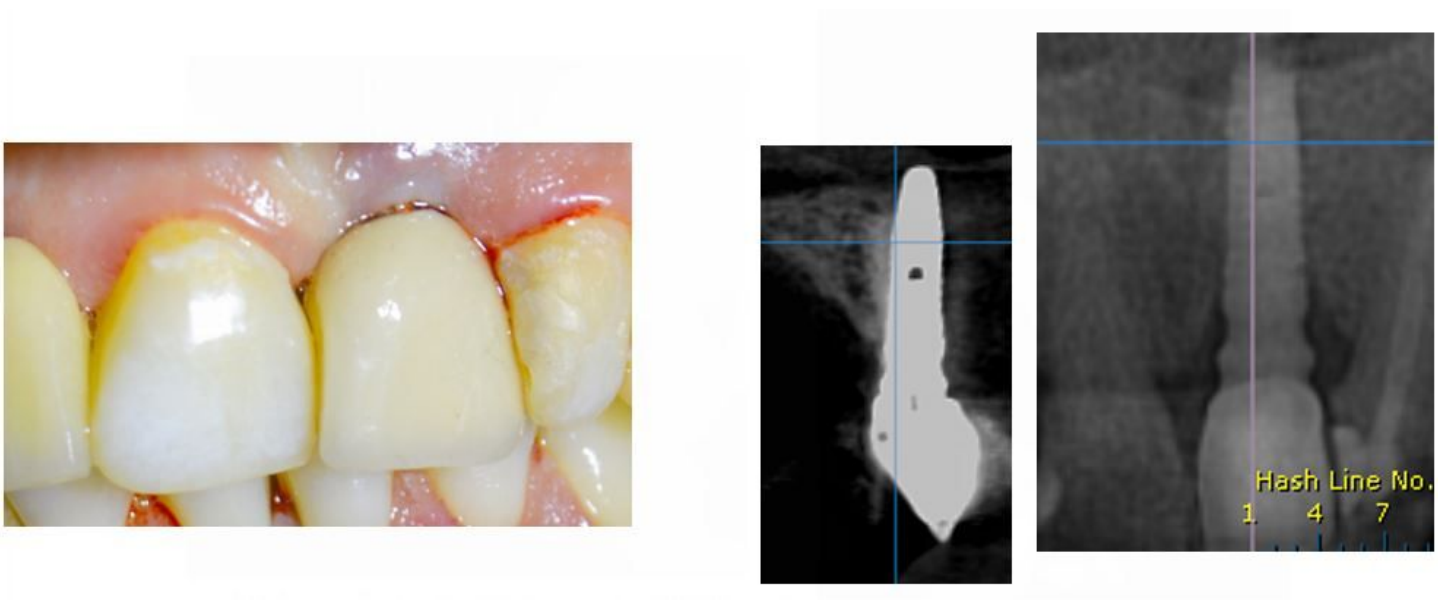

Figure 10

Clinical picture of crown and CBCT inserted at 6 months

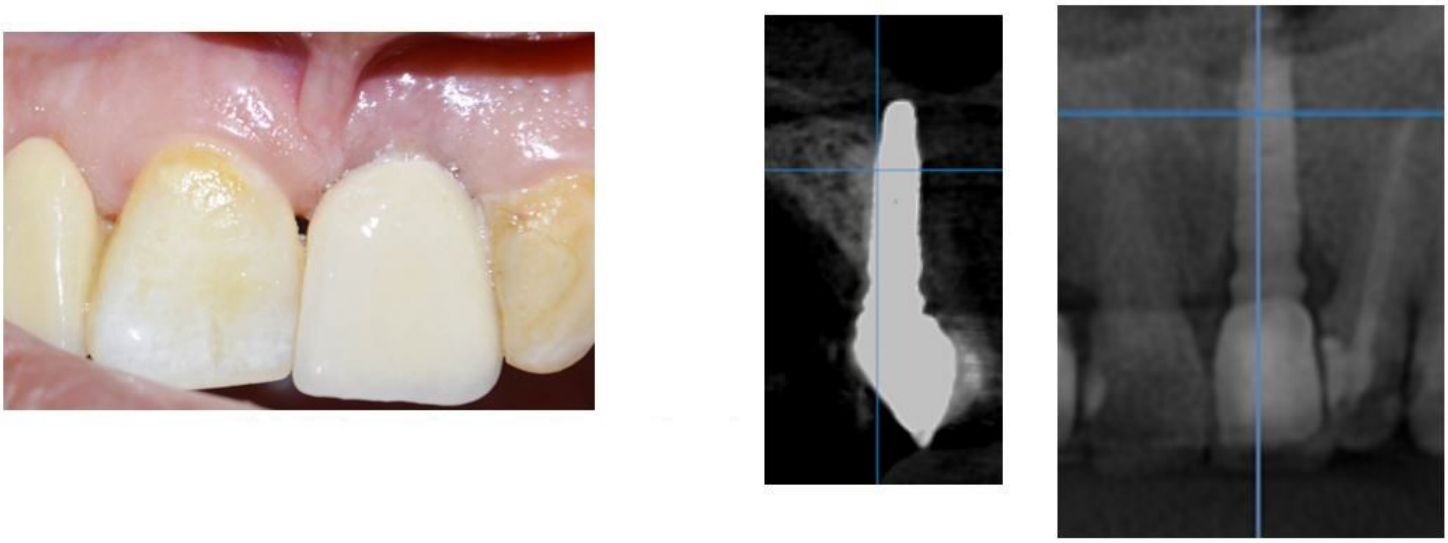

Figure 11

Clinical picture of crown and CBCT inserted follow up at 1 year

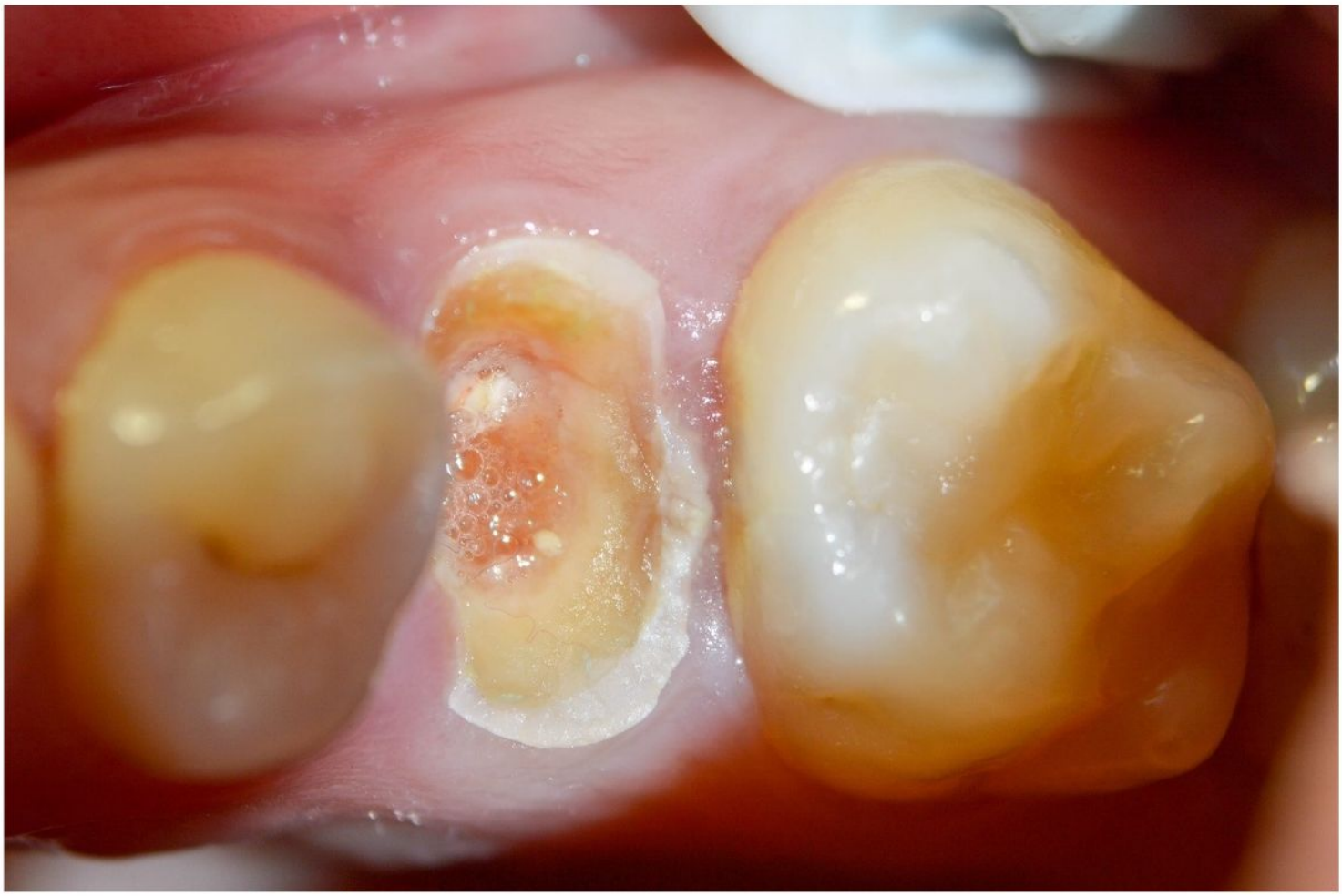

Figure 12

Clinical picture showing the preoperative view immediately before extraction

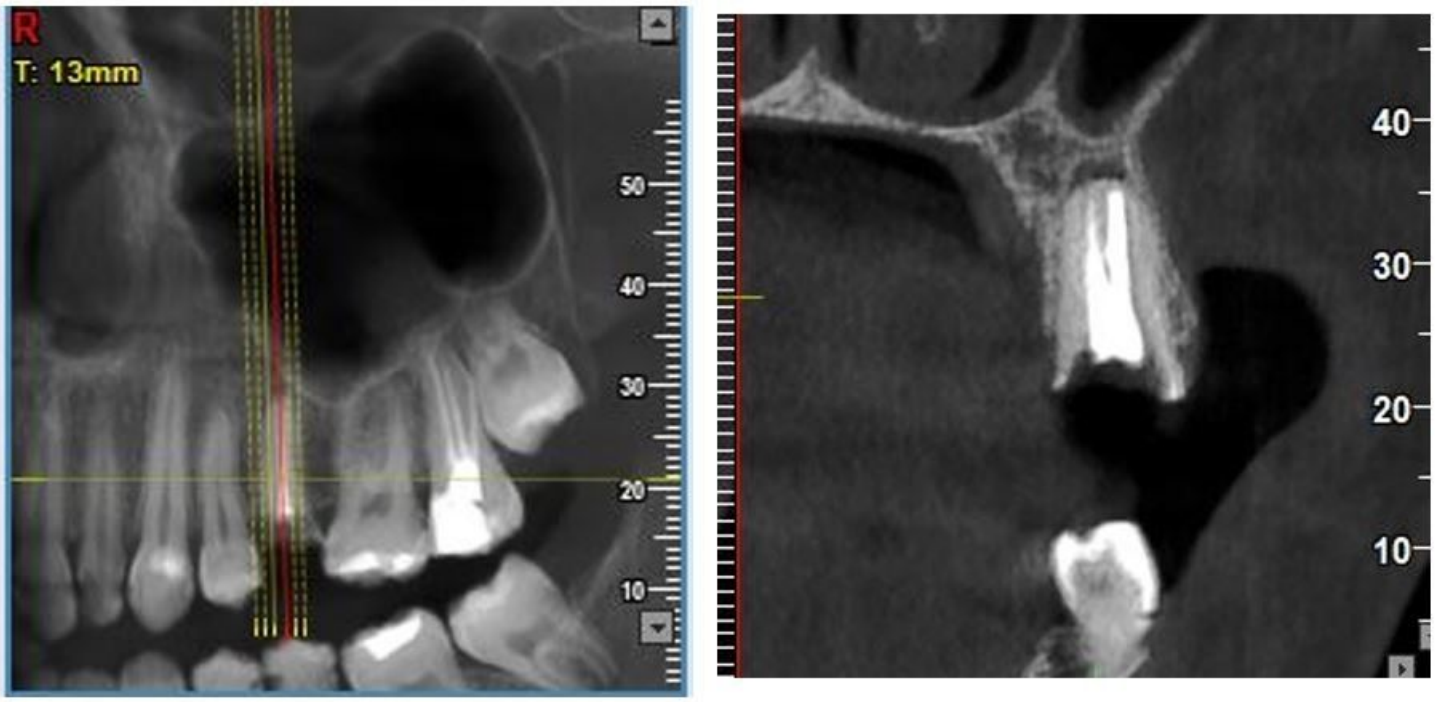

Figure 13

CBCT preoperative for implant size determination

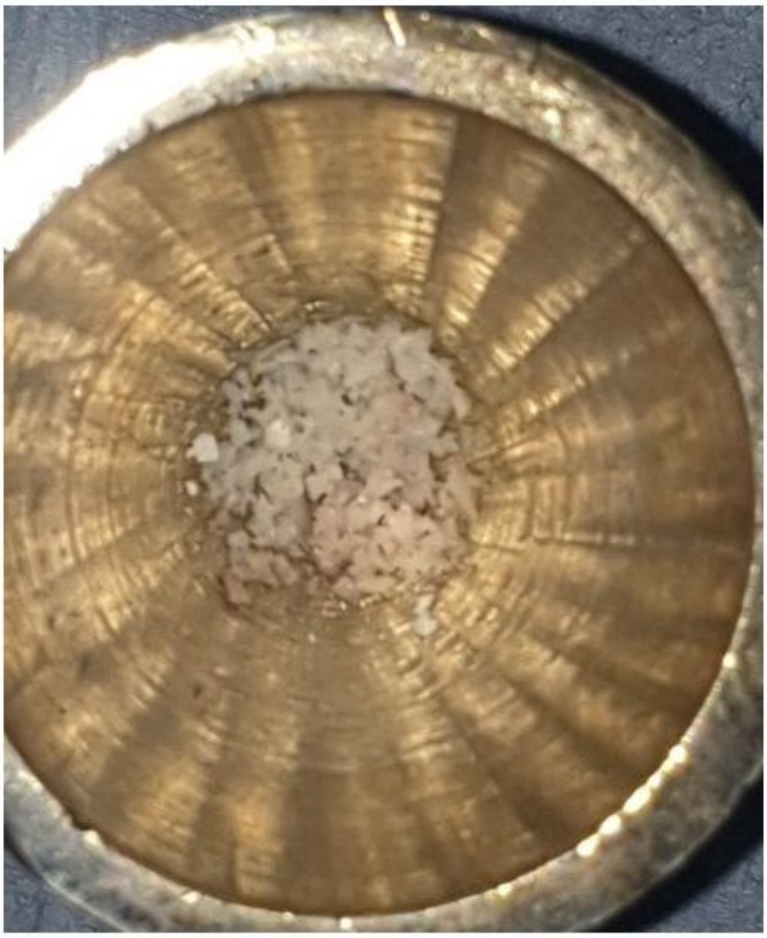

Figure 14

Xenograft

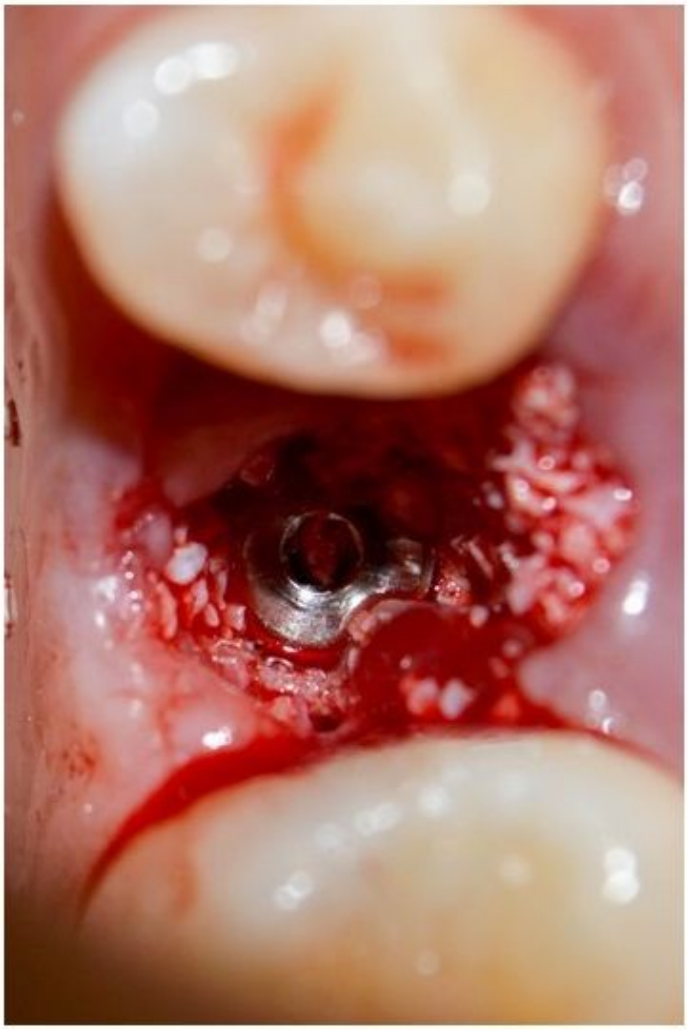

Figure 15

Clinical picture after xenograft overfilling jumping gap

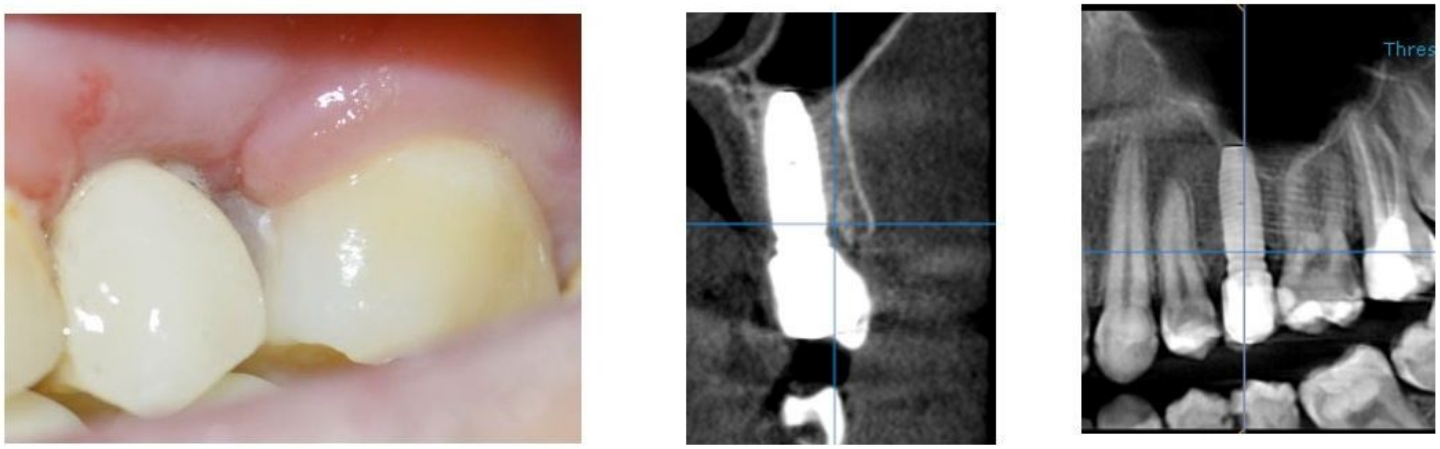

Figure 16

Clinical picture of crown inserted at 6 months and CBCT

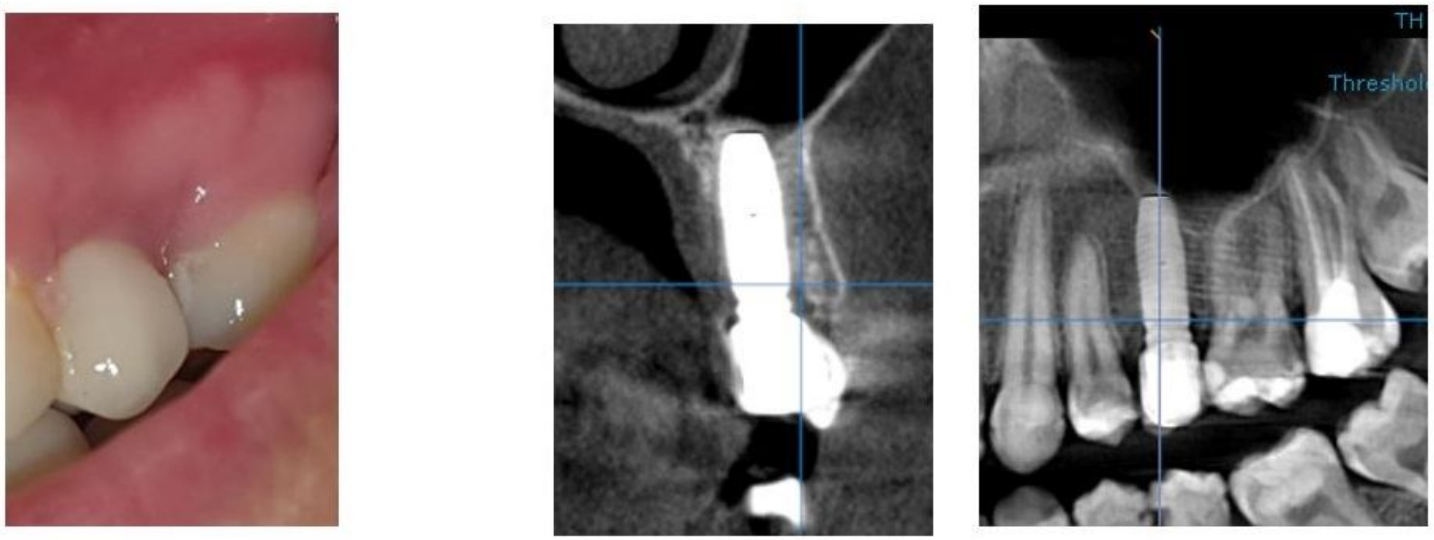

Figure 17

Clinical picture of a crown at 1 year and CBCT

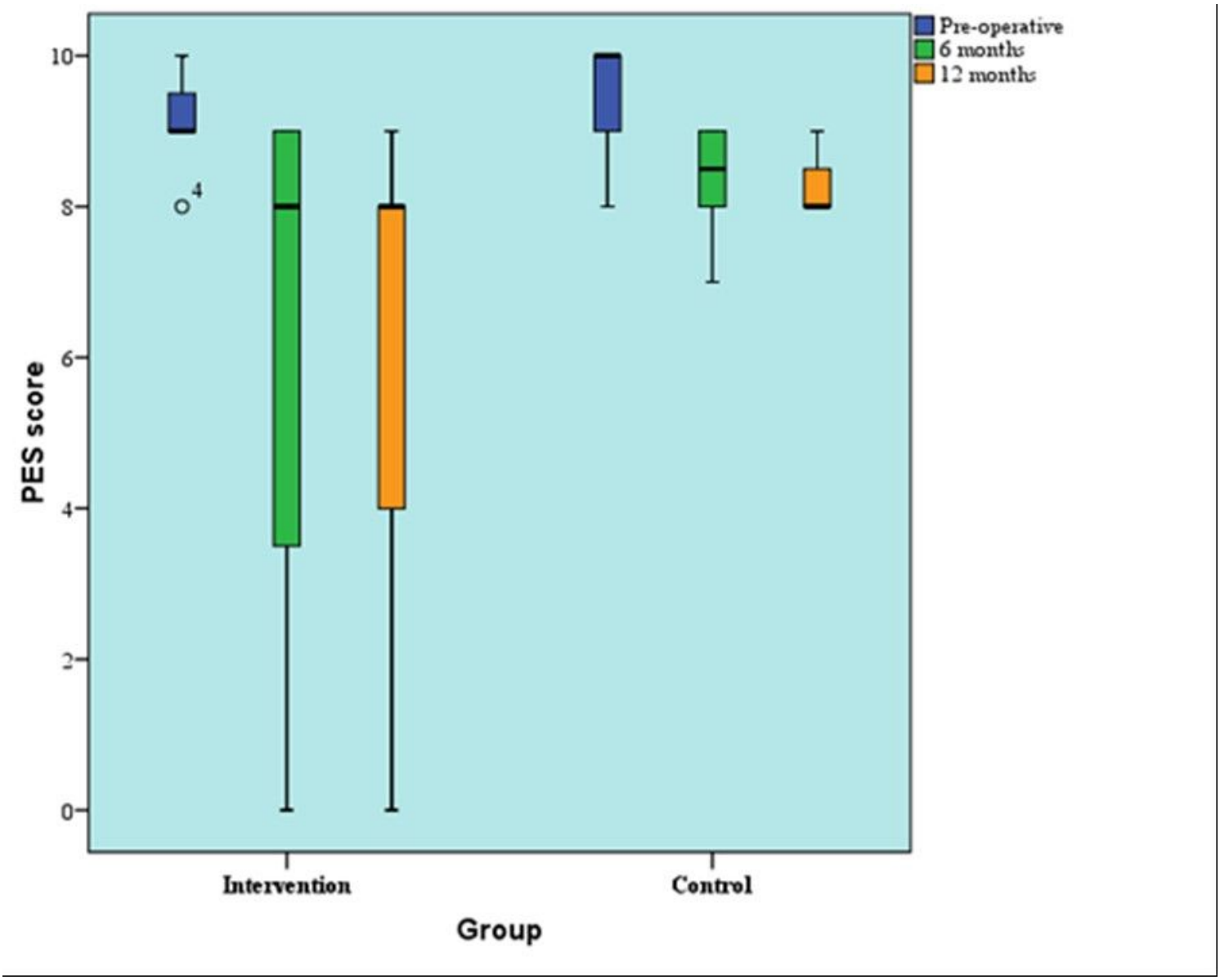

Figure 18

Box plot representing median and range values for PES scores in the two groups (Circle represents outlier)

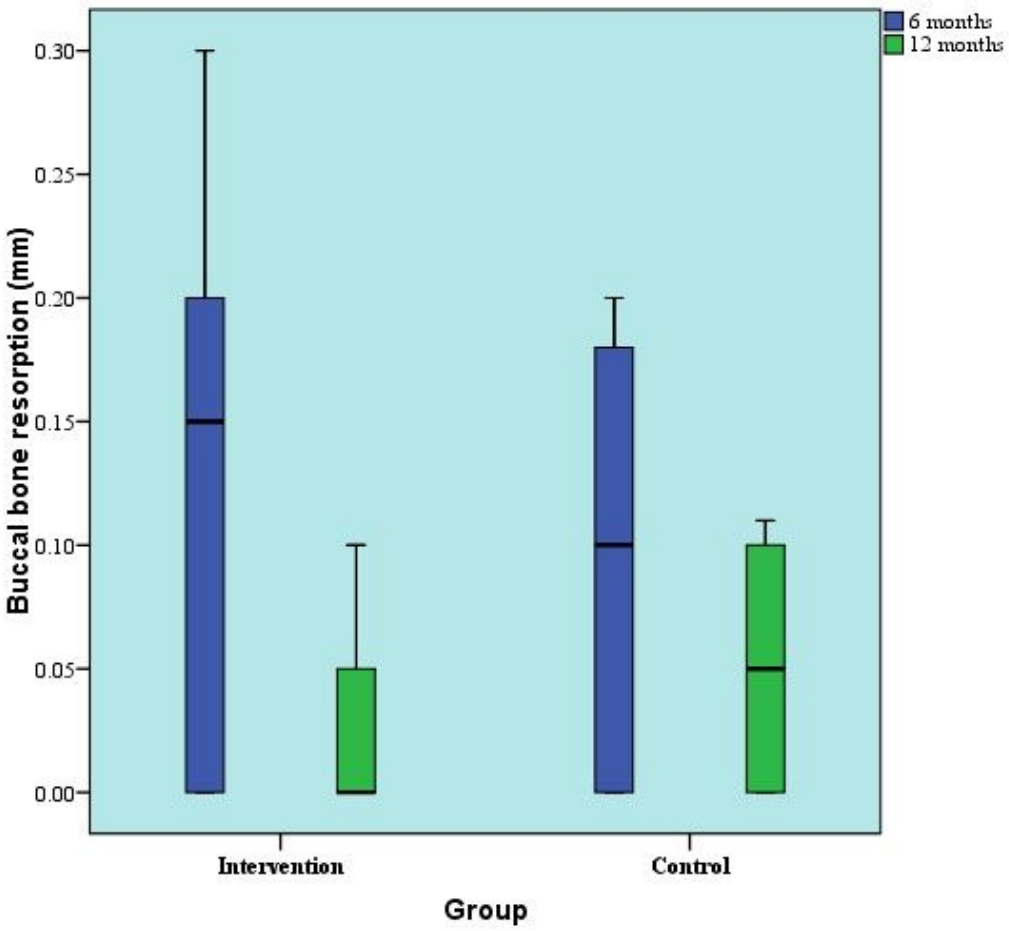

Figure 19

Box plot representing median and range values for buccal bone resorption in the two groups

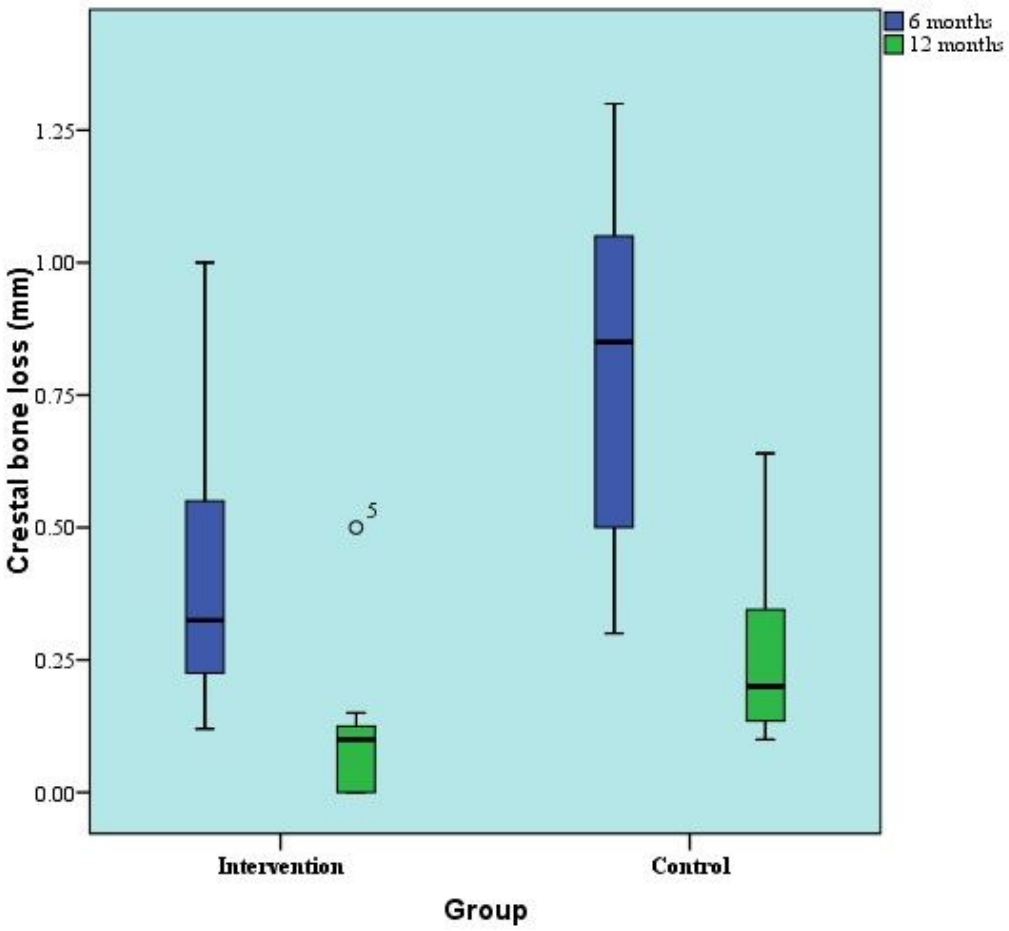

Figure 20

Box plot representing median and range values for crestal bone loss in the two groups (Circle represents outlier)

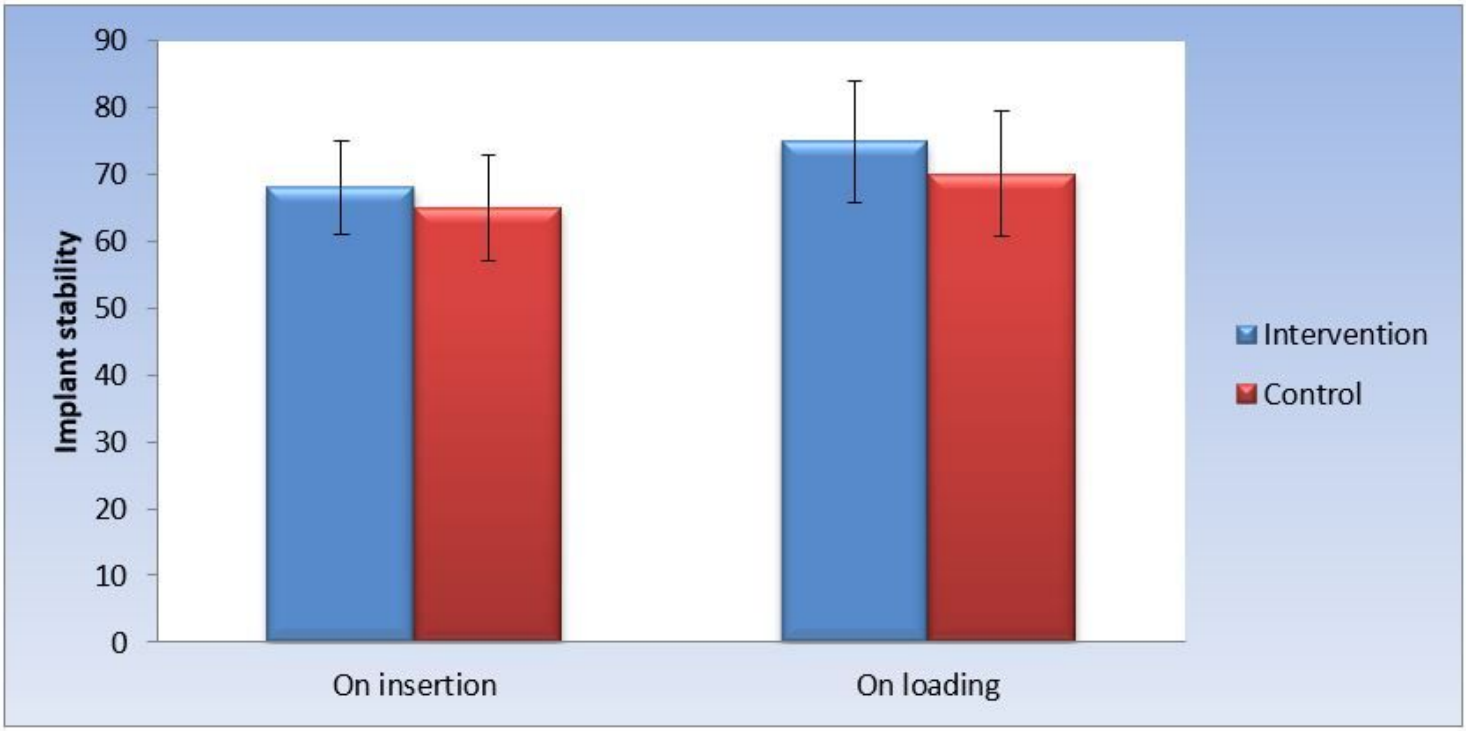

Figure 21

Bar chart representing mean and standard deviation values for implant stability in the two groups

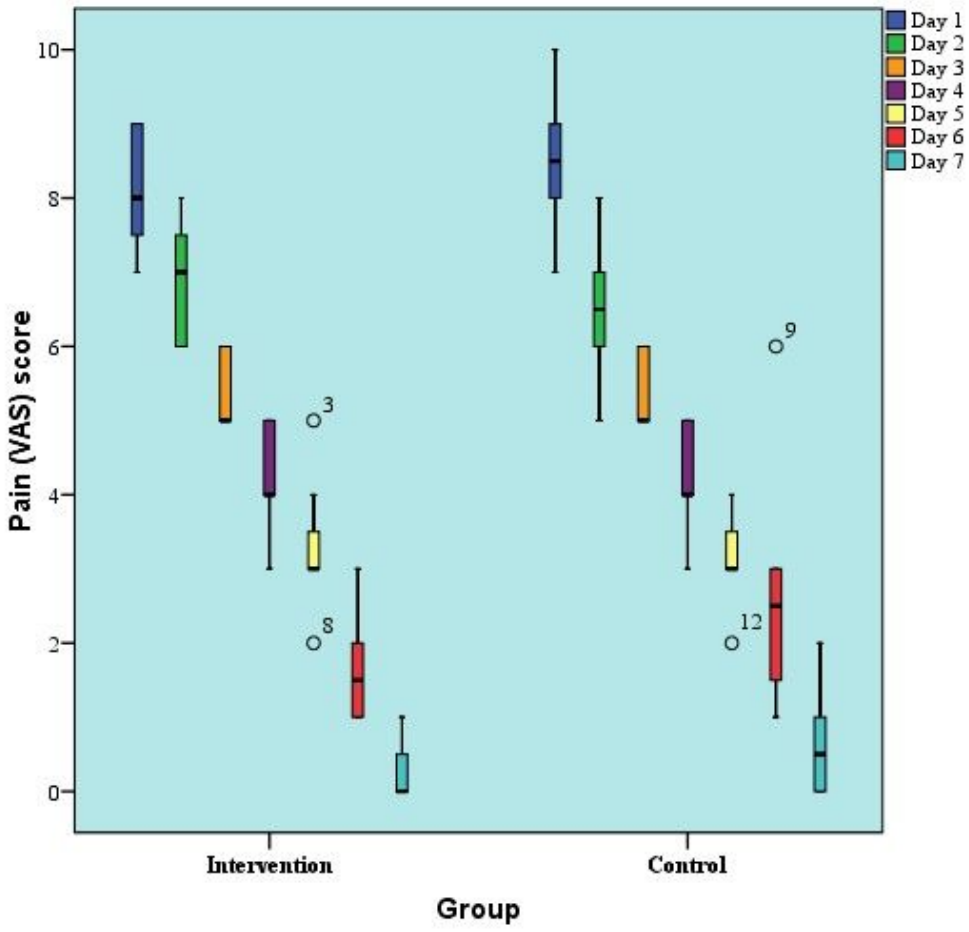

Figure 22

Box plot representing median and range values for pain (VAS) scores in the two groups (Circles represent outliers)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- clinicalgov.pdf
- CONSORT2010Checklist1.doc